

# Clinical implementation of a new antibiotic prophylaxis regimen for percutaneous endoscopic gastrostomy

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## ABSTRACT

**Objectives:** This study was undertaken to test the extent to which a new antibiotic prophylaxis regimen for percutaneous endoscopic gastrostomy (PEG), identified as a justified and simpler alternative to conventional regimen in a randomised clinical trial, has been adopted in clinical practice.

**Design:** A Swedish nationwide implementation survey, conducted in February 2013, assessed the level of clinical implementation of a 20 ml dose of oral solution of sulfamethoxazole and trimethoprim deposited in the PEG catheter immediately after insertion. All hospitals inserting at least five PEGs annually were identified from the Swedish Patient Registry. A clinician involved in the PEG insertions at each hospital participated in a structured telephone interview addressing their routine use of antibiotic prophylaxis.

**Setting:** All Swedish hospitals inserting PEGs (n=60).

**Participants:** Representatives of PEG insertions at each of the 60 eligible hospitals participated (100% participation).

**Main outcome measures:** Use of routine antibiotic prophylaxis for PEG.

**Results:** A total of 32 (53%) of the 60 hospitals had adopted the new regimen. It was more frequently adopted in university hospitals (67%) than in community hospitals (41%). An annual total of 1813 (70%) of 2573 patients received the new regimen. Higher annual hospital volume was associated with a higher level of adoption of the new regimen (80% in the highest vs 31% in the lowest).

**Conclusions:** The clinical implementation of the new antibiotic prophylaxis regimen for PEG was high and rapid (70% of all patients within 3 years), particularly in large hospitals.

## INTRODUCTION

A main goal of clinical research is to improve clinical practice. Yet, evaluations of the implementation of novel research findings are rare and the methodological quality of the existing literature is limited.<sup>1</sup> The process from revealing a clinically relevant research finding to having it adopted in the clinical setting is often difficult and requires

## ARTICLE SUMMARY

### Article focus

- A main goal of clinical research is to change clinical practice, but evaluations of the clinical implementation of novel research findings are rare.
- A randomised clinical trial suggested a new antibiotic prophylaxis regimen with oral solution deposited in the newly inserted percutaneous endoscopic gastrostomy (PEG) catheter could replace conventional intravenous administration.

### Key messages

- This study provides encouraging evidence of a high (70% of all patients) and rapid (within 3 years) clinical implementation of a new antibiotic prophylaxis regimen for PEG, based on the results of a single randomised clinical trial.
- The implementation in routine clinical practice was substantially higher at university hospitals and at hospitals with a higher annual number of PEG insertions compared with smaller hospitals.

### Strengths and limitations of this study

- Strengths include the ability to identify all hospitals inserting PEGs in Sweden, the 100% complete inclusion of all eligible hospitals and the use of structured telephone interviews to collect the data.
- A limitation is the uncertainty whether the results in Sweden are representative of those of other countries.

resources and directed implementation strategies.<sup>2–4</sup> Many patients do not receive appropriate care or receive unnecessary or harmful treatments.<sup>5</sup> This study was undertaken to evaluate the potential clinical implementation of a new antibiotic prophylaxis regimen used to reduce infectious complications after the insertion of percutaneous endoscopic gastrostomy (PEG) for enteral nutrition in patients with eating difficulties, as recommended in a randomised clinical trial published in 2010.<sup>6</sup> The new regimen was a 20 ml dose of the oral solution of sulfamethoxazole and trimethoprim deposited in

the PEG catheter immediately after its insertion. This regimen was tested against a standard of an intravenous dose of 1.5 g cefuroxime administered 1 h before inserting PEG. The trial included 234 patients (116 with the new regimen and 118 with standard regimen), and all patients and evaluators were blinded to which prophylaxis was used. The study outcome was clinical signs of infection, supported by bacterial cultures and blood tests. The trial was a non-inferiority study, that is, if the new regimen was at least as effective as standard treatment it would be preferable since it had advantages that favoured its use, that is, easier to administer, cheaper, not given unnecessarily to the 10% of the cases where PEG is not possible to insert.<sup>7 8</sup> The trial showed that the new regimen was at least as effective in preventing infections, and the results were published as an original article in *BMJ*.<sup>6</sup> We hypothesised that the trial had changed clinical practice and tested this hypothesis in a nationwide Swedish survey.

