Abstract of the thesis entitled

“Evidence-Based Small Bowel Feeding for Nosocomial Pneumonia Prevention in Tube-fed Critically Ill Patients”

Submitted by

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Nosocomial pneumonia is a common and costly infection and it causes considerable morbidity and mortality (Ferrara, 2006). In 2011 - 2012, the total number of inpatient of patients diagnosed with pneumonia was 50,716, accounting for the second leading cause of hospital admission in Hong Kong and 6,211 number of registered deaths (Hospital Authority, 2012). Nasogastric feeding is always used for maintaining nutrition in frail elderly patients with poor oral intake or swallowing problem. Nevertheless, impaired cough reflex and gastrointestinal complications (i.e. aspiration and gastroesophageal reflux) often occur in tube-fed patients, and may subsequently cause pneumonia. Metheny et al. (2006) demonstrated that the pneumonia occurrences gradually increase with the rise in aspiration frequency. Therefore, pneumonia is one of the most common causes of death in tube-fed elderly patients.

Small bowel feeding is believed to be one of the effective solutions for nosocomial pneumonia prevention in tube-fed patients. However, there is no clear guideline to perform small bowel feeding since it is not a
common nursing practice in Hong Kong public hospitals. In view of this, the objectives of this dissertation are to assess the effectiveness of small bowel feeding on nosocomial pneumonia prevention and to develop a list of evidence-based clinical guidelines on small bowel feeding in tube-fed critically ill patients.

Online electronic database searches in PubMed, British Nursing Index and CINAHL Plus were conducted by using keywords related to nosocomial pneumonia and small bowel feeding. A total of 21 potential articles were retrieved for screening and four relevant studies were identified for this dissertation. Data were extracted and the quality of the retrieved studies were analysed and were graded respectively by using the methodology checklist and the grading system from the Scottish Intercollegiate Guidelines Network.

All retrieved studies clearly demonstrated that small bowel feeding reduces the incidence of nosocomial pneumonia including aspiration pneumonia and ventilator-associated pneumonia. Evidence-based small bowel feeding guideline for nosocomial pneumonia prevention in tube-fed critically ill patients is going to be established. Not only does this guideline focus on small bowel feeding, but also includes the nursing care practices on small bowel feeding such as head of bed elevation and gastric residual volume monitoring. Since all of these practices are important in pneumonia prevention along with the help of small bowel feeding. Most importantly, nurses play the leading role in this guideline
as they are always at patients’ bedside.

The implementation potential including the transferability of findings, feasibility of the innovation and the cost-benefit ratio of the guideline were analyzed. The small bowel feeding guideline is applicable and is beneficial in nosocomial pneumonia prevention among tube-fed critically ill patients.

A systematic, comprehensive implementation plan including communication plan and evaluation plan was established. An 18-month project includes stakeholders communication, one-month pilot testing, staff training, promotional activities as well as implementation and evaluation period. The effectiveness of the guideline was evaluated according to different aspects of outcomes. The effectiveness of the guideline would be determined by a reduction in incidence of nosocomial pneumonia, gastrointestinal complications and the length of inpatient stay. Medical expenditure reduction, increase in knowledge of frontline staff and better quality of nursing care would be considered as achievement in acceptability of the guideline.
Evidence-Based Small Bowel Feeding for Nosocomial
Pneumonia Prevention in Tube-fed Critically Ill Patients

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To my parents So Lan and Yuk Man, my sister Chrysanthus, and brother Gary
whose love and support
have nurtured me throughout all my learning endeavour
Declaration

I declare that this thesis represents my own work, except where due acknowledgement is made, and that it has not been previously included in a thesis, dissertation or report submitted to this university or to any other institution for a degree, diploma or other qualifications.

Signed_____________________

Chan Kin Wa

August 2014
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Abbreviations

AP  Aspiration Pneumonia
CDU  Central Devices Unit
CI  Confidence Interval
CPIS  Clinical Pulmonary Infection Score
EBPs  Evidence-based practices
e.g.  for example
GRVs  Gastric Residual Volumes
HA  Hospital Authority
HAP  Hospital-acquired Pneumonia
HOB  Head of Bed
i.e.  that is
ICU  Intensive Care Unit
ITT  Intension-to-Treat
LOS  Length of Stay
ND  Nasoduodenal
NG  Nasogastric
NSD  Nursing Services Division
OGD  Oesophago-gastroduodenoscopy
RCTs  Randomized Control Trials
SIGN  Scottish Intercollegiate Guidelines Network
VAP  Ventilator-associated Pneumonia
Chapter 1

Introduction

1.1 Background

Nosocomial Pneumonia, also known as hospital-acquired pneumonia (HAP), defined as all form of pneumonia with an onset 48 hours or more after admission to hospital, is a common and costly infection, causing considerable morbidity and mortality (Ferrara, 2006). According to American Thoracic Society (2005), HAP was the second leading nosocomial infection and the most common cause of death among nosocomial infections. HAP is the appearance of new lung infiltrates with infectious symptoms such as fever, leucocytosis or purulent sputum. According to the statistical report in 2011-2012 from the Hospital Authority (HA), the total number of inpatient of patients diagnosed with pneumonia (all form) was 50,716, accounting for the second leading cause of admission in Hong Kong and 6,211 number of registered deaths.

Definition of Ventilator-associated Pneumonia and Aspiration-induced Pneumonia. Ventilator-associated pneumonia and aspiration-induced pneumonia are the subset of HAP. Ventilator-associated pneumonia (VAP) refers to pneumonia occurring in patients more than 48 hours after endotracheal intubation and initiation of mechanical ventilation (American Thoracic Society, 2005). Pneumonia means inflammation of lungs while aspiration is defined as the inhalation of oropharyngeal or gastric fluids into the larynx and lower respiratory tract (Cassiere HA, 1998). Therefore, aspiration-induced pneumonia (AP) can be defined as a lung infection caused
by aspirating or inhaling oral secretions, stomach contents, or both (Marik, 2001). VAP and AP are the common infection among frail elderly who are being tube-fed or mechanically ventilated. Small amounts of aspirates may be inhaled into the airway and into the lungs. Usually they are cleared out by normal defence mechanisms such as coughing before they get into the lungs and cause inflammation. When such particles are not cleared due to impaired defence mechanism or large-volume aspirate, pneumonia can be resulted.

The presence of bacteria in the aspirated materials increases the risk of nosocomial infection. Aspiration of colonized secretions from the oropharynx is the primary mechanism by which bacteria gain entrance to the lungs. In elderly patients, pharyngeal colonization by gram-negative bacilli and staphylococcus aureus was significantly higher in patients on enteral feeding than on oral feeding (Nagatake, 2003). Also, colonization of dental plaque by gram-negative bacteria is an important factor to the oropharyngeal bacterial pool in patients who are sedated and patients who are mechanically ventilated (Boeck L 2010).

Pulmonary aspiration in the hospitalized patients can be devastating. Most events of aspiration occur in patients with a swallowing disorder such as dysphagia. According to some journals, reported aspiration rate in dysphagia patients was ranging from 10% to 70% (DeLegge, 2002). Mortality is related to the volume and aspirate content, and is reported to be as high as 70%. Neurologic dysfunction, advancing age, gastroesophageal reflux, reduced consciousness, mechanical ventilation and enteral nutrition all are potential risk factors for the aspiration development.

Nasogastric feeding has been increasingly used for maintaining nutrition in
frail elderly patients with poor oral intake or swallowing problem. However, tube feeding does not prevent aspiration and subsequent pneumonia completely. Aspiration of gastric contents and oropharyngeal secretions often occurs in tube feeding, it can cause higher risk of pneumonia. Therefore, pneumonia is one of the most common causes of death in tube-fed elderly patients.

Apart from witnessed large-volume aspiration, micro-aspiration occurs frequently and silently and it also plays a significant role in AP development. Micro-aspiration is aspiration of small amounts, less than 1 ml, generally causing no clinical significance in normal person since it can be cleared by the mucociliary action or coughing (Lord, 2011). However, tube-fed elderly patients always have dysphagia and impaired cough reflex, which diminish the defence mechanism of the body. Moreover, patients have lost their cough reflex during mechanical ventilation since they are sedated. VAP may result from this. McClave et al. (2005) reported that at least one micro-aspiration occurred in 30 out of 40 gastric-fed patients during the early course of the tube feedings. A prospective descriptive study, Metheny et al. (2006) also reported that 320 out of 360 critically ill tube-fed patients had at least one micro-aspiration. Moreover, another study found that the rate of aspiration in tube-fed and bedridden patients was 64.3% (Nakajoh K, 2000). Furthermore, Metheny et al. (2006) indicated a strong relation between aspiration frequency and subsequent pneumonia in critically ill tube-fed patients. The number of aspiration accumulated over the study period, pneumonia occurrences gradually increased (Day 1: 24%, Day 2: 36%, Day 3: 44%). Therefore, the nasogastric tube feeding cannot be expected to prevent aspiration, and risk of
pneumonia is still high in tube-fed patients.

