National Patient Safety Agency

Patient Safety Alert NPSA/2011/PSA002:
Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants

March 2011

Supporting Information

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Introduction

Nasogastric tube (NGT) feeding is common practice and thousands of tubes are inserted daily without incident. However, there is a risk that the tube can become misplaced into the lungs during insertion, or move out of the stomach at a later stage.

In February 2005, following reports of patient death and harm caused by misplaced nasogastric feeding tubes, the National Patient Safety Agency (NPSA) issued a Patient Safety Alert[1]. Between September 2005 and March 2010 there were a further 21 deaths and 79 cases of harm, related to feeding through misplaced nasogastric tubes, reported to the National Reporting and Learning System (NRLS) (see Appendix 1). We have therefore updated our original Alert to provide organisations with strengthened guidance based on the learning from these reports. In 2009 feeding into the lung from a misplaced nasogastric tube became a Never Event in England[2].

During 2009/10, there were 41 Never Events reported to the NPSA where a misplaced naso or orogastric tube was not detected prior to use. Evidence from the Never Event reports suggests there are issues with x-ray interpretation at all times, and there may be increased risks from nasogastric placement or x-ray checking at night[3].

Scope

This Supporting Information and the Alert it accompanies does not relate to nasogastric feeding in neonates. Patient Safety Alert 09; *Reducing the harm caused by misplaced naso and orogastric feeding tubes in babies under the care of neonatal units*, issued in August 2005 can be found at: www.nrls.npsa.nhs.uk/resources/type/alerts/

This information is not intended to replace clinical judgement. Local policies may vary but must not fall below the standards set out in this document.

In a small number of cases a nasogastric tube has been placed under direct vision by an anaesthetist and/or surgeon. As long as this confirmation of position is properly documented it may be acceptable to forgo other tests. For example it may be considered that the risk of irradiation outweighs the benefit of radiograph confirmation.

Transanastamotic nasogastric tubes require special consideration and are not within the scope of this Alert.

Existing non-feeding tubes (for example drainage tubes) are not recommended for feeding. All nasogastric tubes used for feeding must be radio-opaque throughout their length and have externally visible length markings[4].

Clinical actions

This section of the document elaborates on the clinical actions required within this revised Alert based on the following questions:

1. Is nasogastric tube feeding the right decision for this patient?
2. Is this the right time to place the nasogastric tube and is the appropriate equipment available?
3. Is there sufficient knowledge/expertise available at this time to test for safe placement of the nasogastric tube?

1. Is nasogastric tube feeding the right decision for this patient?

a) Before a decision is made to insert a nasogastric tube, an assessment is undertaken to identify if nasogastric feeding is appropriate for the patient, and the rationale for any decision is recorded in the patient's medical notes.

A decision must be made that balances the risks with the need to feed or administer medications. Patients who are comatose or semi-comatose, have swallowing dysfunction or recurrent retching or vomiting, have a higher risk of placement error or migration of the tube, whereas patients on antacid medication are more likely to have pH levels of 6 and above, making confirmation of tube position more difficult. Actions to reduce all identified risks and the rationale behind these actions should be documented prior to insertion of a nasogastric tube for the purpose of feeding, as follows:

- The details of the assessment must be recorded in the patient's medical notes prior to commencement of feed.
- The decision to insert a nasogastric tube for the purpose of feeding must be made following careful assessment of the risks and benefits by at least two competent health care professionals[5,6,7], including the senior doctor responsible for the patient's care.
- As a minimum, documentation should include signed, dated and timed entry, of the process of initial risk assessment that evaluates the benefits against the risks of introducing a nasogastric tube for the purpose of feeding. For example:

  "Mr xxx has been nil by mouth for the last 24 hours due to having an unsafe swallow following a CVA. An assessment has been made by SALT that it is unsafe for Mr xxx to take diet, fluids and medication orally and recommended NG tube placement to maintain adequate nutrition and hydration. Reassessment of swallow function to take place on 01/01/11..."
- Nasogastric tube insertion can be dangerous as well as difficult in patients with altered anatomy, for example oesophageal fistula or pharyngeal pouch or in certain clinical conditions, such as basal skull fracture. In these situations, or if these are suspected, senior clinical help should be sought and nasogastric tube insertion should only be attempted under fluoroscopic control.

