British Journal of Hospital Medicine

Br. J. Hosp. Med. (Lond) **2026**; 87(10): 55660
https://doi.org/10.31083/BJHM55660

Article

Percutaneous Endoscopic Gastrostomy in Older Palliative Inpatients at Nutritional Risk: Procedural Burden and Survival in a Six-Year Retrospective Cohort

Nermin Mutlu Bilgiç[1,*], Güldan Kahveci[2], Hüseyin Aykut[1], Ekmel Burak Özşenel[3], Beytullah Özcan[4], Sema Basat[3]

[1]Department of Gastroenterology, University of Health Sciences, Ümraniye Training and Research Hospital, 34764 Istanbul, Türkiye
[2]Department of Nutritional Nursing, University of Health Sciences, Ümraniye Training and Research Hospital, 34764 Istanbul, Türkiye
[3]Department of Internal Medicine, University of Health Sciences, Ümraniye Training and Research Hospital, 34764 Istanbul, Türkiye
[4]Department of Radiology, University of Health Sciences, Ümraniye Training and Research Hospital, 34764 Istanbul, Türkiye
*Correspondence: drnerminmutlu@yahoo.com.tr (Nermin Mutlu Bilgiç)

Academic Editor: Ludovico Abenavoli
Submitted: 6 July 2026 Revised: 10 August 2026 Accepted: 28 August 2026 Published: 21 October 2026

Abstract

Aims/Background: Percutaneous endoscopic gastrostomy (PEG) provides long-term enteral access in selected older palliative-care inpatients, but its clinical value depends on prognosis, post-procedure trajectory, and recurrent tube-related interventions. This study aimed to evaluate PEG utilisation, repeat PEG-related procedural burden, and post-PEG outcomes among palliative-care inpatients aged 65 years or older at nutritional risk. **Methods:** This retrospective single-centre cohort included older palliative-care inpatients who underwent PEG placement or PEG-related procedures between January 2020 and December 2025. Among patients with available Nutrition Risk Screening 2002 (NRS-2002) screening data, all met the standard nutritional-risk threshold (score ≥3). The primary outcome was 90-day all-cause mortality after the index PEG date. Kaplan-Meier methods, univariable comparisons, parsimonious logistic regression, and a 90-day censored Cox model were used. Missing-data denominators, survival follow-up availability, and multicollinearity diagnostics were reported. **Results:** The analytic cohort included 141 patients aged 65 years or older; median age was 82.0 years (range 65–112), 60.3% were aged ≥80 years, and 60.3% were female. NRS-2002 score was ≥5 in 84 of 138 patients (60.9%), and serum albumin was <30 g/L in 110 of 141 patients (78.0%). Overall, 181 PEG-related procedures were recorded, and repeat PEG-related procedures occurred in 23 patients (16.3%). Valid survival follow-up was available for 105 patients. Kaplan-Meier mortality estimates were 5.7% at 30 days, 25.7% at 90 days, 43.8% at 180 days, and 53.3% at 365 days; median post-PEG survival was 326 days. In multivariable models, age, lower albumin, and log2-transformed NLR were not statistically significant independent predictors of 90-day mortality. **Conclusion:** Older palliative-care inpatients undergoing PEG placement or PEG-related procedures had substantial nutritional risk, early and 365-day mortality, and measurable repeat-procedure burden. Findings support cautious, goal-oriented PEG decision-making rather than causal inference about procedural benefit.

Keywords: dysphagia; enteral nutrition; neutrophil-to-lymphocyte ratio; palliative care; percutaneous endoscopic gastrostomy

1. Introduction

Hospital-associated malnutrition in older inpatients is rarely an isolated nutritional problem. It commonly occurs together with multimorbidity, dysphagia, cognitive impairment, inflammation, functional dependency, and limited physiological reserve. Contemporary malnutrition frameworks emphasise nutritional risk screening followed by diagnostic assessment of phenotypic and etiologic criteria, including reduced intake and inflammation or disease burden [1]. In this setting, percutaneous endoscopic gastrostomy (PEG) is not simply a technical route for long-term enteral access; it is a clinical decision point that must be interpreted alongside prognosis, discharge planning, caregiver capacity, and patient-centred goals of care [2,3].

This decision is particularly complex in older palliative-care inpatients, especially those with dementia, advanced neurological disease, post-intensive care dependency, recurrent aspiration or pneumonia, and severe nutritional risk. Updated nutrition and ethics guidance stresses that artificial nutrition requires a clear indication, a realistic therapeutic goal, and consent or best-interest decision-making, particularly when illness is advanced or end-of-life care is being considered [3,4,5,6]. Therefore, the practical question for hospital clinicians is not only whether PEG can be placed safely, but whether the expected survival time, likelihood of discharge, and risk of further PEG-related procedures justify the intervention in an individual patient.

Previous studies have linked post-PEG mortality to advanced age, low albumin, inflammatory status, dementia, diabetes, and comorbidity burden [7,8,9]. However, evidence from palliative-care inpatient units remains limited. Many available studies focus on general PEG populations or single diagnostic groups and provide less detail

Copyright: © 2026 The Author(s). Published by IMR Press.
This is an open access article under the CC BY 4.0 license.

Publisher's Note: IMR Press stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

about nutritional risk severity, indications for PEG in palliative pathways, repeat PEG-related procedural burden, and short-term mortality after the index procedure. These gaps are clinically important because early post-PEG death, recurrent tube-related intervention, and incomplete survival follow-up can substantially affect how outcomes are interpreted.

A single-centre hospital cohort cannot determine the causal benefit of PEG without a concurrent control group, but it can provide useful real-world information about patient selection, procedural burden, and post-procedure survival patterns. Such information may support pre-procedure risk discussion, goals-of-care conversations, discharge planning, and institutional review of PEG practice in frail older palliative patients.

Therefore, this study aimed to evaluate PEG utilisation, repeat PEG-related procedural burden, and post-PEG outcomes among palliative-care inpatients aged 65 years or older at nutritional risk in a tertiary training and research hospital over a six-year period. The primary outcome was 90-day all-cause mortality after the index PEG procedure; secondary outcomes included in-hospital outcomes, 30-, 180-, and 365-day post-PEG mortality, median post-PEG survival, and repeat PEG-related procedures.