It is common that critically ill patients have frequent impaired gastric emptying and they cannot tolerate enteral feeding (Acosta-Escribano et al., 2010), manifested as gastroesophageal regurgitation, aspiration and gastric residual volume elevation, which may contribute to nosocomial pneumonia. In these circumstances, physician will choose small bowel feeding method to deliver nutrition because small bowel feeding has theoretical advantages of reducing the risk of gastroesophageal reflux and AP (Heyland, Drover, MacDonald, Novak, & Lam, 2001; Jiyong, Tiancha, Huiqin, & Jingfen, 2013).

1.2 Affirming Needs

The researcher of this study is working as a registered nurse in a medical ward in a public hospital in Hong Kong. Strategies such as head of bed (HOB) elevation during nasogastric tube feeding, oral care and suctioning are performed in order to prevent AP or VAP. However, the incidence of aspiration and nosocomial pneumonia is still high especially in tube-fed patients who are critically ill or advanced in age. By clinical observation in ward, from January 2013 to June 2013, over 85% of monthly admissions of patients were aged 60 or above, and 30% of them were tube-fed (with nasogastric tube). Among the admission of tube-fed elderly, 50% of them eventually developed nosocomial pneumonia during hospitalization. Meanwhile, patients who are critically ill and finally under mechanically ventilation would be internally transferred to researcher’s ward. This kind of patients accounted for 10% of monthly admission. Mechanically ventilated patients were always sedated and were tube-fed. Also, by observation, all of them were diagnosed VAP eventually.
Overall, it could be estimated that about 25% of all inpatients admitted to the medical unit (i.e. 720 patients) were diagnosed pneumonia during hospitalization from the period of January 2013 to June 2013. Their prognoses were always poor after diagnosed with pneumonia. The mean length of hospitalization was 12 days (ranging from 8 - 16 days). Moreover, the mortality rate was very high (i.e. 50%) in the following three months.

Current clinical guidelines of nursing care on nasogastric tube feeding are well documented (Hospital Authority, 2003). In fact, the current guidelines recommend informing physician and considering small bowel feeding for patients with high risk of aspiration. However, the effectiveness and details of small bowel feeding administration are not presented in detail because it is not a common practice in Hong Kong. In addition, small bowel feeding is not a common practice even in researcher’s ward setting. To practice small bowel feeding, tube insertion by physicians and well-trained nurses is required. However, skills and knowledge regarding small bowel feeding are not commonly held among local nurses and doctors. Therefore, practically physicians do order continuous pump feeding instead of small bowel feeding for critically ill patients with high risk of aspiration despite the outcome is not effective. To sum up, given the above statistical data and current situation, in order to prevent tube-fed critically ill patients from developing nosocomial pneumonia, it is essential to establish and implement an evidence-based small bowel feeding. With the standardized clinical guideline, nurses can take better care of tube-fed critically ill patients who have risks of pneumonia.
1.3 Objectives and Significance

The objectives of this dissertation are:

1. To conduct a systematic search of evidence on the effectiveness of small bowel feeding on nosocomial pneumonia prevention for tube-fed critically ill patients;
2. To assess the feasibility and transferability of implementing small bowel feeding in local setting;
3. To develop an evidence-based clinical guideline on small bowel feeding for nosocomial pneumonia prevention in tube-fed critically ill patients in local hospital;
4. To formulate plans for implementing and evaluating this evidence-based clinical guideline in local setting.

Nosocomial pneumonia does not only affect the functional prognosis of tube-fed patients, but also may prolong their length of hospital stays and increase the cost of hospitalization e.g. increase of antibiotic use. Prolonged hospital stay will also increase the workload of clinical staff. In regarding to the above reasons, small bowel feeding should be adopted to better prevent tube-fed patients from getting pneumonia because small bowel feeding method is more effective in avoiding pneumonia related risk factors such as aspiration and thus reducing the incidence of pneumonia. The high incidence rate of nosocomial pneumonia in tube-fed older patients has contributed a significant number of inpatients among patients diagnosed with pneumonia. If we continue to neglect this problem, not only will high incidence of pneumonia create a great burden on Hong Kong health care system, but also
the mortality rate of pneumonia patients will increase. This study tries to identify the effectiveness of small bowel feeding on nosocomial pneumonia prevention in tube-fed patients. After that, an evidence-based clinical guideline will be formulated for nurses to follow when caring tube-fed patients. Successful implementation of this study can help reduce the incidence and mortality rate of nosocomial pneumonia in tube-fed patients, and thus also reduce their hospitalization time and the associated health care expenditure.
Chapter 2

Literature Review and Critical Appraisal

2.1 Search and Appraisal Strategies

2.1.1 Identification of Studies

Reviewed studies are retrieved based on the inclusion and exclusion criteria by searching online electronic databases from medical library of The University of Hong Kong. The searching databases included PubMed, British Nursing Index and CINAHL Plus. The keywords ‘nasogastric tube feeding’, ‘pneumonia’, and ‘small bowel feeding to prevent pneumonia’ are identified. Heading terms are used in the search in each database. No language restrictions are applied to search filters so language bias can be avoided. Only RCTs filter is applied to search results. By screening the titles and abstracts of all citations, full text versions of all potential studies are identified. All potential studies are read thoroughly. Subsequently, the relevant articles are selected for further quality assessment. Further potential studies could be retrieved by hand searching of the reference lists of the retrieved studies or by searching from systematic review.

2.1.2 Inclusion and Exclusion Criteria

Retrieved studies are required to meet inclusion criteria as follows:

1. Studies on any kind of small bowel feeding to prevent nosocomial pneumonia in tube-fed critically ill patients.
2. Randomized controlled trial.
3. The subject population is tube-fed critically ill patients, with or without
mechanical ventilation, aged 18 or above, and regardless of gender.

4. Inclusion of at least one of the related outcome measures: incidence of pneumonia (all forms), the length of hospital stay and the mortality rate.

Studies are excluded if they contain:

1. Pharmacological interventions.
2. Patients with bowel problems.
3. Patients with percutaneous gastrostomy tube feeding.

2.1.3 Data Extraction

The four retrieved articles (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek, Haigh, & Doig, 1999) are analyzed and an evidence table is created to synthesize relevant data from them. Bibliographic citation, study design, patient characteristics, intervention and control group, length of follow up, outcome measures, effect size and level of evidence are included in the table of evidence (Appendix II). All of the studies are randomized control trials (RCTs). The subject patients of all studies are critically ill. Retrieved studies identify different kind of small bowel feeding methods including different regions of small intestine e.g. duodenal feeding. The studies also contain the outcome measures of incidence of pneumonia, mortality rate, length of stay and incidence of aspiration or gastroesophageal regurgitation (known risk factors of AP).

2.1.4 Appraisal Strategy of the Retrieved Studies

In order to assess the methodological quality and internal validity of the retrieved papers, the methodology checklists for controlled trials (2012 version) from the Scottish Intercollegiate Guidelines Network (SIGN) is used to
analyse critically the quality of the retrieved papers. The SIGN checklist is attached in Appendix IV and the quality assessment of studies is summarized in Appendix III.

2.2 Results

2.2.1 Search Results

A systematic search was conducted in August to September 2013, a total of 78 citations and their full texts were retrieved. By screening the titles, total 21 potential relevant studies were identified. Then, two studies were identified via further screening of the abstracts of these 21 potential studies. Meanwhile, two studies were selected via hand searching of the reference lists of the retrieved studies or searching from systematic review. As a result, a total of four relevant articles were identified for the study and for significance and quality assessment. The search strategies are summarized in Appendix I.

2.2.2 Methodological Quality of Studies

The quality of randomized trials and clinical controlled trials are evaluated for the objectives of the research, method of random allocation, blinding, allocation concealment method, patient baseline characteristics, treatment under investigation difference, the reliability and validity of outcome measurement, withdrawals and dropouts, intention-to-treat analysis and comparability of study results between different sites.

All of the four RCTs (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999) clearly stated their objectives of studies by stating the sample population, interventions and the outcome
measurements of their studies in the abstract.

Three RCTs (Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999) clearly stated the randomization process while one RCT (Acosta-Escribano et al., 2010) did not describe its randomization method in details. Heyland et al. (2001) used randomization by taking a sealed opaque envelope. Concealment and blinding are the essential factors to eliminate biases in a RCT. Another two studies randomly assigned the intervention group and control group by using software to generate randomization schedule, and all caregivers were blinded to the randomization sequence (Hsu et al., 2009; Kortbeek et al., 1999). In the studies of Kortbeek et al. (1999) and Heyland et al. (2001) blind to some outcome assessors (i.e. radiologists and laboratory personnel respectively) were mentioned. The remaining two RCTs did not report any blinding to outcome assessors (Acosta-Escribano et al., 2010; Hsu et al., 2009).

The baseline characteristics of the intervention and control group were clearly presented in four studies (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999). All the studies reported that no additional treatment between two groups and the only difference between groups is the treatment under investigation.