2. Is this the right time to place the nasogastric tube and is the appropriate equipment available?

The NPSA is concerned about the number of errors reported as a result of staff confirming tube position out of hours.

It is also a concern that whilst nasogastric feeding and administration of medication via the nasogastric tube can be crucial in the treatment of certain patients, the benefits of this are not always balanced against the risks of tube insertion and enteral feeding.

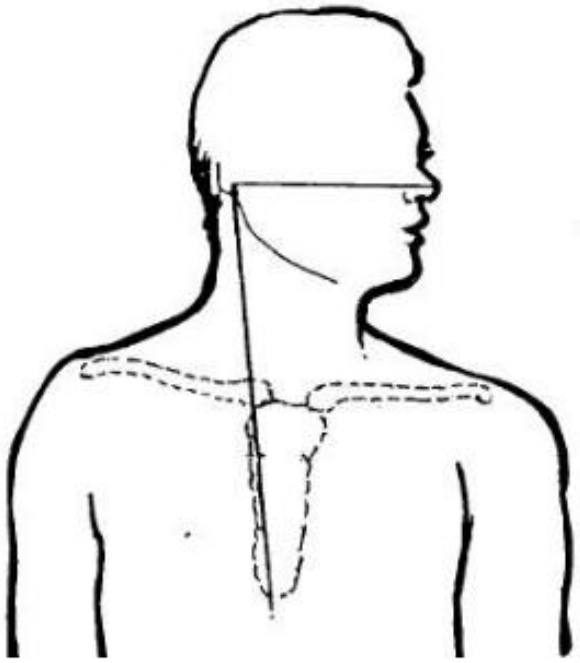
b) If there is not sufficient experienced support available to accurately confirm nasogastric tube placement (for example at night) then, unless clinically urgent, placement should be delayed until that support is available, and that the rationale for any decisions made is recorded in the patient's medical notes.

- Placement of nasogastric tubes should not occur at times when there is insufficient support available to accurately confirm placement (insufficient support may not be available at night or out of hours).
- Initial confirmation of nasogastric tube position should also be made at times when there is sufficient support available to accurately confirm placement, should any ambiguity arise.
- Where an urgent situation might reasonably be expected to arise, for example in intensive/critical care units, the clinical service should produce locally approved guidance for staff to define when nasogastric tubes should be placed for feeding. Guidance should consider the increased risk attached to commencing feeding when the confirmation of the correct placement of a nasogastric tube would be dependent on a doctor in training. The guidance should also cover the documentation required around confirmation of tube placement. This allows each service to decide on the safest course of action after considering the risks and benefits for its own patients.

If the risk of delay in feeding or administering medication to an acutely unwell patient is considered by the senior team member responsible for that patient to outweigh the risk of interpretation of tube position and commencing feeding at night, then this decision and its rationale must be clearly documented in the patient's medical notes[8].

c) Nasogastric tubes used for the purpose of feeding must be radio-opaque throughout their length and have externally visible length markings.

- The tube length should be estimated before insertion using the NEX measurement (place exit port of tube at tip of nose. Extend tube to earlobe, and then to xiphisternum - this is known as the NEX measurement). Once inserted, the external tube length should be recorded and confirmed before each feed.



NEX - Nose to Ear to Xiphoid [23]

d) pH indicator paper must be CE marked and intended by the manufacturer to test human gastric aspirate. [4] [8]

3. Is there sufficient knowledge/expertise available at this time to test for safe placement of the nasogastric tube?

In the following circumstances, patients should NOT be fed unless a pH of between 1 and 5.5 has been obtained and documented OR correct tube placement has been confirmed by a competent person through x-ray and documented:

- following initial insertion;
- following episodes of vomiting, retching or coughing spasms (note that the absence of coughing does not rule out misplacement or migration);
- when there is suggestion of tube displacement (for example, loose tape or portion of visible tube appears longer);
- in the presence of any new or unexplained respiratory symptoms or reduction in oxygen saturation.

While none of the existing bedside methods for testing the position of nasogastric feeding tubes is totally reliable[4] there is evidence to suggest that a pH reading of between 1 and 5.5, can reliably exclude *pulmonary* placement of the nasogastric tube. However, a pH between 1 and 5.5 does not necessarily confirm *gastric* placement of the nasogastric tube, and there is a small possibility that the tube is sitting in the oesophagus, which carries a higher risk of aspiration[4,8,9,10,11,12,13,14,15] (see also Appendix 2).