2. Methods

2.1 Study Design and Reporting

This retrospective, single-centre observational cohort study was conducted in the Palliative Care Unit of University of Health Sciences, Ümraniye Training and Research Hospital, Istanbul, Türkiye. The study evaluated older palliative-care inpatients who underwent PEG placement or PEG-related procedures between 2 January 2020 and 31 December 2025. The study period was defined according to the recorded index PEG date in the patient-level dataset. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for observational studies [10].

2.2 Setting and Study Population

The analytic cohort was restricted to patients aged 65 years or older whose PEG-related care occurred during the study period and whose records contained the cohort-defining fields needed to confirm age, palliative-care admission, PEG-related procedure status, and record linkage. Patients younger than 65 years and patients whose index PEG date was outside the study period were not included in the analytic cohort. Patients with insufficient information to confirm eligibility or reliably link patient and procedure records were excluded. All patients in the study cohort met the standard nutritional risk threshold (NRS-2002 $\geq$3) in terms of NRS-2002 score.

2.3 Data Sources and Variables

Data were extracted from the hospital information management system, patient files, laboratory results, nutrition records, discharge records, and death-date or vital-status fields. The extracted variables were age, sex, PEG date, year of PEG, clinical indication or reason for palliative admission where recorded, Nutrition Risk Screening 2002 (NRS-2002) score, serum albumin, haemoglobin, neutrophil-to-lymphocyte ratio (NLR), recorded comorbidities, discharge status, intensive care unit transfer, in-hospital death, current vital status, date of death where available, and the number of linked PEG-related procedures.

Baseline clinical and laboratory variables were defined using values recorded before or at the index PEG procedure during the same hospital episode. When more than one value was available, the value closest to the index PEG date was used. NRS-2002 was interpreted as a hospital nutritional risk screening tool according to the original ESPEN description [11]; NRS-2002 scores of 3 or higher indicate nutritional risk, and a threshold of 5 or higher was used in this analysis to describe higher nutritional risk. Serum albumin was additionally categorised as <30 g/L, and NLR was analysed as a continuous right-skewed inflammatory marker.

2.4 Outcomes and Follow-Up Definitions

The primary outcome was 90-day all-cause mortality after the index PEG date. Secondary outcomes were in-hospital mortality, intensive care unit transfer, hospital discharge, Kaplan-Meier mortality estimates at 30, 90, 180, and 365 days, median post-PEG survival, and repeat PEG-related procedure.

For survival analyses, time zero was the index PEG date and follow-up time was calculated in days from the index date to death or censoring. Patients recorded as alive were censored on 31 March 2026, the latest vital-status date observed in the workbook. Patients without usable vital status or death-date information were excluded from survival analyses, and the denominator for survival analyses was reported separately. One otherwise eligible patient had an unavailable patient-level index PEG date field because the entry was recorded as time-only rather than as a calendar date. This patient was retained in the analytic cohort because PEG-related procedures were confirmed through linked procedure records; the handling of this date issue was reported in **Supplementary Table 1**.

2.5 Statistical Analysis

Statistical analyses were performed using Python 3.12.13 (Python Software Foundation, Beaverton, OR, USA) with pandas (version 2.2.3) and NumPy (version 2.3.5). Distributional form was assessed using visual inspection and Shapiro-Wilk testing where applicable. Because the main continuous variables were non-normally dis-

tributed, they were summarised as medians and interquartile ranges and compared using the Mann-Whitney U test, with Z statistics reported for univariable comparisons. Categorical variables were summarised as frequencies and percentages and compared using the chi-square test or Fisher exact test, as appropriate. Denominators were based on non-missing data for each variable; therefore, variables such as NRS-2002 are reported with explicit available-case denominators.

Kaplan-Meier methods were used to estimate post-PEG survival and cumulative mortality at 30, 90, 180, and 365 days. Ninety-five percent confidence intervals for Kaplan-Meier estimates were calculated using Greenwood standard errors with log-log transformation, and the survival figure included a 95% confidence band and a number-at-risk table at 0, 30, 90, 180, and 365 days.

The primary multivariable model for the primary outcome was logistic regression for 90-day all-cause mortality. To align the time-to-event analysis with the same primary endpoint, a Cox proportional hazards model was also fitted with follow-up censored at 90 days. General post-PEG survival beyond 90 days was treated as a secondary descriptive survival outcome and was not used as a replacement primary endpoint.

Model covariates were selected a priori on the basis of clinical relevance and the limited number of outcome events. To preserve model stability, the 90-day mortality models were restricted to age per 10-year increase, serum albumin per 5 g/L decrease, and log2-transformed NLR. NLR was log2-transformed to reduce the influence of right skewness and to express effect estimates per doubling. Multicollinearity was assessed using variance inflation factors and tolerance values, and values were reported in a **Supplementary Table 2**.

Repeat PEG-related procedure was analysed as an exploratory secondary outcome using logistic regression with the same parsimonious covariate set. Repeat PEG-related procedure was defined as more than one linked PEG-related procedure recorded for the same patient during the available record linkage period. Because detailed timing of repeat procedures and competing-risk information were not available for all patients, repeat-procedure regression was interpreted descriptively rather than as a definitive causal model.

Survival outcomes were not imputed for patients with unavailable vital status or death-date information. Kaplan-Meier estimates were calculated among patients with valid survival follow-up, and the number and baseline characteristics of patients without valid follow-up were reported separately to assess potential attrition bias.

Regression results are reported as beta coefficients, standard errors, Wald statistics, odds ratios or hazard ratios with 95% confidence intervals, and two-sided p values. A two-sided p value < 0.05 was considered statistically significant.

Missing data were handled by complete-case analysis for the relevant outcome and covariate set. The missing-data profile and survival follow-up availability were provided as **Supplementary Tables 1,3** to clarify denominators.

3. Results

3.1 Baseline Characteristics of the Study Cohort

The analytic cohort included 141 palliative-care inpatients aged 65 years or older who underwent PEG placement or a PEG-related procedure between 2020 and 2025. The median age was 82.0 years (IQR 76.0–86.0; range 65–112), and 85 patients (60.3%) were aged 80 years or older. Female patients constituted 85 patients (60.3%) of the cohort.