All reviewed studies clearly stated that their primary outcomes and secondary outcomes. For instance, the definitions of clinical terms (e.g. pneumonia and VAP) were clearly defined in each study. Also, diagnosis of pneumonia was clearly defined by Acosta-Escribano et al. (2010) with the use of Clinical Pulmonary Infection Score (CPIS). For VAP, it could be diagnosed by interpreting chest radiography, blood result and pathogenic microorganism in
tracheal specimen (Hsu et al., 2009; Kortbeek et al., 1999). Three RCTs (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009) clearly described other pneumonia-related risk factors such as aspiration. Methods of small bowel tube placement have been clearly described (Acosta-Escribano et al., 2010; Hsu et al., 2009; Kortbeek et al., 1999). However, certain degree of the reliability and validity of the other measuring methods might not be achieved as some measuring methods were not reported in detail in some reviewed studies.

The number of patients that dropout of a study should be concerned if the number is higher than a certain rate. According to the checklists from SIGN, less than 20% dropout rate is considered as acceptable. Otherwise, attrition bias may affect the results. Acosta-Escribano et al. (2010) reported that the dropout rates in intervention and control group were 10% and 3.7% respectively. The loss of follow up was due to unsuccessful placement of tube. Heyland et al. (2001) reported that the dropout rates in intervention and control group were 33.3% and 0% respectively, and high dropout rate in small bowel group was resulted from incompletely or wrong treatments as well as patient death. High dropout rate leads to small sample size and thus affects the power of study. The remaining two RCTs did not mention the attrition and did not provide the dropout rate (Hsu et al., 2009; Kortbeek et al., 1999). Intention-to-Treat (ITT) analysis was done before the subjects were assigned in intervention or control group. Two studies (Acosta-Escribano et al., 2010; Hsu et al., 2009) have done ITT analysis. Two RCTs (Hsu et al., 2009; Kortbeek et al., 1999) did not mention the use of ITT analysis.

Results and dates gaining from multiple-centred studies normally have
higher credibility. All of the four studies are single-centred. All subjects are recruited from intensive care units (ICUs).

2.2.3 Summary of the Quality Assessment

In summary, the quality of RCTs is assessed according to appropriateness and clarity of research question, randomization, allocation concealment, blinding, patient baseline characteristics, treatment under investigation difference, the reliability and validity of outcome measurement, withdrawals and dropouts, ITT analysis and comparability of study results between different sites. Two RCTs (Acosta-Escribano et al., 2010; Hsu et al., 2009) have fulfilled most of the criteria in the checklist and were methodologically strong. The remaining two studies (Heyland et al., 2001; Kortbeek et al., 1999) have fulfilled some of the criteria and achieved a moderate quality rating.

In all the four studies, all the subjects of studies were tube-fed and under mechanical ventilation. The studies were all conducted in different kind of ICUs. In the studies by Heyland et al. (2001) and Hsu et al. (2009), the subjects were older patients with mean age over 60. For remaining two studies (Acosta-Escribano et al., 2010; Kortbeek et al., 1999), the age of the subjects ranged from 34- 39. Although not all reviewed studies included older patients as subjects, the demographic characteristics of study patients of all studies were not significantly different. Besides, all the subjects were critically ill. All these characteristics actually were quite similar since the patients were tube-fed and with advanced age, and they usually were critically ill. Based on above data, the results of reviewed studies are applicable to the researcher’s clinical setting, i.e. a medical ward, in which over 30% of older patients require enteral nutrition
and they are at high risk of developing nosocomial pneumonia during hospitalization.

2.3 Data Summary and Synthesis

As mentioned before, all reviewed studies are RCTs, and they all identified the effectiveness of small bowel feeding on prevention of nosocomial pneumonia. In this view point, the use of small bowel feeding method seems to have positive effect on nosocomial pneumonia prevention among tube-fed older patients. The details of this evidence-based intervention and its effectiveness are summarized as follows.

2.3.1 Summary of Data

The reviewed studies included different methods of small bowel feeding in relation to pneumonia prevention. All of the four RCTs recruited subjects who were mechanically ventilated and required enteral nutrition. In order to investigate the effectiveness of small bowel feeding on nosocomial pneumonia prevention, all reviewed studies will be compared according to the different the clinical outcomes between small bowel feeding group and gastric feeding group. Kortbeek et al. (1999) and Hsu et al. (2009) reported duodenal feeding as the intervention group while the remaining two RCTs showed jejunal feeding as the intervention group.

Outcome of Measurement

This study aims to identify the effectiveness of small bowel feeding on nosocomial pneumonia prevention. Therefore, the clinical outcomes of
incidence of pneumonia, mortality and risk factors of pneumonia are included and analyzed in the data synthesis part.

*Incidence of Nosocomial Pneumonia*

The incidence of pneumonia was reported in three RCTs. Kortbeek et al. (1999) and Acosta-Escribano et al. (2010) reported the incidence of pneumonia as clinical outcome while Hsu et al. (2009) reported VAP events. All of them showed positive effect on pneumonia rate reduction.

*Incidence of Gastrointestinal Complications*

As mentioned before, some of the gastrointestinal complications (i.e. aspiration and gastroesophageal regurgitation) are well known risk factors of pneumonia development (Heyland et al., 2001). The incidence of aspiration and vomiting were covered in the studies by Heyland et al. (2001) and Hsu et al. (2009) respectively. Acosta-Escribano et al. (2010) also reported gastrointestinal complications including aspiration incidence as one of the measure outcomes. Moreover, one study showed a significant reduction of gastroesophageal regurgitation in small bowel feeding group (Heyland et al., 2001).

*Length of Hospitalization and Mortality*

All of the studies except Heyland et al. (2001) reported the length of stay (LOS) in hospital and the results were not statistically significant (p > 0.05). In regards to mortality rate, this was only reported by Kortbeek et al. (1999) and Hsu et al. (2009) as clinical outcome. The mortality rate was similar in both
intervention and control groups, and the result was also insignificant.

2.3.2 Data Synthesis

All reviewed studies provided sufficient evidence to support the positive effect of small bowel feeding on nosocomial pneumonia prevention for tube-fed critically ill patients in medical ward. Even though all of the four studies were conducted in ICUs, the patient demographic characteristics were deemed not statistically significant (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999). Moreover, the study populations of all reviewed studies were frail, and the mean age of patients tended to be advanced in two studies (Heyland et al., 2001; Hsu et al., 2009). Therefore, the results of studies could be comparable to local clinical setting since the tube-fed patients were also critically ill and fragile in researcher’s medical ward. According to researcher’s clinical observation, tube-fed patients were prone to develop nosocomial pneumonia during hospitalization. The effectiveness of the small bowel feeding on pneumonia prevention are reviewed and shown as follows:

A distal small bowel feeding site has been highly recommended to minimize aspiration risk and subsequent pneumonia. Metheny, Davis-Jackson, and Stewart (2010) reported that small bowel feeding tube insertion should be ordered when a high-risk patient is identified. Afterwards, a radiograph was necessary to confirm the actual tube location (Hsu et al., 2009; Metheny et al., 2010). Two reviewed RCTs (Acosta-Escribano et al., 2010; Heyland et al., 2001) showed a beneficial effect in jejunal feeding group when compared to gastric feeding group, while the other two studies used duodenal feeding as
intervention group (Hsu et al., 2009; Kortbeek et al., 1999). Acosta-Escribano et al. (2010) evaluated the efficacy of jejunal feeding compared to gastric feeding in brain injury patients. The approach of placing a double-lumen tube in the jejunum via a trans-nasal or a trans-oral route demonstrated significant reduction of incidence of total pneumonia with an odd ratio of 0.3 (34% vs 55%, p= 0.01). Acosta-Escribano et al. (2010) also reported that jejunal feeding group had significant effect on reducing incidence of late pneumonia (i.e. VAP) with an odd ratio 0.2 (24% vs 48%, p= 0.02). Kortbeek et al. (1999) and Hsu et al. (2009) demonstrated duodenal feeding significantly reduced the incidence of pneumonia and VAP respectively.

The study by Heyland et al. (2001) did not evaluate the effect on incidence of pneumonia but demonstrated a significant reduction on gastroesophageal regurgitation in jejunal feeding group (24.9% vs 39.8%, p= 0.04). Heyland et al. (2001) also reported that small bowel feeding reduced the aspiration frequency but the result was insignificant (3.9% vs 7.5%, p = 0.22).

Hsu et al. (2009) presented the situation that older patients received nasoduodenal (ND) feeding in ICU. Comparing to patients receiving nasogastric (NG) feeding, ND feeding group presented a lower incidence rate of vomiting (1.7% vs 12.9%, p= 0.01) and VAP (3.1 vs 8.6 per 1000 ventilator day, p= 0.01). These two RCTs indicated that small bowel feeding was effective in minimizing the risk of gastroesophageal regurgitation, aspiration and subsequent pneumonia. For mortality rate, there was no significant difference between small bowel feeding and gastric feeding groups (Acosta-Escribano et al., 2010; Hsu et al., 2009; Kortbeek et al., 1999). Both Acosta-Escribano et al. (2010) and Hsu et al. (2009) reported the LOS. The
results were similar and not statistically significant.