The NPSA consulted widely with stakeholders on reducing the pH threshold during summer 2010. There was little support for this. Stakeholders, including professional bodies and a sample of local hospitals in England and Wales, noted the impact in terms of increased x-rays (costs, radiation exposure and risks of misinterpretation) and likely delays for patients needing urgent feeding. There were also implications for access to X-rays for patients in the community. These disadvantages appeared to outweigh the benefits of reducing risks of misplacement in the oesophagus.

Following insertion, the tube type, size and external length once secured, should be documented by the person who passed the tube[15,16,17,18,19,20,21,22]. The method of testing the tube position must be documented. Each test and test result should be documented on a chart kept at the patient's bedside (see Appendix 3 for example chart).

e) Nasogastric tubes are not flushed, nor any liquid/feed introduced through the tube following initial placement, until the tube tip is confirmed by pH testing or x-ray, to be in the stomach.

It is essential to ensure that the nasogastric tube is in the stomach to prevent any complications. Some reports to the NRLS suggested staff believed it was acceptable to insert water or other fluid to 'flush out some aspirate'. This is never safe to do.

First Line test method: pH paper

f) pH testing is used as the first line test method, with pH between 1 and 5.5 as the safe range, and that each test and test result is documented on a chart kept at the patient's bedside

- pH readings should be **between 1 and 5.5** for feeding to commence safely. However, the NPSA is aware of the potential difficulty experienced by some staff in differentiating pH readings using currently available pH indicator paper between pH 5 and 6. It is therefore recommended that a second competent person checks any readings that fall within the pH range of 5 to 6.
- All areas where nasogastric feeding tube placement is likely to occur must have access to pH indicator paper that is CE marked and manufactured to test human gastric aspirate.
- All pH tests and test results must be recorded on a chart kept at the patient's bedside (see example chart in Appendix 3).

Documentation following pH testing should include:

- whether aspirate was obtained;
- what the aspirate pH was;
- who checked the aspirate pH;
- when it was confirmed to be safe to administer feed and/or medication (i.e. gastric pH between 1 and 5.5).

Second line test method: X-ray confirmation

g) X-ray is used only as a second line test when no aspirate could be obtained or pH indicator paper has failed to confirm the location of the nasogastric tube and that:

i. The request form must clearly state that the purpose of the x-ray is to establish the position of the nasogastric tube for the purpose of feeding.

ii. It is the radiographer's responsibility to ensure that the nasogastric tube can be clearly seen on the x-ray to be used to confirm tube position.

iii. X-rays must only be interpreted and nasogastric tube position confirmed by someone assessed as competent to do so.

Healthcare professionals are reminded that PACS windows can be manipulated to improve contrast and visualisation.

If there is any difficulty in interpretation the advice of a radiologist should be sought.

Any nasogastric tubes identified to be in the lung should immediately be removed whether in the x-ray department or clinical area[4,20].

Documentation following X-ray should include:

- who authorised the x-ray;
- who confirmed the position of the nasogastric tube. This person must be evidenced as competent to do so;
- confirmation that any x-ray viewed was the most current x-ray for the correct patient.
- the rationale for the confirmation of position of the nasogastric tube, i.e. how placement was interpreted, and clear instructions as to required actions. For example:

19 January 2011, 10:30 – Dr A. Smith – core surgical trainee

- *X-ray taken at 10:15 today*
- *NG tube passed down midline, past level of diaphragm and deviates to left*
- *Tip is seen in stomach*
- *Plan: NG tube safe to use for feeding*

Dr A. Smith

Radiographer's responsibilities

- The radiographer must ensure that exposure of the x-ray is adjusted to allow the nasogastric tube to be visible to the bottom of the film.
- The radiographer must ensure the film is centred lower than would normally be appropriate for a chest x-ray so that it shows the abdomen as far as possible below the diaphragm.
- The x-ray film must show the bottom of both hemi-diaphragms in the midline.
- X-rays that are not as described above will not allow accurate interpretation of nasogastric tube placement and should not be allowed out of the x-ray department.

Radiologist's responsibility

When the radiologist reports the placement film, he or she must document not only the position of the nasogastric tube and tip, but whether it is safe to proceed with the administration of any liquids via the tube.