## METHODS

### Presentation of the trial results

The trial that was assessed in this study was published in *BMJ* in 2010.<sup>6</sup> Moreover, a summary of the study was published in the Swedish Medical Journal (*Lakartidningen*). An oral presentation of the trial was conducted at a National Swedish conference in surgery. Finally, the study was presented at a Swedish meeting for clinicians with an interest in PEG.

### Study design and setting

This was a population-based, nationwide Swedish implementation survey. All hospitals that had conducted an average of at least five PEG insertions/year during the 3-year period 2009–2011 were identified from the Swedish Patient Registry. This registry is complete nationwide and collects data of all diagnoses and surgical procedures (including endoscopic procedures) during in-hospitalisations or specialist outpatient care, and has been found to have excellent completeness and accurateness.<sup>9</sup> A project nurse contacted the clinician responsible for the PEG activities at each of the identified hospitals and conducted a structured telephone interview strictly according to a study questionnaire. There was no mention about the trial under study until after the questions about current antibiotic prophylaxis were completed. All interviews were completed during the period from 30 January to 28 February 2013. The fact that the test regimen was entirely new facilitated the assessment of its potential implication in the clinical setting. The study was approved by the Regional Ethical Review Board in Stockholm, Sweden.

### Statistical analyses

The hospitals were categorised into three groups: (1) university hospitals, (2) county hospitals or (3) community hospitals. We also estimated the number of

inserted PEGs for 2012. This was performed by calculating the arithmetic mean of the number of inserted PEGs during the 3-year period 2009–2011 according to the Swedish Patient Registry for each hospital, and then summarised for all patients. Furthermore, we stratified all patients in 2012 by the use of antibiotic regimen, and in a similar way stratified each category of hospital. An additional categorisation of the hospitals into quintiles, based on the ranking of each hospital according to the estimated mean number of patients, was also conducted. The data management and the diagrams were conducted using the SAS (V.9.2; SAS Institute Inc, Cary, North Carolina, USA).

## RESULTS

There were 60 eligible hospitals in Sweden that inserted at least 5 PEGs/year. All these hospitals participated in the interviews (100% participation rate). A total of 17 (28%) hospitals did not routinely use any antibiotic prophylaxis, most being community hospitals (71%). The rates of implementation of the new regimen at all hospitals and at the three categories of hospitals are presented in [table 1](#). The total number of hospitals which had implemented the new regimen was 32 (53%); among hospitals using antibiotic prophylaxis, this rate was 32 out of 43 (74%). The new regimen was most frequently adopted in university hospitals (67%), while it was less commonly adopted in community hospitals (41%). Of all hospitals that had introduced the new regimen, 25 (78%) had adopted the new regimen within the year 2011. Reasons for having changed to the new regimen are presented in [table 1](#). The most common reason was having read the article published in *BMJ* (63%).

Translated to the number of patients, an annual total of 1813 (70%) of 2573 patients received the new regimen ([figure 1](#), [table 2](#)). Excluding hospitals not using antibiotic prophylaxis, the frequency using the new regimen was 79%. A higher annual hospital volume was associated with an increased adoption of the new regimen; the frequency of use of the new regimen was 31% in the lowest quintile of hospitals and 80% in the highest ([table 2](#)). The distribution of antibiotic prophylaxis according to the number of patients treated at the three categories of hospitals showed a higher frequency of the new regimen in university hospitals (84%), followed by county hospitals (71%) and community hospitals (45%; [figure 2](#)).

## DISCUSSION

This study shows that the new antibiotic prophylaxis, with a solution of sulfamethoxazole and trimethoprim given directly in the newly inserted PEG, had replaced standard prophylaxis with intravenously given antibiotics to a considerable extent in Sweden.