NRS-2002 was available for 138 patients and all had scores ≥3. The median NRS-2002 score was 5.0 (IQR 4.0–6.0), and 84 of 138 patients (60.9%) had an NRS-2002 score of 5 or higher. Hypoalbuminaemia was frequent: the median serum albumin level was 26.1 g/L (IQR 24.0–29.5), and 110 of 141 patients (78.0%) had serum albumin <30 g/L. The median haemoglobin level was 9.3 g/dL (IQR 8.8–10.4), and the median NLR was 3.86 (IQR 2.51–6.15).

Dementia/Alzheimer disease was the most common recorded comorbidity, observed in 85 patients (60.3%). Hypertension was recorded in 78 patients (55.3%), cerebrovascular disease in 48 patients (34.0%), diabetes mellitus in 51 patients (36.2%), malignancy in 12 patients (8.5%), and parkinsonism in 17 patients (12.1%). The median number of recorded comorbidities was 2.0 (IQR 1.0–3.0), as shown in Table 1.

3.2 Annual PEG-Related Procedural Burden and Clinical Indications

During the six-year study period, 141 patients contributed 181 PEG-related procedures. The annual number of patients ranged from 9 in 2025 to 30 in 2021 and 2024, whereas the annual number of PEG-related procedures ranged from 9 in 2025 to 46 in 2020. Repeat PEG-related procedures occurred in 23 patients (16.3%).

Reduced oral intake or dysphagia was the leading recorded indication and was present in 92 patients (65.2%). Post-intensive care follow-up was recorded in 26 patients (18.4%), pneumonia or aspiration pneumonia in 20 patients (14.2%), and other indications in 3 patients (2.1%). Annual procedural burden and indication categories are summarised in Table 2.

3.3 Clinical Outcomes and Post-PEG Survival

Following the index PEG procedure, 109 of 141 patients (77.3%) were discharged from the hospital. In-hospital mortality occurred in 18 patients (12.8%), and intensive care unit transfer was required in 14 patients (9.9%). Valid post-PEG survival follow-up was available for 105 patients (74.5% of the analytic cohort). The remaining 36

Table 1. Baseline demographic, nutritional, laboratory and clinical characteristics of the study cohort.

Characteristic	n/median	%/IQR
Age ≥80 years	85	60.3
Female sex	85	60.3
NRS-2002 ≥5	84/138	60.9
Serum albumin <30 g/L	110/141	78.0
Dementia/Alzheimer disease	85	60.3
Cerebrovascular disease	48	34.0
Hypertension	78	55.3
Diabetes mellitus	51	36.2
Malignancy	12	8.5
Parkinsonism	17	12.1
Age, years, median (IQR; range)	82.0 (76.0–86.0; 65–112)	
NRS-2002 score	5.0 (4.0–6.0)	
Serum albumin, g/L	26.1 (24.0–29.5)	
Haemoglobin, g/dL	9.3 (8.8–10.4)	
NLR	3.86 (2.51–6.15)	
Number of recorded comorbidities	2.0 (1.0–3.0)	

Continuous variables are presented as medians (interquartile range), and categorical variables as n and %. Denominators are shown where data were missing. IQR, interquartile range; NLR, neutrophil-to-lymphocyte ratio; NRS-2002, Nutrition Risk Screening 2002.

patients (25.5%) had unknown vital status and were excluded from survival analyses.

Among patients with valid survival follow-up, 83 of 105 patients (79.0%) died during available post-PEG follow-up. Kaplan-Meier mortality estimates were 5.7% at 30 days (95% CI 2.6–12.3), 25.7% at 90 days (95% CI 18.4–35.2), 43.8% at 180 days (95% CI 35.0–53.8), and 53.3% at 365 days (95% CI 44.2–63.1). Median post-PEG survival was 326 days. Repeat PEG-related procedure was observed in 23 of 141 patients (16.3%). These outcomes are reported in Table 3, and the Kaplan-Meier survival curve with 95% confidence band and number-at-risk table is shown in Fig. 1.

3.4 Univariable Comparisons According to 90-Day Mortality

In the primary 90-day mortality analysis, 27 of 105 patients with valid survival follow-up died within 90 days after the index PEG procedure, whereas 78 patients did not die within 90 days. Patients with 90-day mortality were older than those without 90-day mortality: median age was 84.0 years (IQR 78.5–88.0) versus 81.0 years (IQR 75.2–84.8), respectively ($Z = 1.97$, $p = 0.049$).

NRS-2002 score, serum albumin, haemoglobin, NLR, and number of recorded comorbidities did not differ significantly between the two groups. The median NLR was 4.38 (IQR 2.77–6.16) in patients with 90-day mortality and 3.47 (IQR 2.43–5.01) in those without 90-day mortality ($Z = 1.40$, $p = 0.161$). NRS-2002 score of 5 or higher was present in 18 of 26 patients (69.2%) with 90-day mortality and 48 of 76 patients (63.2%) without 90-day mortality ($p = 0.576$).

Categorical clinical indications and recorded comorbidities were not significantly associated with 90-day mortality in univariable comparisons. Post-intensive care indication was present in 7 of 27 patients (25.9%) with 90-day mortality and 12 of 78 patients (15.4%) without 90-day mortality (Fisher exact $p = 0.251$). Aspiration or pneumonia indication was present in 1 of 27 patients (3.7%) with 90-day mortality and 14 of 78 patients (17.9%) without 90-day mortality (Fisher exact $p = 0.108$). Full univariable comparisons are shown in Table 4.

3.5 Multivariable Models for 90-Day Mortality and Repeat Procedure

In the parsimonious multivariable logistic regression model for the primary outcome of 90-day all-cause mortality, none of the included predictors reached statistical significance. The odds ratio for age was 1.57 per 10-year increase (95% CI 0.85–2.91, $p = 0.149$). The odds ratio for serum albumin was 1.16 per 5 g/L decrease (95% CI 0.63–2.13, $p = 0.638$), and the odds ratio for log2-transformed NLR was 1.16 (95% CI 0.81–1.65, $p = 0.418$).

