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Outcomes following percutaneous endoscopic gastrostomy insertion in patients with learning disability: a retrospective cohort study using The Health Improvement Network (THIN) database

Running Title: Outcomes following PEG in LD patients

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Key words: Percutaneous endoscopic gastrostomy, Learning disability, aspiration pneumonia, mortality

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STRUCTURED ABSTRACT

Objectives: To measure the rates of lower respiratory tract infection (LRTI) and mortality following percutaneous endoscopic gastrotomy (PEG) placement in patients with learning difficulties (LD). Following this to compare these rates between those having LRTI prior to PEG placement and those with no recent LRTI.

Design: Retrospective Cohort Study

Setting and participants: Exposed and unexposed control groups were isolated from 'The Health Improvement Network' database. PEG placement and LD were identified using Read codes previously developed by an expert panel. Subjects with LRTI in the year prior to their PEG placement were considered the exposed cohort and compared to unexposed subjects with an LRTI history.

Main outcome measures: The main outcome measures was the incidence rate ratio (IRR) of developing LRTI and mortality comparing the exposed and unexposed control groups.

Results: 214 subjects with LD had a PEG inserted. 53.7% were male and the median age was 27.6 (IQR 19.6-38.6) years. 27.1% were in the exposed cohort. 18.7% had a LRTI in the year following PEG, with an estimated incidence rate of 254 per 1000-person years. Over the study period the incidence rate of LRTI in exposed subjects was 369 per 1000-person years, in unexposed subjects this was 91 per 1000-person years (IRR 4.04 (95% CI 2.59-6.21) p<0.001). 27.1% of subjects died during study follow-up. Incidence rate of death was 80 and 45 per 1000-person year for exposed and unexposed subjects respectively (IRR 1.76 (1.00-3.11) p=0.047).

Conclusion: In LD subjects no clinically meaningful reduction in LRTI incidence was observed following PEG placement. Mortality and LRTI were higher in subjects with at least one LRTI in the year preceding PEG placement, compared to those without a preceding LRTI.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This study utilised The Health Improvement Network (THIN). THIN is a primary care database including 6% of the UK population, which is representative of national demographics, therefore providing a large cohort for analysis.
- Learning Disability subjects were identified using Read codes developed by an expert panel for use in research, providing a robust mechanism to identify such subjects.
- Percutaneous Endoscopic Gastrostomy is incompletely coded in THIN, therefore new tube feed prescription is used as a surrogate of PEG placement, however some cases will not be identified.
- Respiratory tract infection and death are accurately coded therefore the described rates of these outcomes are robust.

INTRODUCTION

Subjects with learning disability (LD) are known to have high incidence of aspiration on video fluoroscopy[1]. For this reason the National Patient Safety Agency review in 2004 considered swallowing difficulties to be a key cause for concern in this group[2]. Aspiration leads to recurrent episodes of pneumonia, often including hospitalisation. This contributes to the high incidence of chronic lung disease[3] and disproportionately high mortality from respiratory conditions in this subject cohort[4]. Subjects with LD may undergo Percutaneous Endoscopic Gastrostomy (PEG) insertion in an effort to reduce aspiration, usually as part of a multifactorial indication including the need for nutritional support.

Subjects who receive nutrition through a PEG are still at risk of aspiration. A Japanese study looking at elderly subjects demonstrated that in those with prior aspiration pneumonia mortality following PEG insertion was high and the commonest cause of mortality was pneumonia[5]. PEGs placement also did not improve quality of life in a longitudinal study of 40 LD subjects[6].

There is no current evidence describing the outcomes from PEG insertion in subjects with LD with respect to respiratory tract infections. LD subjects are often excluded from clinical studies, despite the recognition that this group has greater healthcare needs, and poorer engagement with healthcare services. For this reason they have been described as a "Cinderella population"[7].

Admission to hospital for subjects with LD is often challenging for both the subject and staff. Best interest decisions and delegated consent for PEG placement are often required. Often the procedure is traumatic for the subject and carers. It is therefore important to ensure that PEG placement is in the LD patient's best interests. Equally important is that the information given to family members and carers, who participate in the decision-making process, is evidence based.

The aim of this study was to examine the impact of PEG placement on the risk of respiratory tract infections and mortality within the LD cohort using The Health Improvement Network (THIN) primary care database.

METHODS

The present study is a retrospective, population-based cohort study of subjects with LD undergoing PEG placement. Subjects were segregated by those with coded lower respiratory tract infection (LRTI) including specific aspiration pneumonia codes within 1 year prior to PEG placement (exposed) and those without (unexposed). Subjects in the exposed group were considered to be those at high risk for aspiration.

Data source

The Health Improvement Network (THIN) represents a group of General Practices (primary care) covering 6% of the UK population, which is representative of the UK population structure[8]. Individual practices were eligible for inclusion in the study from the later of the following two dates to ensure that the practice was making full use of the Electronic Medical Record (EMR): one year after the date their EMR was installed; and after the practice's acceptable mortality recording date. To ensure there was sufficient time to record baseline co-morbidities data, individual subjects were eligible for inclusion from the date their practice became eligible for inclusion in the study or one year after registration with their practice if this date was later. Available information includes demographic, procedural and mortality data. Diagnosis and clinical presentations are recorded in the Read code hierarchical coding system[9].

Study population

Subjects with LD were identified by Read codes developed by NHS Digital for a previous study (Supplementary 1). A panel of four experts reviewed each potential Read code. A code was included If there was agreement by 3 or more experts[10].

PEG placement was identified by one of two methods; Read code for PEG placement, or first prescription of non-oral, enteric, tube feed from the British National Formulary. Although these may also be used with a nasogastric tube, it is highly unlikely that this would be performed outside of a hospital setting.

Subjects aged 16-46 with an LD code from any time point and incident PEG placement between May 1995 and May 2017 were included.

Co-variates and outcome measures

Further variables sought included age, gender, smoking status, body mass index (BMI), Townsend deprivation index, epilepsy and Charlson co-morbidity score.

Episodes of LRTI were identified by Read code following the PEG placement. Mortality was also sought in the THIN database. The full list of Read codes for covariates can be found in supplementary 1.

Statistical analysis

Demographic characteristics were described for the exposed, unexposed and total cohorts. Age is converted to quintiles because any relationship was considered unlikely to be linear. Baseline variables were compared between exposed and unexposed cohorts.

The incidence rate (IR) of LRTI and mortality within 1 year of PEG placement are reported for exposed and unexposed cohorts. The rate of LRTI in the year prior to PEG placement was reported.

IRs were calculated for LRTI and mortality at any time point following PEG placement, in the exposed and unexposed cohorts. Incidence rate ratios (IRR) and 95% confidence intervals (95% CI) are reported. Median time to event and interquartile range (IQR) are reported for LRTI and mortality. Cumulative incidence charts were plotted for mortality and LRTI by exposure group and compared with competing risk regression to allow for competing risks.

A multivariable Poisson regression model was constructed for factors associated with LRTI up to 1 year after PEG placement. Covariates included age, gender, deprivation, Charlson score category (0 or 1+) epilepsy and exposure group.

All statistical analysis was undertaken in Stata version 15 [11]. The threshold for statistical significance was set at $p<0.05$.

THIN data access was provided by IQVIA to the University of Birmingham under a generic multicentre research ethics committee approval in 2003. This study was granted study specific approval (SRC 18THIN008).

Patient Involvement

The data used was from a large anonymous database. Patients were not involved in the setting of the research question, outcome measures or design of the study. Patients were not involved in the interpretation of results nor are there plans to disseminate the information to the patients affected by this research.

RESULTS

Subject Demographics

There were 38,521 subjects with an LD code in THIN, of whom 214 met the inclusion criteria for PEG placement between age 16-46. The median age of the cohort was 27.6 (IQR 19.6-38.6) years and 53.7% were male. Charlson co-morbidity scores were 0, 1, 2 and 3 or more in 155 (72.4%), 39 (18.2%), 9 (4.2%), and 11 (5.1%) respectively. 69.6% had a coded diagnosis of epilepsy. Body mass index (BMI) was available in only 82 (38.3%) subjects, median 20kg/m^2 (IQR 16.5-24.2kg/m^2).

Exposed and unexposed cohorts

The exposed cohort (subjects with one or more LRTIs in the year prior to PEG placement) included 58 subjects, 55.2% of whom were male, median age 30.8 (IQR 19.4 – 39.1) years, and there were 97.6 person-years follow-up. The unexposed cohort included 156 subjects, 53.2% of whom were male, median age 27.0 (IQR 19.9 – 36.7) years. The unexposed cohort had 645.8 person-years follow-up. Full cohort demographics for the whole study population and split by exposure are shown in Table 1.

Table 1: Study subject demographics

		Unexposed (n=156)	Exposed (n=58)	Total (n=214)	P value
Gender	**Male**	83(53.2)	32 (55.2)	115 (53.7)	p= 0.8
	Female	73(46.8)	26 (44.8)	99 (46.3)	
Median age in years (IQR)		27.0 (19.9-36.7)	30.8 (19.4-39.1)	27.6 (19.6-8.6)	p=0.6
Townsend	**1**	31 (19.9)	9 (15.5)	40 (18.7)	p=0.3
	2	30 (19.2)	16 (27.6)	46 (21.5)	
	3	38 (24.4)	14 (24.1)	52 (24.3)	
	4	21 (13.5)	12 (20.7)	33 (15.4)	
	5	25 (16.0)	4 (6.9)	29 (13.6)	
	Missing	11 (7.1)	3 (5.2)	14 (6.5)	
Epilepsy	**Yes**	103 (66.0)	46 (79.3)	149 (69.6)	p=0.06
	No	53 (34.0)	12 (20.7)	65 (30.4)	
Charlson co-morbidity score	**0**	115 (73.7)	40 (69.0)	155 (72.4)	p=0.53
	1	27 (17.3)	12 (20.7)	39 (18.2)	
	2	5 (3.2)	4 (6.9)	9 (4.2)	
	3+	9 (5.8)	2 (3.5)	11 (5.1)	

Values are n (%) unless otherwise specified

Lower respiratory tract infection

40 subjects developed LRTI within 1 year of PEG placement, which was more common in the exposed group compared to the unexposed group; IR 606 per 1000-person years and 149 per 1000-person years respectively. IRR 4.07 (95% CI: 2.09 - 8.06), (p<0.001).

Over the study period IR for LRTI in the exposed group was 369 per 1000-person years. In the unexposed group this was 91 per 1000-person years, IRR 4.04 (95% CI 2.59-6.21, p<0.001). (Table 2 and figure 1). The time from PEG placement to LRTI in the whole study population was 1.33 (IQR 0.4-3.72) years. In the exposed group this was 0.64 (0.27-1.84) years and in the unexposed group 2.37 (0.71-4.90) years.

Table 2: Incidence of lower respiratory tract infections and mortality following PEG placement

	LRTI within 1 year		LRTI at any time		Mortality at any time	
	Exposed	**Unexposed**	**Exposed**	**Unexposed**	**Exposed**	**Unexposed**
Events	22	18	36	59	20	38
Person years	36	121	98	645	251	842
Incidence Rate (per 1000)	606	149	369	91	80	45
Incidence Rate Ratio	4.07 (2.09-8.06)		4.04 (2.59-6.21)		1.76 (1.00-3.11)	
P value	<0.001		P=0.001		P=0.047	

In a multivariable Poisson regression model female gender (IRR 0.48 (95% CI: 0.23-0.97), p=0.042), age 33-40 years (3.36 (1.11-10.16), p=0.031), age >40 years (5.22 (1.73-15.75), p=0.003) and LRTI in the year prior to PEG placement (exposed group) (4.05 (2.09-7.87), p<0.001) were significantly associated with developing LRTI in the year following PEG placement (Table 3).

Table 3: Poisson regression model for lower respiratory tract infection within 1 year of PEG placement

		Incidence Rate Ratio	95% CI	P value
Age quintile	**<19**	1	-	-
	19-24	1.38	0.43-4.43	0.586
	24-33	1.28	0.36-4.63	0.699
	33-40	3.36	1.11-10.16	0.031
	>40	5.22	1.72-15.75	0.003
Gender (female)		0.48	0.23-0.97	0.042
Epilepsy		1.73	0.78-3.81	0.177
Charlson score 1 or above		1.73	0.86-3.47	0.125
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.68	0.25-1.83	0.441
	3	1.11	0.43-2.86	0.822
	4	0.67	0.21-2.19	0.513
	5	0.68	0.17-2.70	0.580
	Missing	0.54	0.10-2.80	0.462
LRTI in the year prior to PEG placement *(Exposed group)*		4.05	2.08-7.87	<0.001

Rate of respiratory tract infections before and after PEG placement

The proportion with LRTI in the year prior to PEG placement was 27.1%. 18.7% developed LRTI in the year after PEG placement, albeit with less than 1 year of follow-up in some subjects. The LRTI incidence ratio for the complete cohort in the year prior to PEG placement was 317 per 1000-person years compared to 254 per 1000-person years in the year after PEG placement.

Mortality

Over the study period 58 subjects died and median age at death was 38.2 (27.8-42.0) years. Exposed group IR was 80 per 1000-person years and 45 per 1000 person years in the unexposed group (adjusted IRR 1.76 (95% CI 1.00-3.11), p=0.047) (Table 2 and Figure 2).

In a multivariable Poisson regression model, age 33-40 years (2.59 (1.03-6.52), p=0.043) and age >40 years (2.62 (1.01-6.77), p=0.047) were significantly associated with mortality during study follow-up following PEG placement. Previous respiratory tract infection in the year prior to PEG placement (exposed group) (1.80 (1.00-3.23), p=0.05), was of borderline significance in this model (Table 4).

Table 4 Poisson regression model for mortality following PEG placement

		Incidence Rate Ratio	95% CI	P value
Age quintile	**<19**	1	-	-
	19-24	1.84	0.71-4.82	0.210
	24-33	1.65	0.62-4.39	0.315
	33-40	2.59	1.03-6.52	0.043
	>40	2.62	1.01-6.77	0.047
Gender (female)		1.08	0.62-1.87	0.792
Epilepsy		0.80	0.44-1.44	0.452
Charleson score 1 or above		1.21	0.68-2.18	0.508
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.57	0.25-1.30	0.183
	3	0.63	0.29-1.38	0.250
	4	0.79	0.33-1.88	0.594
	5	0.42	0.15-1.17	0.098
	Missing	0.32	0.7-1.49	0.146
LRTI in the year prior to PEG placement *(Exposed group)*		1.80	1.00-3.23	0.050

DISCUSSION

This is the first study to assess the outcomes of PEG insertion in a cohort of LD subjects. No reduction in LRTI following PEG placement was observed. Furthermore, subjects having one

or more LRTIs prior to their PEG were more likely to have LRTIs after PEG placement, both in the first year after their PEG and in long term follow-up. Subjects with one or more LRTIs prior to PEG placement also had a small increase in mortality over the study period. Female gender provided a small protective effect for LRTI within 1 year. Increasing age was associated with both increased mortality and LRTI within 1 year of PEG placement.

There are no other studies looking at outcomes following PEG placement specific to subjects with LD. A prospective PEG audit including 350 PEG placements over 571 person years of data found a 1 year mortality of 35%, significantly higher than reported in the above study[12]. However, the median age was 62 years compared to 28 years in the present study and all indications were included. 31 of 350 PEGs were placed in subjects with LD in whom 5 (16.1%) died over median 20 months follow-up. In the present study 11 (5.1%) died within 12 months and over the study period 55 (25.7%) subjects died, albeit with a median time to death of 3.5 years. Although the proportions observed are different, only small numbers of deaths are observed and therefore comparison may be misleading. There is also likely to be variation in practice between providers, with a national overview provided by the present study compared to a single provider in the study by Clarke, Pitts, Latchford, & Lewis[12].

Short term mortality could not be addressed in this study as there were too few outcomes despite the sample size. There was also a wide variation in time to LRTI with large interquartile ranges. Therefore, although there appears to be shorter time to LRTI following PEG placement in subjects in the exposed group compared to the unexposed group, this result requires further evaluation before any implications for clinical practice can be considered.

LRTI are used as a surrogate of aspiration pneumonia in the present study. Although there are codes specifically for aspiration pneumonia, the study included all LRTI codes to provide good sensitivity. In subjects who have a PEG in situ or proceed to have a PEG placed up to one year later, it was assumed that aspiration at least contributed to their LRTI.

A key strength of this analysis compared to others examining the impact of PEG placement is the use of primary care data. The THIN database is an important tool to examine the LD population. The database is recognised to have a high accuracy and is therefore used for analysis for a wide range of conditions and outcomes. Specific benefits for the present study include a relatively large number of LD subjects with robust diagnostic and demographic data. Respiratory infections in this cohort are often managed in primary care and as such, only a small minority of cases present to secondary care. Therefore, presentation to primary care is a more sensitive measure of such infections.

LD subjects are often challenging to identify from medical records. The Read codes used in the current cohort were developed by an expert group, in which codes were only included in the final set if 3 out of 4 panel members agreed that the code was representing a group of subjects with LD. This set of Read codes has been utilised a number of studies previously [13].

This provides reassurance that the cohort in the present study accurately represents LD subjects. Although over 200 were included, and most clinically significant associations are likely to have been identified, a larger cohort would have allowed detection of more subtle factors, including an accurate estimate of their effects.

Identification of subjects undergoing PEG placement in the THIN database was also difficult. As a procedure performed in secondary care, the PEG placement was not always coded in primary care data. Therefore, first feed prescription was used as a surrogate marker to identify when a PEG had been placed. Despite these methods, it is likely that not all PEG placements are captured within the data, however we can be confident that those included represent a cohort of LD subjects undergoing PEG placement.

Unfortunately, data on BMI was missing in a very high proportion of subjects. As such this could not be included in the analysis. It is hypothesised that subjects requiring a PEG are less mobile and therefore, in the absence of appropriate equipment, they do not routinely have their weight checked and recorded in primary care.

CONCLUSION

This is a novel population-based study demonstrates that PEG placement does not appear to confer a reduction in LRTIs in the LD cohort. A small increase in mortality was also noted in subjects with a recent history of respiratory tract infections prior to PEG placement. Physicians making decisions regarding PEG placement in LD subjects should incorporate this into their assessment of risk and benefit and ensure subjects, carers and family members are aware of likely outcomes following PEG placement. Further research is required in subjects with LD to establish sub-groups that are most likely to benefit from PEG placement.

ADDITIONAL INFORMATION

Author contributions: PRH and NJT were responsible for the initial conception of the study. PRH, TT, JSC and KN then contributed to the data collection and analysis of the data. PRH, TT, JSC, NJT, NB and KN all contributed to the final version of the manuscript for submission.

Data sharing and accessibility: The full dataset and statistical code for analysis can be requested from the corresponding author.

