Guidelines for preventing healthcare-associated infections in primary and community care

Section 4 of 5 sections; each section is in an individual file
SECTION 4

Guidelines for preventing healthcare-associated infections during enteral feeding in primary and community care

Introduction

Once enteral feeding (EF) in hospital became common practice in the late 1980s, it was inevitable that those requiring prolonged feeding would continue this treatment at home. Enteral feeding is usually prescribed for patients in hospital requiring artificial nutrition support (ANS) for 7-10 days and long term feeding / home enteral tube feeding (HETF) may be considered for patients needing ANS for more that 30 days.\(^1\) HETF has expanded rapidly and by the end of 2000, 11,817 adult patients receiving HETF were registered with the British Artificial Nutrition Survey (BANS).\(^2\) Of these, 46.5% were over 70 years of age. Over 60% of the patients were receiving tube feeds because of disorders of the central nervous system, of which cerebral vascular accident accounted for 34%. It was reported that over half the adult patients and virtually all children starting home enteral feeding lived in their own home and 40% of adults lived in nursing homes.

Nutrition Support Teams (NST) are recommended to support patients receiving artificial nutrition.\(^2\) However, only 22% of NST stated that they were responsible for HETF and 47% stated that they were never responsible.\(^2\) In addition, only one third felt that they had sufficient time to train patients on HETF prior to discharge from hospital. It is therefore not surprising that enteral feeding places a growing workload on community healthcare personnel\(^3\) and an audit of patients on HETF highlighted a need for continuing support.\(^4\) Contamination of feeds is a key concern in HETF as it has been found that more than 30% of feeds in hospital and home are contaminated with a variety of microorganisms, largely due to the preparation or administration of feeds,\(^5\) and this has been linked to serious clinical infection.\(^6\)

These guidelines apply to adults and children and should be read in conjunction with the guidance on Standard Principles. These recommendations are broad principles of best practice and are not detailed procedural protocols. They need to be adapted and incorporated into local practice guidelines. The recommendations are divided into four distinct interventions:

1. Education of patients, their carers and healthcare personnel;
2. Preparation and storage of feeds;
3. Administration of feeds;
4. Care of insertion site and enteral feeding tube.

References

Systematic review process

Three sets of guidelines were identified as a result of the search for national and international guidelines. These were retrieved and appraised using the AGREE instrument. As all were written prior to 1995, they did not score highly in some areas and their contribution has been used as expert opinion only. (See Appendix EF1)

After appraisal, search questions were developed from advice received from focus groups, stakeholders and our specialist advisers (See Appendix EF2). The following systematic review questions were used:

1. Was one type of feeding system superior to others in terms of infection rates?
2. Did the administration of the feed contribute to infection?
3. Was it safe to reuse equipment used in the administration of feeds?
4. Were there any storage issues that contribute to infection?
5. Was the stoma site a source of infection?
6. Was there any cost effectiveness evidence relating to the above?
7. What were the training and education implications for staff and patients?

In setting up the search the following MeSH terms were used: cross infection; community acquired infection; infection control; food contamination; equipment contamination; enteral nutrition; nutritional support; gastrostomy; gastroenterostomy; jejunostomy. In addition the following thesaurus and free text terms were used: home nutrition; home artificial nutrition; PEG feed; tube feed; tube nutrition; gastric feed; gastric nutrition; enteral feed; enteric feed; nasoenteric; intragastric; post-pyloric; percutaneous; transpyloric; gastrojejunosotomy; gastroduodenostomy; duodenostomy.

These databases were searched from 1990: Medline, Cumulated Index of Nursing and Allied Health Literature (CINAHL), Embase, The Cochrane Library, National Electronic Library for Health, The NHS Centre for Reviews and Dissemination (CRD), The National Research Register, The Web of Science, The Institute of Health Technology, Health CD Database, Health Management Information, Consortium Database.

Search Results: 19369 articles were identified. These articles were initially sifted to determine if they related to infections associated with enteral feeding, were written in English, were primary research or were a systematic review or a meta-analysis, and appeared to inform one or more of the review questions. Following this first sift, 301 full text articles were retrieved. Using the same criteria as in the first sift, retrieved full-text articles were then re-sifted to select those for critical appraisal. A total of 66 full text articles were independently critically appraised by two appraisers. Consensus and grading was achieved through discussion. Following critical appraisal, 30 were accepted into the study (12 were rejected).

Evidence tables for accepted and rejected studies were generated and used to create summary reports, including evidence grades (Appendix EF3). The summary reports were used as the basis for guideline writing.

Guidelines were then drafted which described 15 recommendations within the below 4 intervention categories:
1. Education of patients, their carers and healthcare personnel;
2. Preparation and storage of feeds;
3. Administration of feeds;
4. Care of insertion site and enteral feeding tube.

Despite searching for infection prevention measures associated with nasogastric and jejunostomy feeding, most of the evidence related to gastrostomy or percutaneous endoscopic gastrostomies (PEG feeds). The guideline development group felt that the guidelines relating to feed preparation and storage related to all EF systems but that the administration and care of tubes should only relate to gastrostomies.

References
**Intervention 1  Education of patients, carers and healthcare personnel**

Although not a specific question for our systematic review, it has become evident from our research that the responsibility for preparing and administering HETF lies usually with the patient, their carers and in some cases, community healthcare personnel. An audit of the nursing knowledge of percutaneous endoscopic gastrostomy (PEG)\(^1\) of hospital nurses in a district general hospital identified gaps in their knowledge and management of enteral feeding systems and a similar situation was noted in the community.\(^2\) The BANS survey noted the less than optimum support people on HETF receive\(^3\) despite expert opinion stressing the need for education and training.\(^4,5\) Given that nutrition is a key Department of Health patient-focused benchmark for healthcare practitioners,\(^6\) it is of concern that support and preparation of the patient is not widely available.

A system known as Hazard Analysis and Critical Control Point (HACCP) is employed widely in the food industry to highlight areas where food safety may be at risk. The Parental & Enteral Nutrition Group of the British Dietetic Association supports the use of HACCP in enteral feeding to increase safety and as an educational tool.\(^7\)

**Recommendations**

1. **EF1.** Patients and carers must be educated about, and trained in the techniques of hand decontamination, enteral feeding and the management of the administration system before discharge from hospital.

2. **EF2.** Community staff should be trained in enteral feeding and management of the administration system.

3. **EF3.** Ongoing support of patients and carers should be available for the duration of HETF.

**References**

**Intervention 2 Preparation and storage of feeds**

**Select the right system**

Our systematic review identified two randomised controlled trials, which demonstrated that closed systems (i.e., sterile prefilled ready-to-use feeds) as available from all major manufacturers, have lower contamination rates than open systems (decanted or reconstituted feeds).\(^{(1,2)}\)

The design of the system is also important in order to minimise handling.\(^{(3-5)}\)

**Recommendations**

- **EF4.** Wherever possible use pre-packaged, ready-to-use feeds should be used in preference to feeds requiring decanting reconstitution or dilution.