The 90-day censored Cox model showed a similar pattern and did not identify statistically significant predictors of 90-day mortality. Hazard ratios were 1.40 per 10-year age increase (95% CI 0.88–2.21, $p = 0.157$), 1.16 per 5 g/L lower serum albumin (95% CI 0.69–1.93, $p = 0.578$), and 1.16 for log2-transformed NLR (95% CI 0.89–1.52, $p = 0.269$). Thus, the Cox analysis was aligned with the same 90-day primary endpoint rather than modelling overall mortality across all available follow-up.

In the exploratory logistic regression model for repeat PEG-related procedure, no predictor was statistically significant. Odds ratios were 0.82 for age per 10-year increase (95% CI 0.45–1.50, $p = 0.519$), 0.70 for serum albumin per 5 g/L decrease (95% CI 0.40–1.21, $p = 0.202$), and 0.98 for log2-transformed NLR (95% CI 0.68–1.41, $p = 0.929$). Multivariable model results are presented in Table 5.

3.6 Supplementary Analyses and Data Completeness

Survival follow-up availability is detailed in **Supplementary Table 3**. In the comparison of patients with and without valid survival follow-up, patients without valid follow-up had lower serum albumin levels (median 24.5 versus 27.0 g/L, $p < 0.001$) and higher NLR values (median 6.04 versus 3.56, $p = 0.003$). NRS-2002 score was also lower in the no valid follow-up group when analysed as a continuous variable (median 4.5 versus 5.0, $p = 0.035$), whereas the proportion with NRS-2002 score ≥5 did not differ significantly between groups (64.7% versus 50.0%, $p = 0.120$) (**Supplementary Table 4**).

Table 2. Annual PEG-related procedural burden and clinical indications, 2020–2025.

Year	Patients	PEG-related procedures	Repeat procedure patients, n (%)	Reduced oral intake/dysphagia, n (%)	Post-ICU follow-up, n (%)	Pneumonia/ aspiration pneumonia, n (%)	Other indications, n (%)
2020	28	46	8/28 (28.6%)	21/28 (75.0%)	2/28 (7.1%)	4/28 (14.3%)	1/28 (3.6%)
2021	30	34	4/30 (13.3%)	20/30 (66.7%)	6/30 (20.0%)	4/30 (13.3%)	0/30 (0.0%)
2022	18	21	3/18 (16.7%)	9/18 (50.0%)	4/18 (22.2%)	4/18 (22.2%)	1/18 (5.6%)
2023	26	31	4/26 (15.4%)	14/26 (53.8%)	7/26 (26.9%)	4/26 (15.4%)	1/26 (3.8%)
2024	30	40	4/30 (13.3%)	22/30 (73.3%)	5/30 (16.7%)	3/30 (10.0%)	0/30 (0.0%)
2025	9	9	0/9 (0.0%)	6/9 (66.7%)	2/9 (22.2%)	1/9 (11.1%)	0/9 (0.0%)
Total	141	181	23/141 (16.3%)	92/141 (65.2%)	26/141 (18.4%)	20/141 (14.2%)	3/141 (2.1%)

Indications are presented as n/N (%) according to the number of patients in the corresponding year. Repeat procedure patients were defined as patients with more than one linked PEG-related procedure during the available record linkage period. Only the primary PEG indication was recorded for each patient. ICU, intensive care unit; PEG, percutaneous endoscopic gastrostomy.

Table 3. Clinical outcomes and post-PEG survival in the study cohort.

Outcome	Value
Hospital discharge	109/141 (77.3%)
In-hospital mortality	18/141 (12.8%)
ICU transfer	14/141 (9.9%)
Patients with valid survival follow-up	105/141 (74.5%)
Deaths during available post-PEG follow-up	83/105 (79.0%)
30-day mortality, Kaplan-Meier estimate	5.7% (95% CI 2.6–12.3)
90-day mortality, Kaplan-Meier estimate	25.7% (95% CI 18.4–35.2)
180-day mortality, Kaplan-Meier estimate	43.8% (95% CI 35.0–53.8)
365-day mortality, Kaplan-Meier estimate	53.3% (95% CI 44.2–63.1)
Median post-PEG survival, days	326
Repeat PEG-related procedure	23/141 (16.3%)

Kaplan-Meier estimates are based on patients with valid post-PEG survival follow-up (n = 105).

Numbers at risk are counted immediately before the specified time point; therefore, the 365-day number-at-risk value includes one patient who died exactly on day 365, and the 365-day mortality estimate remains 56/105 (53.3%).

CI, confidence interval; ICU, intensive care unit; PEG, percutaneous endoscopic gastrostomy.

The missing-data profile is summarised in **Supplementary Table 1**. NRS-2002 was missing for 3 of 141 patients (2.1%), and the index PEG date field was unavailable in 1 patient (0.7%). Vital status or death-date information was usable for survival analysis in 105 patients (74.5%). Multicollinearity diagnostics showed no concerning collinearity among the model predictors, with variance inflation factors ranging from 1.00 to 1.11 (**Supplementary Table 2**). Repeat procedures according to short-term survival follow-up stratum are shown in **Supplementary Table 5**.

4. Discussion

The present study describes a frail older palliative-care inpatient cohort in whom PEG placement or PEG-related intervention occurred in the context of severe nutritional risk, multimorbidity, and high post-procedure mortality. Although hospital discharge was achieved in most patients, in-hospital mortality, intensive care transfer, and 90-day mortality were clinically substantial. These findings indicate that PEG in this setting should be interpreted as part of a broader clinical trajectory rather than as an isolated technical nutrition procedure.