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Conflict of interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Transparency: The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

Figure Legends:

Figure 1: Cumulative incidence regression for lower respiratory tract infections following PEG placement

Figure 2: Cumulative incidence regression for mortality following PEG placement

REFERENCES

1. Somerville H, Tzannes G, Wood J, Shun A, Hill C, Arrowsmith F, et al. Gastrointestinal and nutritional problems in severe developmental disability. Dev Med Child Neurol. 2008;50(9):712-6.
2. NPSA. Understanding the patient safety issues for people with learning disabilities. London: National Patient Safety Agency; 2004.
3. Strauss D, Cable W, R S. Causes of excess mortality in cerebral palsy patients. developmental medicine & child neurology. 1999;41:580-5.
4. Hollins S, Attard T, Von Fraunhofer, Mcguigan S, P S. Mortality in peiple with learning disability: risks, causes and death certification findings in London. Developmental medicine & child neurology. 1998;40:50-6.
5. Tokunaga T, Kubo T, Ryan S, Tomizawa M, Yoshida S, Takagi K, et al. Long-term outcome after placement of a percutaneous endoscopic gastrostomy tube. Geriatr Gerontol Int. 2008;8(1):19-23.
6. Lee L, MacPherson M. Long-term percutaneous endoscopic gastrostomy feeding in young adults with multiple disabilities. Intern Med J. 2010;40(6):411-8.
7. Leslie P, Crawford H, Wilkinson H. People with a learning disability and dysphagia: a cinderella population? Dysphagia. 2009;24(1):103-4.
8. Bourke A, Dattani H, Robinson M. Feasibility study and methodology to create a quality-evaluated database of primary care data. Inform Prim Care. 2004(12):171–7.
9. Booth N. What are Read Codes. Health Libraries Review. 1994;11:177-82.
10. The NHS Information Centre PSaPCS. Access to Healthcare for People with Learning Disabilities 2010.
11. Statacorp. Stata Statistical Software: release 14.: TX: StataCorp LP; 2015.
12. Clarke E, Pitts N, Latchford A, Lewis S. A large prospective audit of morbidity and mortality associated with feeding gastrostomies in the community. Clinical Nutrition. 2017;36(2):485-90.
13. Buszewicz M, Welch C, Horsfall L, Nazareth I, Osborn D, Hassiotis A, et al. Assessment of an incentivised scheme to provide annual health checks in primary care for adults with intellectual disability: a longitudinal cohort study. The Lancet Psychiatry. 2014;1(7):522-30.

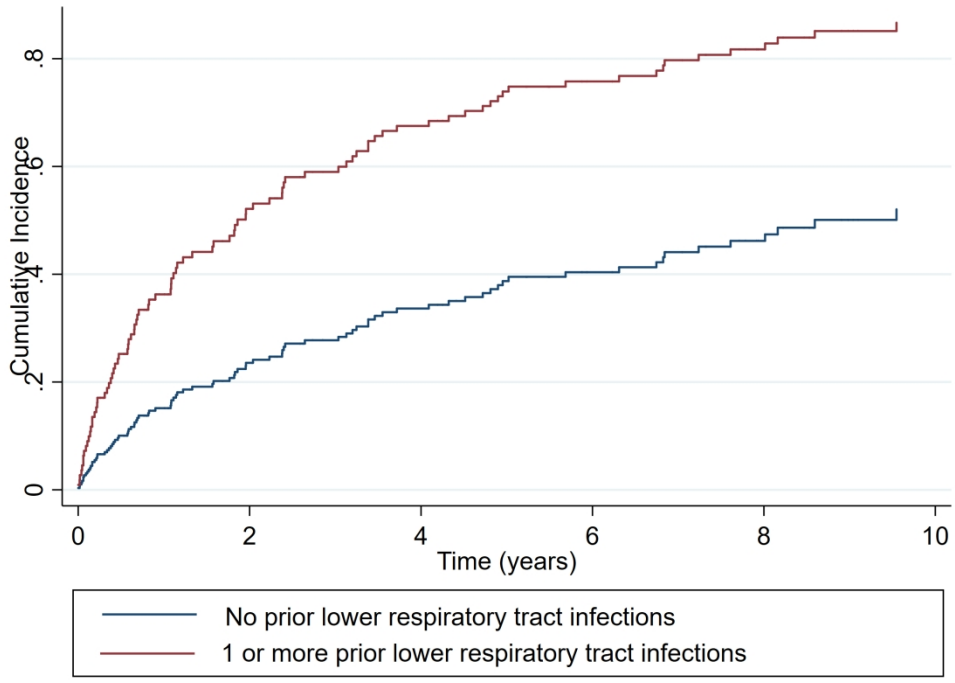

Figure 1: Cumulative incidence regression for lower respiratory tract infections following PEG placement

215x157mm (300 x 300 DPI)

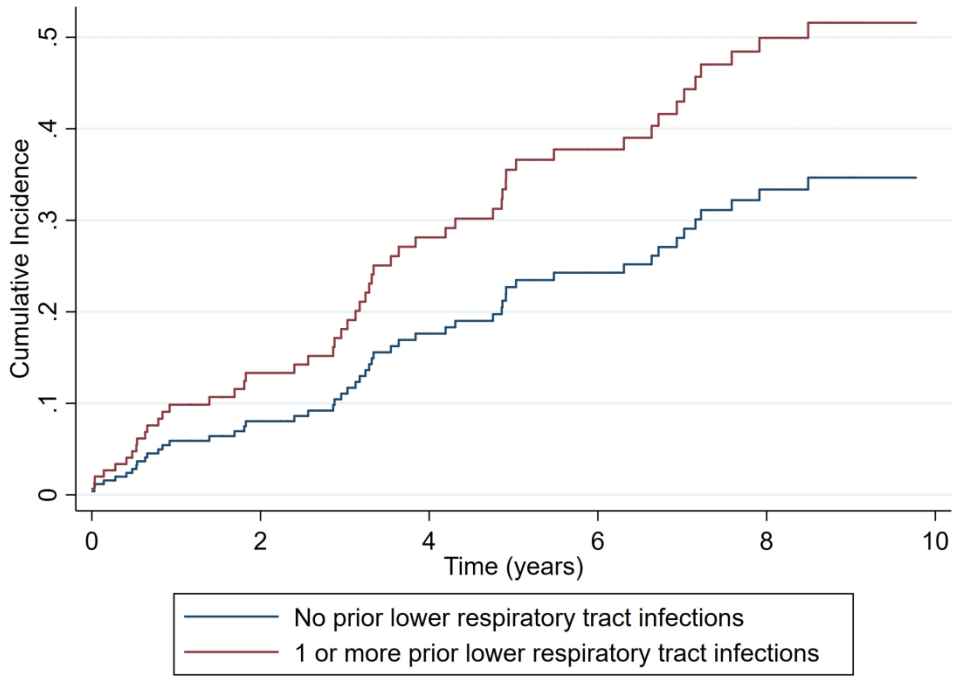

Figure 2: Cumulative incidence regression for mortality following PEG placement

215x157mm (300 x 300 DPI)

Outcomes following percutaneous endoscopic gastrostomy insertion in patients with learning disability: Appendix

1. LD read codes:

6664	Mental handicap problem
13Z3.00	Low I.Q.
8HHP.00	Referral to learning disability team
9HB..00	Learning disabilities administration status
9HB0.00	Learning disabilities health action plan declined
9HB1.00	Learning disabilities health action plan offered
9HB2.00	Learning disabilities health action plan reviewed
9HB3.00	Learning disabilities health assessment
9HB4.00	Learning disabilities health action plan completed
9HB5.00	Learning disabilities annual health assessment
C301.00	Phenylketonuria
E140.00	Infantile autism
E140.11	Kanner's syndrome
E140.12	Autism
E140.13	Childhood autism
E140000	Active infantile autism
E140100	Residual infantile autism
E140z00	Infantile autism NOS
E3...00	Mental retardation
E30..00	Mild mental retardation, IQ in range 50-70
E30..11	Educationally subnormal
E30..12	Feeble minded
E30..13	Moron
E31..00	Other specified mental retardation
E310.00	Moderate mental retardation, IQ in range 35-49
E310.11	Imbecile
E311.00	Severe mental retardation, IQ in range 20-34
E312.00	Profound mental retardation with IQ less than 20
E312.11	Idiocy
E31z.00	Other specified mental retardation NOS
e31z.00	Other specified mental retardation NOS
E3y..00	Other specified mental retardation
E3z..00	Mental retardation NOS
Eu7..00	[X]Mental retardation
Eu70.00	[X]Mild mental retardation
Eu70.11	[X]Feeble mindedness
Eu70.12	[X]Mild mental subnormality
Eu70000	[X]Mld mental retard with statement no or min impairm behav
Eu70100	[X]Mld mental retard sig impairment behav req attent/treatmt
Eu70y00	[X]Mild mental retardation, other impairments of behaviour
Eu70z00	[X]Mild mental retardation without mention impairment behav

Eu71.00	[X]Moderate mental retardation
Eu71.11	[X]Moderate mental subnormality
Eu71000	[X]Mod mental retard with statement no or min impairm behav
Eu71100	[X]Mod mental retard sig impairment behav req attent/treatmt
Eu71y00	[X]Mod retard oth behav impair
Eu71z00	[X]Mod mental retardation without mention impairment behav
Eu72.00	[X]Severe mental retardation
Eu72.11	[X]Severe mental subnormality
Eu72000	[X]Sev mental retard with statement no or min impairm behav
Eu72100	[X]Sev mental retard sig impairment behav req attent/treatmt
Eu72y00	[X]Severe mental retardation, other impairments of behaviour
Eu72z00	[X]Sev mental retardation without mention impairment behav
Eu73.00	[X]Profound mental retardation
Eu73.11	[X]Profound mental subnormality
Eu73000	[X]Profound ment retrd wth statement no or min impairm behav
Eu73100	[X]Profound ment retard sig impairmnt behav req attent/treat
Eu73y00	[X]Profound mental retardation, other impairments of behavr
Eu73z00	[X]Prfnd mental retardation without mention impairment behav Eu7y.00 [X]Other mental retardation
Eu7y000	[X]Oth mental retard with statement no or min impairm behav
Eu7y100	[X]Oth mental retard sig impairment behav req attent/treatmt
Eu7yy00	[X]Other mental retardation, other impairments of behaviour
Eu7yz00	[X]Other mental retardation without mention impairment behav
Eu7z.00	[X]Unspecified mental retardation
Eu7z.11	[X]Mental deficiency NOS
Eu7z.12	[X]Mental subnormality NOS
Eu7z000	[X]Unsp mental retard with statement no or min impairm behav
Eu7z100	[X]Unsp mentl retard sig impairment behav req attent/treatmt
Eu7zy00	[X]Unspecified mental retardatn, other impairments of behav
Eu7zz00	[X]Unsp mental retardation without mention impairment behave
Eu81z00	[X]Developmental disorder of scholastic skills, unspecified
Eu81z11	[X]Learning disability NOS
Eu81z12	[X]Learning disorder NOS
Eu81z13	[X]Learn acquisition disab NOS
Eu84.00	[X]Pervasive developmental disorders
Eu84000	[X]Childhood autism
Eu84011	[X]Autistic disorder
Eu84012	[X]Infantile autism
Eu84013	[X]Infantile psychosis
Eu84014	[X]Kanner's syndrome
Eu84100	[X]Atypical autism
Eu84111	[X]Atypical childhood psychosis
Eu84112	[X]Mental retardation with autistic features
Eu84112	[X]Mental retardation with autistic features
Eu84200	[X]Rett's syndrome
Eu84311	[X]Dementia infantalis
Eu84400	[X]Overactive disorder assoc mental retard/stereotype movts
	[X]Other pervasive developmental disorders

Eu84y00	
Eu84z00	[X]Pervasive developmental disorder, unspecified
Eu84z11	[X]Autistic spectrum disorder
PJ0..00	Down's syndrome trisomy 21
PJ0..11	Mongolism
PJ0..12	Trisomy 21
PJ0..13	Trisomy 22
PJ00.00	Trisomy 21, meiotic nondisjunction
PJ01.00	Trisomy 21, mosaicism
PJ01.11	Trisomy 21, mitotic nondisjunction
PJ02.00	Trisomy 21, translocation
PJ02.11	Partial trisomy 21 in Down's syndrome
PJ0z.00	Down's syndrome NOS
PJ0z.11	Trisomy 21 NOS
PJ1..00	Patau's syndrome trisomy 13
PJ10.00	Trisomy 13, meiotic nondisjunction
PJ11.00	Trisomy 13, mosaicism
PJ11.11	Trisomy 13, mitotic nondisjunction
PJ12.00	Trisomy 13, translocation
PJ12.11	Partial trisomy 13 in Patau's syndrome
PJ1z.00	Patau's syndrome NOS
PJ1z.11	Trisomy 13 NOS
PJ2..00	Edward's syndrome trisomy 18
PJ20.00	Trisomy 18, meiotic nondisjunction
PJ21.00	Trisomy 18, mosaicism
PJ21.11	Trisomy 18, mitotic nondisjunction
PJ22.00	Trisomy 18, translocation
PJ22.11	Partial trisomy 18 in Edward's syndrome
PJ2z.00	Edward's syndrome NOS
PJ2z.11	TRISOMY 18 NOS
PJ3..00	Monosomies and deletions from the autosomes
PJ30.00	Antimongolism syndrome
PJ30.11	Deletion of long arm of chromosome 21
PJ31.00	Criduchat syndrome
PJ31.11	Deletion of short arm of chromosome 5
PJ32.00	Deletion of short arm of chromosome 4
PJ32.11	Wolff Hirschorn syndrome
PJ33.00	Other deletions of part of a chromosome
PJ33000	Deletion of long arm of chromosome 13
PJ33100	Deletion of long arm of chromosome 18
PJ33111	18p syndrome
PJ33200	Deletion of short arm of chromosome 18
PJ33211	18q syndrome
PJ33300	Smith Magenis syndrome
PJ33z00	Other deletion of part of a chromosome NOS
PJ34.00	Deletions seen only at prometaphase
PJ35.00	Deletions with other complex rearrangements
PJ36.00	Whole chromosome monosomy, meiotic nondisjunction

PJ37.00	Whole chromosome monosomy, mosaicism
PJ37.11	Whole chromosome monosomy, mitotic nondisjunction
PJ37.12	Autosomal deletion mosaicism
PJ37000	Monosomy 21, mosaicism
PJ37z00	Whole chromosome monosomy, mosaicism NOS
PJ38.00	Chromosome replaced with ring or dicentric
PJ38.11	Chromosome replaced with dicentric
PJ38.12	Chromosome replaced with ring
PJ3y.00	Other deletions from the autosomes
PJ3y000	Shprintzen syndrome
PJ3y011	Velocardiofacial syndrome
PJ3z.00	Monosomies and deletions from the autosomes NOS
PJ4..00	Balanced autosomal translocation
PJ5..00	Other condition due to autosomal anomaly
PJ50.00	Whole chromosome trisomy syndromes
PJ50000	Trisomy 6
PJ50100	Trisomy 7
PJ50200	Trisomy 8
PJ50300	Trisomy 9
PJ50400	Trisomy 10
PJ50500	Trisomy 11
PJ50600	Trisomy 12
PJ50700	Other trisomy C syndromes
PJ50800	Trisomy 22
PJ50w00	Whole chromosome trisomy, meitotic nondisjunction
PJ50x00	Whole chromosome trisomy, mosaicism
PJ50x11	Whole chromosome trisomy, mitotic nondisjunction
PJ50y00	Other specified whole chromosome trisomy syndrome
PJ50z00	Whole chromosome trisomy syndrome NOS
PJ51.00	Partial trisomy syndromes
PJ51000	Major partial trisomy
PJ51100	Minor partial trisomy
PJ51z00	Partial trisomy syndrome NOS
PJ52.00	Trisomies of autosomes NEC
PJ52000	Duplications seen only at prometaphase
PJ52100	Duplications with other complex rearrangements
PJ52200	Extra marker chromosomes
PJ52300	Triploidy
PJ52400	Polyploidy
PJ52z00	Trisomy of autosomes NEC NOS
PJ53.00	Balanced rearrangements and structural markers NEC
PJ53.11	Balanced translocations
PJ53000	Chromosome inversion in normal individual
PJ53100	Balanced autosomal rearrangement in abnormal individual
PJ53200	Balanced sex/autosomal rearrangement in abnormal individual
PJ53300	Individual with marker heterochromatin
PJ53400	Individual with autosomal fragile site
PJ53500	Shwachman Diamond syndrome

PJ53z00	Balanced rearrangement or structural marker NEC NOS
PJ5y.00	Other specified conditions due to autosomal anomalies
PJ5y.11	Pseudotrisomy 18
PJ5z.00	Unspecified conditions due to autosomal anomalies
PJ5z.11	Aneuploidy NEC
PJ7z.00	Klinefelter's syndrome NOS
PJyy200	Fragile X chromosome
PK5..00	Tuberous sclerosis
PK5..11	Bourneville's disease
PK61.00	Sturge Weber syndrome
PKy0.11	Prader Willi Syndrome
PKy0.12	Prader Willi syndrome
PKy0.13	Noonan's syndrome
PKy0000	Bannayan Riley Ruvalcaba syndrome
PKy8000	Noonan's syndrome
PKy9300	Prader Willi syndrome

2. PEG placement Read codes

7617	gastrostomy operations
7617.12	Creation of gastrostomy
7617000	Creation of permanent gastrostomy
7617100	Creation of temporary gastrostomy
7617111	Creation of gastrostomy NEC
7617700	Maintenance of percutaneous endoscopic gastrostomy tube
7617400	Attention to gastrostomy tube
7617y00	Other specified gastrostomy operation
7617z00	Gastrostomy operation NOS
761E320	Temporary percutaneous endoscopic gastrostomy
761E400	Permanent percutaneous endoscopic gastrostomy
761E600	Fibreoptic endoscopic percutaneous insert gastrostomy (PEG)
761EA00	Fibreoptic endoscopic percutaneous insertion of gastrostomy
8C45000	Gastrostomy feeding
8CJ2.00	percutaneous endsoscopic gastrostomy feeding
8CJ4.00	Button gastrostomy feeding
ZC32.54	PEG - percutaneous endoscopic gastrostomy feeding
ZC65311	PEG - percutaneous endoscopic gastrostomy feeding
ZC65300	percutaneous endsoscopic gastrostomy feeding
ZC65400	Button gastrostomy feeding
ZC65200	Gastrostomy feeding

3. Feed Read codes

97661994	Generic Fresubin Original liquid
95197994	Generic Fresubin Energy liquid
81242994	Generic Fresubin Energy liquid
95501994	Generic Fresubin Original liquid