- **EF5.** The system selected should require minimal handling to assemble and be compatible with the patient's enteral feeding tube.

**References**


**Hygienic preparation of feeds is essential**

Hand hygiene is critical and hand decontamination is discussed more fully in Standard Principles. The International Scientific Forum on Home Hygiene has also published comprehensive guidance on food preparation and cleanliness in the home.\(^{(1)}\) Our systematic review identified three studies\(^{(2-4)}\) concerned with feed preparation. The evidence on the use of gloves is contradictory. Two studies\(^{(2,3)}\) suggested that gloves were preferable and one suggested bare hands if properly decontaminated were acceptable.\(^{(6)}\) However all three studies linked contamination to the amount of manipulation a system required and reinforces the guidance above.

Standard principles stress the importance of hand decontamination and expert opinion\(^{(5-7)}\) stresses the need to prepare the work surface and, where necessary the equipment for reconstituting or diluting the feed. Equipment used for either opening sterile feeds or preparing feeds should be dedicated for enteral feeding use only. It should be cleaned in a dishwasher or washed with hot soapy water, rinsed and then dried and stored covered...
until required. Cooled boiled water or freshly opened sterile water should be used to prepare feeds in the home

Recommendations

EF6. Effective hand decontamination must be carried out before starting feed preparation.

EF7. When decanting, reconstituting or diluting feeds, a clean working area should be prepared and equipment dedicated for enteral feed use only should be used.

EF8. Feeds should be mixed using cooled boiled water or freshly opened sterile water and a no-touch technique.

References


Store feeds safely

Expert opinion(1) and manufacturers(2,3) advise that ready-to–hang feeds should be stored in a clean environment, protected from extremes of temperature. Stock should be rotated to avoid feeds exceeding their best before date.

Where feeds need to be reconstituted or diluted they can be made up for 24 hours. All feeds not required for immediate use must be stored in a refrigerator at a temperature not exceeding 4 degrees Celsius and discarded after 24 hours.(2,3)

Recommendations

EF9. Feeds should be stored correctly according to manufacturer’s instructions and where applicable food hygiene legislation.

EF10. Where ready-to-use feeds are not available, feeds may be prepared for up to a maximum of 24 hours and stored in a refrigerator.

References
Intervention 3  Administration of feeds

Minimal handling reduces risk
Four reports,\(^1\) - \(^4\) which studied enteral feeds delivered in a variety of settings, demonstrated that the risk of contamination is related to the manipulation of the system and the system design. This reinforces earlier guidance about selecting a system that requires minimal handling.

When assembling the system, first assess the condition of the connection. A no-touch technique should be used to connect the feed container to the administration set using the minimum number of connectors possible. Contact with the patient’s clothes should be avoided when attaching the administration set to the enteral feeding tube.\(^5\)

Administering feeds for the maximum time possible reduces handling to a minimum. Sterile ready-to-hang feeds can be left for a maximum time 24 hours and non-sterile (reconstituted) feeds for 4 hours.\(^5\),\(^6\) However even closed systems can become contaminated if hands are not adequately decontaminated.\(^3\)

Bacterial contamination has been associated with the re-use of feedbags and administration sets.\(^7\) One study in a long term care facility\(^2\) suggested that administration set changes could be left up to 72 hours but other studies\(^6\),\(^8\) - \(^10\) suggested that 24 hours is the maximum time acceptable. Three experimental, in vitro studies\(^11\) - \(^13\) considered the re-use of equipment but none identified a satisfactory system for disinfecting equipment that might be acceptable in practice. As evidence suggests re-use is not advisable, the administration system should be considered single use only and discarded after each session.

Currently there appears to be a debate on the re-use of single-use syringes used to flush enteral feeding tubes. Our systematic review found no evidence to either support or refute the reuse of syringes. The Medical Device Agency’s current guidance is that items labelled single use must not be reused under any circumstances and the reuse of such items has legal implications.\(^14\)

Recommendations

\begin{itemize}
\item EF11. Minimal handling and an aseptic no-touch technique should be used to connect the administration system to the enteral feeding tube.
\item EF12. Ready-to-use feeds can be given for a whole administration session up to a maximum of 24 hours if sterile and 4 hours if non-sterile.
\item EF13. Administration sets and feed container are for single use and must be discarded after each feeding session.
\end{itemize}

References


Intervention 4  Care of insertion site and enteral feeding tube

Keep the tube clear
Our systematic review searched for evidence regarding the stoma site as a source of infection. Although some evidence related to infection immediately after insertion of the first tube, we have found no evidence relating to infections in a healed stoma.\(^{(1,2)}\) However, after the stoma site has healed, usually 10-12 days after placement, no dressings are necessary. Instead the site should be inspected and cleaned daily, and dried thoroughly. The tube should be rotated 360 degrees regularly to avoid infections related to ‘buried bumper syndrome.’\(^{(3)}\)

To help minimise the potential risk of microbial colonisation of the internal and external surfaces of enteral feeding tubes, expert opinion suggests that the tube should be flushed with either cooled boiled water or freshly opened sterile water before and after each change of feed, aspiration or drug administration.\(^{(4-7)}\)

Recommendations

**EF14.** The stoma should be washed daily with water and dry thoroughly.

**EF15.** To prevent blockage, the enteral feeding tube should be flushed before and after feeding and/or administrating medication with either cooled boiled water or freshly opened sterile water.

References

Areas for Further Research

In developing the recommendations we identified several areas that were inadequately addressed in the literature. The following recommendations for research are therefore made.

Although comprehensive data is available on the use of HETF in the United Kingdom, very little information is documented about enteral feeding practices. Anecdotal reports suggest a wide variation in practice that may or may not be safe. The use of risk assessment, including HACCP has been reported as a means of reducing risks but little is known about healthcare personnel’s knowledge and use of risk assessment tools.

Descriptive studies of enteral feeding practices in a range of primary care trusts. This should include healthcare personnel, patients and carers, their preparation to undertake enteral feeding and ongoing support, availability and use of equipment. Data should also be collected on the incidence of stoma site infections.

A qualitative study of healthcare practitioners’ understanding and use of risk assessment in practice. Ideally this should be a series of interviews with a range of healthcare personnel about their knowledge of risk assessment and the tools they use. This could be applied to other areas where risk assessment is used.

Randomised control trials to assess the effectiveness of HACCP in reducing the incidence of enteral feeding related infection. These should focus on HETF in a variety of settings and involving a range of patients and healthcare personnel.

Intervention 2: Preparation and storage of feeds

Epidemiological studies of the incidence of clinical infection associated with reconstituting enteral feeds for different populations and in different care settings. These should at least encompass the predominant populations - older people and those with neurological deficits in both institutional and domiciliary settings and children. There needs to be clear definition of the ‘cases’ and the populations from which they are drawn.

Intervention 3: Administration of feeds

Randomised controlled trials of single use, single patient use and reusable syringes. Outcome measures need to include rates of clinical infection, patient/carer satisfaction and cost effectiveness.