Mortality estimates after gastrostomy vary substantially across clinical settings. Among the 105 patients with valid survival follow-up, 6 died within 30 days after the index PEG date (5.7%; observed survival times, 9–28 days). This subgroup showed a phenotype of advanced clinical vulnerability. The median age was 83.5 years, 3 of 6 patients were aged 80 years or older, the median NRS-2002 score was 4.5, 5 of 6 patients had serum albumin <30 g/L, and the median NLR was 6.16. The recorded admission indication was reduced oral intake or dysphagia in 4 patients and post-intensive care follow-up in 2 patients. Dementi-

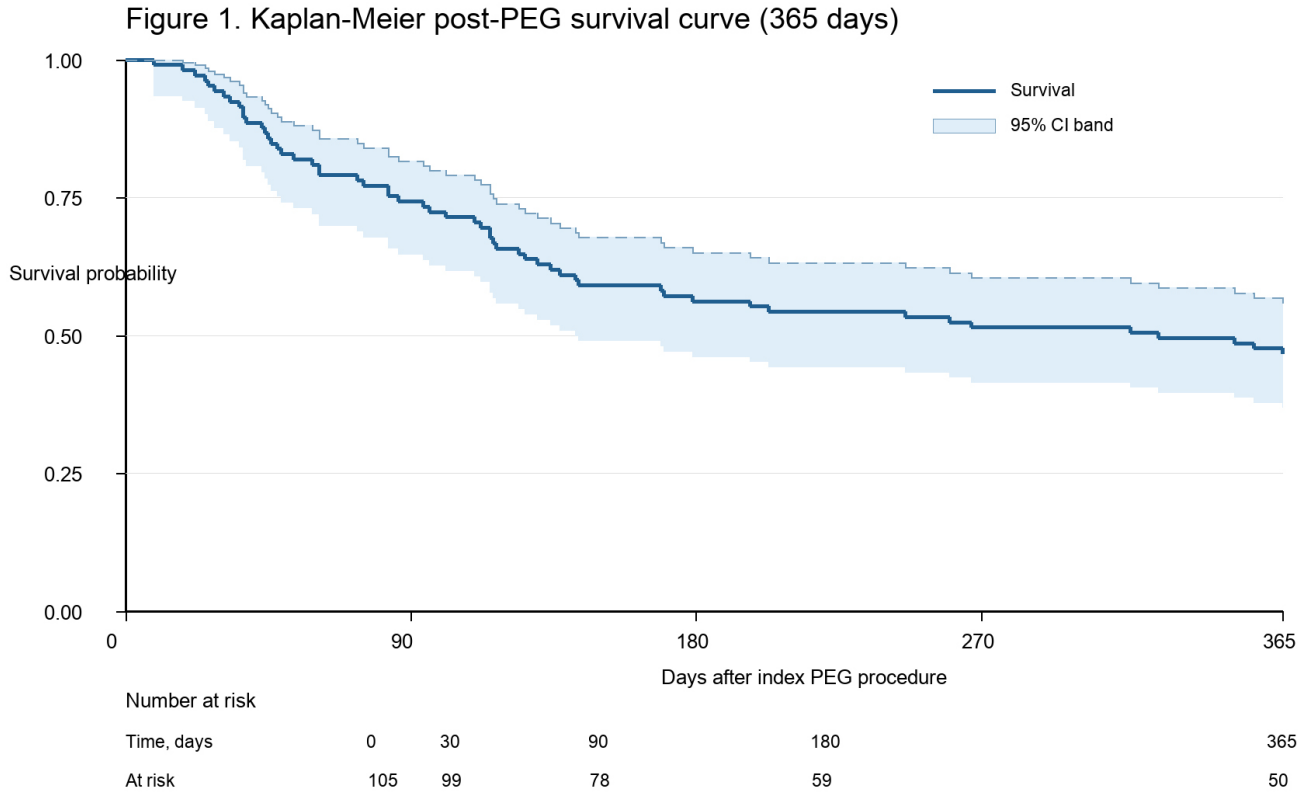


Fig. 1. Post-PEG survival after the index procedure. Kaplan-Meier survival curve for post-PEG survival among patients with valid survival follow-up (n = 105), Numbers at risk are counted immediately before each time point; one patient died exactly on day 365, so the 365-day mortality estimate remains 53.3% (56/105) although the displayed 365-day number at risk is 50. Kaplan-Meier mortality estimates were 5.7% at 30 days, 25.7% at 90 days, 43.8% at 180 days, and 53.3% at 365 days; median post-PEG survival was 326 days. PEG, percutaneous endoscopic gastrostomy.

a/Alzheimer disease was present in 4 patients, cerebrovascular disease in 2, hypertension and diabetes mellitus in 3 each, malignancy in 1, and parkinsonism in 1. These findings suggest that early post-PEG mortality occurred mainly in patients with advanced frailty, nutritional vulnerability, inflammation, and substantial comorbidity burden.

Because PEG is intended to provide long-term enteral access, very early death after PEG placement raises an important patient-selection issue. In patients with extremely advanced disease and very limited life expectancy, PEG may represent potential overutilisation if the expected survival time is too short for the intended nutritional, functional, or discharge-planning goals to be achieved. This does not mean that PEG was inappropriate in these individual patients, because the retrospective design does not allow patient-level judgement about goals of care or clinical decision-making. However, it supports careful pre-procedure discussion of prognosis, reversibility of poor oral intake, expected time to benefit, alternatives to PEG, and patient-centred goals of care, in line with ethical guidance on artificial nutrition and hydration [5,12]. The observed 30-day mortality estimate should also be interpreted cautiously. The 5.7% estimate was calculated among patients with valid survival follow-up, whereas 36 of 141 patients (25.5%) had unavailable vital-status or death-date information and were excluded from time-to-event analyses. Patients without valid follow-up had a poorer baseline profile, including lower serum albumin and higher NLR, than those with valid follow-up. Therefore, the 30-day mortality estimate may represent a conservative underestimate for the full analytic cohort rather than definitive evidence of low early mortality.

The nutritional profile of the cohort is important for interpretation. Median NRS-2002 score was 5.0, and serum albumin <30 g/L was present in 78.0% of patients, reflecting a population with advanced nutritional and inflammatory vulnerability. Current malnutrition frameworks emphasise that nutritional risk should be interpreted together with disease burden, inflammation, reduced intake, and functional reserve rather than by a single laboratory marker [1,3,13]. In this context, low albumin and high inflammatory markers may signal illness severity, but they should not be used alone to determine whether PEG is clinically appropriate.

The procedural findings also have practical relevance. PEG is an established route for long-term enteral access,

Table 4. Univariable comparisons according to 90-day mortality status.