Methodological strengths of the study include the ability to identify all hospitals inserting PEGs in Sweden

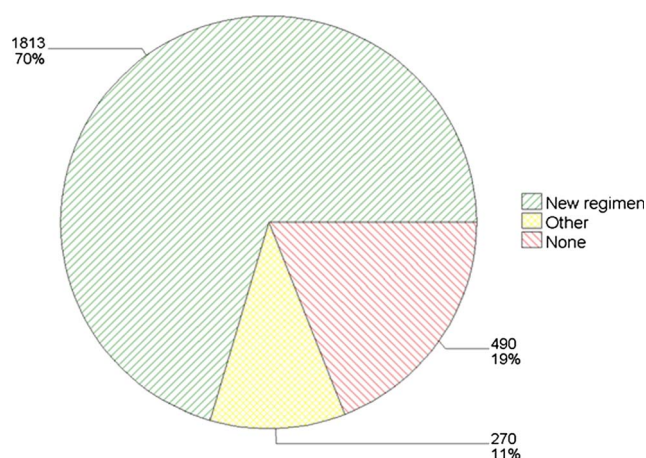
**Table 1** Use of antibiotic regimen as part of the insertion of percutaneous endoscopic gastrostomy in Sweden, presented as number of hospitals and hospitals divided by the three hospital categories community hospitals, county hospitals and university hospitals

	All hospitals (n=60)		Hospital category					
	Number	Per cent	Community (n=27)		County (n=24)		University (n=9)	
			Number	Per cent	Number	Per cent	Number	Per cent
Antibiotic prophylaxis regimen								
New*	32	53	11	41	15	63	6	67
Other†	11	18	4	15	5	21	2	22
None	17	28	12	44	4	17	1	11
Knowledge of the trial								
Yes	38	63	12	44	18	75	8	89
No	22	37	15	56	6	25	1	11
Hospitals using the new regimen								
Year of introduction								
2010	10	31	2	7	7	29	1	11
2011	15	47	4	15	7	29	4	44
2012	7	22	5	19	1	4	1	11
Reason for introduction								
Read the article	20	63	5	45	9	60	6	100
Scientific meeting	7	22	3	27	4	27	0	0
Colleague	4	13	2	18	2	13	0	0
Unknown	1	3	1	9	0	0	0	0

\*20 ml dose of oral solution of sulfamethoxazole and trimethoprim deposited in the PEG catheter immediately after insertion.

†Intravenously administered antibiotics before percutaneous endoscopic gastrostomy insertion.

through the Patient Registry, making it population-based in design and reducing the risk of selection bias. The 100% complete inclusion of all eligible hospitals further counteracted biased selection. Finally, the use of structured telephone interviews to collect the data should minimise the misclassification of the information collected. These advantages should provide high internal validity of the study.<sup>1</sup> The external validity, however, is



**Figure 1** Use of antibiotic regimen as part of the insertion of percutaneous endoscopic gastrostomy in Sweden, presented as number of patients. New regimen: 20 ml dose of oral solution of sulfamethoxazole and trimethoprim deposited in the percutaneous endoscopic gastrostomy (PEG) catheter immediately after insertion. Other regimen: intravenously administered antibiotics before PEG insertion.

uncertain since it is unknown whether the results in Sweden are representative of those of other countries. The trial being followed up was conducted in Sweden, which should facilitate its implementation in this country in particular, while the implementation in other countries might be more limited.

Scientific evidence suggests that enabling research findings to change clinical practice requires comprehensive approaches and effective strategies at different levels, tailored to specific settings and target groups.<sup>3-5</sup> The present study shows that it is possible to influence clinical practice based on a single randomised clinical trial if the results are convincing and easy to adopt in routine care. The implementation of the new regimen tested in the present study was facilitated by the fact that it had practical advantages and was cheaper to use compared with the standard regimen. In other trials, the tested treatment might often be more complex to use and more costly, which might make its introduction into routine clinical use less likely. For example, another implementation study of an endoscopic procedure was a large cohort study in the USA which showed that low rates of duodenal biopsy remained in more recent calendar periods in patients with clinical indications for biopsy to identify coeliac disease despite clinical recommendations to conduct such biopsies more frequently.<sup>10</sup>