Repeat checks AFTER initially correct placement has been confirmed

As stated above, after initial insertion and after circumstances, signs or symptoms that indicate the tube could have been displaced, only a pH between 1 and 5.5 or x-ray confirmation is an acceptable checking method.

It is recognised that despite correct confirmation of nasogastric tube position prior to commencement of feed, it is still possible for the tube to migrate or be dislodged away from the stomach and into the oesophagus or into the lungs where feeding could prove fatal.

Because of this, British Association of Parenteral and Enteral Nutrition (BAPEN) recommends repeat placement checks are made as follows:

- before administering each feed;
- before giving medication (see BAPEN guidance at www.bapen.org.uk/res_drugs.html);
- at least once daily.

Where feed/medication has already passed through the tube, a minimum of an hour delay, without any further feeding, should be instigated prior to testing of gastric aspirate using the correct pH paper wherever aspirate can be obtained. However, in some situations, such as when patients are fed continuously, when they are treated with acid-reducing medication,

and when medications are frequently given down nasogastric tubes, it may not be possible to obtain aspirate with a pH between 1 and 5.5, and daily x-rays are not practical or safe.

Therefore, in circumstances where the initial placement was appropriately confirmed, and there is no reason to suspect displacement since (i.e. no vomiting, retching or coughing spasms and no unexplained respiratory symptoms) the only practical method of determining if the tube remains correctly placed prior to each administration of medications or feed may be through external observation of the tube. Where local guidance permits this, this should include confirmation that the length of the external tube remains identical to that recorded initially in the patient's notes, and that fixation tapes or plasters have not moved or worked loose.

Tube length should be recorded on a daily basis and prior to administration of any liquid via the nasogastric tube on the bedside chart. If there is any indication that the length has changed, appropriate action should be taken to assess tube tip position prior to using the nasogastric tube.

If there is evidence that the tube has become displaced, for whatever reason, then only checking the position at the nose would be inappropriate as it could be coiled in the back of the mouth, so in this circumstance (which should be defined in local guidance) second line testing through x-ray, or removal of the tube if seen to be coiled in the mouth, would be appropriate.

Electromagnetic bedside feeding devices are being used in a number of units and may increasingly have a place as a second line testing method[24,25,26,27,28].

Competency

h) Healthcare professionals should ensure that if involved with nasogastric tube position checks they have been assessed as competent through theoretical and practical training

A useful training resource on x-ray interpretation of nasogastric tube position is available at www.trainingngt.co.uk

An NPSA audit of 166 junior doctors across five sites highlighted that only 31 per cent of junior doctors have any formal guidance or training on the use of x-ray for checking nasogastric tube positioning[29]. We have therefore provided an x-ray interpretation aid with our Alert, for distribution across relevant clinical areas. The aid is not meant as a replacement for clinical judgement and it should only be used to assist x-ray interpretation in conjunction with formal competency training of all clinical staff responsible for the care of patients receiving nasogastric tube feeding. Minimising the number of x-rays is important in order to avoid increased exposure to radiation, loss of feeding time and increased handling of seriously ill patients.

i) Whoosh tests, acid/alkaline test using litmus paper, or interpretation of the appearance of aspirate are never used to confirm nasogastric tube position as these are not reliable[1].

Transfer of care to community settings

Outside the acute care setting access to radiology can be difficult, particularly if the patient requires transportation from the community.

j) A full multidisciplinary supported risk assessment should be made and documented, before a patient with a nasogastric tube is discharged from acute care to the community.

Guidance on ongoing confirmation of nasogastric tube placement by community staff should be provided and communicated with this risk assessment.

Learning from errors

Feeding into the lung, through a misplaced nasogastric tube is now a Never Event[2] in England. All misplacement incidents must be reported locally as well as nationally to the NRLS.

Organisations are required to ensure that staff report incidents of misplaced nasogastric feeding tubes through their local risk management system, for uploading to the NRLS. This will enable both local and national monitoring of misplaced nasogastric feeding tubes and further understanding of the issue[2].

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Appendices

Appendix 1: Summary of reported incidents relating to misplaced nasogastric feeding tubes between issue of the NPSA Alert between 2005 and 31 March 2010

Since the September 2005 NPSA Alert, *Reducing the harm caused by misplaced nasogastric feeding tubes*, the NPSA has become aware of 21 deaths and 79 other cases of harm due to feeding into the respiratory tract through misplaced nasogastric tubes. In 45 per cent of cases the harm was due to misinterpreted x-rays.