After reviewing the above mentioned four retrieved studies, it can be concluded that small bowel feeding is an effective intervention for preventing nosocomial pneumonia and related risk factors of pneumonia in tube-fed critically ill and older patients. The reviewed methods of small bowel feeding included jejunal and duodenal feeding. After considerations, small bowel feeding methods are selected since all studies demonstrated that small bowel feeding was evidence-based and showed beneficial effects on pneumonia prevention.
Chapter 3

Translation and Application

3.1 Implementation Potential

In previous chapter, the integrated literature review has demonstrated enough supporting evidence that small bowel feeding method is effective in preventing nosocomial pneumonia in tube-fed critically ill patients. Before implementing this evidence-based intervention into the local clinical setting, the implementation potential of this innovation should be assessed to find out the potential supports and obstacles. The implementation potential includes three main dimensions: accordingly the transferability of findings, feasibility of the innovation and the cost-benefit ratio of the guideline.

3.1.1 Transferability of the Findings

In order to assess the transferability of the findings of the retrieved studies, the patients’ demographic characteristics and the study settings should be compared to determine whether the proposed innovation is applicable to local setting. Moreover, the philosophy of care and number of benefiting patients should also be considered for the transferability.

The local clinical setting is a general medical ward of a public hospital that comprises four specialties: General Medicine, Respiratory, Stroke Rehabilitation and Cardiac Rehabilitation. Each specialty has two wards, including one male ward and one female ward. Hence, there are a total of eight wards in the medical department. For annual admission in the whole
department, the male proportion was 70% while female proportion was 30%, and the mean age was 60.

In the four reviewed articles, the demographic patients’ characteristics of all retrieved studies were similar and were not substantially different. Most patients were critically ill and suffered from multiple medical illnesses. The male patients’ population was greater than the female patients’ population (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999). The mean age of study patients was over 60 in two retrieved studies (Heyland et al., 2001; Hsu et al., 2009) while the mean age of patients was about 40 in other two studies. Therefore, the demographic characteristics of the target population in retrieved studies are similar to that in the local setting.

Besides, the philosophy of care underlying the new innovation and the local setting are fundamentally similar in providing an excellent and evidence-based care. According to all retrieved studies, the purposes of implementing small bowel feeding were to prevent nosocomial pneumonia in critically ill patients so as to reduce morbidity and mortality. The motto of the local hospital is “Quality in Service and Excellence in Care”, which is consistent to the proposed evidence-based small bowel feeding. Nurses are encouraged to provide quality care through implementing evidence-based and innovative interventions.

Another element of transferability is the number of patients benefiting. By clinical observation from January 2013 to June 2013, there were a total of 3600 patients admitted to target medical department with about 30% of them requiring nasogastric tube feeding during hospitalization regardless their
diagnosis. Therefore, the estimated number of tube-fed patients who will be benefited from the new innovation would be around 2160 per year (1080 x 2, i.e. 2160), which is a substantial number.

Furthermore, the time for implementation and evaluation of innovation should be within 18 months. To make it clearly, the whole schedule will be split in three time frames, including preparation phase, pilot testing, as well as implementation and evaluation phase. Firstly, in-service training and preparation are required. Then, the innovation will be piloted in one designated medical ward for one month. The innovation will be further implemented in whole medical department (8 wards) for seven months. Evaluation will be done during implementation period.

### 3.1.2 Feasibility of the Innovation

Apart from transferability, feasibility of the innovation should be taken into consideration. The following elements should be assessed to evaluate the feasibility: the freedom of implementation, the readiness of staff, consensus and potential resistance among staff, administration support, availability and accessibility of resources, staff development and availability of evaluation tool.

#### 3.1.2.1 The Freedom of Implementation

Nurse endoscopist is an established post in the United Kingdom (Pathmakanthan, Murray, Smith, Heeley, & Donnelly, 2001). Nurses can perform oesophago-gastroduodenoscopy (OGD) independently with no compromise in safety. In Hong Kong, OGD can be done by well-trained
endoscopy nurse as well. Moreover, in the local hospital, nurses can initiate defibrillation on patients without the presence of physician when the shock-able waveforms are identified during resuscitation. This evidence-based practice is highly promoted in the local hospital because there is evidence showing that successful resuscitation can be achieved by early defibrillation. The nurse-led clinical practice can also be applied to the present innovation.

For nasogastric tube feeding, nurses can perform tube insertion and associated nursing care on tube-fed patients. However, for the small bowel feeding methods, the procedure of small feeding tube insertion is not performed by nurses but by physicians traditionally. Therefore, initiating small bowel feeding will firstly need the agreement from physicians. Moreover, nurses should acquire the insertion skills before implementing this innovation. Most importantly, nurses should take responsibility to inform physicians and initiate the innovation based on patients’ physical condition since nurses are more readily available in wards. After the insertion of small bowel feeding tube and the confirmation of site by X-ray, nurses can start small bowel feeding and perform related nursing care similar to that of nasogastric tube feeding, e.g. serial pH and tube location monitoring. Therefore, nurses still are playing an important role in this innovation regardless of who will perform small bowel feeding tube insertion.

3.1.2.2 Consensus and Potential Resistance among Staff

Implementation of the new innovation will definitely affect the existing practice. All staff including nurses and physicians should be familiar with the skills and knowledge of the new intervention. During pilot testing, nurses may
need more time to adapt to the new protocol. Even though training will be provided to nurses before pilot test, it is expected that nurses will spend longer time to complete each insertion when compared with nasogastric tube insertion. It is because small bowel feeding tube insertion requires more techniques and equipment. Given the above reason, plus there will be no extra manpower, it is though expected that the workload of staff will increase in the early implementation of the new practice, it will not be a major problem when nurses become more familiar with the innovation. The most importantly, all nursing and medical staff should understand the purpose of initializing small bowel feeding is to reduce nosocomial pneumonia among critically ill patients so as to reduce its mortality and morbidity. In the long run, the reduction in the LOS in the hospital will mean the reduction of the overall staff workload. This will be one of the essential factors to gain staff consensus and overcome their resistance to implementing this new innovation.

3.1.2.3 Administration Support

The administrators of the hospital will fully support the new innovation since the organizational climate is conducive to evidence-based nursing practice. The Departmental Operational Manager (DOM) of medical department and Ward Managers (WMs) always encourage research sharing and utilization in the hospital. In addition, Journal Club, established by Nursing Services Division (NSD) since 2009, holds regularly every four months to promote nursing research and encourage nurses to share their knowledge to each other. By sharing evidence-based practices (EBPs) from other countries, the hospital can improve current nursing care system as well
as the quality of services. Therefore, intensive meetings will be arranged to
seek support and approval of the proposed innovation from parties mentioned
since the local hospital is a small hospital and has limited funding on new
project.

3.1.2.4 Availability and Accessibility of Resources

Small bowl feeding requires small bowel feeding tube that is much longer
than nasogastric tube because it will be placed at the region of duodenum or
jejunum. Small bowel feeding tube has to be purchased since the local hospital
has no stock of the item. Small bowel feeding tube can be placed by using
endoscopy or ultrasound guidance machine to achieve higher success rate. All
deroscopic equipment and bedside ultrasound machines are available in
Central Devices Unit (CDU) of the local hospital. Four endoscopy nurses are
also available. Tube insertion related equipment, similar to that of nasogastric
tube insertion, e.g. pH paper, lubricant jelly, gloves, adhesive tape, feeding
syringe, stethoscope, are already available at every medical ward and can be
easily bought from medical suppliers. The radiology department is also
available and is responsible for performing abdominal X-ray to confirm tube
placement.

3.1.2.5 Skills Requirement and Staff Development

Small bowel feeding requires specific insertion skills to place the feeding
tube at the region of duodenum or jejunum. Nurses need to acquire tube
insertion skills and the knowledge of the protocol accordingly. Thus, an
educational class and skills workshop will be held. It is estimated that around
180 patients requiring nasogastric tube feeding will be admitted to the local hospital monthly and most of them will be suitable for small bowel feeding unless contradicted. Therefore, three senior nurses from each speciality (i.e. $3 \times 4 = 12$) will be selected by WMs to attend this group training. The in-service training program will be completed within two months. Four sessions of educational classes and four sessions of skills workshops will be conducted and each session will last for one hour. All well-trained nurses will be expected to share their knowledge and skills to other junior nurses. Trained senior nurses will become trainers to train other nurses. Regular audit will be done by internal audit team from NSD to maintain the standard of skill performance.

3.1.2.6 Availability of Evaluation Tool

Furthermore, outcome measuring tools are available to evaluate the effectiveness of the innovation. The outcome measures include the incidence of nosocomial pneumonia, incidence of gastrointestinal complications, length of hospitalization and mortality. All of these outcomes can be retrieved from routine medical records. Integration and analysis of retrieved data will be needed to obtain the statistical results.

3.1.3 Cost-Benefit Ratio of the Guideline

To assess the cost-benefit ratio of the innovation, both the risks the tube-fed patients would be exposed to during the implementation of small bowel feeding and the potential benefits should be considered first. As mentioned before, the proposed intervention is to prevent nosocomial pneumonia in
tube-fed critically ill patients. It is already known that tube-fed critically ill patients were easily susceptible to aspiration, which might contribute to nosocomial pneumonia (Jiyong et al., 2013), and resulting in antibiotic treatments and prolonged hospitalization.