University hospitals and PEG high-volume hospitals were clearly more likely to adopt the new regimen compared with smaller hospitals. This might be due to a higher academic interest and a higher interest in the PEG procedure, respectively, which might increase the

**Table 2** Use of antibiotic regimen as part of the insertion of percutaneous endoscopic gastrostomy in Sweden, presented as number of patients per year and hospital, divided in quintiles of hospital volume (12 hospitals in each quintile)

Antibiotic prophylaxis regimen	All (n=2573)		Quintile									
			1 (n=101)		2 (n=220)		3 (n=341)		4 (n=495)		5 (n=1417)	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
New*	1813	70	31	31	115	52	202	59	335	68	1130	80
Other†	270	11	20	20	60	27	114	33	77	15	0	0
None	490	19	50	49	45	20	25	7	83	17	287	20

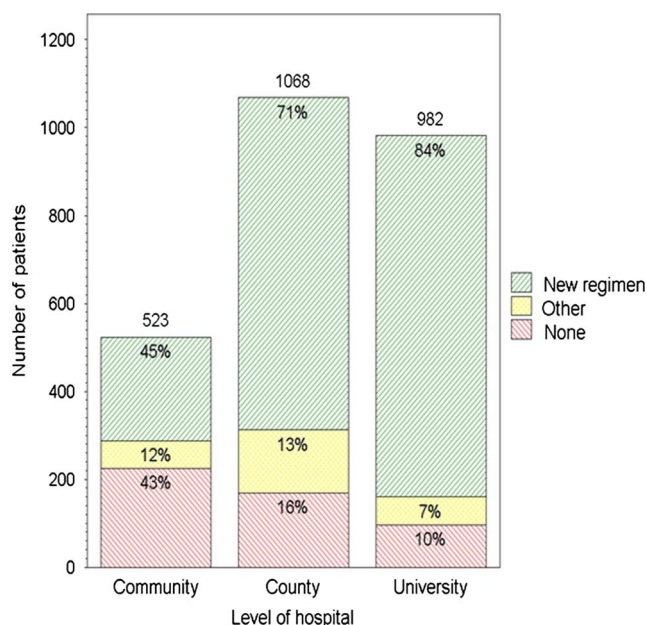
\*20 ml dose of oral solution of sulfamethoxazole and trimethoprim deposited in the PEG catheter immediately after insertion.

†Intravenously administered antibiotics before PEG insertion.

PEG, percutaneous endoscopic gastrostomy.

likelihood of reading scientific articles and willingness to adopt new treatments. The lack of use of any antibiotic prophylaxis was not negligible, which might not be entirely justified considering the amount of evidence showing a high risk of infectious complications,<sup>11</sup> and an absolute risk reduction of such complications by 14–17% with the use of antibiotic prophylaxis.<sup>7 8</sup>

Although it is pleasing to find such rapid and positive uptake of an innovation, any recommendation for uptake of this new practice should be made with caution since it is based on one clinical trial of 200 patients only. A systematic review, which incorporates multiple sources of evidence, might provide a stronger basis for changing clinical practice.



**Figure 2** Use of antibiotic regimen as part of the insertion of percutaneous endoscopic gastrostomy (PEG) in Sweden, presented as number of patients, and divided by the three hospital categories community hospitals, county hospitals and university hospitals. New regimen: 20 ml dose of oral solution of sulfamethoxazole and trimethoprim deposited in the PEG catheter immediately after insertion. Other: intravenously administered antibiotics before PEG insertion.

In conclusion, this nationwide complete Swedish survey provides encouraging evidence of a high (53% of all hospitals and 70% of all patients) and rapid clinical implementation of a new antibiotic prophylaxis regimen for PEG based on the results of one well-designed randomised clinical trial. The level of adoption of the new regimen was substantially higher in university hospitals and PEG high-volume hospitals compared with smaller hospitals. This should encourage further randomised clinical trials addressing clinically relevant topics.