84497994	Generic Fresubin Protein Energy drink
95215994	Generic Fresubin Original Fibre liquid
99308994	Generic Fresubin Original liquid
92452994	Generic Fresubin Energy Fibre liquid
56087979	Generic fresubin energy liquid
95000994	Generic Fresubin Energy liquid
90080994	Generic Fresubin 1000 Complete liquid
91887994	Generic Fresubin Original liquid
91067994	Generic Fresubin Energy Fibre liquid
99689994	Generic fresubin 200ml liquid (fresenius kabi ltd)
95218994	Generic Fresubin Energy liquid
94257994	Generic fresubin he liquid (fresenius kabi ltd)
97659994	Generic fresubin -750 500ml liquid (fresenius kabi ltd)
89828994	Generic Fresubin 1200 Complete liquid
93150994	Generic Fresubin HP Energy liquid
56088979	Generic fresubin energy fibre liquid
56086979	Generic fresubin original liquid
99475994	Generic Fresubin Original liquid
95502994	Generic Fresubin Original liquid
93615994	Generic fresubin liquid (fresenius kabi ltd)
87966979	Generic Fresubin Energy liquid
79096994	Generic fresubin 2250 complete liquid
95487994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87967979	Generic fresubin energy liquid
87980979	Generic Fresubin Energy Fibre liquid
70468994	Generic Fresubin 1500 Complete liquid
99468994	Generic fresubin liquid (fresenius kabi ltd)
87947979	Generic Fresubin Energy liquid
77233994	Generic fresubin 1800 complete liquid
87985979	Generic Fresubin Energy liquid
95600994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87933979	Generic Fresubin Original liquid
91886994	Generic Fresubin Original liquid
92370994	Generic fresubin 750 mct liquid (fresenius kabi ltd)
87945979	Generic fresubin energy liquid
87981979	Generic Fresubin Energy Fibre liquid
87932979	Generic Fresubin Original liquid
87948979	Generic Fresubin Energy Fibre liquid
87931979	Generic Fresubin Original liquid
95579994	Generic fresubin 500ml liquid (fresenius kabi ltd)
81422994	Generic Fresubin Soya Fibre liquid
99060994	Generic fresubin 500ml liquid (fresenius kabi ltd)
88988994	Generic Nutrison Energy Multi Fibre liquid
91198994	Generic Nutrison Multi Fibre liquid
99385994	Generic Nutrison Energy liquid
99767994	Generic Nutrison liquid
86819994	Generic Nutrison 1200 Complete Multi Fibre liquid
83589994	Generic Nutrison 1000 Complete Multi Fibre liquid

95577994	Generic Nutrison Peptisorb liquid
98116994	Generic Nutrison Soya liquid
95348994	Generic nutrison fibre liquid (nutricia ltd)
99009994	Generic Nutrison Energy liquid
96652994	Generic Nutrison Soya liquid
93444994	Generic Nutrison Concentrated liquid
99146994	Generic Nutrison Soya liquid
96563992	Nutrison steriflo
99384994	Generic nutrison fibre liquid (nutricia ltd)
84589978	Generic Nutrison 800 Complete Multi Fibre liquid
84859994	Generic Nutrison Protein Plus liquid
84858994	Generic Nutrison Protein Plus Multifibre liquid
95578994	Generic Nutrison Peptisorb liquid
95035992	Generic Nutrison liquid
79867994	Generic Nutrison Soya Multi Fibre liquid
93796992	Generic Nutrison Energy liquid
93877992	Generic Nutrison Soya liquid
67245994	Generic Nutrison 800 Complete Multi Fibre liquid
91884994	Generic Nutrison MCT liquid
99362994	Generic Nutrison Peptisorb liquid
91199994	Generic Nutrison Multi Fibre liquid
95659994	Generic nutrison mct 500ml liquid (nutricia ltd)
95457994	Generic Jevity liquid
92369994	Generic Jevity Plus liquid
86504994	Generic Jevity 1.5kcal liquid
84496994	Generic Jevity Promote liquid
94806994	Generic Jevity liquid
92368994	Generic Jevity Plus liquid
91471994	Generic Jevity Plus liquid
93157994	Generic Jevity liquid
99546994	Generic Jevity liquid
76051994	Generic Jevity Plus HP gluten free liquid
84769979	Generic Jevity liquid
95053994	Peptamen liquid
82770994	Generic Peptamen HN liquid
97873992	Peptamen liquid
95018994	Generic peptamen peptide liquid (nestle clinical nutrition) 250ml
94807994	Generic Perative liquid
95211994	Generic perative liquid
95212994	Generic perative liquid (abbott nutrition) 237ml
86877979	Generic perative liquid
89276994	Generic novasource gi forte liquid
96653994	Generic Osmolite liquid
91518994	Generic Osmolite Plus liquid
96654994	Generic Osmolite liquid
97835992	Osmolite liq
94808994	Generic Osmolite liquid

99549994	Generic osmolite rth isotonic complete food (abbott nutrition)
93568992	Osmolite
93158994	Generic Osmolite liquid
99501994	Generic osmolite isotonic complete food (abbott nutrition)
67681994	Generic osmolite hp liquid
91517994	Generic Osmolite Plus liquid
59524979	Generic Vital 1.5kcal liquid
67243994	Generic Vital 1.5kcal liquid

4. Lower respiratory tract infection Read codes

A022200	Salmonella pneumonia
A3BXB00	Klebsiella pneumoniae/cause/disease classifd/oth chapters
H2...00	Pneumonia and influenza
H21..00	Lobar (pneumococcal) pneumonia
H21..11	Chest infection - pneumococcal pneumonia
H22..00	Other bacterial pneumonia
H22..11	Chest infection - other bacterial pneumonia
H220.00	Pneumonia due to klebsiella pneumonia
H221.00	Pneumonia due to pseudomonas
H222.00	Pneumonia due to haemophilus influenza
H222.11	Pneumonia due to haemophilus influenza
H223.00	Pneumonia due to streptococcus
H223000	Pneumonia due to streptococcus, group B
H224.00	Pneumonia due to staphylococcus
H22y.00	Pneumonia due to other specified bacteria
H22y000	Pneumonia due to escherichia coli
H22y011	E.coli pneumonia
H22y100	Pneumonia due to proteus
H22y200	Pneumonia – Legionella
H22yX00	Pneumonia due to other aerobic gram-negative bacteria
H22yz00	Pneumonia due to bacteria NOS
H22z.00	Bacterial pneumonia NOS
H23..00	Pneumonia due to other specified organisms
H23..11	Chest infection - pneumonia organism OS
H230.00	Pneumonia due to Eaton's agent
H231.00	Pneumonia due to mycoplasma pneumonia
H232.00	Pneumonia due to pleuropneumonia like organisms
H233.00	Chlamydial pneumonia
H23z.00	Pneumonia due to specified organism NOS
H24..00	Pneumonia with infectious diseases EC
H24..11	Chest infection with infectious disease EC
H25..00	Bronchopneumonia due to unspecified organism
H25..11	Chest infection - unspecified bronchopneumonia
H26..00	Pneumonia due to unspecified organism
H26..11	Chest infection - pnemonia due to unspecified organism

H260.00	Lobar pneumonia due to unspecified organism
H260000	Lung consolidation
H261.00	Basal pneumonia due to unspecified organism
H262.00	Postoperative pneumonia
H28..00	Atypical pneumonia
H2B..00	Community acquired pneumonia
H2C..00	Hospital acquired pneumonia
H2y..00	Other specified pneumonia or influenza
H2z..00	Pneumonia or influenza NOS
H30..11	Chest infection - unspecified bronchitis
H47..00	Pneumonitis due to inhalation of solids or liquids
H47..11	Aspiration pneumonitis
H470.00	Pneumonitis due to inhalation of food or vomitus
H470.11	Aspiration pneumonia
H470000	Pneumonitis due to inhalation of regurgitated food
H470100	Pneumonitis due to inhalation of gastric secretions
H470200	Pneumonitis due to inhalation of milk
H470300	Pneumonitis due to inhalation of vomitus
H470311	Vomit inhalation pneumonitis
H470312	Aspiration pneumonia due to vomit
H470z00	Pneumonitis due to inhalation of food or vomitus NOS
H0...00	Acute respiratory infections
H062.00	Acute lower respiratory tract infection
H06z000	Chest infection NOS
H06z011	Chest infection
H06z100	Lower resp tract infection
H06z111	Respiratory tract infection
H06z112	Acute lower respiratory tract infection
H06z200	Recurrent chest infection
H07..00	Chest cold
H0y..00	Other specified acute respiratory infections
H0z..00	Acute respiratory infection NOS

5. Epilepsy Read codes

F132100	Progressive myoclonic epilepsy
F25..00	Epilepsy
F250.00	Generalised nonconvulsive epilepsy
F250000	Petit mal (minor) epilepsy
F250011	Epileptic absences
F250100	Pykno-epilepsy
F250200	Epileptic seizures – atonic
F250300	Epileptic seizures - akinetic
F250400	Juvenile absence epilepsy
F250500	Lennox-Gastaut syndrome
F250y00	Other specified generalised nonconvulsive epilepsy
F250z00	Generalised nonconvulsive epilepsy NOS

F251.00	Generalised convulsive epilepsy
F251000	Grand mal (major) epilepsy
F251011	Tonic-clonic epilepsy
F251100	Neonatal myoclonic epilepsy
F251111	Otohara syndrome
F251200	Epileptic seizures – clonic
F251300	Epileptic seizures - myoclonic
F251400	Epileptic seizures – tonic
F251500	Tonic-clonic epilepsy
F251y00	Other specified generalised convulsive epilepsy
F251z00	Generalised convulsive epilepsy NOS
F252.00	Petit mal status
F253.00	Grand mal status
F253.11	Status epilepticus
F254.00	Partial epilepsy with impairment of consciousness
F254000	Temporal lobe epilepsy
F254100	Psychomotor epilepsy
F254200	Psychosensory epilepsy
F254300	Limbic system epilepsy
F254400	Epileptic automatism
F254500	Complex partial epileptic seizure
F254z00	Partial epilepsy with impairment of consciousness NOS
F255.00	Partial epilepsy without impairment of consciousness
F255000	Jacksonian, focal or motor epilepsy
F255011	Focal epilepsy
F255012	Motor epilepsy
F255100	Sensory induced epilepsy
F255200	Somatosensory epilepsy
F255300	Visceral reflex epilepsy
F255311	Partial epilepsy with autonomic symptoms
F255400	Visual reflex epilepsy
F255500	Unilateral epilepsy
F255600	Simple partial epileptic seizure
F255y00	Partial epilepsy without impairment of consciousness OS
F255z00	Partial epilepsy without impairment of consciousness NOS
F256.00	Infantile spasms
F256000	Hypsarrhythmia
F256100	Salaam attacks
F256.11	Lightning spasms
F256.12	West syndrome
F256z00	Infantile spasms NOS
F257.00	Kojevnikov's epilepsy
F258.00	Post-ictal state
F259.00	Early infant epileptic encephalopathy wth suppression bursts
F259.11	Ohtahara syndrome
F25A.00	Juvenile myoclonic epilepsy
F25B.00	Alcohol-induced epilepsy

F25C.00	Drug-induced epilepsy
F25D.00	Menstrual epilepsy
F25E.00	Stress-induced epilepsy
F25F.00	Photosensitive epilepsy
F25X.00	Status epilepticus, unspecified
F25y.00	Other forms of epilepsy
F25y000	Cursive (running) epilepsy
F25y100	Gelastic epilepsy
F25y200	Locl-rlt(foc)(part)idiop epilep&epilptic syn seiz locl onset
F25y300	Complex partial status epilepticus
F25y400	Benign Rolandic epilepsy
F25y500	Panayiotopoulos syndrome
F25yz00	Other forms of epilepsy NOS
F25z.00	Epilepsy NOS
SC20000	Traumatic epilepsy

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, explain how loss to follow-up was addressed	5
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6 and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) Summarise follow-up time (eg, average and total amount)	6
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7,8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,8
		(*b*) Report category boundaries when continuous variables were categorized	6,7,8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	6,7,8
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9,10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9,10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Outcomes following percutaneous endoscopic gastrostomy placement in patients with learning disability

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Outcomes following percutaneous endoscopic gastrostomy placement in patients with learning disability

Running Title: Outcomes following PEG in LD patients

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Key words: Percutaneous endoscopic gastrostomy, Learning disability, aspiration pneumonia, mortality

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STRUCTURED ABSTRACT

Objectives: To measure the rates of lower respiratory tract infection (LRTI) and mortality following percutaneous endoscopic gastrotomy (PEG) placement in patients with learning difficulties (LD). Following this to compare these rates between those having LRTI prior to PEG placement and those with no recent LRTI.

Design: Retrospective Cohort Study

Setting and participants: Exposed and unexposed control groups were isolated from 'The Health Improvement Network' database. PEG placement and LD were identified using Read codes previously developed by an expert panel. Subjects with LRTI in the year prior to their PEG placement were considered the exposed cohort and compared to unexposed subjects with an LRTI history.

Main outcome measures: The main outcome measures was the incidence rate ratio (IRR) of developing LRTI and mortality comparing the exposed and unexposed control groups.

Results: 214 subjects with LD had a PEG inserted including 743.4 person years follow-up. 53.7% were male and the median age was 27.6 (IQR 19.6-38.6) years. 27.1% were in the exposed cohort. 18.7% had a LRTI in the year following PEG, with an estimated incidence rate of 254 per 1000-person years. Over the study period the incidence rate of LRTI in exposed subjects was 369 per 1000-person years, in unexposed subjects this was 91 per 1000-person years (IRR 4.04 (95% CI 2.59-6.21) p<0.001). 27.1% of subjects died during study follow-up. Incidence rate of death was 80 and 45 per 1000-person year for exposed and unexposed subjects respectively (IRR 1.76 (1.00-3.11) p=0.047).

Conclusion: In LD subjects no clinically meaningful reduction in LRTI incidence was observed following PEG placement. Mortality and LRTI were higher in subjects with at least one LRTI in the year preceding PEG placement, compared to those without a preceding LRTI.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This study utilised The Health Improvement Network (THIN). THIN is a primary care database including 6% of the UK population, which is representative of national demographics, therefore providing a large cohort for analysis.
- Learning Disability subjects were identified using Read codes developed by an expert panel for use in research, providing a robust mechanism to identify such subjects.
- Percutaneous Endoscopic Gastrostomy is incompletely coded in THIN, therefore new tube feed prescription is used as a surrogate of PEG placement, however some cases will not be identified.
- Respiratory tract infection and death are largely accurately coded therefore the described rates of these outcomes are robust.

INTRODUCTION

Subjects with learning disability (LD) are known to have high incidence of aspiration on video fluoroscopy[1]. For this reason the National Patient Safety Agency review in 2004 considered swallowing difficulties to be a key cause for concern in this group[2]. Aspiration is associated with recurrent episodes of pneumonia, often including hospitalisation. This contributes to the high incidence of chronic lung disease[3] and disproportionately high mortality from respiratory conditions in this subject cohort[4]. Subjects with LD may undergo Percutaneous Endoscopic Gastrostomy (PEG) insertion in an effort to reduce aspiration, usually as part of a multifactorial indication including the need for nutritional support.

Subjects who receive nutrition through a PEG are still at risk of aspiration. A Japanese study looking at elderly subjects demonstrated that in those with prior aspiration pneumonia mortality following PEG insertion was high and the commonest cause of mortality was pneumonia[5]. PEGs placement also did not improve quality of life in a longitudinal study of 40 LD subjects[6].

There is no current evidence describing the outcomes from PEG insertion in subjects with LD with respect to respiratory tract infections. LD subjects are often excluded from clinical studies, despite the recognition that this group has greater healthcare needs, and poorer engagement with healthcare services. For this reason they have been described as a "Cinderella population"[7].

Admission to hospital for subjects with LD is often challenging for both the subject and staff. Best interest decisions and delegated consent for PEG placement are often required. Often the procedure is traumatic for the subject and carers. It is therefore important to ensure that PEG placement is in the LD patient's best interests. Equally important is that the information given to family members and carers, who participate in the decision-making process, is evidence based.

The aim of this study was to examine the impact of PEG placement on the risk of respiratory tract infections and mortality within the LD cohort using The Health Improvement Network (THIN) primary care database.

METHODS

The present study is a retrospective, population-based cohort study of subjects with LD undergoing PEG placement. Subjects were segregated by those with coded lower respiratory tract infection (LRTI) including specific aspiration pneumonia codes within 1 year prior to PEG placement (exposed) and those without (unexposed). Subjects in the exposed group were considered to be those at high risk for aspiration.

Data source

The Health Improvement Network (THIN) represents a group of General Practices (primary care) covering 6% of the UK population, which is representative of the UK population structure[8]. Individual practices were eligible for inclusion in the study from the later of the following two dates to ensure that the practice was making full use of the Electronic Medical Record (EMR): one year after the date their EMR was installed; and after the practice's acceptable mortality recording date. To ensure there was sufficient time to record baseline co-morbidities data, individual subjects were eligible for inclusion from the date their practice became eligible for inclusion in the study or one year after registration with their practice if this date was later. Available information includes demographic, procedural and mortality data. Diagnosis and clinical presentations are recorded in the Read code hierarchical coding system[9].

THIN data access was provided by IQVIA to the University of Birmingham under a generic multicentre research ethics committee approval in 2003. This study was granted study specific approval (SRC 18THIN008).

Study population

Subjects with LD were identified by Read codes developed by NHS Digital for a previous study (Supplementary 1). A panel of four experts reviewed each potential Read code. A code was included If there was agreement by 3 or more experts[10].

PEG placement was identified by one of two methods; Read code for PEG placement, or first prescription of non-oral, enteric, tube feed from the British National Formulary. Although these may also be used with a nasogastric tube, it is highly unlikely that this would be performed outside of a hospital setting.

Subjects aged 16-46 with an LD code from any time point and incident PEG placement between May 1995 and May 2017 were included.

Co-variates and outcome measures

Further variables sought included age, gender, smoking status, body mass index (BMI), Townsend deprivation index, epilepsy and Charlson co-morbidity score.

Episodes of LRTI were identified by Read code following the PEG placement. Mortality was also sought in the THIN database. The full list of Read codes for covariates can be found in supplementary 1.

Statistical analysis

Demographic characteristics were described for the exposed, unexposed and total cohorts. Age is converted to quintiles because any relationship was considered unlikely to be linear. Baseline variables were compared between exposed and unexposed cohorts.

The incidence rate (IR) of LRTI and mortality within 1 year of PEG placement are reported for exposed and unexposed cohorts. The rate of LRTI in the year prior to PEG placement was reported.