Therefore, the major advantage of implementing the new innovation is the reduction in antibiotic use and duration of hospitalization. Subsequently, the medical expenditure can be reduced. Moreover, nurses can implement EBP and enhance the quality of patient care. By implementing the guideline, nurses will be able to perform appropriate action promptly according to patients’ conditions. At the same time, the knowledge of nurses can be sharpened and the culture of EBPs in the hospital can be promoted. The organizational image of the local hospital can also be enhanced among the public.

Nevertheless, the new innovation may cause some risks. Nasogastric tube insertion is a basic nursing technique and its failure rate is relatively low. However, positioning a feeding tube into the small intestine is technically more challenging than positioning into the stomach. Success rate for tube insertion is related to the available equipment and placement techniques (Cresci & Martindale, 2003). The success rates of gastric tube and small bowel feeding tube are 93.3% and 82% respectively (Jose & Kenneth., 2006). Hsu et al. (2009) presented that the incidence of tube replacement of small bowel feeding tube is higher than that of gastric tube (15.3% vs 9.7%). Frequent reinsertion of small bowel feeding tube will also increase the workload of nurses or doctors, delay feeding even may increase the risk of complications such as gastrointestinal bleeding and small bowel perforation. Moreover, the small bowel feeding tube tends to be blocked more easily since it is usually
longer and has finer bore. Therefore, the tube should be flushed regularly to maintain patency.

For the operational cost for implementation of new innovation, it can be divided into material cost and non-material cost. Material cost includes expenses for small bowel feeding tube to replace nasogastric tube. According to ORACLE iProcurement from HA intranet, the price of nasogastric tube (12Fr - 16Fr) is around HK$1.5 whereas the price of small bowel feeding tube is much more expensive that it costs HK$50. The equipment required for feeding tube insertion, continuous feeding pump and endoscopic equipment all are available in the local setting. The estimated annual costs for guideline documentation and printing materials are HK$2000 and HK$4000 respectively. The non-material cost includes the cost of staff development such as educational class and workshop. A total of eight sessions of classes and workshops will be held, each session will last for one hour. A total of 12 senior nurses from medical ward will be assigned to attend the above training. Moreover, all frontline staff, including 35 physicians and 170 nurses, will be scheduled to attend the seminar for 30 minutes. The venue for training workshops and seminars is the multifunction room in the hospital. The estimated cost for training program will be HK$39,100 (Appendix VI). Moreover, small bowel feeding tube insertion will require longer time than that of nasogastric tube and it is estimated to be 40 minutes for each insertion, and the additional working time accounts to a great proportion of the operational cost. As a result, the total annual cost for implementing the proposed innovation will be HK$1,198,540 and is calculated in details in Appendix VI.
The reduction in antibiotics use and patient’s LOS is considered to be the main source of saving. According to the reviewed studies, implementation of the small bowel feeding will reduce the incidence of nosocomial pneumonia among critically ill tube-fed patients. Physician will prescribe intravenous (IV) antibiotic immediately if the patients are diagnosed with pneumonia. IV Augmentin 1.2 g will be initiated first and the course of intravenous antibiotic will be applied three times per day commonly and will last for 1 - 2 weeks. The estimated cost of antibiotic therapy will be HK$2,540,160 (Appendix VII). The usage of IV antibiotic can be reduced when the incidence of pneumonia reduces. The numbers of injection and preparation time for IV antibiotics by nurses can also be reduced. Meanwhile, the follow up medical investigations such as blood test and sputum test can be avoided. The workload of nurses can be reduced subsequently. Furthermore, the LOS in hospital, the length of mechanical ventilation and mortality will also be decreased (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999). The HA statistical report 2011 - 2012 reported that the LOS for older patients (age > 60 years) was 12 - 17 days. High incidence of pneumonia in this patient group was also mentioned. According to the expenditure of public hospitals reported by HA, the estimated daily cost for one medical bed is HK$ 3700. Therefore, every decrease of one day in hospital stay will contribute to huge savings in the local hospital. If antibiotic cost only is considered for calculation, the estimated annual savings is beyond HK$2,540,160 (Appendix VII).

After assessing the transferability, the feasibility and cost-benefit ratio of the small bowel feeding guideline, the potential benefits and barriers are
identified. With evidence from the reviewed studies, it can be concluded that the proposed innovation is able to provide sufficient positive effect to patients, and the potential benefits it brings about are greater than the potential barriers and the operational cost. With good support from administration and staff, it will be implemented to the local setting successfully.

3.2 Evidence-Based Practice Guideline

After assessing the implementation potential of the small bowel feeding, small bowel feeding can be potentially applicable to the local setting, and it is cost effective in prevention of nosocomial pneumonia among critically ill tube-fed patients. An evidence-based guideline titled ‘Small Bowel Feeding Guideline for Nosocomial Pneumonia Prevention in Critically Ill Tube-fed Patients’ is going to be established based on the reviewed evidence. Nevertheless, the reviewed studies were not sufficient to produce all instructions of guideline. Also, this guideline focuses on the nursing care on small bowel feeding. Therefore, some instructions and recommendations from two high quality clinical guidelines (Kreymann et al., 2006; Nicola R, 2007), especially the insertion procedures, will also be adopted to generate some instructions in this guideline. There are total five recommendations formed and summarized in Appendix VIII. The ‘Small Bowel Feeding Guideline for Nosocomial Pneumonia Prevention in Critically Ill Tube-fed Patients’ and its modified tube insertion guideline are formulated in Appendix IX and Appendix X respectively.
Chapter 4
Implementation Plan

In previous chapter, the new evidence-based clinical guideline is formulated. The guideline standardizes the care procedures to prevent nosocomial pneumonia for critically ill patients with tube feeding, which are highly applicable to the local setting. In order to implement the new innovation successfully, a strategic communication plan for the related parties is essential. Only through strategic communications can the strengths and weaknesses of the new innovation be raised and evaluated, and thus be favorably accomplished and further improved. Therefore, a systematic, thorough implementation and evaluation plan should be well developed prior to the execution of the guideline in local clinical setting.

4.1 Communication Plan
4.1.1 Introduction
An effective communication is critical for distributing information and clarifying questions concerning the new innovation. To facilitate the innovation implementation, a strategic communication plan should take into account different potential users and stakeholders who may be affected by the new practice adoption. The communication process and strategy among stakeholders should be developed in order to gain their supports and sustain the change process of the innovation.
4.1.2 Stakeholders Identification

The first step of the communication plan is to identify the stakeholders. Stakeholders are defined as any group or individual who can affect or is affected by the achievement of the organization’s objectives (Freeman, 1984), and whose importance should be identified according to their degree of influence. In this study, stakeholders are divided into three groups: Administrators, Project Coordination Team and all Frontline Staff.

Administrators are the Chief of Services (COS), the DOM and WMs of the Medical Department. The COS and the DOM are important stakeholders because they manage all the resources and manpower in the hospital, and they are the major decision makers. Four WMs from eight medical wards are also key parties. Not only do they take responsibilities for arranging daily operation in each ward, but also they assume responsibilities for coordinating with eight Advanced Practice Nurses (APNs) and four designated senior nurses, who together will form a project coordination team to assist the implementation of the new innovation. The team will be responsible for delivering messages, promoting the new practice to all frontline staff, and helping in innovation enhancement. The third major group of stakeholders consists of all frontline staff, including medical consultants, medical officers, CDU nurses and ward nurses. Frontline staff perform a crucial role in this innovation since they are the ones who implement the new practice to target patients during implementation period.

4.1.3 Communication Process and Strategies

In this 18-month-program (Appendix XI), it can be divided into three
phases including preparation phase, pilot testing, as well as implementation and evaluation phase.

In the preparation phase, communication to identified stakeholders is the initiation of the new innovation. Gaining administrative support from the COS and the DOM is the first step towards the implementation of the new practice to local setting. The DOM should be approached first for various reasons. First, the DOM is generally helpful and supportive in innovative patient care as well as staff development. In addition, journal sharing within the department is highly encouraged and therefore effective communication is more easily accomplished. Furthermore, evidence-based practice has been highly promoted in local hospital, which indicates the sign that the new innovation is more readily accepted. The proposal of the new practice will be presented to the DOM. The presentation will mention the problems of nosocomial pneumonia especially that of aspiration pneumonia among tube-fed critically ill patients and the significance of small bowel feeding. The presentation should be precise and the concept of innovation should be explained to the DOM clearly with benefits highlighted.

After gaining support from the DOM, the COS will be approached together with the DOM. The benefits of the new innovation will be presented to the COS from physician’s perspective. As the new innovation promotes nurse-led small bowel feeding, not only does it save physician’s time on tube insertion, but also it helps reduce pneumonia rate. Once the incidence of pneumonia reduces, all the medical treatments and investigations for pneumonia (e.g. blood test, oral or intravenous antibiotics) can be saved. When the support from both the COS and the DOM is gained, a written approval of the
implementation plan will be sought.