Randomised controlled trial comparing the use of cooled boiled water versus sterile water to flush enteral feeding tubes. Outcome measures need to include rates of clinical infection; patient/carer satisfaction, and cost effectiveness.
## Key Audit Criteria

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<th>Aim</th>
<th>Criteria</th>
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<tr>
<td>Identify all patients undergoing HETF are linked to a Nutrition Support Team or community specialist for ongoing support.</td>
<td>All patients should have a patient record that documents their contact person for ongoing support.</td>
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<td>Standard 100%</td>
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<td>Data collection: Review of patient notes</td>
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<td>Ensure that all healthcare personnel are trained and competent in administration of HETF.</td>
<td>All healthcare personnel involved in care are trained, updated and have their competence assessed annually.</td>
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<td>Data collection: Review of staff education records</td>
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<tr>
<td>To prevent infections associated with the administration of HETF.</td>
<td>All healthcare personnel must decontaminate their hands before manipulation of the system.</td>
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<td>Data collection: Observation/self audit, incidence of HETF related infection.</td>
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<tr>
<td>To prevent infections associated with the administration of HETF by maintaining a closed system.</td>
<td>Ready-to-hang feeds should be used wherever possible and hung for the maximum time</td>
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<td>Data collection: Observation/patient records, incidence of HETF related infection.</td>
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<tr>
<td>To prevent infections associated with the administration of HETF caused by blocking.</td>
<td>All patients should have a patient record that documents the care of their enteral tube, including flushing regimen</td>
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<tr>
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<td>Standard 100%</td>
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<td>To ensure patients and carers are informed and educated about HETF.</td>
<td>All patients and carers are aware of the need to:</td>
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<tr>
<td></td>
<td>• Decontaminate their hands;</td>
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<td>• Keep the system closed;</td>
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<td>• Seek professional help when they suspect clinical infection.</td>
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### Glossary

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<tr>
<td>Enteral feeding</td>
<td>Feeding via a tube that can include any method of providing nutrition via the gastrointestinal tract.</td>
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<tr>
<td>HACCP</td>
<td>Hazard analysis and critical control point. A system to identify potential hazards in food preparation.</td>
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<td>Buried bumper syndrome</td>
<td>A complication of PEG tubes where the internal disc becomes buried in the stomach lining.</td>
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<tr>
<td>Closed System</td>
<td>Sterile, pre-filled ready-to-use feeds.</td>
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<tr>
<td>No touch technique</td>
<td>Avoiding direct contact of the hand with feed ingredients.</td>
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<tr>
<td>Hang time</td>
<td>The total time during which the feed is held in the nutrient container at room temperature while being administered. <strong>This includes periods of time when administration of the feed is interrupted temporarily.</strong></td>
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<tr>
<td>Open System</td>
<td>Feeds that need to be reconstituted, diluted and/or decanted into a feed container.</td>
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<tr>
<td>Single use</td>
<td>For use on one occasion only.</td>
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# APPENDIX EF1 – AGREE SCORES

**AGREE Monitoring Appraisal Form** (Enteral and Parenteral Nutrition in the Community – British Association for Parenteral and Enteral Nutrition. Nov 1994)

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**Domain Scores**

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### AGREE Monitoring Appraisal Form (Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. ASPEN 1993)

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### Domain Scores

**Domain 1**
- Maximum possible score = 4 x 3 x 1 = 12
- Standardised domain score is: (10/12) x 100 = **83%**

**Domain 4**
- Maximum possible score = 4 x 4 x 1 = 16
- Standardised domain score is: (12/16) x 100 = **75%**

**Domain 2**
- Maximum possible score = 4 x 4 x 1 = 16
- Standardised domain score is: (8/16) x 100 = **50%**

**Domain 5**
- Maximum possible score = 4 x 3 x 1 = 12
- Standardised domain score is: (3/12) x 100 = **25%**

**Domain 3**
- Maximum possible score = 4 x 7 x 1 = 28
- Standardised domain score is: (14/28) x 100 = **50%**

**Domain 6**
- Maximum possible score = 4 x 2 x 1 = 8
- Standardised domain score is: (3/8) x 100 = **38%**

| Domain | Item 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | Total |
|--------|--------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|     |
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| Appraiser 2 | 3 | 1 | 2 | 6 | 1 | 1 | 1 | 1 | 4 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 8 | 3 | 3 | 3 | 2 | 11 | 1 | 1 | 1 | 3 | 1 | 1 | 2 (34) |
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**Domain Scores**

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<td>Domain 2</td>
<td>4 x 4 x 2 = 32</td>
<td>(9/32) x 100 = <strong>28%</strong></td>
</tr>
<tr>
<td>Domain 3</td>
<td>4 x 7 x 2 = 56</td>
<td>(17/56) x 100 = <strong>30%</strong></td>
</tr>
<tr>
<td>Domain 4</td>
<td>4 x 4 x 2 = 32</td>
<td>(20/32) x 100 = <strong>63%</strong></td>
</tr>
<tr>
<td>Domain 5</td>
<td>4 x 3 x 2 = 24</td>
<td>(6/24) x 100 = <strong>25%</strong></td>
</tr>
<tr>
<td>Domain 6</td>
<td>4 x 2 x 2 = 16</td>
<td>(4/16) x 100 = <strong>25%</strong></td>
</tr>
</tbody>
</table>
APPENDIX EF2: Enteral Feeding - Systematic Review Process

The Systematic Review Process

Systematic Review Questions
Review questions are devised based on the scope of the review and advice from the Guideline Development Group, stakeholders and professional bodies.

1. Was one type of feeding system superior to others in terms of infection rates?
2. Did the administration of the feed contribute to infection?
3. Was it safe to reuse equipment used in the administration of feeds?
4. Were there any storage issues that contribute to infection?
5. Was the stoma site a source of infection?
6. Was there any cost effectiveness evidence relating to the above?
7. What were the training and education implications for staff and patients?

Literature Search
Databases to be searched are determined together with search strategy, i.e., relevant medical subject headings (MESH), free text and thesaurus terms.

MESH TERMS
infection control; cross infection; community-acquired infections; food contamination; equipment contamination; enteral nutrition, nutritional support, gastrostomy, gastroenterostomy, jejunostomy.

THESAURUS & FREE TEXT TERMS
PEG feed; tube feed; tube nutrition; gastric feed; gastric nutrition; enteral feed; enteral nutrition; nasoenteric feed or nutrition; intragastric feed or nutrition; post pyloric feed or nutrition; percutaneous feed or nutrition; transpyloric feed or nutrition; gastrojejunostomy; gastroduodenostomy; duodenostomy.

Exclusions: letters
Sift 1

Abstracts of all articles retrieved from the search are reviewed against pre-determined inclusion / exclusion criteria.

SEARCH results: 19639

Sift 2

Full text of all articles meeting inclusion criteria are reviewed against pre-determined criteria to identify primary research which answers review questions.