IRs were calculated for LRTI and mortality at any time point following PEG placement, in the exposed and unexposed cohorts. Incidence rate ratios (IRR) and 95% confidence intervals (95% CI) are reported. Median time to event and interquartile range (IQR) are reported for LRTI and mortality. Cumulative incidence charts were plotted for mortality and LRTI by exposure group and compared with competing risk regression to allow for competing risks and time to event data.

A multivariable Poisson regression model was constructed for factors associated with LRTI up to 1 year after PEG placement. Poisson regression was employed because this was counted data. Covariates included age, gender, deprivation, Charlson score category (0 or 1+) epilepsy and exposure group.

All statistical analysis was undertaken in Stata version 15 [11]. The threshold for statistical significance was set at $p<0.05$.

Patient Involvement

The data used was from a large anonymous database. Patients were not involved in the setting of the research question, outcome measures or design of the study. Patients were not involved in the interpretation of results nor are there plans to disseminate the information to the patients affected by this research.

RESULTS

Subject Demographics

There were 38,521 subjects with an LD code in THIN, of whom 214 met the inclusion criteria for PEG placement between age 16-46. The median age of the cohort was 27.6 (IQR 19.6-38.6) years and 53.7% were male. Charlson co-morbidity scores were 0, 1, 2 and 3 or more in 155 (72.4%), 39 (18.2%), 9 (4.2%), and 11 (5.1%) respectively. 69.6% had a coded diagnosis of epilepsy. Body mass index (BMI) was available in only 82 (38.3%) subjects, median 20kg/m^2 (IQR 16.5-24.2kg/m^2).

Exposed and unexposed cohorts

The exposed cohort (subjects with one or more LRTIs in the year prior to PEG placement) included 58 subjects, 55.2% of whom were male, median age 30.8 (IQR 19.4 – 39.1) years, and there were 97.6 person-years follow-up. The unexposed cohort included 156 subjects, 53.2% of whom were male, median age 27.0 (IQR 19.9 – 36.7) years. The unexposed cohort had 645.8 person-years follow-up. Full cohort demographics for the whole study population and split by exposure are shown in Table 1.

Table 1: Study subject demographics

Gender	**Male**	83(53.2)	32 (55.2)	115 (53.7)	p= 0.8
	Female	73(46.8)	26 (44.8)	99 (46.3)	
Median age in years (IQR)		27.0 (19.9-36.7)	30.8 (19.4-39.1)	27.6 (19.6-8.6)	p=0.6
Townsend	**1**	31 (19.9)	9 (15.5)	40 (18.7)	p=0.3
	2	30 (19.2)	16 (27.6)	46 (21.5)	
	3	38 (24.4)	14 (24.1)	52 (24.3)	
	4	21 (13.5)	12 (20.7)	33 (15.4)	
	5	25 (16.0)	4 (6.9)	29 (13.6)	
	Missing	11 (7.1)	3 (5.2)	14 (6.5)	
Epilepsy	**Yes**	103 (66.0)	46 (79.3)	149 (69.6)	p=0.06
	No	53 (34.0)	12 (20.7)	65 (30.4)	
Charlson co-morbidity score	**0**	115 (73.7)	40 (69.0)	155 (72.4)	p=0.53
	1	27 (17.3)	12 (20.7)	39 (18.2)	
	2	5 (3.2)	4 (6.9)	9 (4.2)	
	3+	9 (5.8)	2 (3.5)	11 (5.1)	

Values are n (%) unless otherwise specified

Lower respiratory tract infection

40 subjects developed LRTI within 1 year of PEG placement, which was more common in the exposed group compared to the unexposed group; IR 606 per 1000-person years and 149 per 1000-person years respectively. IRR 4.07 (95% CI: 2.09 - 8.06), (p<0.001).

Over the study period IR for LRTI in the exposed group was 369 per 1000-person years. In the unexposed group this was 91 per 1000-person years, IRR 4.04 (95% CI 2.59-6.21, p<0.001). (Table 2 and figure 1). The time from PEG placement to LRTI in the whole study

population was 1.33 (IQR 0.4-3.72) years. In the exposed group this was 0.64 (0.27-1.84) years and in the unexposed group 2.37 (0.71-4.90) years.

Table 2: Incidence of lower respiratory tract infections and mortality following PEG placement

	Exposed	Unexposed	Exposed	Unexposed	Exposed	Unexposed
Events	22	18	36	59	20	38
Person years	36	121	98	645	251	842
Incidence Rate (per 1000)	606	149	369	91	80	45
Incidence Rate Ratio	4.07 (2.09-8.06)		4.04 (2.59-6.21)		1.76 (1.00-3.11)	
P value	<0.001		P=0.001		P=0.047	

In a multivariable Poisson regression model female gender (IRR 0.48 (95% CI: 0.23-0.97), p=0.042), age 33-40 years (3.36 (1.11-10.16), p=0.031), age >40 years (5.22 (1.73-15.75), p=0.003) and LRTI in the year prior to PEG placement (exposed group) (4.05 (2.09-7.87), p<0.001) were significantly associated with developing LRTI in the year following PEG placement (Table 3).

Table 3: Poisson regression model for lower respiratory tract infection within 1 year of PEG placement

Age quintile	**<19**	1	-	-
	19-24	1.38	0.43-4.43	0.586
	24-33	1.28	0.36-4.63	0.699
	33-40	3.36	1.11-10.16	0.031
	>40	5.22	1.72-15.75	0.003
Gender (female)		0.48	0.23-0.97	0.042
Epilepsy		1.73	0.78-3.81	0.177
Charlson score 1 or above		1.73	0.86-3.47	0.125
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.68	0.25-1.83	0.441
	3	1.11	0.43-2.86	0.822
	4	0.67	0.21-2.19	0.513
	5	0.68	0.17-2.70	0.580
	Missing	0.54	0.10-2.80	0.462
LRTI in the year prior to PEG placement *(Exposed group)*		4.05	2.08-7.87	<0.001

Rate of respiratory tract infections before and after PEG placement

The proportion with LRTI in the year prior to PEG placement was 27.1%. 18.7% developed LRTI in the year after PEG placement, albeit with less than 1 year of follow-up in some subjects. The LRTI incidence ratio for the complete cohort in the year prior to PEG placement was 317 per 1000-person years compared to 254 per 1000-person years in the year after PEG placement.

Mortality

Over the study period 58 subjects died and median age at death was 38.2 (27.8-42.0) years. Exposed group IR was 80 per 1000-person years and 45 per 1000 person years in the unexposed group (adjusted IRR 1.76 (95% CI 1.00-3.11), p=0.047) (Table 2 and Figure 2).

In a multivariable Poisson regression model, age 33-40 years (2.59 (1.03-6.52), p=0.043) and age >40 years (2.62 (1.01-6.77), p=0.047) were significantly associated with mortality during study follow-up following PEG placement. Previous respiratory tract infection in the year prior to PEG placement (exposed group) (1.80 (1.00-3.23), p=0.05), was of borderline significance in this model (Table 4).

Table 4 Poisson regression model for mortality following PEG placement

Age quintile	**<19**	1	-	-
	19-24	1.84	0.71-4.82	0.210
	24-33	1.65	0.62-4.39	0.315
	33-40	2.59	1.03-6.52	0.043
	>40	2.62	1.01-6.77	0.047
Gender (female)		1.08	0.62-1.87	0.792
Epilepsy		0.80	0.44-1.44	0.452
Charleson score 1 or above		1.21	0.68-2.18	0.508
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.57	0.25-1.30	0.183
	3	0.63	0.29-1.38	0.250
	4	0.79	0.33-1.88	0.594
	5	0.42	0.15-1.17	0.098
	Missing	0.32	0.7-1.49	0.146
LRTI in the year prior to PEG placement *(Exposed group)*		1.80	1.00-3.23	0.050

DISCUSSION

This is the first study to assess the outcomes of PEG insertion in a cohort of LD subjects. No reduction in LRTI following PEG placement was observed. Furthermore, subjects having one or more LRTIs prior to their PEG were more likely to have LRTIs after PEG placement, both in the first year after their PEG and in long term follow-up. Subjects with one or more LRTIs prior to PEG placement also had a small increase in mortality over the study period. Female gender provided a small protective effect for LRTI within 1 year. Increasing age was associated with both increased mortality and LRTI within 1 year of PEG placement.

There are no other studies looking at outcomes following PEG placement specific to subjects with LD. A prospective PEG audit including 350 PEG placements over 571 person years of data found a 1 year mortality of 35%, significantly higher than reported in the above study[12]. However, the median age was 62 years compared to 28 years in the present study and all indications were included. 31 of 350 PEGs were placed in subjects with LD in whom 5 (16.1%) died over median 20 months follow-up. In the present study 11 (5.1%) died within 12 months and over the study period 55 (25.7%) subjects died, albeit with a median time to death of 3.5 years. Although the proportions observed are different, only small numbers of deaths are observed and therefore comparison may be misleading. There is also likely to be variation in practice between providers, with a national overview provided by the present study compared to a single provider in the study by Clarke, Pitts, Latchford, & Lewis[12].

Short term mortality could not be addressed in this study as there were too few outcomes despite the sample size. There was also a wide variation in time to LRTI with large interquartile ranges. Therefore, although there appears to be shorter time to LRTI following PEG placement in subjects in the exposed group compared to the unexposed group, this result requires further evaluation before any implications for clinical practice can be considered.

LRTI are used as a surrogate of aspiration pneumonia in the present study. Although there are codes specifically for aspiration pneumonia, the study included all LRTI codes to provide good sensitivity. In subjects who have a PEG in situ or proceed to have a PEG placed up to one year later, it was assumed that aspiration at least contributed to their LRTI.

A key strength of this analysis compared to others examining the impact of PEG placement is the use of primary care data. The THIN database is an important tool to examine the LD population. The database is recognised to have a high accuracy and is therefore used for analysis for a wide range of conditions and outcomes. Specific benefits for the present study include a relatively large number of LD subjects with robust diagnostic and demographic data. Respiratory infections in this cohort are often managed in primary care and as such, only a small minority of cases present to secondary care. Therefore, presentation to primary care is a more sensitive measure of such infections.

LD subjects are often challenging to identify from medical records. The Read codes used in the current cohort were developed by an expert group, in which codes were only included in the final set if 3 out of 4 panel members agreed that the code was representing a group of subjects with LD. This set of Read codes has been utilised a number of studies previously [13]. This provides reassurance that the cohort in the present study accurately represents LD subjects. Although over 200 were included, and most clinically significant associations are likely to have been identified, a larger cohort would have allowed detection of more subtle factors, including an accurate estimate of their effects.

Identification of subjects undergoing PEG placement in the THIN database was also difficult. As a procedure performed in secondary care, the PEG placement was not always coded in primary care data. Therefore, first feed prescription was used as a surrogate marker to identify when a PEG had been placed. Despite these methods, it is likely that not all PEG placements are captured within the data, however we can be confident that those included represent a cohort of LD subjects undergoing PEG placement.

The indication for PEG placement, e.g. dysphagia, recurrent aspiration or insufficient calorific intake, could not be identified in this study, which is a significant limitation. It is accepted that PEG placement will be for inadequate oral nutrition which may have multi-factorial causes. By seeking respiratory tract infections within 1 year prior to PEG placement, subjects in whom this is a component of the indication for PEG placement are identified and compared to those with other indications.

Unfortunately, data on BMI was missing in a very high proportion of subjects. As such this could not be included in the analysis. It is hypothesised that subjects requiring a PEG are less mobile and therefore, in the absence of appropriate equipment, they do not routinely have their weight checked and recorded in primary care.

CONCLUSION

This is a novel population-based study demonstrates that PEG placement does not appear to confer a reduction in LRTIs in the LD cohort. A small increase in mortality was also noted in subjects with a recent history of respiratory tract infections prior to PEG placement. Physicians making decisions regarding PEG placement in LD subjects should incorporate this into their assessment of risk and benefit and ensure subjects, carers and family members are aware of likely outcomes following PEG placement. Further research is required in subjects with LD to establish sub-groups that are most likely to benefit from PEG placement.

ADDITIONAL INFORMATION

Author contributions: PRH and NJT were responsible for the initial conception of the study. PRH, TT, JSC and KN then contributed to the data collection and analysis of the data. PRH, TT, JSC, NJT, NB and KN all contributed to the final version of the manuscript for submission.

Data sharing and accessibility: The full dataset and statistical code for analysis can be requested from the corresponding author.

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Conflict of interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Transparency: The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned (and, if relevant, registered) have been explained.

Figure Legends:

Figure 1: Cumulative incidence regression for lower respiratory tract infections following PEG placement

Figure 2: Cumulative incidence regression for mortality following PEG placement

REFERENCES

1. Somerville H, Tzannes G, Wood J, Shun A, Hill C, Arrowsmith F, et al. Gastrointestinal and nutritional problems in severe developmental disability. Dev Med Child Neurol. 2008;50(9):712-6.
2. NPSA. Understanding the patient safety issues for people with learning disabilities. London: National Patient Safety Agency; 2004.
3. Strauss D, Cable W, R S. Causes of excess mortality in cerebral palsy patients. developmental medicine & child neurology. 1999;41:580-5.
4. Hollins S, Attard T, Von Fraunhofer, Mcguigan S, P S. Mortality in peiple with learning disability: risks, causes and death certification findings in London. Developmental medicine & child neurology. 1998;40:50-6.
5. Tokunaga T, Kubo T, Ryan S, Tomizawa M, Yoshida S, Takagi K, et al. Long-term outcome after placement of a percutaneous endoscopic gastrostomy tube. Geriatr Gerontol Int. 2008;8(1):19-23.
6. Lee L, MacPherson M. Long-term percutaneous endoscopic gastrostomy feeding in young adults with multiple disabilities. Intern Med J. 2010;40(6):411-8.
7. Leslie P, Crawford H, Wilkinson H. People with a learning disability and dysphagia: a cinderella population? Dysphagia. 2009;24(1):103-4.
8. Bourke A, Dattani H, Robinson M. Feasibility study and methodology to create a quality-evaluated database of primary care data. Inform Prim Care. 2004(12):171–7.
9. Booth N. What are Read Codes. Health Libraries Review. 1994;11:177-82.
10. The NHS Information Centre PSaPCS. Access to Healthcare for People with Learning Disabilities 2010.
11. Statacorp. Stata Statistical Software: release 14.: TX: StataCorp LP; 2015.
12. Clarke E, Pitts N, Latchford A, Lewis S. A large prospective audit of morbidity and mortality associated with feeding gastrostomies in the community. Clinical Nutrition. 2017;36(2):485-90.
13. Buszewicz M, Welch C, Horsfall L, Nazareth I, Osborn D, Hassiotis A, et al. Assessment of an incentivised scheme to provide annual health checks in primary care for adults with intellectual disability: a longitudinal cohort study. The Lancet Psychiatry. 2014;1(7):522-30.

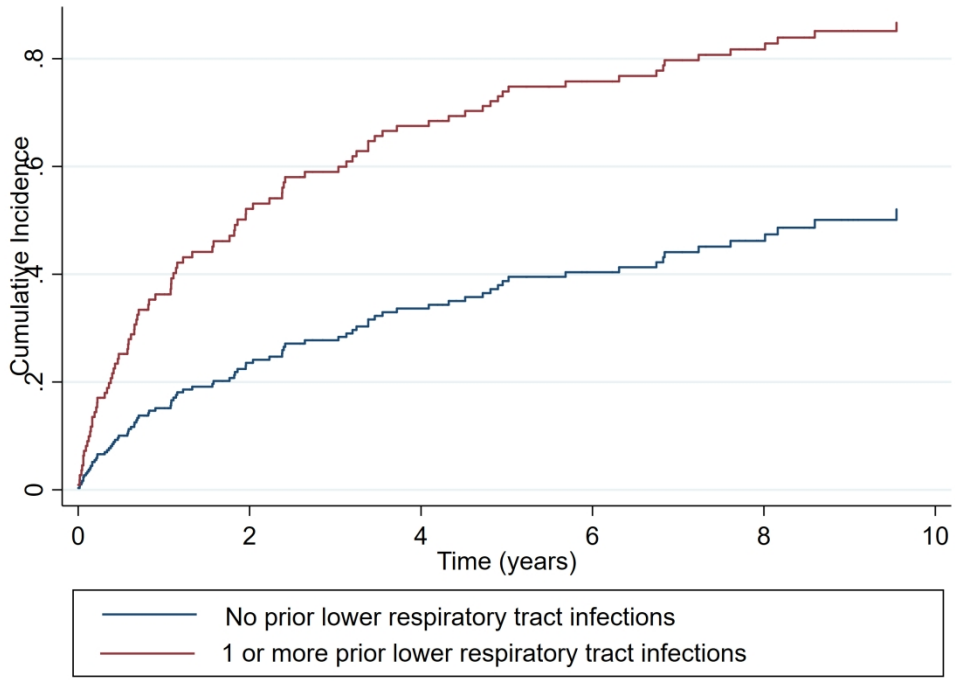

Figure 1: Cumulative incidence regression for lower respiratory tract infections following PEG placement

215x157mm (300 x 300 DPI)

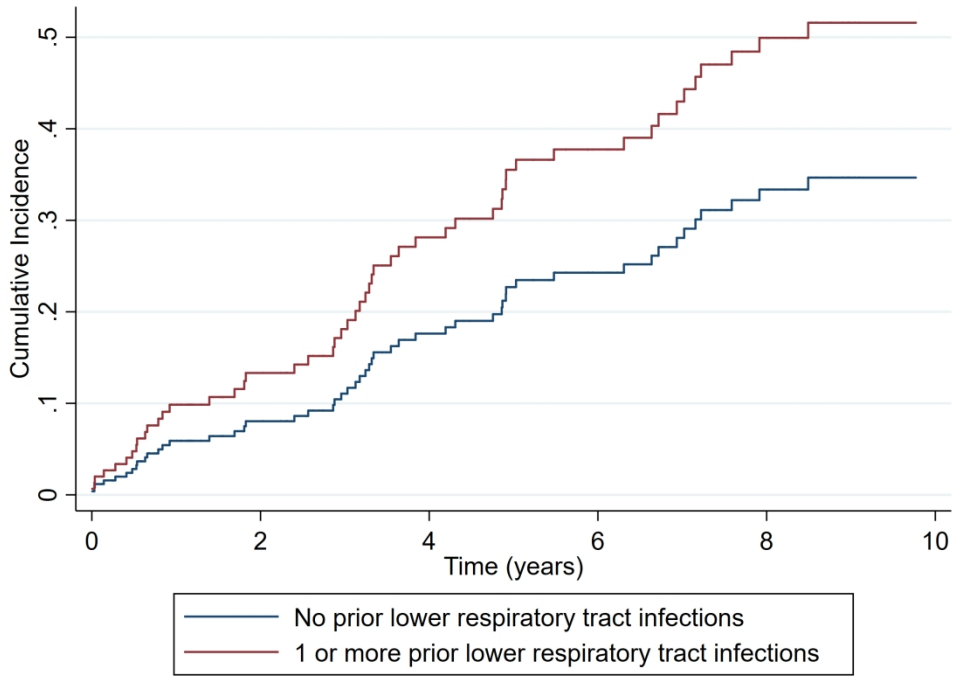

Figure 2: Cumulative incidence regression for mortality following PEG placement

215x157mm (300 x 300 DPI)