The Communication Team will then be formed after gaining permission from administrators. The members of the communication team include the DOM, the COS and four WMs from eight medical wards. The first discussion of this communication team will be held casually in a relaxing atmosphere. A comprehensive proposal with evidence and clear objectives will be presented at the beginning. This presentation aims to convince them the value and importance of the new practice, and thus persuade them to give administrative support. Constructive advice and substantial supports will be gained from the members at the mean time. The communication team meeting will be arranged every six months with the existing departmental nursing meeting.

As mentioned in stakeholders’ identification, the project coordination team consists of the proposer of this new innovation, four WMs, eight APNs and four designated senior nurses. Once support from the communication team is gained, intensive project coordination team meetings will be held to organize and supervise the implementation activities. Evidence-based small bowel feeding guideline for nosocomial pneumonia prevention will be reported during meetings. In addition, all major outcomes of new practice and the cost-benefit ratio of the guideline will be discussed. Feedbacks from all stakeholders in the meeting will also be discussed in order to seek enhancement of the new practice. The meetings will be held for the first successive four months and then half-yearly with the existing senior nurses meeting. The progress of the innovation will become an agenda item and will be reported in the meetings.

Along with the meetings mentioned above, promotional activities will be
practiced in order to advertise the new innovation and to motivate frontline staff to be ready for it. Informative posters about small bowel feeding guideline will be posted in each ward. In addition, copies of small bowel feeding guideline and related procedure references will be printed out and made available in each ward. A seminar on the introduction of the innovation will be held for all frontline staff by providing evidence on nosocomial pneumonia prevention so to raise their awareness.

To keep them informed, frontline staff of each ward will receive updated information of new innovation regularly via the existing monthly ward meetings, hospital emails and announcements from shift-in-charge during shift-change reporting. The updated information will also be available in the hospital webpage. Apart from the promotional activities, equipment needed for small bowel feeding tube insertion will be prepared, and stocks of small bowel feeding tubes will be ready for pilot test.

Before pilot testing, two-month in-service training including four sessions of educational classes and four sessions of skills training workshops will be designed by the project coordination team with the help of a medical consultant and medical officers. Each session will be held every Friday and will last for one hour. The educational classes will be held first. In the classes, details of small bowel feeding guideline, patient recruitment and assessment form of small bowel feeding will be introduced and discussed. The skills training workshops will introduce the indication of small bowel feeding with concrete evidence and the small bowel feeding tube insertion technique. Return demonstration and skills assessment are required to assess the skill level of all designated senior nurses after the four training sessions.
4.2 Pilot Testing

A one-month pilot test will be carried out before full implementation of the guideline to assess the feasibility of the new innovation. It helps detect potential misconception and unexpected problems of the innovation. In addition, it helps find out the potential difficulties in running the innovation, and helps assess the degree of necessity for additional resources. Data collected from the pilot study will be useful for revising the original protocol.

Two medical wards (one male ward and one female ward) will be selected to carry out the pilot test. According to researcher’s clinical observation, the estimated number of tube-fed patients who will be benefited from the new innovation will be around 2160 patients annually in eight medical wards. At a rough estimate (i.e. 2160/12 months/8 wards = 22.5 patients), about 45 patients will be recruited from two wards. Eligible patients are recruited by team nurses and project coordinators (APNs and designated senior nurses) according to the basic eligible criteria and aspiration risk factors (Appendix IX).

After patient recruitment, the new guideline will be implemented step by step. The project coordinators are responsible for supervising the adoption of the new guideline by all frontline staff. Before the pilot test, all frontline nurses and physicians should be familiar with applying small bowel feeding tube to critically ill tube-fed patients through training programs and regular announcement from meetings. Before tube insertion, assessment will be done by the project coordinators to confirm the appropriateness of small bowel feeding tube insertion, thus to ensure the patient safety. Insertion of small bowel feeding tube will be performed by APNs or trained senior nurses, and
the procedures of small bowel feeding tube insertion will be supervised by the project coordinators and physician in the CDU. Gastric residual volumes (GRVs) will be monitored every four hours and will be recorded accordingly on the fluid balance chart and new observation chart (Appendix XII) after insertion of small bowel feeding tube. GRV is a key indicator of identification of aspiration risk of patients in short period of time. The project coordinators will continuously follow up the conditions of the recruited patients and evaluate the effectiveness of the pilot test.

All data collected in the pilot test (including patients’ demographic background, pattern of GRVs, incidence of pneumonia, onset time of nosocomial pneumonia, etc.) will be evaluated in the following months. Meanwhile, all difficulties of the clinical application (e.g. staff compliance and tube insertion skills) encountered in the pilot test will be discussed and investigated. Evaluation form (Appendix XIII) will be distributed to frontline staff after the pilot test. Modification of the protocol and additional training may be needed for further enhancement before full implementation of new guideline in eight medical wards. After the evaluation of the pilot test, the evaluation report including the finalized protocol and the outcomes of new innovation will be presented to the DOM, the COS and all WMs.

### 4.3 Evaluation Plan

To evaluate the effectiveness of the small bowel feeding clinical guideline, a well-organized evaluation plan is necessary. In the evaluation plan, several aspects are included to assess the benefits of the innovation, and they can be categorized into patient outcomes, healthcare provider outcomes and system
4.3.1 Patient Outcomes

The primary patient outcome is the incidence of nosocomial pneumonia. Nosocomial pneumonia is defined as all form of pneumonia with an onset 48 hours or more after admission to the hospital (Ferrara, 2006). The follow up time of each recruited patient will last for one month so as to compare the differences between the nasogastric tube feeding and small bowel feeding. The onset time of nosocomial pneumonia of each patient will be measured. Days will be used as the unit for time measurement. The reduction of number of days of pneumonia development may reduce unnecessary hospitalization and subsequent risk of nosocomial infection. Thus, the LOS in ward will be measured. The LOS is defined as the total time patients stay in medical ward from admission until the time of discharge. The unit for measurement is days. Another patient outcome is the incidence rate of gastrointestinal complications. Incidence of aspiration and incidence of gastroesophageal regurgitation, which are well known risk factors of pneumonia development, will be measured by clinical observation.

4.3.2 Healthcare Provider Outcomes

Another important category of parameters to be measured is healthcare provider outcomes. All frontline staff including nurses and physicians should be evaluated. The evaluations include nurses’ tube insertion skill, satisfaction level of frontline staff and their knowledge towards the new clinical guideline. Besides, the degree of staff’s compliance with the clinical guideline will be
monitored by existing internal audit team. An audit form (Appendix XIV) is designed to assess nurses’ skills on small bowel feeding tube insertion. The audit content will be judged by the medical consultant of the department. All the staff have to fulfill all critical items and achieve 90% above of the standard criteria in skill assessment to get a pass. An additional 30 minutes revision class and re-assessment will be provided for those who fail the skill assessment. Furthermore, Staff Self-Evaluation Questionnaire (Appendix XV) will be distributed to all frontline staff to assess their degree of compliance, confidence and satisfaction level towards the new innovation.

4.3.3 System Outcomes

Due to limited financial budget on healthcare services, administrators always economically allocate the resources according to cost-benefit ratio. The operational cost including the material cost, medical expenditure and the manpower is evaluated and considered as system outcomes. The material cost includes copies of clinical guideline and all equipment for small bowel feeding. For the medical expenditures, they include the cost used in treating nosocomial pneumonia, the cost of antibiotics and the cost of hospitalization. The manpower expenses are additional workload, unexpected extra manpower required and overtime (i.e. attend the training program). The operational cost and savings from the new innovation will be calculated after the implementation.

4.3.4 Nature and Number of Clients to Be Involved

Target population recruitment will be the same as that in the pilot test (i.e.
22 - 23 patients per ward). Convenience sampling is used during patient recruitment. Patients admitted to any one of eight medical wards during implementation period will be subject to recruitment. The inclusion criteria of target patients will be identical to selection criteria stated in the guideline. Details of the selection criteria can be referred to in the algorithm of small bowel feeding guideline (Appendix IX). The follow up period of recruited patients is one month.

The sample size is calculated based on the main primary outcome, i.e. incidence of nosocomial pneumonia. According to the reviewed studies, the reduction in nosocomial pneumonia was ranging from 15% (Kortbeek et al., 1999) to 21% (Acosta-Escribano et al., 2010). By using the computer software (Piface), statistical test for one proportion is performed against the current incidence rate in local setting i.e. 50%. Margin of error will be set as 5%. 278 patients would be needed in the full study. Therefore, 23 patients will be required monthly (i.e. 278÷12 months = 23 patients per month).

4.3.5 Data Collection

All patients’ demographic background and medical conditions can be obtained from medical records. For the patient outcomes (e.g. incidence of nosocomial pneumonia), data of each recruited patient will be collected by the project coordinators throughout the implementation period. For the healthcare provider outcomes, the data will be collected during the pilot test evaluation and at the end of the implementation period via the staff self-evaluation questionnaires. For the system outcomes, the operational cost and saving will be evaluated in the halfway (i.e. March 2016). At the end of the
implementation period, the total expenditure on the innovation will be analyzed entirely.