Variable	90-day mortality (n = 27)	No 90-day mortality (n = 78)	Test statistic	*p* value
Age, years	84.0 (78.5–88.0)	81.0 (75.2–84.8)	Z = 1.97	0.049
NRS-2002 score	5.0 (4.0–6.0)	5.0 (4.0–6.0)	Z = 0.79	0.430
Serum albumin, g/L	26.0 (25.0–29.2)	27.0 (24.9–30.5)	Z = –0.90	0.371
Haemoglobin, g/dL	9.2 (8.5–9.8)	9.6 (8.9–10.7)	Z = –1.82	0.069
NLR	4.38 (2.77–6.16)	3.47 (2.43–5.01)	Z = 1.40	0.161
Number of recorded comorbidities	2.0 (1.0–3.0)	2.0 (1.0–3.0)	Z = 1.06	0.290
Male sex	8/27 (29.6%)	30/78 (38.5%)	chi-square = 0.68	0.410
Age ≥80 years	17/27 (63.0%)	42/78 (53.8%)	chi-square = 0.68	0.411
Serum albumin <30 g/L	21/27 (77.8%)	56/78 (71.8%)	chi-square = 0.37	0.545
NRS-2002 ≥5	18/26 (69.2%)	48/76 (63.2%)	chi-square = 0.31	0.576
Reduced oral intake/dysphagia indication	19/27 (70.4%)	50/78 (64.1%)	chi-square = 0.35	0.554
Post-intensive care indication	7/27 (25.9%)	12/78 (15.4%)	Fisher exact	0.251
Aspiration/pneumonia indication	1/27 (3.7%)	14/78 (17.9%)	Fisher exact	0.108
Dementia/Alzheimer disease	16/27 (59.3%)	45/78 (57.7%)	chi-square = 0.02	0.887
Cerebrovascular disease	11/27 (40.7%)	28/78 (35.9%)	chi-square = 0.20	0.653
Hypertension	16/27 (59.3%)	45/78 (57.7%)	chi-square = 0.02	0.887
Diabetes mellitus	11/27 (40.7%)	27/78 (34.6%)	chi-square = 0.33	0.568
Malignancy	4/27 (14.8%)	4/78 (5.1%)	Fisher exact	0.199
Parkinsonism	4/27 (14.8%)	8/78 (10.3%)	Fisher exact	0.500
Other indications	0/27 (0.0%)	2/78 (2.6%)	Fisher exact	1.000

Continuous variables are presented as medians (interquartile range), and categorical variables as n/N (%). Between-group comparisons used the Mann-Whitney U test, chi-square test, or Fisher exact test, as appropriate.

NLR, neutrophil-to-lymphocyte ratio; NRS-2002, Nutrition Risk Screening 2002.

Table 5. Multivariable models for post-PEG mortality and repeat PEG-related procedure.

Outcome/model	Predictor	beta	SE	Wald	HR/OR (95% CI)	*p* value	Model n/events
90-day logistic	Age, per 10-year increase	0.454	0.314	2.09	OR 1.57 (0.85–2.91)	0.149	105/27
90-day logistic	Albumin, per 5 g/L lower	0.147	0.312	0.22	OR 1.16 (0.63–2.13)	0.638	105/27
90-day logistic	NLR, log2-transformed	0.147	0.182	0.65	OR 1.16 (0.81–1.65)	0.418	105/27
90-day Cox	Age, per 10-year increase	0.334	0.235	2.01	HR 1.40 (0.88–2.21)	0.157	105/27
90-day Cox	Albumin, per 5 g/L lower	0.145	0.260	0.31	HR 1.16 (0.69–1.93)	0.578	105/27
90-day Cox	NLR, log2-transformed	0.150	0.135	1.22	HR 1.16 (0.89–1.52)	0.269	105/27
Repeat-procedure logistic	Age, per 10-year increase	–0.199	0.308	0.42	OR 0.82 (0.45–1.50)	0.519	141/23
Repeat-procedure logistic	Albumin, per 5 g/L lower	–0.362	0.284	1.63	OR 0.70 (0.40–1.21)	0.202	141/23
Repeat-procedure logistic	NLR, log2-transformed	–0.016	0.185	0.01	OR 0.98 (0.68–1.41)	0.929	141/23

The 90-day logistic and 90-day Cox models use 90-day all-cause mortality as the endpoint; the Cox model was censored at 90 days. The repeat-procedure model is exploratory. CI, confidence interval; HR, hazard ratio; OR, odds ratio; SE, standard error.

and contemporary ASGE guidance addresses gastrostomy technique selection, peri-procedural antithrombotic management, and the timing of feeding initiation after placement [2]. However, the observed repeat PEG-related procedure rate of 16.3% highlights that PEG can generate continuing procedural demand after the index intervention. For palliative-care services, this burden matters because repeat tube-related procedures may occur in patients with limited survival, high dependency, and competing goals of care.

Dementia and advanced neurological disease are central to the clinical meaning of these results. Dementia/Alzheimer disease was recorded in 60.3% of the cohort, making guidance on artificial nutrition in dementia directly relevant [3]. Ethical nutrition guidance frames artificial nutrition as a medical intervention that requires a clear indication, a realistic therapeutic goal, and consent or best-interest decision-making [5,12]. A recent large cohort study of hospitalised older adults with dementia found that feeding tube insertion was not associated with improved survival or post-discharge outcomes [14]. Although the present cohort is not directly comparable because it was restricted to palliative-care inpatients undergoing PEG-related procedures, the dementia literature supports careful goal-concordant decision-making.

The multivariable findings support a cautious interpretation of baseline predictors. Age was associated with 90-day mortality in univariable analysis, but age, lower albumin, and log2-transformed NLR were not statistically

significant in the parsimonious logistic or 90-day censored Cox models. This does not mean that these markers are clinically irrelevant. Rather, it suggests that in a cohort already enriched for malnutrition, neurological dependency, inflammation, and multimorbidity, short-term mortality is unlikely to be explained by any single routinely available variable.