Outcomes following percutaneous endoscopic gastrostomy insertion in patients with learning disability: Appendix

1. LD read codes:

6664	Mental handicap problem
13Z3.00	Low I.Q.
8HHP.00	Referral to learning disability team
9HB..00	Learning disabilities administration status
9HB0.00	Learning disabilities health action plan declined
9HB1.00	Learning disabilities health action plan offered
9HB2.00	Learning disabilities health action plan reviewed
9HB3.00	Learning disabilities health assessment
9HB4.00	Learning disabilities health action plan completed
9HB5.00	Learning disabilities annual health assessment
C301.00	Phenylketonuria
E140.00	Infantile autism
E140.11	Kanner's syndrome
E140.12	Autism
E140.13	Childhood autism
E140000	Active infantile autism
E140100	Residual infantile autism
E140z00	Infantile autism NOS
E3...00	Mental retardation
E30..00	Mild mental retardation, IQ in range 50-70
E30..11	Educationally subnormal
E30..12	Feeble minded
E30..13	Moron
E31..00	Other specified mental retardation
E310.00	Moderate mental retardation, IQ in range 35-49
E310.11	Imbecile
E311.00	Severe mental retardation, IQ in range 20-34
E312.00	Profound mental retardation with IQ less than 20
E312.11	Idiocy
E31z.00	Other specified mental retardation NOS
e31z.00	Other specified mental retardation NOS
E3y..00	Other specified mental retardation
E3z..00	Mental retardation NOS
Eu7..00	[X]Mental retardation
Eu70.00	[X]Mild mental retardation
Eu70.11	[X]Feeble mindedness
Eu70.12	[X]Mild mental subnormality
Eu70000	[X]Mld mental retard with statement no or min impairm behav
Eu70100	[X]Mld mental retard sig impairment behav req attent/treatmt
Eu70y00	[X]Mild mental retardation, other impairments of behaviour
Eu70z00	[X]Mild mental retardation without mention impairment behav

Eu71.00	[X]Moderate mental retardation
Eu71.11	[X]Moderate mental subnormality
Eu71000	[X]Mod mental retard with statement no or min impairm behav
Eu71100	[X]Mod mental retard sig impairment behav req attent/treatmt
Eu71y00	[X]Mod retard oth behav impair
Eu71z00	[X]Mod mental retardation without mention impairment behav
Eu72.00	[X]Severe mental retardation
Eu72.11	[X]Severe mental subnormality
Eu72000	[X]Sev mental retard with statement no or min impairm behav
Eu72100	[X]Sev mental retard sig impairment behav req attent/treatmt
Eu72y00	[X]Severe mental retardation, other impairments of behaviour
Eu72z00	[X]Sev mental retardation without mention impairment behav
Eu73.00	[X]Profound mental retardation
Eu73.11	[X]Profound mental subnormality
Eu73000	[X]Profound ment retrd wth statement no or min impairm behav
Eu73100	[X]Profound ment retard sig impairmnt behav req attent/treat
Eu73y00	[X]Profound mental retardation, other impairments of behavr
Eu73z00	[X]Prfnd mental retardation without mention impairment behav Eu7y.00 [X]Other mental retardation
Eu7y000	[X]Oth mental retard with statement no or min impairm behav
Eu7y100	[X]Oth mental retard sig impairment behav req attent/treatmt
Eu7yy00	[X]Other mental retardation, other impairments of behaviour
Eu7yz00	[X]Other mental retardation without mention impairment behav
Eu7z.00	[X]Unspecified mental retardation
Eu7z.11	[X]Mental deficiency NOS
Eu7z.12	[X]Mental subnormality NOS
Eu7z000	[X]Unsp mental retard with statement no or min impairm behav
Eu7z100	[X]Unsp mentl retard sig impairment behav req attent/treatmt
Eu7zy00	[X]Unspecified mental retardatn, other impairments of behav
Eu7zz00	[X]Unsp mental retardation without mention impairment behave
Eu81z00	[X]Developmental disorder of scholastic skills, unspecified
Eu81z11	[X]Learning disability NOS
Eu81z12	[X]Learning disorder NOS
Eu81z13	[X]Learn acquisition disab NOS
Eu84.00	[X]Pervasive developmental disorders
Eu84000	[X]Childhood autism
Eu84011	[X]Autistic disorder
Eu84012	[X]Infantile autism
Eu84013	[X]Infantile psychosis
Eu84014	[X]Kanner's syndrome
Eu84100	[X]Atypical autism
Eu84111	[X]Atypical childhood psychosis
Eu84112	[X]Mental retardation with autistic features
Eu84112	[X]Mental retardation with autistic features
Eu84200	[X]Rett's syndrome
Eu84311	[X]Dementia infantalis
Eu84400	[X]Overactive disorder assoc mental retard/stereotype movts
	[X]Other pervasive developmental disorders

Eu84y00	
Eu84z00	[X]Pervasive developmental disorder, unspecified
Eu84z11	[X]Autistic spectrum disorder
PJ0..00	Down's syndrome trisomy 21
PJ0..11	Mongolism
PJ0..12	Trisomy 21
PJ0..13	Trisomy 22
PJ00.00	Trisomy 21, meiotic nondisjunction
PJ01.00	Trisomy 21, mosaicism
PJ01.11	Trisomy 21, mitotic nondisjunction
PJ02.00	Trisomy 21, translocation
PJ02.11	Partial trisomy 21 in Down's syndrome
PJ0z.00	Down's syndrome NOS
PJ0z.11	Trisomy 21 NOS
PJ1..00	Patau's syndrome trisomy 13
PJ10.00	Trisomy 13, meiotic nondisjunction
PJ11.00	Trisomy 13, mosaicism
PJ11.11	Trisomy 13, mitotic nondisjunction
PJ12.00	Trisomy 13, translocation
PJ12.11	Partial trisomy 13 in Patau's syndrome
PJ1z.00	Patau's syndrome NOS
PJ1z.11	Trisomy 13 NOS
PJ2..00	Edward's syndrome trisomy 18
PJ20.00	Trisomy 18, meiotic nondisjunction
PJ21.00	Trisomy 18, mosaicism
PJ21.11	Trisomy 18, mitotic nondisjunction
PJ22.00	Trisomy 18, translocation
PJ22.11	Partial trisomy 18 in Edward's syndrome
PJ2z.00	Edward's syndrome NOS
PJ2z.11	TRISOMY 18 NOS
PJ3..00	Monosomies and deletions from the autosomes
PJ30.00	Antimongolism syndrome
PJ30.11	Deletion of long arm of chromosome 21
PJ31.00	Criduchat syndrome
PJ31.11	Deletion of short arm of chromosome 5
PJ32.00	Deletion of short arm of chromosome 4
PJ32.11	Wolff Hirschorn syndrome
PJ33.00	Other deletions of part of a chromosome
PJ33000	Deletion of long arm of chromosome 13
PJ33100	Deletion of long arm of chromosome 18
PJ33111	18p syndrome
PJ33200	Deletion of short arm of chromosome 18
PJ33211	18q syndrome
PJ33300	Smith Magenis syndrome
PJ33z00	Other deletion of part of a chromosome NOS
PJ34.00	Deletions seen only at prometaphase
PJ35.00	Deletions with other complex rearrangements
PJ36.00	Whole chromosome monosomy, meiotic nondisjunction

PJ37.00	Whole chromosome monosomy, mosaicism
PJ37.11	Whole chromosome monosomy, mitotic nondisjunction
PJ37.12	Autosomal deletion mosaicism
PJ37000	Monosomy 21, mosaicism
PJ37z00	Whole chromosome monosomy, mosaicism NOS
PJ38.00	Chromosome replaced with ring or dicentric
PJ38.11	Chromosome replaced with dicentric
PJ38.12	Chromosome replaced with ring
PJ3y.00	Other deletions from the autosomes
PJ3y000	Shprintzen syndrome
PJ3y011	Velocardiofacial syndrome
PJ3z.00	Monosomies and deletions from the autosomes NOS
PJ4..00	Balanced autosomal translocation
PJ5..00	Other condition due to autosomal anomaly
PJ50.00	Whole chromosome trisomy syndromes
PJ50000	Trisomy 6
PJ50100	Trisomy 7
PJ50200	Trisomy 8
PJ50300	Trisomy 9
PJ50400	Trisomy 10
PJ50500	Trisomy 11
PJ50600	Trisomy 12
PJ50700	Other trisomy C syndromes
PJ50800	Trisomy 22
PJ50w00	Whole chromosome trisomy, meitotic nondisjunction
PJ50x00	Whole chromosome trisomy, mosaicism
PJ50x11	Whole chromosome trisomy, mitotic nondisjunction
PJ50y00	Other specified whole chromosome trisomy syndrome
PJ50z00	Whole chromosome trisomy syndrome NOS
PJ51.00	Partial trisomy syndromes
PJ51000	Major partial trisomy
PJ51100	Minor partial trisomy
PJ51z00	Partial trisomy syndrome NOS
PJ52.00	Trisomies of autosomes NEC
PJ52000	Duplications seen only at prometaphase
PJ52100	Duplications with other complex rearrangements
PJ52200	Extra marker chromosomes
PJ52300	Triploidy
PJ52400	Polyploidy
PJ52z00	Trisomy of autosomes NEC NOS
PJ53.00	Balanced rearrangements and structural markers NEC
PJ53.11	Balanced translocations
PJ53000	Chromosome inversion in normal individual
PJ53100	Balanced autosomal rearrangement in abnormal individual
PJ53200	Balanced sex/autosomal rearrangement in abnormal individual
PJ53300	Individual with marker heterochromatin
PJ53400	Individual with autosomal fragile site
PJ53500	Shwachman Diamond syndrome

PJ53z00	Balanced rearrangement or structural marker NEC NOS
PJ5y.00	Other specified conditions due to autosomal anomalies
PJ5y.11	Pseudotrisomy 18
PJ5z.00	Unspecified conditions due to autosomal anomalies
PJ5z.11	Aneuploidy NEC
PJ7z.00	Klinefelter's syndrome NOS
PJyy200	Fragile X chromosome
PK5..00	Tuberous sclerosis
PK5..11	Bourneville's disease
PK61.00	Sturge Weber syndrome
PKy0.11	Prader Willi Syndrome
PKy0.12	Prader Willi syndrome
PKy0.13	Noonan's syndrome
PKy0000	Bannayan Riley Ruvalcaba syndrome
PKy8000	Noonan's syndrome
PKy9300	Prader Willi syndrome

2. PEG placement Read codes

7617	gastrostomy operations
7617.12	Creation of gastrostomy
7617000	Creation of permanent gastrostomy
7617100	Creation of temporary gastrostomy
7617111	Creation of gastrostomy NEC
7617700	Maintenance of percutaneous endoscopic gastrostomy tube
7617400	Attention to gastrostomy tube
7617y00	Other specified gastrostomy operation
7617z00	Gastrostomy operation NOS
761E320	Temporary percutaneous endoscopic gastrostomy
761E400	Permanent percutaneous endoscopic gastrostomy
761E600	Fibreoptic endoscopic percutaneous insert gastrostomy (PEG)
761EA00	Fibreoptic endoscopic percutaneous insertion of gastrostomy
8C45000	Gastrostomy feeding
8CJ2.00	percutaneous endsoscopic gastrostomy feeding
8CJ4.00	Button gastrostomy feeding
ZC32.54	PEG - percutaneous endoscopic gastrostomy feeding
ZC65311	PEG - percutaneous endoscopic gastrostomy feeding
ZC65300	percutaneous endsoscopic gastrostomy feeding
ZC65400	Button gastrostomy feeding
ZC65200	Gastrostomy feeding

3. Feed Read codes

97661994	Generic Fresubin Original liquid
95197994	Generic Fresubin Energy liquid
81242994	Generic Fresubin Energy liquid
95501994	Generic Fresubin Original liquid

84497994	Generic Fresubin Protein Energy drink
95215994	Generic Fresubin Original Fibre liquid
99308994	Generic Fresubin Original liquid
92452994	Generic Fresubin Energy Fibre liquid
56087979	Generic fresubin energy liquid
95000994	Generic Fresubin Energy liquid
90080994	Generic Fresubin 1000 Complete liquid
91887994	Generic Fresubin Original liquid
91067994	Generic Fresubin Energy Fibre liquid
99689994	Generic fresubin 200ml liquid (fresenius kabi ltd)
95218994	Generic Fresubin Energy liquid
94257994	Generic fresubin he liquid (fresenius kabi ltd)
97659994	Generic fresubin -750 500ml liquid (fresenius kabi ltd)
89828994	Generic Fresubin 1200 Complete liquid
93150994	Generic Fresubin HP Energy liquid
56088979	Generic fresubin energy fibre liquid
56086979	Generic fresubin original liquid
99475994	Generic Fresubin Original liquid
95502994	Generic Fresubin Original liquid
93615994	Generic fresubin liquid (fresenius kabi ltd)
87966979	Generic Fresubin Energy liquid
79096994	Generic fresubin 2250 complete liquid
95487994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87967979	Generic fresubin energy liquid
87980979	Generic Fresubin Energy Fibre liquid
70468994	Generic Fresubin 1500 Complete liquid
99468994	Generic fresubin liquid (fresenius kabi ltd)
87947979	Generic Fresubin Energy liquid
77233994	Generic fresubin 1800 complete liquid
87985979	Generic Fresubin Energy liquid
95600994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87933979	Generic Fresubin Original liquid
91886994	Generic Fresubin Original liquid
92370994	Generic fresubin 750 mct liquid (fresenius kabi ltd)
87945979	Generic fresubin energy liquid
87981979	Generic Fresubin Energy Fibre liquid
87932979	Generic Fresubin Original liquid
87948979	Generic Fresubin Energy Fibre liquid
87931979	Generic Fresubin Original liquid
95579994	Generic fresubin 500ml liquid (fresenius kabi ltd)
81422994	Generic Fresubin Soya Fibre liquid
99060994	Generic fresubin 500ml liquid (fresenius kabi ltd)
88988994	Generic Nutrison Energy Multi Fibre liquid
91198994	Generic Nutrison Multi Fibre liquid
99385994	Generic Nutrison Energy liquid
99767994	Generic Nutrison liquid
86819994	Generic Nutrison 1200 Complete Multi Fibre liquid
83589994	Generic Nutrison 1000 Complete Multi Fibre liquid

95577994	Generic Nutrison Peptisorb liquid
98116994	Generic Nutrison Soya liquid
95348994	Generic nutrison fibre liquid (nutricia ltd)
99009994	Generic Nutrison Energy liquid
96652994	Generic Nutrison Soya liquid
93444994	Generic Nutrison Concentrated liquid
99146994	Generic Nutrison Soya liquid
96563992	Nutrison steriflo
99384994	Generic nutrison fibre liquid (nutricia ltd)
84589978	Generic Nutrison 800 Complete Multi Fibre liquid
84859994	Generic Nutrison Protein Plus liquid
84858994	Generic Nutrison Protein Plus Multifibre liquid
95578994	Generic Nutrison Peptisorb liquid
95035992	Generic Nutrison liquid
79867994	Generic Nutrison Soya Multi Fibre liquid
93796992	Generic Nutrison Energy liquid
93877992	Generic Nutrison Soya liquid
67245994	Generic Nutrison 800 Complete Multi Fibre liquid
91884994	Generic Nutrison MCT liquid
99362994	Generic Nutrison Peptisorb liquid
91199994	Generic Nutrison Multi Fibre liquid
95659994	Generic nutrison mct 500ml liquid (nutricia ltd)
95457994	Generic Jevity liquid
92369994	Generic Jevity Plus liquid
86504994	Generic Jevity 1.5kcal liquid
84496994	Generic Jevity Promote liquid
94806994	Generic Jevity liquid
92368994	Generic Jevity Plus liquid
91471994	Generic Jevity Plus liquid
93157994	Generic Jevity liquid
99546994	Generic Jevity liquid
76051994	Generic Jevity Plus HP gluten free liquid
84769979	Generic Jevity liquid
95053994	Peptamen liquid
82770994	Generic Peptamen HN liquid
97873992	Peptamen liquid
95018994	Generic peptamen peptide liquid (nestle clinical nutrition) 250ml
94807994	Generic Perative liquid
95211994	Generic perative liquid
95212994	Generic perative liquid (abbott nutrition) 237ml
86877979	Generic perative liquid
89276994	Generic novasource gi forte liquid
96653994	Generic Osmolite liquid
91518994	Generic Osmolite Plus liquid
96654994	Generic Osmolite liquid
97835992	Osmolite liq
94808994	Generic Osmolite liquid

99549994	Generic osmolite rth isotonic complete food (abbott nutrition)
93568992	Osmolite
93158994	Generic Osmolite liquid
99501994	Generic osmolite isotonic complete food (abbott nutrition)
67681994	Generic osmolite hp liquid
91517994	Generic Osmolite Plus liquid
59524979	Generic Vital 1.5kcal liquid
67243994	Generic Vital 1.5kcal liquid

4. Lower respiratory tract infection Read codes

A022200	Salmonella pneumonia
A3BXB00	Klebsiella pneumoniae/cause/disease classifd/oth chapters
H2...00	Pneumonia and influenza
H21..00	Lobar (pneumococcal) pneumonia
H21..11	Chest infection - pneumococcal pneumonia
H22..00	Other bacterial pneumonia
H22..11	Chest infection - other bacterial pneumonia
H220.00	Pneumonia due to klebsiella pneumonia
H221.00	Pneumonia due to pseudomonas
H222.00	Pneumonia due to haemophilus influenza
H222.11	Pneumonia due to haemophilus influenza
H223.00	Pneumonia due to streptococcus
H223000	Pneumonia due to streptococcus, group B
H224.00	Pneumonia due to staphylococcus
H22y.00	Pneumonia due to other specified bacteria
H22y000	Pneumonia due to escherichia coli
H22y011	E.coli pneumonia
H22y100	Pneumonia due to proteus
H22y200	Pneumonia – Legionella
H22yX00	Pneumonia due to other aerobic gram-negative bacteria
H22yz00	Pneumonia due to bacteria NOS
H22z.00	Bacterial pneumonia NOS
H23..00	Pneumonia due to other specified organisms
H23..11	Chest infection - pneumonia organism OS
H230.00	Pneumonia due to Eaton's agent
H231.00	Pneumonia due to mycoplasma pneumonia
H232.00	Pneumonia due to pleuropneumonia like organisms
H233.00	Chlamydial pneumonia
H23z.00	Pneumonia due to specified organism NOS
H24..00	Pneumonia with infectious diseases EC
H24..11	Chest infection with infectious disease EC
H25..00	Bronchopneumonia due to unspecified organism
H25..11	Chest infection - unspecified bronchopneumonia
H26..00	Pneumonia due to unspecified organism
H26..11	Chest infection - pnemonia due to unspecified organism