Articles retrieved: 301

Critical Appraisal

All articles which describe primary research, a systematic review or, a meta-analysis are independently critically appraised by two appraisers. Consensus and grading is achieved through discussion in the context of pre-determined grading criteria.

Articles appraised

Evidence Tables

Evidence tables for accepted and rejected studies were generated and used to create evidence summary reports. The summary reports were, in turn, used as the basis for guideline writing.

See PEG appendix 3
## APPENDIX EF3 – Enteral Feeding Evidence Tables

### EF Accepted Studies

<table>
<thead>
<tr>
<th>ID</th>
<th>Quest. Number</th>
<th>Author, Date, Country of Origin and Objective</th>
<th>Design, Setting, Sample Size and Population</th>
<th>Outcomes</th>
<th>Strengths and Limitations</th>
</tr>
</thead>
</table>
| P1 | 1             | Dentinger B, Faucher KJ, Ostrom SM et al. 1995. USA. Assess the contamination in a closed system of enteral feeding over 36 hours. | Design: Experimental Laboratory Study  
Setting: Care Centre  
Sample: 211 containers were used to simulate continuous enteral feeding for 36 hours. Pop*: In-patients of care facility. | Of the 211 samples, 18 had one cfu and one had 137 cfu. That is 19 (9%) had some contamination. No feeding bottles had separation or coagulation (not defined) immediately or one week after the study indicating they had no contamination. It appears from the data presented here that microbiological contamination does not enter from the formula, closed system or administration set. | Patients were not actually fed; the level of contamination is extremely likely to be an underestimate of the level observed when patients are fed. A higher protocol standard than normal regarding handling was used. Study supported by industry. |
| P2 | 1             | Beattie TK and Anderton A. 1998. UK. To compare the risks of introducing microbial contamination when assembling and running two commonly used, ready-to-hang, enteral feeding systems with a newly introduced feeding system. Nutrition glass bottles and steriflo vs nutrition pack. | Design: Experimental Laboratory Study  
Setting: Laboratory  
Sample: 7 experimental protocols reported 5 times per protocol. NB sampling variable for each protocol. Total samples=90 (5x11) + baseline:-7x5. Pop*: Laboratory Study | Results indicate sterilisation of a sealed system (steriflo), prior to assembly or during further manipulation, reduces microbiological contamination. Disinfection of a non-sealed system of nutrition glass bottles does not prevent contamination when faulty handling occurs. | Lack of standardisation between the 7 protocols in terms of interventions and numbers of samples makes comparison difficult. No details of control. |

To compare four enteral feeding systems in terms of their ability to limit the chance of introducing microbial contamination during the set up of the systems: nutriset bag, nutriset container, nutriset crown cork bottle and nutriset steriflo.

| Design: | Experimental |
| Setting: | 2 hospitals (ICU) and 2 simulated ward conditions |
| Sample: | 48 cultures |
| Pop*: | Not stated |

NB “>” indicates the system(s) on the left of the sign had higher levels of counts – which is worse - than the system(s) to the right of the sign.

1: samples with cfus just after setting up time (0 hrs), no significant diff between systems (although there were difference observed in cfus: Bag>all other methods)

2: a) samples with different levels of counts after 6 hrs (crown cork) 12 hrs (all other systems): no significant differences between systems at 100cfu/ml level
   b) looking at the systems with ANY cfus (vs. NO cfus): Bag> crown cork, container>Steriflo significant at 5%

3: number of bags with no counts after incubation for 72hrs: Bag>Crown cork, container, Steriflo significant at 5%

Steriflo system emerged as safest in this study.

BUT NOTE:
1: no feed samples reached 100cfu/ml during the times they were recommended for ward use (6hr for crown cork; 12 hrs for all others)
2: the significant differences between systems were measuring absence of counts, NOT the British Dietetic Standards of 100cfu/ml

The main issue in the interpretation of this paper is whether total absence of cfus is important (in which case Steriflo is the best) or whether the BDA standard should be used, in which case, there is no significant difference between systems. Patients do not appear to have been involved.
<table>
<thead>
<tr>
<th>P7</th>
<th>1</th>
<th>Wagner DR, Elmore MF, Knoll DM. 1994. USA.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>To quantify: factors associated with the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>use of three different feeding-delivery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>systems for peptide-based diets, sterile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>closed, open system-can, open system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>powder:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• preparation time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• total formula waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• bacterial contamination</td>
</tr>
</tbody>
</table>

| Design: | Random Controlled Trial |
| Setting: | Two critical care units in a community hospital |
| Sample: | Samples: 87 closed system (CS), 72 open system can (OS-Can), 60 open system powder (OS-powder). |
| Pop*: | Critical care patients requiring enteral feeding |

1: initial contamination: No contamination in any CS, compared with 22 (30%) of OS-Can and (60) 100% of OS powder, with ANY growth (differences between OS-Can and OS-Powder significant) p<0.001.  
2: initial contamination: No high contamination (defined as >10,000cfu/ml) in any CS, compared with 4(5%) in OS-Can and 24(40%) in OS Powder (differences between OS-Can and OS-Powder significant) p<0.001.  
3: final contamination: 5 (6%) of CS, 58 (80%) of OS-Can and 60 (100%) of OS powder had any growth at the end of delivery (difference between CS and other two systems significant) p<0.001.  
4: final contamination (high) 2 (2%) CS had high contamination compared with (60%) OS-Can and 50 (83%) OS Powder (all differences significant) 43 (p<0.001).

The BDA standard of 100 cfu/ml is not used or reported so it is not possible to compare the results with other similar studies. Inadequate information given about potentially confounding factors.

|----|----|-----------------------------------------------|
|    |    | Compare open and closed systems in two long-term care facilities (each with two units) on the following:  
|    |    | a) Bacterial contamination  
|    |    | b) Diarrhoea |

| Design: | Randomised Crossover Experiment |
| Setting: | 4 chronic care units in two long-term care facilities |
| Sample: | 36. Facility A-13, B-23 |
| Pop*: | People with brain injury |

Bacterial contamination: Overall, with the 72 samples:  
no growth at all in 20 (56%) of closed systems compared with only 1 (3%) of open systems no significant level reported.  
High contamination (greater than 10,000 cfu/ml) found in 78% open samples compared with 39% from closed system (p<0.05)  
Coliform found in 5.6% of closed system compared with 28% open system (significant at p<0.05)  
BUT: there were no significant differences in facility A compared with very highly significant differences in facility B between the two systems.

The study is, perhaps, a little small in size, but appears well-conducted with major sources of confounding identified or removed.
### P9 1
Vanek VW. 2000. USA.

To review the compliance rate with maximum enteral feeding hang-time policy for open vs. closed systems and to determine the incidence of tube feeding contamination.

<table>
<thead>
<tr>
<th>Design</th>
<th>Setting</th>
<th>Sample</th>
<th>Pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive</td>
<td>One hospital site many different units</td>
<td>138 (69M, 69F)</td>
<td>In-patients requiring enteral feeding</td>
</tr>
</tbody>
</table>

67% compliance for open delivery system. 10 closed systems hung for 20.8 – 45.8 hours sterile. 8 open systems hung for 6.8 – 26.6 hours. Compliance with hang times 67% open 88% closed. 2 contaminated. Recommend closed systems whenever possible.