In a Swedish multicentre cohort of 389 adults, Stenberg et al. [15] reported 30- and 90-day mortality rates of 15% and 28%, respectively, with adverse outcomes associated with clinical indication and patient-level factors including older age, lower body mass index, and higher C-reactive protein. In a seven-year UK audit of 691 endoscopic gastrostomy procedures, Porter et al. [16] reported 30-day and one-year mortality rates of 8.4% and 47.6%, respectively; age, alkaline phosphatase, and clinical indication were independently associated with survival, whereas the overall prognostic utility of routine blood biomarkers was limited. In contrast, Blomberg et al. [17] reported 12% 30-day mortality in a prospective cohort of 484 patients and identified low serum albumin and elevated C-reactive protein as short-term mortality risk factors. In the present follow-up cohort, the Kaplan–Meier mortality estimate was lower at 30 days (5.7%), close to the Swedish multicentre series at 90 days (25.7%), and slightly higher than the UK audit at 365 days (53.3%). These differences, together with the absence of independent associations for albumin and $\log_2$-transformed NLR in our adjusted models, may reflect variation in clinical indication, disease severity, index-procedure definition, timing of gastrostomy, and follow-up ascertainment. Collectively, these findings argue against using any single laboratory marker as a stand-alone criterion for pre-procedure decision-making.

Beyond mortality, the observed 16.3% repeat-procedure rate indicates a clinically relevant longitudinal service burden. Rosenberger et al. [18] followed 563 PEGs and documented a 12.8% lifetime accidental dislodgement rate; 49 of 72 dislodgements occurred after discharge, and most required emergency evaluation, gastrostomy-tube replacement, and radiographic confirmation of tube position. Although these outcomes are not directly equivalent—because the present endpoint included all linked repeat PEG-related procedures and could not distinguish scheduled tube exchange from unplanned complication-driven reintervention—the comparison demonstrates that tube-related healthcare use may extend beyond the index admission. This downstream burden should therefore be considered during discharge planning, caregiver counselling, and assessment of access to tube-replacement services.

The survival results should also be read with attention to denominator and follow-up completeness. Valid post-PEG survival follow-up was available for 105 of 141 patients, and 36 patients had unknown vital status. Patients without valid follow-up differed from those with follow-up in albumin and NLR, so attrition bias cannot be excluded. For this reason, the survival estimates are best understood as describing patients with usable follow-up rather than the entire analytic cohort.

5. Limitation

This study has several limitations. Its retrospective, single-centre design limits causal inference and external generalisability. The absence of a concurrent nasogastric-tube or conservative-care comparator precludes assessment of whether PEG itself improved or worsened survival, discharge outcomes, comfort, or quality of life. Survival follow-up was incomplete, and baseline differences between patients with and without valid follow-up may have introduced attrition bias. Several clinically relevant variables—including body mass index, recent weight loss, frailty, functional status, dementia severity, detailed swallowing assessment, disease-stage measures, the Palliative Performance Scale, the Palliative Prognostic Score, caregiver burden, discharge destination, tube type, operator-level characteristics, standardised PEG care protocols, and cause-of-death classification—were not consistently available. Consequently, the contribution of these factors to patient selection and post-procedure outcomes could not be evaluated. The indication category “post-intensive care follow-up” could not be further classified according to transfer after intensive care stabilisation versus clinical deterioration during palliative hospitalisation. Similarly, repeat PEG-related procedures could not be reliably distinguished as scheduled tube exchanges or unplanned complication-driven reinterventions. The limited number of repeat-procedure events, together with death as a competing event that precluded subsequent reintervention, further restricts interpretation of the exploratory repeat-procedure model. These limitations warrant cautious interpretation and support prospective, multicentre studies incorporating standardised clinical, functional, procedural, and follow-up measures.

Despite these limitations, the study provides real-world service-level data by integrating nutritional risk, clinical indications, annual procedural workload, hospital outcomes, early mortality, 365-day survival, follow-up availability, and repeat-procedure burden within a defined cohort of older palliative-care inpatients. The findings should not be interpreted as evidence that PEG should be routinely avoided or preferred. Rather, they support individualised decision-making that incorporates explicit prognostic framing, transparent discussion of uncertainty, goals of care, and the likelihood that patients will survive long enough to achieve the intended goals of enteral nutrition.

6. Conclusion

In conclusion, older palliative-care inpatients undergoing PEG placement or PEG-related procedures had severe nutritional risk, high comorbidity burden, substan-

tial early and 365-day mortality, and measurable repeat-procedure demand. In parsimonious models, age, lower serum albumin, and NLR did not independently predict 90-day mortality, and no baseline predictor was significantly associated with repeat PEG-related procedure. These findings support a cautious, goal-oriented PEG decision model that integrates prognosis, nutritional risk, discharge planning, caregiver capacity, and the possibility of further tube-related procedures rather than relying on a single biomarker or assuming procedural benefit.

Key Points

• The study cohort included 141 palliative-care inpatients aged 65 years or older who underwent PEG placement or PEG-related procedures between 2020 and 2025.

• Nutritional risk was substantial, with median NRS-2002 score of 5.0 and serum albumin <30 g/L in 78.0% of patients.

• Among patients with valid survival follow-up, Kaplan-Meier mortality estimates were 25.7% at 90 days and 53.3% at 365 days, with median post-PEG survival of 326 days.

• The 90-day logistic and 90-day censored Cox models did not identify statistically significant independent predictors among age, lower albumin, and log2-transformed NLR.

• PEG decision-making in older palliative-care inpatients should include prognosis, goals of care, discharge planning, caregiver capacity, and the possibility of repeat PEG-related procedures.

Availability of Data and Materials

The data supporting the findings of this study are not publicly available because they are derived from hospital medical records and are subject to institutional restrictions and applicable data-protection regulations. De-identified data may be available from the corresponding author upon reasonable request, subject to institutional approval and applicable ethical and data-protection requirements.

Author Contributions

Conceptualization, NMB, SB; Methodology, NMB, HA, SB; Formal analysis, NMB, HA; Investigation, NMB, GK, HA, EBÖ, BÖ; Data curation, NMB, GK, BÖ; Writing - original draft, NMB; Writing - review and editing, NMB, GK, HA, EBÖ, BÖ, SB; Supervision, SB. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was reviewed and approved by the Clinical Research Ethics Committee of Ümraniye Training and Research Hospital, Istanbul, Türkiye, on 15 January 2026 (document number: E-54132226-000-301941031; approval number: B.10.1.TKH.4.34.H.GP.0.01/41). Because of the retrospective design, use of routinely collected medical record data, absence of any study-related intervention, and analysis of de-identified data, the requirement for written informed consent was waived by the ethics committee.