H260.00	Lobar pneumonia due to unspecified organism
H260000	Lung consolidation
H261.00	Basal pneumonia due to unspecified organism
H262.00	Postoperative pneumonia
H28..00	Atypical pneumonia
H2B..00	Community acquired pneumonia
H2C..00	Hospital acquired pneumonia
H2y..00	Other specified pneumonia or influenza
H2z..00	Pneumonia or influenza NOS
H30..11	Chest infection - unspecified bronchitis
H47..00	Pneumonitis due to inhalation of solids or liquids
H47..11	Aspiration pneumonitis
H470.00	Pneumonitis due to inhalation of food or vomitus
H470.11	Aspiration pneumonia
H470000	Pneumonitis due to inhalation of regurgitated food
H470100	Pneumonitis due to inhalation of gastric secretions
H470200	Pneumonitis due to inhalation of milk
H470300	Pneumonitis due to inhalation of vomitus
H470311	Vomit inhalation pneumonitis
H470312	Aspiration pneumonia due to vomit
H470z00	Pneumonitis due to inhalation of food or vomitus NOS
H0...00	Acute respiratory infections
H062.00	Acute lower respiratory tract infection
H06z000	Chest infection NOS
H06z011	Chest infection
H06z100	Lower resp tract infection
H06z111	Respiratory tract infection
H06z112	Acute lower respiratory tract infection
H06z200	Recurrent chest infection
H07..00	Chest cold
H0y..00	Other specified acute respiratory infections
H0z..00	Acute respiratory infection NOS

5. Epilepsy Read codes

F132100	Progressive myoclonic epilepsy
F25..00	Epilepsy
F250.00	Generalised nonconvulsive epilepsy
F250000	Petit mal (minor) epilepsy
F250011	Epileptic absences
F250100	Pykno-epilepsy
F250200	Epileptic seizures – atonic
F250300	Epileptic seizures - akinetic
F250400	Juvenile absence epilepsy
F250500	Lennox-Gastaut syndrome
F250y00	Other specified generalised nonconvulsive epilepsy
F250z00	Generalised nonconvulsive epilepsy NOS

F251.00	Generalised convulsive epilepsy
F251000	Grand mal (major) epilepsy
F251011	Tonic-clonic epilepsy
F251100	Neonatal myoclonic epilepsy
F251111	Otohara syndrome
F251200	Epileptic seizures – clonic
F251300	Epileptic seizures - myoclonic
F251400	Epileptic seizures – tonic
F251500	Tonic-clonic epilepsy
F251y00	Other specified generalised convulsive epilepsy
F251z00	Generalised convulsive epilepsy NOS
F252.00	Petit mal status
F253.00	Grand mal status
F253.11	Status epilepticus
F254.00	Partial epilepsy with impairment of consciousness
F254000	Temporal lobe epilepsy
F254100	Psychomotor epilepsy
F254200	Psychosensory epilepsy
F254300	Limbic system epilepsy
F254400	Epileptic automatism
F254500	Complex partial epileptic seizure
F254z00	Partial epilepsy with impairment of consciousness NOS
F255.00	Partial epilepsy without impairment of consciousness
F255000	Jacksonian, focal or motor epilepsy
F255011	Focal epilepsy
F255012	Motor epilepsy
F255100	Sensory induced epilepsy
F255200	Somatosensory epilepsy
F255300	Visceral reflex epilepsy
F255311	Partial epilepsy with autonomic symptoms
F255400	Visual reflex epilepsy
F255500	Unilateral epilepsy
F255600	Simple partial epileptic seizure
F255y00	Partial epilepsy without impairment of consciousness OS
F255z00	Partial epilepsy without impairment of consciousness NOS
F256.00	Infantile spasms
F256000	Hypsarrhythmia
F256100	Salaam attacks
F256.11	Lightning spasms
F256.12	West syndrome
F256z00	Infantile spasms NOS
F257.00	Kojevnikov's epilepsy
F258.00	Post-ictal state
F259.00	Early infant epileptic encephalopathy wth suppression bursts
F259.11	Ohtahara syndrome
F25A.00	Juvenile myoclonic epilepsy
F25B.00	Alcohol-induced epilepsy

F25C.00	Drug-induced epilepsy
F25D.00	Menstrual epilepsy
F25E.00	Stress-induced epilepsy
F25F.00	Photosensitive epilepsy
F25X.00	Status epilepticus, unspecified
F25y.00	Other forms of epilepsy
F25y000	Cursive (running) epilepsy
F25y100	Gelastic epilepsy
F25y200	Locl-rlt(foc)(part)idiop epilep&epilptic syn seiz locl onset
F25y300	Complex partial status epilepticus
F25y400	Benign Rolandic epilepsy
F25y500	Panayiotopoulos syndrome
F25yz00	Other forms of epilepsy NOS
F25z.00	Epilepsy NOS
SC20000	Traumatic epilepsy

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, explain how loss to follow-up was addressed	5
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6 and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) Summarise follow-up time (eg, average and total amount)	6
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7,8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,8
		(*b*) Report category boundaries when continuous variables were categorized	6,7,8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	6,7,8
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9,10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9,10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Outcomes following feeding gastrostomy (FG) insertion in patients with learning disability: a retrospective cohort study using The Health Improvement Network (THIN) database

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Outcomes following feeding gastrostomy (FG) insertion in patients with learning disability: a retrospective cohort study using The Health Improvement Network (THIN) database

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STRUCTURED ABSTRACT

Objectives: To measure the rates of lower respiratory tract infection (LRTI) and mortality following feeding gastrotomy (FG) placement in patients with learning difficulties (LD). Following this to compare these rates between those having LRTI prior to FG placement and those with no recent LRTI.

Design: Retrospective Cohort Study

Setting and participants: The study population included patients with LD undergoing FG placement in the 'The Health Improvement Network' database. Patients with LRTI in the year prior (LYP) to their FG placement were compared to patients without a history of LRTI in the year prior (non-LYP) to FG placement. FG placement and LD were identified using Read codes previously developed by an expert panel.

Main outcome measures: Incidence rate ratio (IRR) of developing LRTI and mortality following FG, comparing patients with LRTI in the year prior to FG placement to patients without a history of LRTI.

Results: 214 patients with LD had a FG inserted including 743.4 person years follow-up. 53.7% were males and the median age was 27.6 (IQR 19.6-38.6) years. 27.1% were in the LYP patients. 18.7% had a LRTI in the year following FG, with an estimated incidence rate of 254 per 1000-person years. Over the study period the incidence rate of LRTI in LYP patients was 369 per 1000-person years, in non-LYP patients this was 91 per 1000-person years (adjusted IRR 4.21 (95% CI 2.68-6.63) p<0.001). 27.1% of patients died during study follow-up. Incidence rate of death was 80 and 45 per 1000-person year for LYP and non-LYP patients respectively (adjusted IRR 1.80 (1.00-3.23) p=0.05).

Conclusion: In LD patients, no clinically meaningful reduction in LRTI incidence was observed following FG placement. Mortality and LRTI were higher in patients with at least one LRTI in the year preceding FG placement, compared to those without a preceding LRTI.

STRENGTHS AND LIMITATIONS OF THE STUDY

- This study utilised The Health Improvement Network (THIN). THIN is a primary care database including 6% of the UK population, which is representative of national demographics, therefore providing a large cohort for analysis.
- Patients with learning disability were identified using Read codes developed by an expert panel for use in research, providing a robust mechanism to identify such patients.
- Feeding Gastrostomy is incompletely coded in THIN, therefore new tube feed prescription is used as a surrogate of FG placement, however some cases will not be identified.
- Respiratory tract infection and death are largely accurately coded therefore the described rates of these outcomes are robust.

INTRODUCTION

Patients with learning disability (LD) are known to have high incidence of aspiration on video fluoroscopy[1]. For this reason the National Patient Safety Agency review in 2004 considered swallowing difficulties to be a key cause for concern in this group[2]. Aspiration is associated with recurrent episodes of pneumonia, often including hospitalisation. This contributes to the high incidence of chronic lung disease[3] and disproportionately high mortality from respiratory conditions in this patient cohort[4]. Patients with LD may undergo Feeding Gastrostomy (FG) insertion in an effort to reduce aspiration, usually as part of a multifactorial indication including the need for nutritional support.

Patients who receive nutrition through a FG are still at risk of aspiration. A Japanese study looking at elderly patients demonstrated that in those with prior aspiration pneumonia mortality following FG insertion was high and the commonest cause of mortality was pneumonia[5]. FG placement also did not improve quality of life in a longitudinal study of 40 patients with LD[6].

There is no current evidence describing the outcomes from FG insertion in patients with LD with respect to respiratory tract infections. Patients with LD are often excluded from clinical studies, despite the recognition that this group has greater healthcare needs, and poorer engagement with healthcare services. For this reason they have been described as a "Cinderella population"[7].

Admission to hospital for patients with LD is often challenging for both the patients and staff. Best interest decisions and delegated consent for FG placement are often required. Often the procedure is traumatic for the patient and carers. It is therefore important to ensure that FG placement is in the LD patient's best interests. Equally important is that the information given to family members and carers, who participate in the decision-making process, is evidence based.

The aim of this study was to examine the impact of FG placement on the risk of respiratory tract infections and mortality within the LD cohort using The Health Improvement Network (THIN) primary care database.

METHODS

The present study is a retrospective, population-based cohort study of all patients with LD, whom underwent FG placement. Patients were segregated by those with coded lower respiratory tract infection (LRTI) including specific aspiration pneumonia codes within 1 year prior (LYP) to FG placement and those without (non-LYP). LYP Patients were considered to be those at high risk for aspiration.

Data source

The Health Improvement Network (THIN) represents a group of General Practices (primary care) covering 6% of the UK population, which is representative of the UK population structure[8]. Individual practices were eligible for inclusion in the study from the later of the following two dates to ensure that the practice was making full use of the Electronic Medical Record (EMR): one year after the date their EMR was installed; and after the practice's acceptable mortality recording date. To ensure there was sufficient time to record baseline co-morbidities data, individual patients were eligible for inclusion from the date their practice became eligible for inclusion in the study or one year after registration with their practice if this date was later. Available information includes demographic, procedural and mortality data. Diagnosis and clinical presentations are recorded in the Read code hierarchical coding system[9].

THIN data access was provided by IQVIA to the University of Birmingham under the NHS South-East multicentre research ethics committee approval in 2003, prior to independent scientific review. This study was granted study specific approval (SRC18THIN008) from the IMS Health Scientific review committee.

Study population

Patients with LD were identified by Read codes developed by NHS Digital for a previous study (Supplementary 1). A panel of four experts reviewed each potential Read code. A code was included If there was agreement by 3 or more experts[10].

FG placement was identified by one of two methods; Read code for FG placement, or first prescription of non-oral, enteric, tube feed from the British National Formulary. Although these may also be used with a nasogastric tube, it is highly unlikely that this would be performed outside of a hospital setting.

Patients aged 16-46 with an LD code from any time point and incident FG placement between May 1995 and May 2017 were included.

Co-variates and outcome measures

Further variables sought included age, gender, smoking status, body mass index (BMI), Townsend deprivation index, epilepsy and Charlson co-morbidity score.

Episodes of LRTI were identified by Read code following the FG placement. Mortality was also sought in the THIN database. The full list of Read codes for covariates can be found in supplementary 1.

Statistical analysis

Demographic characteristics were described for the LYP, non-LYP and total cohorts. Age is converted to quintiles because any relationship was considered unlikely to be linear. Baseline variables were compared between LYP and non-LYP cohorts.

The incidence rate (IR) of LRTI and mortality within 1 year of FG placement are reported for LYP and non-LYP cohorts. The rate of LRTI in the year prior to FG placement was also reported.

IRs were calculated for LRTI and mortality at any time point following FG placement, in the LYP and non-LYP cohorts. Incidence rate ratios (IRR) and 95% confidence intervals (95% CI) are reported. Median time to event and interquartile range (IQR) are reported for LRTI and mortality. Cumulative incidence charts were plotted for mortality and LRTI by LYP group and compared with competing risk regression to allow for competing risks and time to event data.

A multivariable Poisson regression model was constructed for factors associated with LRTI up to 1 year after FG placement. Covariates included age, gender, deprivation, Charlson score category (0 or 1+) epilepsy and LYP history.

All statistical analysis was undertaken in Stata version 15 [11]. The threshold for statistical significance was set at $p<0.05$.

Patient and public involvement

Neither patients nor the public were involved in the development of the research question or design of the study. Patients or the public were not involved in the data collection or analysis stages of the paper. As the study utilises anonymised data, it is not possible to disseminate the study findings to the specific patients included. The study is published open access and therefore clinicians who look after patients relevant to this study will be able to view the findings to inform their practice.

RESULTS

Patient Demographics

There were 38,521 patients with an LD code in THIN, of whom 214 patients met the inclusion criteria for FG placement between age 16-46. The median age of the total cohort was 27.6 (IQR 19.6-38.6) years and 53.7% were male. Charlson co-morbidity scores were 0, 1, 2 and 3 or more in 155 (72.4%), 39 (18.2%), 9 (4.2%), and 11 (5.1%) respectively. 69.6% had a coded diagnosis of epilepsy. Body mass index (BMI) was available in only 82 (38.3%) patients, median 20kg/m^2 (IQR 16.5-24.2kg/m^2).

There were 58 LYP patients, 55.2% of whom were male, median age 30.8 (IQR 19.4 – 39.1) years, and there were 97.6 person-years follow-up. 156 non-LYP patients were included, 53.2% of whom were male, median age 27.0 (IQR 19.9 – 36.7) years. The non-LYP patients had 645.8 person-years follow-up. Full cohort demographics for the whole study population and split by exposure are shown in Table 1.

Lower respiratory tract infection in the year after Feeding Gastrostomy placement

40 patients developed LRTI within 1 year of FG placement, which was more common in the LYP patients compared to the non-LYP group; IR 606 per 1000-person years and 149 per 1000-person years respectively. Unadjusted IRR 4.07 (95% CI: 2.09 - 8.06), (p<0.001) and adjusted IRR 4.05 (2.08-7.87), (p<0.001).

Lower respiratory tract infections in the whole follow-up period

Over the study period IR for LRTI in the LYP group was 369 per 1000-person years. In the non-LYP group this was 91 per 1000-person years, unadjusted IRR 4.04 (95% CI 2.59-6.21, p<0.001). (Table 2 and figure 1). The time from FG placement to LRTI in the whole study population was 1.33 (IQR 0.4-3.72) years. In LYP patients this was 0.64 (0.27-1.84) years and in the non-LYP patients 2.37 (0.71-4.90) years.

In a multivariable Poisson regression model male gender (IRR 2.10 (95% CI: 1.03-4.29), p=0.042), age 33-40 years (3.36 (1.11-10.16), p=0.031), age >40 years (5.22 (1.73-15.75), p=0.003) and LYP (4.05 (2.09-7.87), p<0.001) were significantly associated with developing LRTI in the year following FG placement (Table 3).

Lower respiratory tract infection before and after feeding gastrostomy

The proportion with LYP was 27.1%. 18.7% developed LRTI in the year following FG placement, albeit with less than 1 year of follow-up in some patients. The LRTI incidence ratio for the complete cohort in the year prior to FG placement was 317 per 1000-person years compared to 254 per 1000-person years in the year after FG placement.

Mortality

Over the study period 58 patients died and median age at death was 38.2 (27.8-42.0) years. The IR in LYP patients was 80 per 1000-person years and 45 per 1000 person years in the non-LYP patients (unadjusted IRR 1.76 (95% CI 1.00-3.11), p=0.047) (Table 2 and Figure 2).

In a multivariable Poisson regression model, age 33-40 years (2.59 (1.03-6.52), p=0.043) and age >40 years (2.62 (1.01-6.77), p=0.047) were significantly associated with mortality during study follow-up following FG placement in comparison to age group < 19 years. LYP (1.80 (1.00-3.23), p=0.05) was of borderline significance in this adjusted model (Table 4).

DISCUSSION

This is the first study to assess the outcomes of FG insertion in a cohort of patients with LD. No reduction in LRTI following FG placement was observed. Furthermore, patients having one or more LRTIs prior to their FG (LYP) were more likely to have LRTIs after FG placement, both in the first year after their FG and in long term follow-up. Patients with one or more LRTIs prior to FG placement also had increase in mortality over the study period. Male gender was associated with increased LRTI within 1 year. Increasing age was associated with both increased mortality and LRTI within 1 year of FG placement.

There are no other studies looking at outcomes following FG placement specific to patients with LD. A prospective FG audit including 350 FG placements over 571 person years of data found a 1 year mortality of 35%, significantly higher than reported in the above study[12]. However, the median age was 62 years compared to 28 years in the present study and all indications were included. 31 of 350 FG were placed in patients with LD in whom 5 (16.1%) died over median 20 months follow-up. In the present study 11 (5.1%) died within 12 months and over the study period 55 (25.7%) patients died, albeit with a median time to death of 3.5 years. Although the proportions observed are different, only small numbers of deaths are observed and therefore comparison may be misleading. There is also likely to be variation in practice between providers, with a national overview provided by the present study compared to a single provider in the study by Clarke, Pitts, Latchford, & Lewis[12].

Short term mortality could not be addressed in this study as there were too few outcomes despite the sample size. There was also a wide variation in time to LRTI with large interquartile ranges. Therefore, although there appears to be shorter time to LRTI following FG placement in patients in the LYP patient group compared to the non-LYP group, this

result requires further evaluation before any implications for clinical practice can be considered.

LRTI are used as a surrogate of aspiration pneumonia in the present study. Although there are codes specifically for aspiration pneumonia, the study included all LRTI codes to provide good sensitivity. In patients who have a FG in situ or proceed to have a FG placed up to one year later, it was assumed that aspiration at least contributed to their LRTI.

A key strength of this analysis compared to others examining the impact of FG placement is the use of primary care data. The THIN database is an important tool to examine the LD population. The database is recognised to have a high accuracy and is therefore used for analysis for a wide range of conditions and outcomes. Specific benefits of the present study include a relatively large number of patients with LD with robust diagnostic and demographic data. Respiratory infections in this cohort are often managed in primary care and as such, only a small minority of cases present to secondary care. Therefore, presentation to primary care is a more sensitive measure of such infections.