Many different sites within the hospital but all patients included.

### P12 1 & 2
Lee CH, Hodgkiss IJ. 1999. Hong Kong.

To compare two commercially available enteral feeding systems IsoSource Closed system (Novartis), and Compat Pumpset (Novartis) and the effect on the level of contamination when subjected to different handling procedures.

<table>
<thead>
<tr>
<th>Design</th>
<th>Setting</th>
<th>Sample</th>
<th>Pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Laboratory</td>
<td>2 experimental protocol repeated 3 times per protocol. Total sample = 24 (3x6) + (baseline x 6)</td>
<td>Laboratory Study</td>
</tr>
</tbody>
</table>

Suggests a complete ready assembled system is best to reduce risk of contamination and wearing of gloves.

No bacterial contamination with sterile gloves even when manipulation faulty

Bare hand contamination noted at 4 hours and rising

Contaminated hands contamination noted at 4 hours at a higher level than bare hands

No differences between the 2 systems “to resist bacterial challenge”.

No contamination was detected when clean non-sterile gloves were used but study showed it was possible to deliver a sterile feed even when using bare hands. Conclusion is that the level of contamination is related to the degree of manipulation of the system.

No details of control.
### P13

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>To determine whether more prolonged intervals between bag and tubing changes adversely affected patient health.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Design:</strong></th>
<th>Randomised Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setting:</strong></td>
<td>417 bed long-term care facility</td>
</tr>
<tr>
<td><strong>Sample:</strong></td>
<td>11 patients for the first study period and 12 for the second.</td>
</tr>
<tr>
<td><strong>Pop:</strong></td>
<td>Elderly, clinically stable and suffering neurological disease.</td>
</tr>
</tbody>
</table>

No significant differences in morbidity when 24 hour tube changes compared with 72 hours. The results indicate that it may not be necessary to change tubing and bags every 24 hours and that they could be left for 72 hours without increased infection.

A range of feeding access was used, including nasogastric which may have had some bearing on the result.

2 study periods, data collection and definition. Consistent sampling frame known. Randomisation method satisfactory and explicit.

### P15

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>To compare the levels and types of micro-organisms present in residual feed in nutritional containers and giving sets when either 500mls or 1000 mls pre-filled, ready-to-hang nutritional containers were used to administer 1-2 litre quantities of feed to patients on hospital wards over 24 hours using a single giving set over this period.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Design:</strong></th>
<th>Randomised Controlled Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setting:</strong></td>
<td>Urban hospital</td>
</tr>
<tr>
<td><strong>Sample:</strong></td>
<td>42 (gender not stated)</td>
</tr>
<tr>
<td><strong>Pop:</strong></td>
<td>In-patients requiring enteral feeds.</td>
</tr>
</tbody>
</table>

Number of days feeds contaminated: 3/30 (10%) 500ml 2/30 (7%) 1000ml

Most frequently and heavily contaminated from distal end.

The results indicate that the more frequently the bags are changed the more likely it is that the feed will become infected.

No information on patients’ underlying conditions.
To examine the effects of improvements in the enteral feeding protocol, coupled with an intensive staff training programme on bacterial contamination. | **Design:** Descriptive Study  
**Setting:** Urban Hospital/Some patients’ homes  
**Sample:** 21 children (gender not stated)  
**Pop:*** All patients receiving Nutrison paediatric standard as an enteral feed. | **In patients:** using the new protocol only 3/77 (4%) of samples were contaminated at the end of the administration period as compared with 28 (45%) using the old protocol.  
*p*<0.001  
**Home patients:** 2/36 (6%) samples contaminated compared with 8 (28%) at the start and 18 (62%) at the end under previous protocol.  
*p*<0.001.  
New protocol involved priming the feeding on an alcohol treated metal tray, spraying the bottle opener and top with 70% alcohol wearing sterile non-disposable gloves and filling the feeding reservoir with feed for up to 24 hours use rather than 4 hours. |
| --- | --- | --- | --- |
| P17 | 2 | Rupp MM, Weseman R, Nedra M et al. 1999. USA.  
To determine whether prolonged infusion of a sterile, closed system, non-air dependent enteral feeding solution was associated with bacterial contamination or nosocomial infection. | **Design:** Descriptive study  
**Setting:** Urban hospital  
**Sample:** 15(7M, 8F)  
**Pop:** Patients who underwent liver transplantation | 5 patients had 8 nosocomial infections, none associated with feeds.  
Mean infusion time 22.7 hours. None contaminated.  
Concludes that when properly handled, non-air dependent, sterile, closed system enteral feeds can be safely administered with hang times of 24 hours. |

No patient details given.  
Small sample.  
Cannot identify which changes to the protocol are the most important.
| P19 | 2 | Patchell CJ, Anderton A, MacDonald A, George I et al. 1994. UK. | **Design:** Randomised Trial  
**Setting:** One Urban Hospital in-patients compared with home patients  
**Sample:** 35 children (21M, 14F)  
**Pop:** Children 1-5 years or weighing 8-20 Kg receiving at least 50% energy needs via enteral feeding. | **Inpatients:** Although no contamination of the modular feeds was detected immediately after mixing 14% had evidence of contamination by the start of administration, which had increased to nearly 50% by the end (p<0.001). Despite less contamination at the start (2%) the ready-to-use feeds were equally contaminated as the modular feed at the end of the administration.  
**Home patients:** As in hospital the modular feeds were significantly more contaminated at the start of administration with over 75% of feeds contaminated compared with 28% of ready to use feeds. This significant difference was maintained by the end of administration when all modular feeds were contaminated compared with nearly two thirds of ready-to-use feeds (p<0.01).  
The study highlights the importance of hygiene training for parents and the desirability of a ready-to-use formula. | Research on home patients using PEGs however, no information is given about the diseases the children are suffering from. |
|---|---|---|---|---|---|
| P20 | 2 | Anderton A and Aidoo KE. 1991. UK. | **Design:** Experimental  
**Setting:** Laboratory  
**Sample:** 40 (gender not stated)  
**Pop:** Volunteers with uninfected and undamaged skin. | No feed contamination from subjects wearing sterile gloves, and only <1 cfu per plate when the volunteers wore non-sterile gloves, compared with 54 cfu/ml when no gloves used. | Needs to be repeated in a clinical setting. |
To investigate the levels of contamination in four currently used 1000mL, 'ready-to-hang' enteral feeding systems Osmolite (Ross Ready-to-Hang), Steriflo, Dripac-flex and Easybag when faulty procedures were used during assembly of the systems.

**Design:** Experimental

**Setting:** Laboratory

**Sample:** 65 samples (5x4x3) + 5 catheters.

**Pop**: Laboratory Study

Contamination. 87% Osmolite, 27% Dripac, 80% Steriflo, 13% Easybag (p<0.05). 13% had >10^4 cfu/ml.