Table 1: Summary of all reported incidents relating to misplaced nasogastric feeding tubes between September 2005 and 31 March 2010

Checking method where error occurred:	Total number of reported incidents	Number of reported deaths (out of total)
X-ray misinterpretation	45	**12**
Fed despite aspirate tested as pH 6-8 (i.e. existing advice ignored)	7	**2**
Fed after apparently obtaining pH 1-5.5*	9	**1**
Water instilled down nasogastric tube before testing pH (i.e. existing advice ignored)	2	**0**
Not checked at all	9	**1**
Apparent migration after initially correct placement (e.g. after suction)	8	**1**
No information obtained on checking method used	17	**4**
Other		
• **Placed under endoscopic guidance**	1	**0**
• **Visual appearance of aspirate**	1	**0**
• **Bubble test**	1	**0**
TOTAL	**100**	**21**

** note almost none of these pH levels were contemporaneously recorded but were recalled by staff during subsequent local investigation*

Appendix 2: Summary of PSRP funded research

Following the release of the 2005 Alert, Prof. G Hanna and his team were commissioned to conduct a systematic review and decision analysis in order to address the lack of consensus opinion regarding the optimum method of checking nasogastric tube position[20]. The overall purpose of this project was to develop an evidence-based guideline for verifying nasogastric tube position in adult patients, considering only those tests that can be used at the bedside, either in isolation or in combination, with the aim of differentiating among four tube sites: lung, oesophagus, stomach and intestine.

Twenty-two citations of human studies published in English between 1980 and 2008 were included in the review, which demonstrated the following:

- *Traditional bedside methods*: Observing for respiratory signs or symptoms such as coughing, dyspnoea, or cyanosis does not provide evidence of tube misplacement into the airway. Neither does identification of tube site by the appearance of the feeding tube aspirates.[3]
- *Auscultation*: The auscultation method (whoosh test) has been discredited largely due to numerous case reports of tube misplacement in which this method falsely indicated correct gastric position, including reports in the recent literature.[13]
- *Gastric Residual Volumes (GRV)*: GRV are frequently used to monitor the safety and efficacy of tube feeds. The definition of a high gastric aspirate as an appropriate marker for the risk of aspiration is extremely variable in clinical practice.
- *Capnometry and colorimetry*: This technique has been reported in three pilot studies and 3 prospective clinical studies using either capnography or colorimetry for CO_2 detection. Overall sensitivity is 95.8 per cent and overall specificity 99.6 per cent. However the technique does have significant limitations as it gives no information about tube placement within the gastrointestinal tract.
- *Magnetic devices*: This system demonstrates 100 per cent agreement with x-ray for tubes placed in the stomach (n=4) with a sensitivity for small bowel placement of 79 per cent (n=19). There is incomplete and inconsistent presentation of the data for this study, making worthwhile interpretation of the results difficult.
- *Accuracy of pH paper*: There are mixed reports of the accuracy of pH indicator papers in common clinical usage. Some authors question the validity of using pH paper for accurate measurement of gastric pH, particularly in the critical pH range of 4 – 6.[16]
- *Influence of acid-inhibiting medication*: Acid-inhibiting medication reduces the sensitivity[17] of pH measurement for gastric placement, but does not alter the specificity or render the method unsafe with regard to feeding decisions.
- *Feeding and medication history*: Results do not support any benefit of fasting for longer than an hour prior to aspirating the feeding tube.
- *Patients who have high risk for aspiration*: Guidelines for safe insertion of feeding tubes may have limited applicability to high-risk patients, and therefore a risk assessment for individual patients needs to be carried out.

Results of the evidence review were shared with a group of clinical nutrition experts. Risk stratification was employed to assess different checking methods, in isolation or in combination. The team concluded that a pH of ≤5.5 was sufficient to exclude pulmonary placement of the tube, assuming the appropriate precautions were taken in obtaining the aspirate sample. A pH of ≤4 would increase the likelihood that the tip of the tube was resting in the stomach as between 4-5.5 there is a small chance that the tube is positioned in the oesophagus which carries with it an unquantifiable risk of aspiration. Where this was of particular concern, x-ray identification of tube position was recommended. [18]

Appendix 3: Example Nasogastric feeding bedside chart

Nasogastric tube placement bedside checklist

This bedside checklist should be completed for all patients requiring nasogastric tube placement, on insertion and on all subsequent insertions, before administration of artificial nutrition or medication via the nasogastric tube.