4.3.6 Data Analysis

For statistical analysis, the primary outcome (i.e. incidence of nosocomial pneumonia) will be analyzed by using a two-tailed z-test to test for the significant difference. The null hypothesis will be that the incidence of nosocomial pneumonia has no significant change after the small bowel feeding clinical guideline implementation. A two-tailed z-test is also used to determine if the change in the incidence of aspiration and incidence of gastroesophageal regurgitation. Level of significance will be set as 5% (i.e. p-value < 0.05). To evaluate the onset time of nosocomial pneumonia, Kaplan Meier analysis is used to estimate the median time to develop pneumonia with a 95% confidence interval.

4.3.7 Basis for an Effective Change of Practice

The new clinical guideline can be validated as effective if the outcomes of evaluation are positive. For patient outcomes, the major patient outcome is the incidence of nosocomial pneumonia. As the results are different among the reviewed studies (15% - 21%), compared to retrospective group, a reduction of 15% in incidence of nosocomial pneumonia will demonstrate guideline’s effectiveness. For the incidence of gastrointestinal complications, the target is to reduce its mean incidence rate by 18%. Regarding the LOS in ward, the mean LOS was 12 days from January 2013 to June 2013. Thus, any reduction in the LOS will be indicated as practically effective.
For healthcare provider outcomes, the result from staff self-evaluation questionnaire requires overall positive comments. Meanwhile, all staff are required to achieve the passing marks in regular audit to maintain the standard of tube insertion skills.

In terms of system outcomes, it is expected that the new guideline can achieve better resources utilization and deliver higher quality of care to patients. The new guideline aims to reduce the incidence of nosocomial pneumonia in critically ill tube-fed patients. An overall reduction of antibiotics use and hospitalization time will accomplish the financial cost reduction on healthcare service. Moreover, staff satisfaction level is also the main concern because the guideline implementation aims at not creating too much extra workload to staff. As a result, staff’s compliance and satisfaction towards the new practice can be maintained.

**4.4 Conclusion**

Nosocomial pneumonia requires a high treatment fee, and it is common in patients with nasogastric tube feeding. Existing measures such as oral care and suctioning are not effective to achieve pneumonia prevention especially in critically ill older patients. Effective intervention, such as reducing pneumonia rate and unnecessary hospitalization, should be identified to improve quality care on tube-fed patients. Based on reviewed evidence, the small bowel feeding clinical guideline for nosocomial pneumonia prevention among critically ill tube-fed patients is formulated. After assessing the implementation potential, small bowel feeding is regarded to be transferable and feasible in local setting.
Small bowel feeding is beneficial to patients by reducing incidence of pneumonia. Incidence of gastrointestinal complications can also be reduced. Meanwhile, hospital service can be enhanced, and the reduction in antibiotics use and the LOS is suggested to be the main source of saving. Even though the new guideline may increase staff’s workload, overall staff’s satisfaction level can be raised via improved patient outcomes, enhanced quality of nursing care, self-knowledge and skills improvement on small bowel feeding. Through strong support from administrators, active participation and communication between project coordination team and frontline staff, the small bowel feeding clinical guideline can be successfully and fully implemented in the medical wards.
### Appendix I - Searching Strategies

Database – PubMed, British Nursing Index and CINAHL Plus

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<tr>
<td>Hand searching article from reference lists</td>
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<td>Hand searching article from reference lists</td>
<td>0</td>
<td>Hand searching article from reference lists</td>
<td>1</td>
</tr>
<tr>
<td>Final reviewed studies</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
### Appendix II - Table of Evidence

<table>
<thead>
<tr>
<th>Bibliographic Citation/Study Type</th>
<th>Patient Characteristics</th>
<th>Intervention(s)</th>
<th>Control</th>
<th>Length of Follow Up</th>
<th>Outcome Measures</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kortbeek et al., 1999 - RCT (1+)</td>
<td>Trauma patients required enteral feeding and mechanically ventilated - from the adult ICU - male: 77% - mean age = 34 (n = 80)</td>
<td>Oral- or naso-duodenal feeding (n = 37)</td>
<td>Gastric feeding (n = 43)</td>
<td>7</td>
<td>Primary outcome: (1) Incidence of pneumonia (2) Time to tolerate full-strength feeds Secondary outcomes: (3) Length of mechanical ventilation (4) Length of ICU stay (5) Length of hospital stay (6) Mortality</td>
<td>Duodenal Feeding vs Gastric Feeding (1) 27% vs 42% (95% CI, -5.4, 35.4) (2) 34.0 vs 43.8 hours (p = 0.02) (3) 9 vs 5 days (p &gt; 0.05) (4) 10 vs 7 days (p &gt; 0.05) (5) 30 vs 25 days (p &gt; 0.05) (6) 10.8% vs 7.0% (p &gt; 0.05)</td>
</tr>
<tr>
<td>Heyland et al., 2001 - RCT (1+)</td>
<td>Adult patients required enteral feeding and mechanically ventilated - from the medical or surgical ICU - male: 58% - mean age = 60 (n = 33)</td>
<td>Jejunal feeding (n = 12)</td>
<td>Gastric feeding (n = 21)</td>
<td>7</td>
<td>Primary outcomes: (1) Incidence of Gastroesophageal regurgitation (2) Incidence of aspiration Secondary outcomes: (3) Duodenogastric reflux (4) Gastric pH</td>
<td>Jejunal Feeding vs Gastric Feeding (1) 24.9% vs 39.8% (p = 0.04) (2) 3.9% vs 7.5% (p = 0.22) (3) 92% vs 82.6% (p = 0.09) (4) 4.1 vs 5.0 (p = 0.04)</td>
</tr>
<tr>
<td>Hsu et al., 2009 - RCT (1++)</td>
<td>Adult patients required enteral feeding and mechanically ventilated - from ICU of</td>
<td>Nasoduodenal feeding (ND) (n = 59)</td>
<td>Nasogastric feeding (NG) (n = 62)</td>
<td>2 years</td>
<td>Primary outcomes: (1) Time to goal tube feed rate (2) Daily calorie Secondary outcomes: (3) Incidence of vomiting</td>
<td>ND vs NG: (1) 32.4 vs 54.5 hours (p = 0.004) (2) 1658 vs 1426 kcal/day (p = 0.02) (3) 1.7% vs 12.9% (p = 0.01)</td>
</tr>
<tr>
<td>Acosta-Escribano et al., 2010</td>
<td>RCT</td>
<td>Adult patients with severe traumatic brain injury</td>
<td>- required enteral feeding and mechanically ventilated</td>
<td>- from ICU of the University General Hospital of Alicante (Spain)</td>
<td>Male: 86%</td>
<td>Mean age = 39</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----</td>
<td>-------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>--------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>university–affiliated tertiary medical centre</td>
<td>- Male: 70%</td>
<td>- Mean age = 68</td>
<td>(n= 121)</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix III - Quality Assessment Summary of the Retrieved Studies

#### INTERNAL VALIDITY

<table>
<thead>
<tr>
<th>RCTs</th>
<th>Kortbeek et al., 1999</th>
<th>Heyland et al., 2001</th>
<th>Hsu et al., 2009</th>
<th>Acosta-Escribano et al., 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.1</strong> The study addresses an appropriate and clearly focused question</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.2</strong> The assignment of subjects to treatment groups is randomised.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.3</strong> An adequate concealment method is used.</td>
<td>Can’t say</td>
<td>Yes</td>
<td>Yes</td>
<td>Can’t say</td>
</tr>
<tr>
<td><strong>1.4</strong> Subjects and investigators are kept ‘blind’ about treatment allocation.</td>
<td>Can’t say</td>
<td>Can’t say</td>
<td>Yes</td>
<td>Can’t say</td>
</tr>
<tr>
<td><strong>1.5</strong> The treatment and control groups are similar at the start of the trial.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.6</strong> The only difference between groups is the treatment under investigation.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.7</strong> All relevant outcomes are measured in a standard, valid and reliable way.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.8</strong> What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>Didn’t mention</td>
<td>Intervention group: 6/18 x 100% = 33.3% Control group = 0%</td>
<td>Didn’t mention</td>
<td>Intervention group: 5/50 x 100% = 10% Control group: 2/54 x 100% = 3.7%</td>
</tr>
<tr>
<td><strong>1.9</strong> All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>1.10</strong> Where the study is carried out at more than one site, results are comparable for all sites</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

#### OVERALL ASSESSMENT OF THE STUDY

| 2.1 How well was the study done to minimise bias? Code as follows: High quality (+++) Acceptable (+) Unacceptable – reject 0 | (+) | (+) | (+++) | (+++) |
**Remarks**: Section 2 relates to the overall assessment of the paper. It starts by rating the methodological quality of the study, based on your responses in Section 1 and using the following coding system:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High ++</td>
<td><strong>All or most</strong> of the criteria have been fulfilled. Where they have not been fulfilled the conclusions of the study or review are thought very unlikely to alter.</td>
</tr>
<tr>
<td>Fair +</td>
<td><strong>Some</strong> of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.</td>
</tr>
<tr>
<td>Low -</td>
<td><strong>Few or no</strong> criteria fulfilled. The conclusions of the study are thought likely or very likely to alter.</td>
</tr>
</tbody>
</table>
**Methodology Checklist 2: Controlled Trials**

**Before** completing this checklist, consider:

1. Is the paper a **randomised controlled trial** or a **controlled clinical trial**? If in doubt, check the study design algorithm available from SIGN and make sure you have the correct checklist. If it is a **controlled clinical trial** questions 1.2, 1.3, and 1.4 are not relevant, and the study cannot be rated higher than 1+

2. Is the paper relevant to key question? Analyse using PICO (Patient or Population Intervention Comparison Outcome). IF NO REJECT (give reason below). IF YES complete the checklist.