‘Closed’ systems do become contaminated, especially when manufacturers instructions are not followed.

To evaluate the effectiveness of a representative range of currently used cleaning procedures in removing bacteria from the lumina of the tubes.

**Design:** Experimental

**Setting:** Laboratory

**Sample:** In vitro study (3 systems, 5 cleaning methods, each duplicated)

**Pop**: Laboratory Study

The only effective cleaning method was a complicated procedure involving hypochlorite, unlikely to be followed completely in practice. Reuse is not advised.

Not explicitly stated whether all 3 types of catheter were subjected to all 5 cleaning regimens.

To assess the microbiological colonization of the Ross Hide-A-Port extension tubes challenged with 4 separate organisms S. epiudermis, Entereobacter aerogenes, Candida Albicans and Acinetobacter.

**Design:** Experimental

**Setting:** Laboratory

**Sample:** 132 tubes

**Pop**: Laboratory Study

At 18 days:- Water alone ineffective in eliminating organisms. Soap and water did not prevent adherence of bacteria and yeast though better than water alone and reduced Candida to <10^3. Use of ammonia sanitizer significantly reduced organisms.

Lab study, use of sanitizer needs to be demonstrated in clinical practice.
| P25 | 2 | Kohn CL. 1991. USA.  
To determine whether formula contamination increased when delivery sets were used for 24 hours in the clinical settings and for an additional 48 hours in the laboratory. | **Design:** Descriptive study  
**Setting:** Urban hospital and Laboratory  
**Sample:** 21 (10M, 11F)  
**Pop**: Patients requiring continuous, full strength Osmolite feeds in a pump. | Of 21 delivery sets 23.8% unacceptably contaminated at 24 hours and by 48 hours 42.9% unacceptable.  
Suggests if use $10^5$ cfu/ml, giving sets should not be used for more than 24 hours, due to the amount of contamination. Therefore the cost effective advantage of prolonged use is not met. | No universal definition of unacceptable contamination.  
This study used $10^5$ cfu/ml. |
| P30 | 5 | Sturgis TM, Yancy W, Cole JC et al. 1996. USA.  
To determine whether prophylactic antibiotic treatment with Cefazolin reduces the incidence of peristomal infection after percutaneous gastrostomy. | **Design:** Randomised Controlled Trials  
**Setting:** Hospital and follow-up nursing home  
**Sample:** 115 patients, 30 Cefazolin, 31 placebo and 54 already on antibiotics.  
**Pop**: Patients referred for PEG. | Wound infections:-  
4/30 (13%) cefazolin  
Placebo 6/31 (19%)  
2/54 (3%) on antibiotics  
58% infections occurred 72 hours after insertion.  
A single dose of Cefazolin does not reduce the overall peristomal wound infection in percutaneous endoscopic infection. Patients receiving prior extended antibiotic therapy have fewer peristomal wound infections. | Wound evaluation on patients discharged were by telephone though seen by an investigator if an infection was thought to be developing. |
| P32 | 5 | Kozarek RA, Payne M, Barkin J et al. 1995. USA.  
A prospective multicentre trial to establish the use, ease of insertion and short and long term safety profile of the One-step button gastrostomy | **Design:** Descriptive Study  
**Setting:** 5 urban hospitals  
**Sample:** 86 (gender not stated)  
**Pop**: Patients with CVA, neurological problems, Cancer, including head and neck | Peristomal infection before 1 week: 7, after 4 weeks: 4.  
Suggests the theoretical advantages on one-step gastrostomies are outweighed by placement problems and subsequent complications and suggests further work is needed  
Follow up longer than usually reported, mean 1.5 months range 2-180 days | Study largely about insertion but contains important infection data. |
<table>
<thead>
<tr>
<th>P74</th>
<th>Duncan HD, Bray MJ, Kapadia SA et al. 1996, UK.</th>
<th>To determine if UK size is important in affecting the complications of PEGs, i.e. infection and leakage.</th>
<th>Design: Randomised Uncontrolled Trial</th>
<th>Setting: Urban district general hospital</th>
<th>Sample: 52 (18M, 34F)</th>
<th>Pop*: Patients referred for PEGs.</th>
<th>No significant differences in the number of PEG site infections between the 12 and 20 FG groups, suggesting that the larger 20 FG offers no advantage over the 12 FG tube apart from its ease of insertion. 12 FG–Minor peristomal infection 5, serious 3. 20 FG–Minor peristomal infection 6, serious 6.</th>
<th>21 deaths during follow-up though no significant difference between tubes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P75</td>
<td>Van den Hazel S, Mulder C and Den Hartog G et al. 2000, Netherlands.</td>
<td>A randomized controlled trial to compare two PEG catheters which were similar in design, but one was made of polyurethane and the other of silicone. These catheters were compared with regard to PEG-related complications and PEG survival.</td>
<td>Design: Randomised Trial</td>
<td>Setting: Hospital</td>
<td>Sample: 106 (gender not stated)</td>
<td>Pop*: All patients requiring PEG catheters.</td>
<td>During the first four weeks of follow-up, major complications occurred twice with both polyurethane and silicone PEGs (relative risk 3.8, 95% confidence interval: 1.37-10.5). Long-term follow-up was available in 96 patients. Seven polyurethane PEGs and 10 silicone PEGs were removed because of PEG malfunctioning, the remainder functioned well until death or the reinstitution of oral feeding. The median complication-free survival was 916 days for the polyurethane PEG and 354 days for the silicone PEG (Log rank test: P=0.24).</td>
<td>No analysis is done about whether the different surgeons have different rates of infection. The mean period for PEG placement was considerably less for the polyurethane PEG than for the silicone PEG.</td>
</tr>
<tr>
<td>Page</td>
<td>Reference</td>
<td>Design:</td>
<td>Setting:</td>
<td>Sample:</td>
<td>Pop:</td>
<td>Notes</td>
<td></td>
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<tr>
<td>P77 2</td>
<td>Anderton A and Aidoo KE. 1990. UK.</td>
<td>Experimental</td>
<td>Laboratory</td>
<td>160 (80 feed containers disinfected, 80 not disinfected)</td>
<td>Laboratory Study</td>
<td>When using non-disinfected containers and the feed decanted wearing sterile gloves and using disinfected bottle openers or scissors no contamination was detected in samples from crown cap or screw cap bottles, but the feed from the cans (3/12 – 4 hours, 12/20 – 2 hours) and the tetrapaks (6/20 – 24 hours) were contaminated by organisms from their surfaces. More samples from cans were contaminated. The main source of contamination seemed to come from the experimenter’s hands and counts up to 10^2 cfu/ml were recorded for feeds that had been decanted from screw-cap bottles, tetrapaks and cans by experimenters with either unprotected bare hands or experimentally contaminated hands.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P78 2 &amp; 4</td>
<td>Fagerman KE. 1992. USA.</td>
<td>Descriptive Study</td>
<td>Hospital A – 500 bed tertiary care facility. Hospital B – 100 primary care referring hospital.</td>
<td>Incomplete information. Hosp A – 6000 feeds.</td>
<td>No details given.</td>
<td>ENS samples were either contamination free or within acceptable limits after modifications to protocols in both hospitals. Improved sanitation in preparation has greatest improvement in reducing bacterial levels. Q4: Use of Potassium Sorbate as a preservative was effective in maintaining feeds sterile at 12 hours in room temperature.</td>
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</tbody>
</table>

An experimental setting.