Patient Name:

NHS Number/Hospital Number:

DOB:

Ward:

Nasogastric tube insertion/reinsertion

Date and time of insertion/reinsertion					
NEX Measurement					
External length once secured					
Nostril used on insertion/reinsertion - L/R					
Aspirate obtain – Y/N					
Ph of aspirate (if obtained)					
x-ray required – Y/N					
Inserted by:					

X-ray interpretation (if applicable)

Date and time of x-ray interpretation					
Is this the most current x-ray? Y/N					
Is the x-ray for the correct patient? Y/N					
x-ray results Eg *"NG has passed down midline past level of diaphragm and deviates to left. It is safe to feed via the NGT".*					
X-ray interpreted by:					

Nasogastric tube position confirmation record

Patient Name:

NHS Number/Hospital Number:

DOB:

Ward:

The position of the nasogastric tube should be checked:

- Following initial insertion (please use placement checklist to record this).
- Before administering each feed.
- Before giving medications.
- Any new or unexplained respiratory symptoms or if oxygen saturations decrease.
- At least once daily during continuous feeds.
- Following episodes of vomiting, retching or coughing spasms.
- When there is suggestion of tube displacement.

If you are not able to confirm that the tube is in the stomach it should be removed and reinserted. This should be documented on the nasogastric tube placement bedside checklist.

Date							
Time							
pH							
External tube length							
Checked by:							
Date							
Time							
pH							
External tube length							
Checked by:							

If any new or unexplained respiratory symptoms, contact medical team immediately and stop feed.

Appendix 4: Action rationale and suggested compliance checklist

Action	Rationale	Suggested evidence of compliance
1. A named clinical lead is assigned to have responsibility for implementing all actions in this Alert.	Maintaining high levels of training and competency and compliance with agreed policies and protocols requires leadership, formal monitoring, and support from a named senior clinical lead within the organisation.	The name of the clinician(s) who has been identified, a record of their agreed role.
2. All policies, protocols, and bedside documentation are reviewed to ensure compliance with steps (a) to (j) outlined on page 2 of alert every time a nasogastric tube is inserted and used to administer medication, fluids or feed.	Collaboratively written and agreed policies, protocols and bedside documentation ensure there is understanding across the relevant staff groups about the safe processes to follow when a nasogastric feeding tube is to be inserted and tested for correct placement	A record of the review of locally agreed policies / protocols and bedside documentation is made at the appropriate clinical governance forum.
3. An ongoing programme of audit is put in place to monitor compliance.	The results of such an audit will enable a proactive approach to be taken to confirm the effectiveness of policies and protocols and the compliance with these in practice.	An agreed audit programme is devised and disseminated across the organisation and frequency of audit agreed at the relevant governance where results are discussed and any corrective actions proposed based on these results.
4. Staff training, competency frameworks and supervision are reviewed to ensure that all healthcare professionals involved with nasogastric tube position checks have been assessed as competent. Competency training should include theoretical and practical learning.	Clear training and competency frameworks must underpin the theoretical and practical training aspects of all relevant healthcare professionals.	An example eModule training tool for x-ray interpretation of nasogastric tube position is available at: www.trainingngt.co.uk Ensure the following is made available at the appropriate clinical governance forum: a staff training plan / competency framework, supervision and bedside documentation, competencies and standards of supervision as well as a printout of a spreadsheet or database to maintain an active list of staff who are competent in nasogastric tube position checks.

5. Purchasing policies are revised and old stock systematically removed to ensure all nasogastric tubes used for the purpose of feeding are radio-opaque throughout their length and have externally visible length markings. 6. Purchasing policies are revised and old stock systematically removed to ensure all pH paper is CE marked and intended by the manufacturer to test human gastric aspirate	An agreed organisational purchasing policy together with removal of non compliant (with agreed policies and protocols) equipment is an effective way of reducing human error by selection of wrong equipment	A record of the review of locally agreed purchasing systems together with a record of alterations to routine stock ordering systems. Clear evidence in written policies of the essential characteristics of the equipment to be used