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**Contributors** JL had the original idea to conduct this study. JL and PL planned the study and completed the data collection. FM did the analyses, tables and figures. JL made the first draft of the article, and PL and FM contributed with input on the article writing. JL is responsible for the overall content as guarantor. All authors have read and approved the final manuscript.

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**Competing interests** None.

**Ethics approval** The study was approved by the Regional Ethical Review Board in Stockholm, Sweden (diary number 2013/131-32).

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** Data sharing: full dataset and statistical code are available from the corresponding author at jesper.lagergren@ki.se.

**STROBE guidelines** We followed the recommendation of the STROBE guidelines for observational studies.

**REFERENCES**

1. Fan E, Laupacis A, Pronovost PJ, *et al.* How to use an article about quality improvement. *JAMA* 2010;304:2279–87.
2. Gilbody S, Whitty P, Grimshaw J, *et al.* Educational and organizational interventions to improve the management of depression in primary care: a systematic review. *JAMA* 2003;289:3145–51.
3. Althabe F, Buekens P, Bergel E, *et al.* A behavioral intervention to improve obstetrical care. *N Engl J Med* 2008;358:1929–40.
4. Bessen T, Clark R, Shakib S, *et al.* A multifaceted strategy for implementation of the Ottawa ankle rules in two emergency departments. *BMJ* 2009;339:b3056.
5. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *Lancet* 2003;362:1225–30.

6. Blomberg J, Lagergren P, Martin L, *et al.* Novel approach to antibiotic prophylaxis in percutaneous endoscopic gastrostomy (PEG): randomised controlled trial. *BMJ* 2010;341:c3115.
7. Lipp A, Lusardi G. Systemic antimicrobial prophylaxis for percutaneous endoscopic gastrostomy. *Cochrane Database Syst Rev (Online)* 2006;(4):CD005571.
8. Lipp A, Lusardi G. A systematic review of prophylactic antimicrobials in PEG placement. *J Clin Nurs* 2009;18:938–48.
9. Ludvigsson JF, Andersson E, Ekblom A, *et al.* External review and validation of the Swedish national inpatient register. *BMC Public Health* 2011;11:450.
10. Lebowitz B, Tennyson CA, Holub JL, *et al.* Sex and racial disparities in duodenal biopsy to evaluate for celiac disease. *Gastrointest Endosc* 2012;76:779–85.
11. Blomberg J, Lagergren J, Martin L, *et al.* Complications after percutaneous endoscopic gastrostomy in a prospective study. *Scand J Gastroenterol* 2012;47:737–42.

## **Study protocol**

Implementation of a new antibiotic prophylaxis for percutaneous endoscopic gastrostomy (PEG) in Sweden.

## **Background**

In year 2010 we published a randomised clinical trial in BMJ testing a new antibiotic prophylaxis regimen to prevent infectious complications after insertion of PEG. The study shows that new regimen could replace the standard intravenous treatment. A number of advantages with the new prophylaxis was a reason for us analysing the study as a non-inferiority study, i.e. if the new regimen was equally good as the existing one it would be preferable for other reasons. An oral solution of the antibiotic type Bactrim 20 ml directly injected into the stomach through the newly inserted PEG catheter could replace the previous standard prophylaxis with intravenously given Zinacef 1.5 g given 1 hour before the PEG was inserted. The results clearly show that the new regimen was at least as good as the standard regimen in the prevention of infectious complications. Advantages with the new regimen included it is cheaper price, easier to administer, fewer side effects, not given in vain whenever the PEG was not possible to insert (10% in the cases) and a better ecological pattern. We now want to assess whether this study had any clinical implications. Implementation studies are rare, but if research will actually lead to any changes in clinical practice, such studies should be conducted.

## **Aims**

Assess that clinical implementation of the new antibiotic regimen based on the randomised clinical trial published in BMJ. Specifically this aim will be reached by:

- 1/ Clarifying to what extent the new antibiotic regimen that was recommended in BMJ study had any clinical influence in Sweden.
- 2/ Clarifying the potential patterns between the characteristics of the hospitals, i.e. comparing university hospitals with county hospitals and community hospitals, as well as a comparing hospital volumes of PEG's inserted per year and how that might have influenced the introduction of a new antibiotic regimen.