This is really 2 studies reported in one paper.
P80 1 McKinlay J, Wildgoose A, Wood W et al. 2001. UK.
To investigate the effect that recent changes in system design may have in reducing the risk of contamination when administering Nutricia, Ross and Abbott feeds

<table>
<thead>
<tr>
<th>Design:</th>
<th>Randomised Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting:</td>
<td>Urban Hospital</td>
</tr>
<tr>
<td>Sample:</td>
<td>85 (gender not stated)</td>
</tr>
<tr>
<td>Pop*: In-patients requiring enteral feeds</td>
<td></td>
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</tbody>
</table>

Contamination found in 14/120 (12%) Nutrison packs compared with 25/120 (21%) Ross (p<0.05). On 19 occasions similar organisms were isolated from both the feed and patient specimens. Most frequently and heavily contaminated specimens were collected from the distal end of giving set. Retrograde spread of the patient’s own flora is a source of contamination and samples from a distal end may reflect endogenous rather than exogenous contamination. System design is important re contamination.

A useful clinical study
Randomisation not blinded

To evaluate the risk of contamination of enteral feeding systems in children fed at home via gastrostomy

<table>
<thead>
<tr>
<th>Design:</th>
<th>Descriptive Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting:</td>
<td>Homes</td>
</tr>
<tr>
<td>Sample:</td>
<td>20 children (12M, 8F)</td>
</tr>
<tr>
<td>Pop*: Children with a gastrostomy and fed at home</td>
<td></td>
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</tbody>
</table>

45% distal giving sets showed overgrowth and 30% were contaminated. Manipulation error observed in 40% cases though this was not associated with contamination of feeds. No difference in contamination between gastrostomy button or tube. Gastric bacterial over growth was not associated with retrograde colonization. Demonstrates that to avoid /minimise contamination, closed systems should be used in preference to open systems for feeding at home.

All observations and samples taken by one person during a normal procedure. Defined overgrowth as $10^4$ cfu/ml. Observation by study operator may have influenced outcome. Small sample but a limited population.
### P86 3 Grunow JE, Christenson JC, Doris Moutous D. 1989. USA.

To determine the incidence of contamination in a delivery system reused in vitro simulating nocturnal supplemental enteral feeding.

**Design:** Laboratory Experiment  
**Setting:** ‘Vacant room’ in a children’s hospital  
**Sample:** Flexiflo Top Fill Enteral Nutrition Systems (Ross Laboratories)  
**Pop**: Not Applicable

Clean enteral nutrition systems can be reused after short infusion periods and used up to 7 days in vitro without significant contamination. Bacteria cannot be eradicated from heavily contaminated bags by rinsing.

**Well conducted laboratory study.**

### P89 2 Freedland CP, Roller RD, Wolfe BM et al. 1989. USA.

Evaluation of an open, continuous enteral tube feeding system in clinical use, i.e., Biosearch Top Fill 500cc enteral feeding bag, extension tubing and a Dobhoff enteral pump or an Imed Volumetric Infusion pump.

**Design:** Descriptive Study  
**Setting:** Urban hospital  
**Sample:** 33 patients (gender not specified) 82 enteral feeding cultures.  
**Pop**: All hospital patients (except neonates) undergoing continuous enteral pump feeding for a minimum of 3 days without interruption >24 hours.

Contaminated enteral feeds may constitute reservoirs for contamination of other body sites. Contamination of feeds with Serratia marcescens correlated with cultures for the same organisms in patient’s other body sites (p<0.01).

Undiluted canned feeds were significantly less contaminated at 24hrs than those requiring mixing of powder (p<0.0001).

**Well conducted study.**
To determine whether administering enteral feeding intermittently as opposed to continuously results in decreased rates of gastric colonisation in mechanically ventilated patients.

<table>
<thead>
<tr>
<th>P92</th>
<th>2</th>
<th>Skiest DJ, Khan N, Feld R et al. 1996. USA.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>To determine whether administering enteral feeding intermittently as opposed to continuously results in decreased rates of gastric colonisation in mechanically ventilated patients.</td>
</tr>
</tbody>
</table>

**Design:** Randomised Controlled Trial

**Setting:** 2 urban hospitals

**Sample:** 16 [CEF (4M, 3F), IEF (5M, 4F)]

**Pop*: ICU patients about to begin enteral feeding

IEF resulted in lower gastric pH and gastric colonisation. Mean am gastric pH in IEF significantly lower than CEF (p=0.0008). No significant difference in pm pH – (p>0.05).

This is a hospital based critical care study and it is difficult to extrapolate to community setting Very small sample size to generalise (Pilot Study)
Schroeder P, Fisher D, Volz M et al. 1983. USA. To estimate the type and amount of contamination that occur in nutrient feeding solutions in a community hospital using normal procedures.

<table>
<thead>
<tr>
<th>Design:</th>
<th>Setting:</th>
<th>Sample:</th>
<th>Pop*:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive Study</td>
<td>Community hospital</td>
<td>9 in study 5. The others were Laboratory and simulated clinical studies.</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

Enteral feeding systems can support considerable microbial contamination that varies in type and amount. Awareness of study and education did not reduce contamination. Study 1 looked at the sterility of unrefrigerated NFS using 5 cans and samples taken at 4 hr intervals (laboratory). Study 2 contamination due to decanting (laboratory). Study 3 contamination due to decanting and nurses unaware they were being monitored (simulated clinical). Study 4 duplicated study 3 (different systems). Study 5 contamination in gavage feeding bags without nurses being aware of the study (clinical). Study 6 contamination in gavage feeding bags with nurses aware of the study (clinical). Study 7 contamination as a result of organisms travelling from a colonised nasogastric tube into gavage tubing (laboratory). Study 1 Ensure did not reveal growth over 24 hours. Study 2 No bacterial growth over 48 hours regardless of delivery systems. Study 3 Contamination in all systems by 24 hours. Study 4 Less growth than study 3 even at 36 hours. Study 5 All but one system contaminated at 24 hours. Study 6 Considerable growth at 24 hours. Study 7 No bacterial growth in any tube samples.

Effect of enteral contamination on patients not measured. Samples small.
| Design: | Experimental |
| Setting: | Acute setting, possibly ICU |
| Sample: | 58 infusion sets, patient details missing |
| Pop*: | Not stated |

Suggests feeds may be hung for 24 hours without reservoir bag change with no major risk of reservoir contamination.

Little risk to patient and reduction in costs if reservoir bags and connection tubes are hung with good technique.