Acknowledgment

The authors thank the clinical and administrative staff of the Palliative Care Unit of Ümraniye Training and Research Hospital for their support in medical record access and routine clinical data management.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used Codex (OpenAI) for linguistic editing, academic phrasing, and structural refinement of the texts. No AI tool was used for the study design, data collection, interpretation of the results, or generation of the original clinical dataset. All AI-assisted outputs were critically reviewed, verified and edited by the authors. The authors take full responsibility for the content, accuracy, and integrity of this final manuscript.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/BJHM55660.

References

[1] Jensen GL, Cederholm T, Correia MITD, Gonzalez MC, Fukushima R, Pisprasert V, et al. GLIM consensus approach to diagnosis of malnutrition: A 5-year update. JPEN. Journal of Parenteral and Enteral Nutrition. 2025; 49: 414–427. https://doi.org/10.1002/jpen.2756

[2] ASGE Standards of Practice Committee, Kohli DR, Abidi WM, Cosgrove N, Machicado JD, Desai M, et al. American Society for Gastrointestinal Endoscopy guideline on gastrostomy feeding tubes: summary and recommendations. Gastrointestinal Endoscopy. 2025; 101: 25–35. https://doi.org/10.1016/j.gie.2024.08.044

[3] Volkert D, Beck AM, Faxén-Irving G, Frühwald T, Hooper L, Keller H, et al. ESPEN guideline on nutrition and hydration in dementia - Update 2024. Clinical Nutrition (Edinburgh, Scotland). 2024; 43: 1599–1626. https://doi.org/10.1016/j.clnu.2024.04.039

[4] Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Hooper L, Kiesswetter E, et al. ESPEN practical guideline: Clinical nutrition and hydration in geriatrics. Clinical Nutrition (Edin-

burgh, Scotland). 2022; 41: 958–989. https://doi.org/10.1016/j.clnu.2022.01.024

[5] Cardenas D, Burgos R, Rothenberg E, Ballmer P, Barrocas A, Bischoff SC, et al. ESPEN practical guideline on ethical aspects of medical nutrition therapy. Clinical Nutrition (Edinburgh, Scotland). 2026; 60: 106622. https://doi.org/10.1016/j.clnu.2026.106622

[6] Lima DL, Miranda LEC, Lima RNCL, Romero-Velez G, Chin R, Shadduck PP, et al. Factors Associated with Mortality after Percutaneous Endoscopic Gastrostomy. JSLS: Journal of the Society of Laparoendoscopic Surgeons. 2023; 27: e2023.00005. https://doi.org/10.4293/JSLS.2023.00005

[7] Mutlu Bilgiç N, Kahveci G, Aykut H, Özer Y, Özşenel EB, Basat S. Risk Factors for Complications and 90-Day Mortality After Percutaneous Endoscopic Gastrostomy: The Role of Nutritional and Inflammatory Markers. Medicina (Kaunas, Lithuania). 2025; 61: 1916. https://doi.org/10.3390/medicina61111916

[8] Pei R, Wang D. Prognostic nutritional index negative associated with mortality in older Japanese patients with dysphagia. Frontiers in Nutrition. 2025; 12: 1586248. https://doi.org/10.3389/fnut.2025.1586248

[9] Sezer S, Aytaç S. Predictors of Early Mortality After Percutaneous Endoscopic Gastrostomy in Geriatric Patients. European Journal of Geriatrics and Gerontology. 2025; 7: 6–10. https://doi.org/10.4274/ejgg.galenos.2025.2024-12-3

[10] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet (London, England). 2007; 370: 1453–1457. https://doi.org/10.1016/S0140-6736(07)61602-X

[11] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clinical Nutrition (Edinburgh, Scotland). 2003; 22: 321–336. https://doi.org/10.1016/s0261-5614(02)00214-5

[12] Druml C, Ballmer PE, Druml W, Oehmichen F, Shenkin A, Singer P, et al. ESPEN guideline on ethical aspects of artificial nutrition and hydration. Clinical Nutrition (Edinburgh, Scotland). 2016; 35: 545–556. https://doi.org/10.1016/j.clnu.2016.02.006

[13] Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - A consensus report from the global clinical nutrition community. Journal of Cachexia, Sarcopenia and Muscle. 2019; 10: 207–217. https://doi.org/10.1002/jcsm.12383

[14] Hartford AM, Li W, Qureshi D, Talarico R, Fung SG, Bush SH, et al. Use of Feeding Tubes Among Hospitalized Older Adults With Dementia. JAMA Network Open. 2025; 8: e2460780. https://doi.org/10.1001/jamanetworkopen.2024.60780

[15] Stenberg K, Eriksson A, Odensten C, Darehed D. Mortality and complications after percutaneous endoscopic gastrostomy: a retrospective multicentre study. BMC Gastroenterology. 2022; 22: 361. https://doi.org/10.1186/s12876-022-02429-0

[16] Porter RJ, McKinlay AW, Metcalfe EL. Gastropexy can be as safe as conventional percutaneous endoscopic gastrostomy (PEG), and biomarkers do not predict short-term or long-term outcomes: a 7-year follow-up audit. Frontline Gastroenterology. 2019; 11: 364–370. https://doi.org/10.1136/flgastro-2019-101306

[17] Blomberg J, Lagergren P, Martin L, Mattsson F, Lagergren J. Albumin and C-reactive protein levels predict short-term mortality after percutaneous endoscopic gastrostomy in a prospective cohort study. Gastrointestinal Endoscopy. 2011; 73: 29–36. https://doi.org/10.1016/j.gie.2010.09.012

[18] Rosenberger LH, Newhook T, Schirmer B, Sawyer RG. Late accidental dislodgement of a percutaneous endoscopic gastrostomy tube: an underestimated burden on patients and the health care system. Surgical Endoscopy. 2011; 25: 3307–3311. https://doi.org/10.1007/s00464-011-1709-y