Patients with LD are often challenging to identify from medical records. The Read codes used in the current cohort were developed by an expert group, in which codes were only included in the final set if 3 out of 4 panel members agreed that the code was representing a group of patients with LD. This set of Read codes has been utilised a number of studies previously [13]. This provides reassurance that the cohort in the present study accurately represents patients with LD. Although over 200 were included, and most clinically significant associations are likely to have been identified, a larger cohort would have allowed detection of more subtle factors, including an accurate estimate of their effects.

Identification of patients undergoing FG placement in the THIN database was also difficult. As a procedure performed in secondary care, the FG placement was not always coded in primary care data. Therefore, first feed prescription was used as a surrogate marker to identify when a FG had been placed. Despite these methods, it is likely that not all FG placements are captured within the data; however, we can be confident that those included represent a cohort of patients with LD undergoing FG placement. Unfortunately READ codes describing treatment decisions around FG placement also prevented identification of a cohort in whom FG placement was recommended but rejected. Therefore, comparison of a cohort with FG in-situ to a control group without FG was not feasible.

The indication for FG placement, e.g. dysphagia, recurrent aspiration or insufficient calorific intake, could not be identified in this study, which is a significant limitation. It is accepted that FG placement will be for inadequate oral nutrition which may have multi-factorial causes. By seeking respiratory tract infections within 1 year prior to FG placement, patients in whom this is a component of the indication for FG placement are identified and compared to those with other indications.

Unfortunately, data on BMI was missing in a very high proportion of patients. As such this could not be included in the analysis. It is hypothesised that patients requiring a FG are less mobile and therefore, in the absence of appropriate equipment, they do not routinely have their weight checked and recorded in primary care.

CONCLUSION

This is a novel population-based study demonstrates that FG placement does not appear to confer a reduction in LRTIs in the LD cohort. A small increase in mortality was also noted in

patients with a recent history of respiratory tract infections prior to FG placement. Physicians making decisions regarding FG placement in patients with LD should incorporate this into their assessment of risk and benefit and ensure patients, carers and family members are aware of likely outcomes following FG placement. Further research is required in patients with LD to establish sub-groups that are most likely to benefit from FG placement.

Table 1: Patient demographics

		Non-LYP (n=156)	LYP* (n=58)	Total (n=214)	P value
Gender	**Male**	83(53.2)	32 (55.2)	115 (53.7)	p= 0.8
	Female	73(46.8)	26 (44.8)	99 (46.3)	
Median age in years (IQR)		27.0 (19.9-36.7)	30.8 (19.4-39.1)	27.6 (19.6-8.6)	p=0.6
Townsend	**1**	31 (19.9)	9 (15.5)	40 (18.7)	p=0.3
	2	30 (19.2)	16 (27.6)	46 (21.5)	
	3	38 (24.4)	14 (24.1)	52 (24.3)	
	4	21 (13.5)	12 (20.7)	33 (15.4)	
	5	25 (16.0)	4 (6.9)	29 (13.6)	
	Missing	11 (7.1)	3 (5.2)	14 (6.5)	
Epilepsy	**Yes**	103 (66.0)	46 (79.3)	149 (69.6)	p=0.06
	No	53 (34.0)	12 (20.7)	65 (30.4)	
Charlson co-morbidity score	**0**	115 (73.7)	40 (69.0)	155 (72.4)	p=0.53
	1	27 (17.3)	12 (20.7)	39 (18.2)	
	2	5 (3.2)	4 (6.9)	9 (4.2)	
	3+	9 (5.8)	2 (3.5)	11 (5.1)	

Values are n(%) unless otherwise specified

LYP – LRTI in the Year Prior to feeding gastrostomy placement

Table 2: Incidence rate ratio (IRR) of lower respiratory tract infections and mortality following FG placement

	LRTI within 1 year		LRTI at any time		Mortality at any time	
	LYP	**Non-LYP**	**LYP**	**Non- LYP**	**LYP**	**Non- LYP**
Events	22	18	36	59	20	38
Person years	36	121	98	645	251	842
Incidence Rate (per 1000)	606	149	369	91	80	45
Incidence Rate Ratio	4.07 (2.09-8.06)		4.04 (2.59-6.21)		1.76 (1.00-3.11)	
P value	<0.001		P=0.001		P=0.047	
Incidence Rate Ratio (adjusted)	4.05 (2.08-7.87)		4.21 (2.68-6.63)		1.80 (1.00-3.23)	
P value (adjusted)	<0.001		<0.001		P=0.05	

Table 3: Poisson regression model for lower respiratory tract infection within 1 year of FG placement

		Incidence Rate Ratio	95% CI	P value
Age quintile	**<19**	1	-	-
	19-24	1.38	0.43-4.43	0.586
	24-33	1.28	0.36-4.63	0.699
	33-40	3.36	1.11-10.16	0.031
	>40	5.22	1.72-15.75	0.003
Gender (male)		2.10	1.03-4.29	0.042
Epilepsy		1.73	0.78-3.81	0.177
Charleson score 1 or above		1.73	0.86-3.47	0.125
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.68	0.25-1.83	0.441
	3	1.11	0.43-2.86	0.822
	4	0.67	0.21-2.19	0.513
	5	0.68	0.17-2.70	0.580
	Missing	0.54	0.10-2.80	0.462
LRTI in the year prior to PEG placement *(LYP)*		4.05	2.08-7.87	<0.001

Table 4 Poisson regression model for mortality following FG placement

		Incidence Rate Ratio	95% CI	P value
Age quintile	**<19**	1	-	-
	19-24	1.84	0.71-4.82	0.210
	24-33	1.65	0.62-4.39	0.315
	33-40	2.59	1.03-6.52	0.043
	>40	2.62	1.01-6.77	0.047
Gender (male)		0.93	0.54-1.61	0.792
Epilepsy		0.80	0.44-1.44	0.452
Charlson score 1 or above		1.21	0.68-2.18	0.508
Townsend deprivation score *(5 is the most deprived)*	**1**	1	-	-
	2	0.57	0.25-1.30	0.183
	3	0.63	0.29-1.38	0.250
	4	0.79	0.33-1.88	0.594
	5	0.42	0.15-1.17	0.098
	Missing	0.32	0.7-1.49	0.146
LRTI in the year prior to PEG placement *(LYP)*		1.80	1.00-3.23	0.050

Figure Legends:

Figure 1: Cumulative incidence regression for lower respiratory tract infections following FG placement

Figure 2: Cumulative incidence regression for mortality following FG placement

ADDITIONAL INFORMATION

Contributorship statement: PRH and NJT were responsible for the initial conception of the study. PRH, TT, JSC and KN then contributed to the data collection and analysis of the data. PRH, TT, JSC, NJT, NB and KN all contributed to the final version of the manuscript for submission.

Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Data sharing statement: The full dataset and statistical code for analysis can be requested from the corresponding author.

REFERENCES

1. Somerville H, Tzannes G, Wood J, Shun A, Hill C, Arrowsmith F, et al. Gastrointestinal and nutritional problems in severe developmental disability. Dev Med Child Neurol. 2008;50(9):712-6.
2. NPSA. Understanding the patient safety issues for people with learning disabilities. London: National Patient Safety Agency; 2004.
3. Strauss D, Cable W, R S. Causes of excess mortality in cerebral palsy patients. developmental medicine & child neurology. 1999;41:580-5.
4. Hollins S, Attard T, Von Fraunhofer, Mcguigan S, P S. Mortality in peiple with learning disability: risks, causes and death certification findings in London. Developmental medicine & child neurology. 1998;40:50-6.
5. Tokunaga T, Kubo T, Ryan S, Tomizawa M, Yoshida S, Takagi K, et al. Long-term outcome after placement of a percutaneous endoscopic gastrostomy tube. Geriatr Gerontol Int. 2008;8(1):19-23.
6. Lee L, MacPherson M. Long-term percutaneous endoscopic gastrostomy feeding in young adults with multiple disabilities. Intern Med J. 2010;40(6):411-8.
7. Leslie P, Crawford H, Wilkinson H. People with a learning disability and dysphagia: a cinderella population? Dysphagia. 2009;24(1):103-4.
8. Bourke A, Dattani H, Robinson M. Feasibility study and methodology to create a quality-evaluated database of primary care data. Inform Prim Care. 2004(12):171–7.
9. Booth N. What are Read Codes. Health Libraries Review. 1994;11:177-82.
10. The NHS Information Centre PSaPCS. Access to Healthcare for People with Learning Disabilities 2010.
11. Statacorp. Stata Statistical Software: release 14.: TX: StataCorp LP; 2015.
12. Clarke E, Pitts N, Latchford A, Lewis S. A large prospective audit of morbidity and mortality associated with feeding gastrostomies in the community. Clinical Nutrition. 2017;36(2):485-90.
13. Buszewicz M, Welch C, Horsfall L, Nazareth I, Osborn D, Hassiotis A, et al. Assessment of an incentivised scheme to provide annual health checks in primary care for adults with intellectual disability: a longitudinal cohort study. The Lancet Psychiatry. 2014;1(7):522-30.

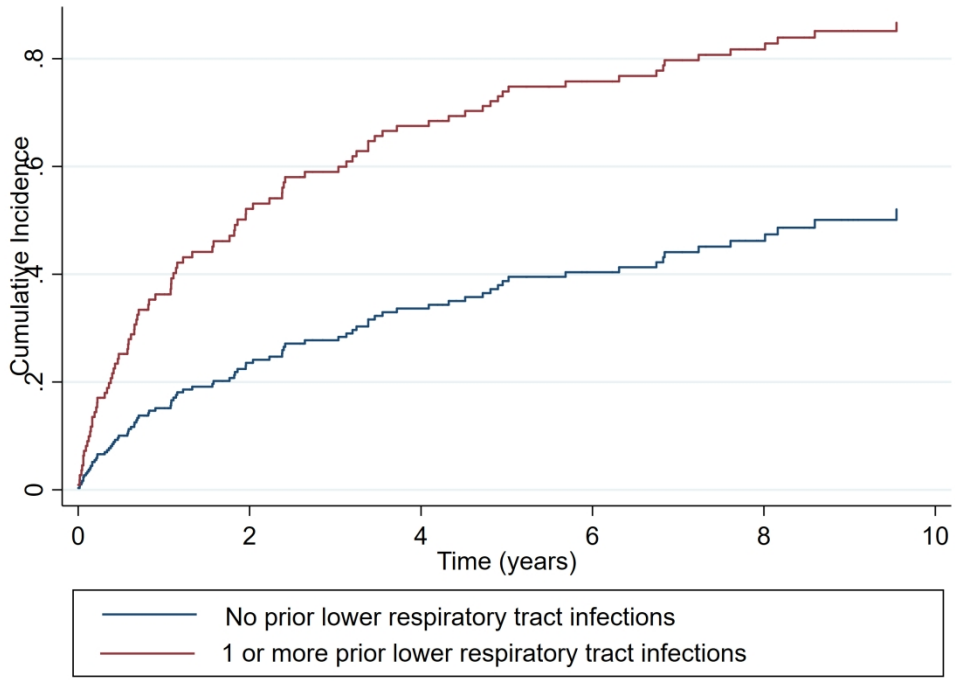

Figure 1: Cumulative incidence regression for lower respiratory tract infections following PEG placement

215x157mm (300 x 300 DPI)

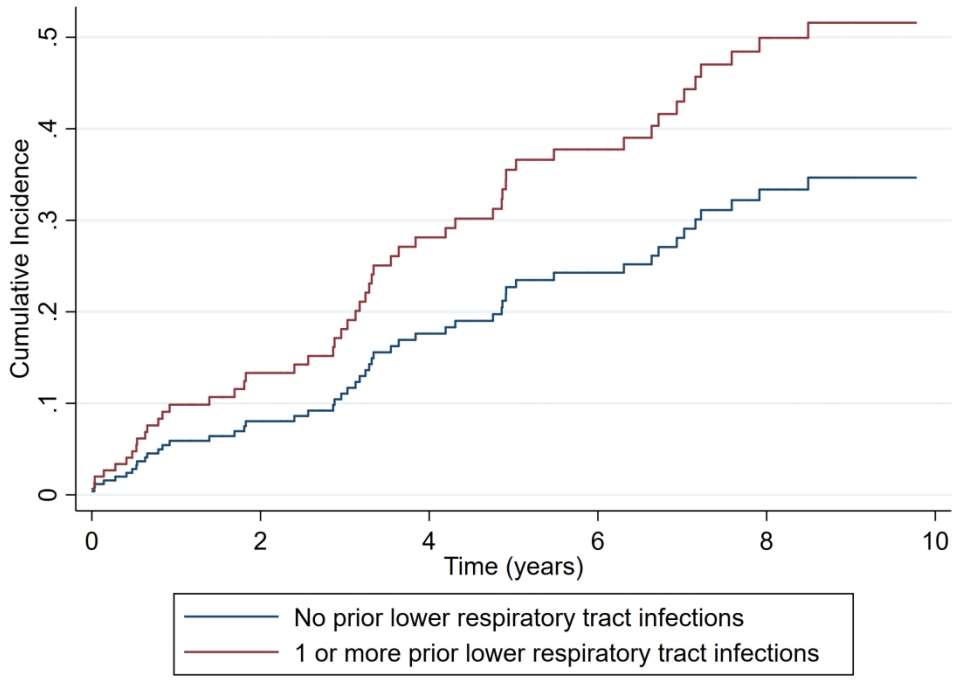

Figure 2: Cumulative incidence regression for mortality following PEG placement

215x157mm (300 x 300 DPI)

Outcomes following percutaneous endoscopic gastrostomy insertion in patients with learning disability: Appendix

1. LD read codes:

6664	Mental handicap problem
13Z3.00	Low I.Q.
8HHP.00	Referral to learning disability team
9HB..00	Learning disabilities administration status
9HB0.00	Learning disabilities health action plan declined
9HB1.00	Learning disabilities health action plan offered
9HB2.00	Learning disabilities health action plan reviewed
9HB3.00	Learning disabilities health assessment
9HB4.00	Learning disabilities health action plan completed
9HB5.00	Learning disabilities annual health assessment
C301.00	Phenylketonuria
E140.00	Infantile autism
E140.11	Kanner's syndrome
E140.12	Autism
E140.13	Childhood autism
E140000	Active infantile autism
E140100	Residual infantile autism
E140z00	Infantile autism NOS
E3...00	Mental retardation
E30..00	Mild mental retardation, IQ in range 50-70
E30..11	Educationally subnormal
E30..12	Feeble minded
E30..13	Moron
E31..00	Other specified mental retardation
E310.00	Moderate mental retardation, IQ in range 35-49
E310.11	Imbecile
E311.00	Severe mental retardation, IQ in range 20-34
E312.00	Profound mental retardation with IQ less than 20
E312.11	Idiocy
E31z.00	Other specified mental retardation NOS
e31z.00	Other specified mental retardation NOS
E3y..00	Other specified mental retardation
E3z..00	Mental retardation NOS
Eu7..00	[X]Mental retardation
Eu70.00	[X]Mild mental retardation
Eu70.11	[X]Feeble mindedness
Eu70.12	[X]Mild mental subnormality
Eu70000	[X]Mld mental retard with statement no or min impairm behav
Eu70100	[X]Mld mental retard sig impairment behav req attent/treatmt
Eu70y00	[X]Mild mental retardation, other impairments of behaviour
Eu70z00	[X]Mild mental retardation without mention impairment behav

Eu71.00	[X]Moderate mental retardation
Eu71.11	[X]Moderate mental subnormality
Eu71000	[X]Mod mental retard with statement no or min impairm behav
Eu71100	[X]Mod mental retard sig impairment behav req attent/treatmt
Eu71y00	[X]Mod retard oth behav impair
Eu71z00	[X]Mod mental retardation without mention impairment behav
Eu72.00	[X]Severe mental retardation
Eu72.11	[X]Severe mental subnormality
Eu72000	[X]Sev mental retard with statement no or min impairm behav
Eu72100	[X]Sev mental retard sig impairment behav req attent/treatmt
Eu72y00	[X]Severe mental retardation, other impairments of behaviour
Eu72z00	[X]Sev mental retardation without mention impairment behav
Eu73.00	[X]Profound mental retardation
Eu73.11	[X]Profound mental subnormality
Eu73000	[X]Profound ment retrd wth statement no or min impairm behav
Eu73100	[X]Profound ment retard sig impairmnt behav req attent/treat
Eu73y00	[X]Profound mental retardation, other impairments of behavr
Eu73z00	[X]Prfnd mental retardation without mention impairment behav Eu7y.00 [X]Other mental retardation
Eu7y000	[X]Oth mental retard with statement no or min impairm behav
Eu7y100	[X]Oth mental retard sig impairment behav req attent/treatmt
Eu7yy00	[X]Other mental retardation, other impairments of behaviour
Eu7yz00	[X]Other mental retardation without mention impairment behav
Eu7z.00	[X]Unspecified mental retardation
Eu7z.11	[X]Mental deficiency NOS
Eu7z.12	[X]Mental subnormality NOS
Eu7z000	[X]Unsp mental retard with statement no or min impairm behav
Eu7z100	[X]Unsp mentl retard sig impairment behav req attent/treatmt
Eu7zy00	[X]Unspecified mental retardatn, other impairments of behav
Eu7zz00	[X]Unsp mental retardation without mention impairment behave
Eu81z00	[X]Developmental disorder of scholastic skills, unspecified
Eu81z11	[X]Learning disability NOS
Eu81z12	[X]Learning disorder NOS
Eu81z13	[X]Learn acquisition disab NOS
Eu84.00	[X]Pervasive developmental disorders
Eu84000	[X]Childhood autism
Eu84011	[X]Autistic disorder
Eu84012	[X]Infantile autism
Eu84013	[X]Infantile psychosis
Eu84014	[X]Kanner's syndrome
Eu84100	[X]Atypical autism
Eu84111	[X]Atypical childhood psychosis
Eu84112	[X]Mental retardation with autistic features
Eu84112	[X]Mental retardation with autistic features
Eu84200	[X]Rett's syndrome
Eu84311	[X]Dementia infantalis
Eu84400	[X]Overactive disorder assoc mental retard/stereotype movts
	[X]Other pervasive developmental disorders