## **Methods**

### *Data collection*

- 1/ All hospitals which have inserted at least 5 PEGs per year during the years 2009-2011 will be identified in the Swedish Patient Registry (about 60 hospitals). PEG has the procedure code JBB10..
- 2/ The responsible physician for PEG insertions at each hospital will be identified.
- 3/ A structured telephone interview will be held with the responsible physician for PEG insertions according to a written form.

### *Questionnaire, see attachment*

The structured interview will be tested by interviewing 3 clinically active physicians with knowledge in PEG.

## **Work plan**

We will conduct telephone interviews in February 2013. Statistical analysis February-March 2013. Manuscript writing March 2013.

**Collaborators**

Jesper Lagergren, Fredrik Mattsson and Pernilla Lagergren and an the research nurse (interviewer) Isabella Linder-Rosén.

**Reference**

Blomberg J, Lagergren P, Martin L, Mattsson F, Lagergren J. Novel approach to antibiotic prophylaxis in percutaneous endoscopic gastrostomy (PEG): randomised controlled trial. *BMJ (Clinical research ed)* 2010;341:c3115.

Bilaga (Attachment)

## Implementering av ny antibiotikaprofylax vid PEG i Sverige

Telefonintervju med PEG ansvarig

### BASINFORMATION

Sjukhusets namn	
Klinik	
PEG-ansvariges namn	
PEG-ansvariges titel	
Kontaktuppgifter/noteringar	
Sjukhustyp	<input type="checkbox"/> Universitetssjukhus <input type="checkbox"/> Länsjukhus <input type="checkbox"/> Länsdelssjukhus <input type="checkbox"/> Annat:
Intervjun gjordes med	<input type="checkbox"/> PEG-ansvarig läkare (se ovan uppgifter)  <input type="checkbox"/> Hänvisad till sekundärt ansvarig läkare: Namn: _____ Titel: _____  <input type="checkbox"/> Sjuksköterska vid endoskopienheten: Namn: _____ Titel: _____  <input type="checkbox"/> Annan: _____ Namn: _____ Titel: _____

#### Studieinformation till deltagare:

Vi genomför en studie för att undersöka hur regimen för antibiotikaprofylax ser ut i samband med PEG-läggning i Sverige. Jag undrar därför om det går bra att ställa några frågor till dig om hur det ser ut i din verksamhet.

Det är 8 frågor och intervjun tar ca X minuter.



# INTERVJUFRÅGOR

Datum för intervju	
1. Ungefär hur många PEG lade ni in under förra året (år 2012)? Svar:	
2. Använder ni som rutin antibiotikaproylax vid PEG? <input type="checkbox"/> JA <input type="checkbox"/> NEJ (gå till fråga 5)	
3. Vilken antibiotikaproylax används för närvarande i 1:a hand? <input type="checkbox"/> Cefalosporin intravenöst (t.ex. Zinacef) <input type="checkbox"/> Bactrim mixtur i PEG <input type="checkbox"/> Annan Namn: _____ Administreringsväg: <input type="checkbox"/> intravenöst <input type="checkbox"/> peroralt <input type="checkbox"/> via PEG	
4. Om Bactrim används enligt ovan a) Vilket år införde ni denna profylax? År: _____ b) Varför införde ni denna profylax? Svar:	
5. Känner du till en svensk randomiserad klinisk prövning som publicerades i British Medical Journal (BMJ) som visade att Bactrim givet direkt i den nyinlagda PEGen kan ersätta intravenös antibiotikaproylax? <input type="checkbox"/> JA <input type="checkbox"/> NEJ	
6. Får jag skicka dig ett särtryck av studien? <input type="checkbox"/> JA <input type="checkbox"/> NEJ	
Vilken adress:	
Är det något övrigt du vill tillägga eller kommentera?	

Stort tack för att du tog dig tid att besvara frågorna!