In vivo: No growth at 12 hours in bag or reservoir end of tubing. At 24 hours 2/58 had growth.

In vivo: no growth in bag or reservoir end tubing at 24 hours. Patient end of tubing all contaminated with challenge bacteria.

Several details missing, numbers small.
### EF Rejected Studies

|----|---------------|-----------------------------------|-----------|------------------------------------------|-----------------------|
| P3 | 1             | Iber, Fl, Livak AL and Patel M. 1996. USA. | To describe 111 PEG tubes with a view to learning more about the reasons for PEG failure | Design: Descriptive study  
Setting: Hospital Department of Gastroenterology  
Sample: 111 PEGs removed, replaced or dislodged at the hospital during an 11 month period  
Pop*: In-patients receiving PEG feedings. | Lack of control of possible confounders. |
| P4 | 1             | Payne-James, J; Rana SK, Bray MJ et al. 1992. UK. | To compare contamination of enteral diet containers using three different giving sets. | Design: Descriptive study  
Setting: Urban DGH  
Sample: 55 (gender not specified)  
Pop*: In patients receiving continuous 24 hour infusion.  
Phase I (18 patients)  
Phase II (17 patients)  
Phase III (18 patients) | Small sample in each phase. |
| P1 | 1             | Gottlieb K, Leya J, Kruss D et al. 1993. USA. | To investigate the prevalence of fungal colonization in a variety of PEG types. | Design: Descriptive Study  
Setting: Veterans Affairs Hospital  
Sample: 10 (Males)  
Pop*: Patients from 2 wards with functioning pegs in-site. | The sample size is not appropriate |
<table>
<thead>
<tr>
<th>Page</th>
<th>Study Number</th>
<th>Authors</th>
<th>Title</th>
<th>Design</th>
<th>Setting</th>
<th>Sample</th>
<th>Population Information</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>P21</td>
<td>2</td>
<td>Thurn J, Crossley K, Gerds A et al. 1990. USA.</td>
<td>A prospective study to determine the relationship between contamination of enteral feeds and nosocomial infection.</td>
<td>Descriptive Study</td>
<td>One hospital but 3 different intensive care areas</td>
<td>24 patients (20M, 4F)</td>
<td>Patients requiring enteral feeds between Sept 1986 - April 1987.</td>
<td>The sample size is not appropriate</td>
</tr>
<tr>
<td>P27</td>
<td>2 &amp; 3</td>
<td>Donius MA. 1996. USA.</td>
<td>To compare contamination of formula collected from the distal end of the tubing set of a refillable bag with contamination of a commercially prepared 1000ml pre-filled ready-to-hang enteral feeding system.</td>
<td>Descriptive study</td>
<td>Long-term care facility</td>
<td>4 patients (gender not stated)</td>
<td>Stable patients requiring enteral feeds.</td>
<td>Very small study, underpowered, though it confirms findings in another study</td>
</tr>
<tr>
<td>P31</td>
<td>5</td>
<td>Nunley D, Berk SL. 1992. USA.</td>
<td>A retrospective study to evaluate the gastrostomy site as source of MRSA colonization.</td>
<td>Descriptive Study</td>
<td>Urban hospital</td>
<td>26 reports of Gastrostomy site cultures.</td>
<td>Patients with gastrostomy</td>
<td>A retrospective study of notes 1985-1987 but reported in 1992, therefore old data and dependant on accurate record keeping.</td>
</tr>
<tr>
<td>P76</td>
<td>2</td>
<td>Weenk G, van Unen E, van Ess I et al. 1995. Netherlands.</td>
<td>To assess the risks of using a ready-to-use 1 litre enteral feeding system in a centre for burns patients.</td>
<td>Descriptive Study</td>
<td>Burns unit</td>
<td>5 patients (gender not specified)</td>
<td>Patients with severe burns requiring enteral feeding.</td>
<td>The sample size is not appropriate</td>
</tr>
<tr>
<td>ID</td>
<td>N</td>
<td>Reference</td>
<td>Design</td>
<td>Setting</td>
<td>Sample</td>
<td>Notes</td>
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<tr>
<td>P81</td>
<td>2</td>
<td>Anderton A, Nwogh CE, McKune I et al. 1993. UK.</td>
<td>Descriptive Study</td>
<td>Patients’ homes and hospital</td>
<td>95 feeds sampled from 6 children (gender not stated)</td>
<td>Patients and parents collected home samples which may have altered contamination levels.</td>
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<td>To investigate and compare the levels and types of bacterial contamination in enteral feeds prepared and administered in hospital and the home</td>
<td></td>
<td></td>
<td>Children being fed at home and in hospital over a 3 month period.</td>
<td>Parents and patients were responsible for collection and storage of home samples. Children received multiple doses of antibiotics for their cystic fibrosis</td>
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<td></td>
</tr>
<tr>
<td>P83</td>
<td>2</td>
<td>Perez SK, Brandt K. 1989. USA.</td>
<td>Quasi experimental</td>
<td>Hospital</td>
<td>Unclear – 32 surgical bedded but data only given for 10 people</td>
<td>Small study no controls. Findings inconclusive. No data on patients.</td>
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<td>To explore the differences in bacterial growth in continuous enteral feeding when using tap water versus sterile water over 24 and 48 hours.</td>
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<td>To examine the contamination of enteral feeding solution immediately after administration, after 30 mins and 2hrs and the effectiveness of decontaminating administration containers for reuse.</td>
<td></td>
<td></td>
<td>No patient details given</td>
<td></td>
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<tr>
<td>P90</td>
<td>1</td>
<td>Heyland DK. 1998. Canada.</td>
<td>Systematic Review and Meta-analysis</td>
<td></td>
<td>Adult patients undergoing major surgery, suffering major trauma.</td>
<td>This review offers little evidence of use for the guideline development.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Determining Short and Long Term Complications Associated with Needle Catheter Jejunostomy

**Eddy VA, Snell JE, Morris JA. 1996. USA.**

**Design:** Descriptive Study  
**Setting:** University medical centre  
**Sample:** 122 (95M, 27F)  
**Pop**: Patients who had received needle catheter jejunostomies included in study over 6 year period.

NEJ relevant but conduct of study means results are unreliable.
APPENDIX EF4 – Full Reference List


(8) Beattie TK, Anderton A. Microbiological evaluation of four enteral feeding systems which have been deliberately subjected to faulty handling procedures. J Hosp Infect 1999; 42:11-20.


(11) Boyce JM, Kellisher S, Vallande N. Skin irritation and dryness associated with two hand-hygiene regimens: Soap-and-water hand washing versus hand antisepsis with an alcoholic hand gel. Infection Control and Hospital Epidemiology 2000; 21(7):442-448.


(146) Seymour VM, Dhallu TS, Moss HA, Tebbs SE, Elliot TSJ. A prospective clinical study to investigate the microbial contamination of a needleless connector. J Hosp Infect 2000; 45:165-168.


NOTE: SECTIONS 1–3 AND SECTION 5 ARE AVAILABLE AS SEPARATE FILES