Eu84y00	
Eu84z00	[X]Pervasive developmental disorder, unspecified
Eu84z11	[X]Autistic spectrum disorder
PJ0..00	Down's syndrome trisomy 21
PJ0..11	Mongolism
PJ0..12	Trisomy 21
PJ0..13	Trisomy 22
PJ00.00	Trisomy 21, meiotic nondisjunction
PJ01.00	Trisomy 21, mosaicism
PJ01.11	Trisomy 21, mitotic nondisjunction
PJ02.00	Trisomy 21, translocation
PJ02.11	Partial trisomy 21 in Down's syndrome
PJ0z.00	Down's syndrome NOS
PJ0z.11	Trisomy 21 NOS
PJ1..00	Patau's syndrome trisomy 13
PJ10.00	Trisomy 13, meiotic nondisjunction
PJ11.00	Trisomy 13, mosaicism
PJ11.11	Trisomy 13, mitotic nondisjunction
PJ12.00	Trisomy 13, translocation
PJ12.11	Partial trisomy 13 in Patau's syndrome
PJ1z.00	Patau's syndrome NOS
PJ1z.11	Trisomy 13 NOS
PJ2..00	Edward's syndrome trisomy 18
PJ20.00	Trisomy 18, meiotic nondisjunction
PJ21.00	Trisomy 18, mosaicism
PJ21.11	Trisomy 18, mitotic nondisjunction
PJ22.00	Trisomy 18, translocation
PJ22.11	Partial trisomy 18 in Edward's syndrome
PJ2z.00	Edward's syndrome NOS
PJ2z.11	TRISOMY 18 NOS
PJ3..00	Monosomies and deletions from the autosomes
PJ30.00	Antimongolism syndrome
PJ30.11	Deletion of long arm of chromosome 21
PJ31.00	Criduchat syndrome
PJ31.11	Deletion of short arm of chromosome 5
PJ32.00	Deletion of short arm of chromosome 4
PJ32.11	Wolff Hirschorn syndrome
PJ33.00	Other deletions of part of a chromosome
PJ33000	Deletion of long arm of chromosome 13
PJ33100	Deletion of long arm of chromosome 18
PJ33111	18p syndrome
PJ33200	Deletion of short arm of chromosome 18
PJ33211	18q syndrome
PJ33300	Smith Magenis syndrome
PJ33z00	Other deletion of part of a chromosome NOS
PJ34.00	Deletions seen only at prometaphase
PJ35.00	Deletions with other complex rearrangements
PJ36.00	Whole chromosome monosomy, meiotic nondisjunction

PJ37.00	Whole chromosome monosomy, mosaicism
PJ37.11	Whole chromosome monosomy, mitotic nondisjunction
PJ37.12	Autosomal deletion mosaicism
PJ37000	Monosomy 21, mosaicism
PJ37z00	Whole chromosome monosomy, mosaicism NOS
PJ38.00	Chromosome replaced with ring or dicentric
PJ38.11	Chromosome replaced with dicentric
PJ38.12	Chromosome replaced with ring
PJ3y.00	Other deletions from the autosomes
PJ3y000	Shprintzen syndrome
PJ3y011	Velocardiofacial syndrome
PJ3z.00	Monosomies and deletions from the autosomes NOS
PJ4..00	Balanced autosomal translocation
PJ5..00	Other condition due to autosomal anomaly
PJ50.00	Whole chromosome trisomy syndromes
PJ50000	Trisomy 6
PJ50100	Trisomy 7
PJ50200	Trisomy 8
PJ50300	Trisomy 9
PJ50400	Trisomy 10
PJ50500	Trisomy 11
PJ50600	Trisomy 12
PJ50700	Other trisomy C syndromes
PJ50800	Trisomy 22
PJ50w00	Whole chromosome trisomy, meitotic nondisjunction
PJ50x00	Whole chromosome trisomy, mosaicism
PJ50x11	Whole chromosome trisomy, mitotic nondisjunction
PJ50y00	Other specified whole chromosome trisomy syndrome
PJ50z00	Whole chromosome trisomy syndrome NOS
PJ51.00	Partial trisomy syndromes
PJ51000	Major partial trisomy
PJ51100	Minor partial trisomy
PJ51z00	Partial trisomy syndrome NOS
PJ52.00	Trisomies of autosomes NEC
PJ52000	Duplications seen only at prometaphase
PJ52100	Duplications with other complex rearrangements
PJ52200	Extra marker chromosomes
PJ52300	Triploidy
PJ52400	Polyploidy
PJ52z00	Trisomy of autosomes NEC NOS
PJ53.00	Balanced rearrangements and structural markers NEC
PJ53.11	Balanced translocations
PJ53000	Chromosome inversion in normal individual
PJ53100	Balanced autosomal rearrangement in abnormal individual
PJ53200	Balanced sex/autosomal rearrangement in abnormal individual
PJ53300	Individual with marker heterochromatin
PJ53400	Individual with autosomal fragile site
PJ53500	Shwachman Diamond syndrome

PJ53z00	Balanced rearrangement or structural marker NEC NOS
PJ5y.00	Other specified conditions due to autosomal anomalies
PJ5y.11	Pseudotrisomy 18
PJ5z.00	Unspecified conditions due to autosomal anomalies
PJ5z.11	Aneuploidy NEC
PJ7z.00	Klinefelter's syndrome NOS
PJyy200	Fragile X chromosome
PK5..00	Tuberous sclerosis
PK5..11	Bourneville's disease
PK61.00	Sturge Weber syndrome
PKy0.11	Prader Willi Syndrome
PKy0.12	Prader Willi syndrome
PKy0.13	Noonan's syndrome
PKy0000	Bannayan Riley Ruvalcaba syndrome
PKy8000	Noonan's syndrome
PKy9300	Prader Willi syndrome

2. PEG placement Read codes

7617	gastrostomy operations
7617.12	Creation of gastrostomy
7617000	Creation of permanent gastrostomy
7617100	Creation of temporary gastrostomy
7617111	Creation of gastrostomy NEC
7617700	Maintenance of percutaneous endoscopic gastrostomy tube
7617400	Attention to gastrostomy tube
7617y00	Other specified gastrostomy operation
7617z00	Gastrostomy operation NOS
761E320	Temporary percutaneous endoscopic gastrostomy
761E400	Permanent percutaneous endoscopic gastrostomy
761E600	Fibreoptic endoscopic percutaneous insert gastrostomy (PEG)
761EA00	Fibreoptic endoscopic percutaneous insertion of gastrostomy
8C45000	Gastrostomy feeding
8CJ2.00	percutaneous endsoscopic gastrostomy feeding
8CJ4.00	Button gastrostomy feeding
ZC32.54	PEG - percutaneous endoscopic gastrostomy feeding
ZC65311	PEG - percutaneous endoscopic gastrostomy feeding
ZC65300	percutaneous endsoscopic gastrostomy feeding
ZC65400	Button gastrostomy feeding
ZC65200	Gastrostomy feeding

3. Feed Read codes

97661994	Generic Fresubin Original liquid
95197994	Generic Fresubin Energy liquid
81242994	Generic Fresubin Energy liquid
95501994	Generic Fresubin Original liquid

84497994	Generic Fresubin Protein Energy drink
95215994	Generic Fresubin Original Fibre liquid
99308994	Generic Fresubin Original liquid
92452994	Generic Fresubin Energy Fibre liquid
56087979	Generic fresubin energy liquid
95000994	Generic Fresubin Energy liquid
90080994	Generic Fresubin 1000 Complete liquid
91887994	Generic Fresubin Original liquid
91067994	Generic Fresubin Energy Fibre liquid
99689994	Generic fresubin 200ml liquid (fresenius kabi ltd)
95218994	Generic Fresubin Energy liquid
94257994	Generic fresubin he liquid (fresenius kabi ltd)
97659994	Generic fresubin -750 500ml liquid (fresenius kabi ltd)
89828994	Generic Fresubin 1200 Complete liquid
93150994	Generic Fresubin HP Energy liquid
56088979	Generic fresubin energy fibre liquid
56086979	Generic fresubin original liquid
99475994	Generic Fresubin Original liquid
95502994	Generic Fresubin Original liquid
93615994	Generic fresubin liquid (fresenius kabi ltd)
87966979	Generic Fresubin Energy liquid
79096994	Generic fresubin 2250 complete liquid
95487994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87967979	Generic fresubin energy liquid
87980979	Generic Fresubin Energy Fibre liquid
70468994	Generic Fresubin 1500 Complete liquid
99468994	Generic fresubin liquid (fresenius kabi ltd)
87947979	Generic Fresubin Energy liquid
77233994	Generic fresubin 1800 complete liquid
87985979	Generic Fresubin Energy liquid
95600994	Generic fresubin 500ml liquid (fresenius kabi ltd)
87933979	Generic Fresubin Original liquid
91886994	Generic Fresubin Original liquid
92370994	Generic fresubin 750 mct liquid (fresenius kabi ltd)
87945979	Generic fresubin energy liquid
87981979	Generic Fresubin Energy Fibre liquid
87932979	Generic Fresubin Original liquid
87948979	Generic Fresubin Energy Fibre liquid
87931979	Generic Fresubin Original liquid
95579994	Generic fresubin 500ml liquid (fresenius kabi ltd)
81422994	Generic Fresubin Soya Fibre liquid
99060994	Generic fresubin 500ml liquid (fresenius kabi ltd)
88988994	Generic Nutrison Energy Multi Fibre liquid
91198994	Generic Nutrison Multi Fibre liquid
99385994	Generic Nutrison Energy liquid
99767994	Generic Nutrison liquid
86819994	Generic Nutrison 1200 Complete Multi Fibre liquid
83589994	Generic Nutrison 1000 Complete Multi Fibre liquid

95577994	Generic Nutrison Peptisorb liquid
98116994	Generic Nutrison Soya liquid
95348994	Generic nutrison fibre liquid (nutricia ltd)
99009994	Generic Nutrison Energy liquid
96652994	Generic Nutrison Soya liquid
93444994	Generic Nutrison Concentrated liquid
99146994	Generic Nutrison Soya liquid
96563992	Nutrison steriflo
99384994	Generic nutrison fibre liquid (nutricia ltd)
84589978	Generic Nutrison 800 Complete Multi Fibre liquid
84859994	Generic Nutrison Protein Plus liquid
84858994	Generic Nutrison Protein Plus Multifibre liquid
95578994	Generic Nutrison Peptisorb liquid
95035992	Generic Nutrison liquid
79867994	Generic Nutrison Soya Multi Fibre liquid
93796992	Generic Nutrison Energy liquid
93877992	Generic Nutrison Soya liquid
67245994	Generic Nutrison 800 Complete Multi Fibre liquid
91884994	Generic Nutrison MCT liquid
99362994	Generic Nutrison Peptisorb liquid
91199994	Generic Nutrison Multi Fibre liquid
95659994	Generic nutrison mct 500ml liquid (nutricia ltd)
95457994	Generic Jevity liquid
92369994	Generic Jevity Plus liquid
86504994	Generic Jevity 1.5kcal liquid
84496994	Generic Jevity Promote liquid
94806994	Generic Jevity liquid
92368994	Generic Jevity Plus liquid
91471994	Generic Jevity Plus liquid
93157994	Generic Jevity liquid
99546994	Generic Jevity liquid
76051994	Generic Jevity Plus HP gluten free liquid
84769979	Generic Jevity liquid
95053994	Peptamen liquid
82770994	Generic Peptamen HN liquid
97873992	Peptamen liquid
95018994	Generic peptamen peptide liquid (nestle clinical nutrition) 250ml
94807994	Generic Perative liquid
95211994	Generic perative liquid
95212994	Generic perative liquid (abbott nutrition) 237ml
86877979	Generic perative liquid
89276994	Generic novasource gi forte liquid
96653994	Generic Osmolite liquid
91518994	Generic Osmolite Plus liquid
96654994	Generic Osmolite liquid
97835992	Osmolite liq
94808994	Generic Osmolite liquid

99549994	Generic osmolite rth isotonic complete food (abbott nutrition)
93568992	Osmolite
93158994	Generic Osmolite liquid
99501994	Generic osmolite isotonic complete food (abbott nutrition)
67681994	Generic osmolite hp liquid
91517994	Generic Osmolite Plus liquid
59524979	Generic Vital 1.5kcal liquid
67243994	Generic Vital 1.5kcal liquid

4. Lower respiratory tract infection Read codes

A022200	Salmonella pneumonia
A3BXB00	Klebsiella pneumoniae/cause/disease classifd/oth chapters
H2...00	Pneumonia and influenza
H21..00	Lobar (pneumococcal) pneumonia
H21..11	Chest infection - pneumococcal pneumonia
H22..00	Other bacterial pneumonia
H22..11	Chest infection - other bacterial pneumonia
H220.00	Pneumonia due to klebsiella pneumonia
H221.00	Pneumonia due to pseudomonas
H222.00	Pneumonia due to haemophilus influenza
H222.11	Pneumonia due to haemophilus influenza
H223.00	Pneumonia due to streptococcus
H223000	Pneumonia due to streptococcus, group B
H224.00	Pneumonia due to staphylococcus
H22y.00	Pneumonia due to other specified bacteria
H22y000	Pneumonia due to escherichia coli
H22y011	E.coli pneumonia
H22y100	Pneumonia due to proteus
H22y200	Pneumonia – Legionella
H22yX00	Pneumonia due to other aerobic gram-negative bacteria
H22yz00	Pneumonia due to bacteria NOS
H22z.00	Bacterial pneumonia NOS
H23..00	Pneumonia due to other specified organisms
H23..11	Chest infection - pneumonia organism OS
H230.00	Pneumonia due to Eaton's agent
H231.00	Pneumonia due to mycoplasma pneumonia
H232.00	Pneumonia due to pleuropneumonia like organisms
H233.00	Chlamydial pneumonia
H23z.00	Pneumonia due to specified organism NOS
H24..00	Pneumonia with infectious diseases EC
H24..11	Chest infection with infectious disease EC
H25..00	Bronchopneumonia due to unspecified organism
H25..11	Chest infection - unspecified bronchopneumonia
H26..00	Pneumonia due to unspecified organism
H26..11	Chest infection - pnemonia due to unspecified organism

H260.00	Lobar pneumonia due to unspecified organism
H260000	Lung consolidation
H261.00	Basal pneumonia due to unspecified organism
H262.00	Postoperative pneumonia
H28..00	Atypical pneumonia
H2B..00	Community acquired pneumonia
H2C..00	Hospital acquired pneumonia
H2y..00	Other specified pneumonia or influenza
H2z..00	Pneumonia or influenza NOS
H30..11	Chest infection - unspecified bronchitis
H47..00	Pneumonitis due to inhalation of solids or liquids
H47..11	Aspiration pneumonitis
H470.00	Pneumonitis due to inhalation of food or vomitus
H470.11	Aspiration pneumonia
H470000	Pneumonitis due to inhalation of regurgitated food
H470100	Pneumonitis due to inhalation of gastric secretions
H470200	Pneumonitis due to inhalation of milk
H470300	Pneumonitis due to inhalation of vomitus
H470311	Vomit inhalation pneumonitis
H470312	Aspiration pneumonia due to vomit
H470z00	Pneumonitis due to inhalation of food or vomitus NOS
H0...00	Acute respiratory infections
H062.00	Acute lower respiratory tract infection
H06z000	Chest infection NOS
H06z011	Chest infection
H06z100	Lower resp tract infection
H06z111	Respiratory tract infection
H06z112	Acute lower respiratory tract infection
H06z200	Recurrent chest infection
H07..00	Chest cold
H0y..00	Other specified acute respiratory infections
H0z..00	Acute respiratory infection NOS

5. Epilepsy Read codes

F132100	Progressive myoclonic epilepsy
F25..00	Epilepsy
F250.00	Generalised nonconvulsive epilepsy
F250000	Petit mal (minor) epilepsy
F250011	Epileptic absences
F250100	Pykno-epilepsy
F250200	Epileptic seizures – atonic
F250300	Epileptic seizures - akinetic
F250400	Juvenile absence epilepsy
F250500	Lennox-Gastaut syndrome
F250y00	Other specified generalised nonconvulsive epilepsy
F250z00	Generalised nonconvulsive epilepsy NOS

F251.00	Generalised convulsive epilepsy
F251000	Grand mal (major) epilepsy
F251011	Tonic-clonic epilepsy
F251100	Neonatal myoclonic epilepsy
F251111	Otohara syndrome
F251200	Epileptic seizures – clonic
F251300	Epileptic seizures - myoclonic
F251400	Epileptic seizures – tonic
F251500	Tonic-clonic epilepsy
F251y00	Other specified generalised convulsive epilepsy
F251z00	Generalised convulsive epilepsy NOS
F252.00	Petit mal status
F253.00	Grand mal status
F253.11	Status epilepticus
F254.00	Partial epilepsy with impairment of consciousness
F254000	Temporal lobe epilepsy
F254100	Psychomotor epilepsy
F254200	Psychosensory epilepsy
F254300	Limbic system epilepsy
F254400	Epileptic automatism
F254500	Complex partial epileptic seizure
F254z00	Partial epilepsy with impairment of consciousness NOS
F255.00	Partial epilepsy without impairment of consciousness
F255000	Jacksonian, focal or motor epilepsy
F255011	Focal epilepsy
F255012	Motor epilepsy
F255100	Sensory induced epilepsy
F255200	Somatosensory epilepsy
F255300	Visceral reflex epilepsy
F255311	Partial epilepsy with autonomic symptoms
F255400	Visual reflex epilepsy
F255500	Unilateral epilepsy
F255600	Simple partial epileptic seizure
F255y00	Partial epilepsy without impairment of consciousness OS
F255z00	Partial epilepsy without impairment of consciousness NOS
F256.00	Infantile spasms
F256000	Hypsarrhythmia
F256100	Salaam attacks
F256.11	Lightning spasms
F256.12	West syndrome
F256z00	Infantile spasms NOS
F257.00	Kojevnikov's epilepsy
F258.00	Post-ictal state
F259.00	Early infant epileptic encephalopathy wth suppression bursts
F259.11	Ohtahara syndrome
F25A.00	Juvenile myoclonic epilepsy
F25B.00	Alcohol-induced epilepsy

F25C.00	Drug-induced epilepsy
F25D.00	Menstrual epilepsy
F25E.00	Stress-induced epilepsy
F25F.00	Photosensitive epilepsy
F25X.00	Status epilepticus, unspecified
F25y.00	Other forms of epilepsy
F25y000	Cursive (running) epilepsy
F25y100	Gelastic epilepsy
F25y200	Locl-rlt(foc)(part)idiop epilep&epilptic syn seiz locl onset
F25y300	Complex partial status epilepticus
F25y400	Benign Rolandic epilepsy
F25y500	Panayiotopoulos syndrome
F25yz00	Other forms of epilepsy NOS
F25z.00	Epilepsy NOS
SC20000	Traumatic epilepsy

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, explain how loss to follow-up was addressed	5
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6 and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) Summarise follow-up time (eg, average and total amount)	6
Outcome data	15*	Report numbers of outcome events or summary measures over time	6,7,8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,8
		(*b*) Report category boundaries when continuous variables were categorized	6,7,8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	6,7,8
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9,10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9,10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.