**Reason for rejection:**
1. Paper not relevant to key question □
2. Other reason □ (please specify):

### Section 1: Internal validity

**In a well conducted RCT study...**

<table>
<thead>
<tr>
<th>Key Question No</th>
<th>Reviewer</th>
<th>Study identification (Include author, title, year of publication, journal title, pages)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.2</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.3</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.4</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.5</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.6</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.7</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td>1.8</td>
<td>Yes □</td>
<td>No □ Can't say □</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td><strong>All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).</strong>&lt;sup&gt;viii&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.10</td>
<td>Where the study is carried out at more than one site, results are comparable for all sites.&lt;sup&gt;x&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

**SECTION 2: OVERALL ASSESSMENT OF THE STUDY**

| 2.1 | **How well was the study done to minimise bias?**
**Code as follows:**<sup>xi</sup> |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High quality (++)&lt;sup&gt;&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Acceptable (+)&lt;sup&gt;&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Unacceptable – reject 0&lt;sup&gt;&lt;/sup&gt;</td>
</tr>
<tr>
<td>2.2</td>
<td>Taking into account clinical considerations, your evaluation of the methodology used, and the statistical power of the study, are you certain that the overall effect is due to the study intervention?</td>
</tr>
<tr>
<td>2.3</td>
<td>Are the results of this study directly applicable to the patient group targeted by this guideline?</td>
</tr>
<tr>
<td>2.4</td>
<td><strong>Notes.</strong> Summarise the authors’ conclusions. Add any comments on your own assessment of the study, and the extent to which it answers your question and mention any areas of uncertainty raised above.</td>
</tr>
</tbody>
</table>

---

<sup>i</sup> Unless a clear and well defined question is specified, it will be difficult to assess how well the study has met its objectives or how relevant it is to the question you are trying to answer on the basis of its conclusions.

<sup>ii</sup> Random allocation of patients to receive one or other of the treatments under investigation, or to receive either treatment or placebo, is fundamental to this type of study.

<sup>iii</sup> Allocation concealment refers to the process used to ensure that researchers are unaware which group patients are being allocated to at the time they enter the study. Research has shown that where allocation concealment is inadequate, investigators can overestimate the effect of interventions by up to 40%.

<sup>iv</sup> Blinding refers to the process whereby people are kept unaware of which treatment an individual patient has been receiving when they are assessing the outcome for that patient. It can be carried out up to three levels. Single blinding is where patients are unaware of which treatment they are receiving. In double blind studies neither the clinician nor the patient knows which treatment is being given. In very rare cases studies may be triple blinded, where neither patients, clinicians, nor those conducting the analysis are aware of which patients received which treatment. The higher the level of blinding, the lower the risk of bias in the study.

<sup>v</sup> Patients selected for inclusion in a trial must be as similar as possible. The study should report any significant differences in the composition of the study groups in relation to gender mix, age, stage of disease (if appropriate), social background, ethnic origin, or co-morbid conditions. These factors may be covered by inclusion and exclusion...
criteria, rather than being reported directly. Failure to address this question, or the use of inappropriate groups, should lead to the study being downgraded.

vi If some patients received additional treatment, even if of a minor nature or consisting of advice and counselling rather than a physical intervention, this treatment is a potential confounding factor that may invalidate the results. If groups were not treated equally, the study should be rejected unless no other evidence is available. If the study is used as evidence it should be treated with caution.

vii The primary outcome measures used should be clearly stated in the study. If the outcome measures are not stated, or the study bases its main conclusions on secondary outcomes, the study should be rejected. Where outcome measures require any degree of subjectivity, some evidence should be provided that the measures used are reliable and have been validated prior to their use in the study.

viii The number of patients that drop out of a study should give concern if the number is very high. Conventionally, a 20% drop out rate is regarded as acceptable, but this may vary. Some regard should be paid to why patients dropped out, as well as how many. It should be noted that the drop out rate may be expected to be higher in studies conducted over a long period of time. A higher drop out rate will normally lead to downgrading, rather than rejection of a study.

ix In practice, it is rarely the case that all patients allocated to the intervention group receive the intervention throughout the trial, or that all those in the comparison group do not. Patients may refuse treatment, or contra-indications arise that lead them to be switched to the other group. If the comparability of groups through randomisation is to be maintained, however, patient outcomes must be analysed according to the group to which they were originally allocated irrespective of the treatment they actually received. (This is known as intention to treat analysis.) If it is clear that analysis was not on an intention to treat basis, the study may be rejected. If there is little other evidence available, the study may be included but should be evaluated as if it were a non-randomised cohort study.

x In multi-site studies, confidence in the results should be increased if it can be shown that similar results were obtained at the different participating centres.

xi Rate the overall methodological quality of the study, using the following as a guide: High quality (++): Majority of criteria met. Little or no risk of bias. Results unlikely to be changed by further research. Acceptable (+): Most criteria met. Some flaws in the study with an associated risk of bias, Conclusions may change in the light of further studies. Low quality (0): Either most criteria not met, or significant flaws relating to key aspects of study design. Conclusions likely to change in the light of further studies.
### Levels of Evidence

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+++</td>
<td>High quality meta-analyses, systematic reviews of RCTs, with a very low risk of bias</td>
</tr>
<tr>
<td>1+</td>
<td>Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias</td>
</tr>
<tr>
<td>1-</td>
<td>Meta-analyses, systematic reviews, or RCTs with a high risk of bias</td>
</tr>
<tr>
<td>2+++</td>
<td>High quality systematic reviews of case control or cohort or studies</td>
</tr>
<tr>
<td></td>
<td>High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal</td>
</tr>
<tr>
<td>2+</td>
<td>Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal</td>
</tr>
<tr>
<td>2-</td>
<td>Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal</td>
</tr>
<tr>
<td>3</td>
<td>Non-analytic studies, e.g. case reports, case series</td>
</tr>
<tr>
<td>4</td>
<td>Expert opinion</td>
</tr>
</tbody>
</table>
### Grades of Recommendations

<table>
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<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or&lt;br&gt;A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or&lt;br&gt;Extrapolated evidence from studies rated as 1++ or 1+</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or&lt;br&gt;Extrapolated evidence from studies rated as 2++</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Evidence level 3 or 4; or&lt;br&gt;Extrapolated evidence from studies rated as 2+</td>
</tr>
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</table>
Appendix VI

Estimated Operational Cost for the Small Bowel Feeding Guideline (Annual Budget)

(A) Material Costs

<table>
<thead>
<tr>
<th>Items</th>
<th>Calculations</th>
<th>Price (HK$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small bowel feeding tube (12F-16F)</td>
<td>HK$50 x *2160 x **8</td>
<td>864,000</td>
</tr>
<tr>
<td>Equipment for feeding tube insertion (e.g. pH paper, lubricant jelly, gloves, adhesive tape, feeding syringe, stethoscope)</td>
<td>Available</td>
<td>Hospital Provision</td>
</tr>
<tr>
<td>Abdominal X-ray for tube confirmation</td>
<td>Available</td>
<td>Hospital Provision</td>
</tr>
<tr>
<td>Continuous feeding pump</td>
<td>Available</td>
<td>Hospital Provision</td>
</tr>
<tr>
<td>Endoscopic equipment</td>
<td>Available</td>
<td>Hospital Provision</td>
</tr>
<tr>
<td>Bedside ultrasound machine</td>
<td>Available</td>
<td>Hospital Provision</td>
</tr>
<tr>
<td>Motility agent (intravenous Metoclopramide 5mg/ml, 2ml)</td>
<td>HK$11.5/ampoule</td>
<td>Rough estimate: 6% of subject population will develop gastric residual elevation (Acosta-Escribano et al., 2010) i.e. *2160 x 6% = 130 patients</td>
</tr>
<tr>
<td>Documents of the guideline</td>
<td>HK$2000</td>
<td>2000</td>
</tr>
<tr>
<td>Printing and photocopying (Guideline, posters, new observation chart and evaluation questionnaires)</td>
<td>HK$4000</td>
<td>4000</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td></td>
<td><strong>870,000</strong></td>
</tr>
</tbody>
</table>

(B) Non-material Costs

<table>
<thead>
<tr>
<th>Items</th>
<th>Calculations</th>
<th>Price (HK$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills training workshops (4 sessions, @ 1 hour)</td>
<td>HK$200 x 4 x 12 senior nurses (medical ward) (mean: Point 25)</td>
<td>9,600</td>
</tr>
<tr>
<td>Educational classes (4 sessions, @ 1 hour)</td>
<td>HK$200 x 4 x 12 senior nurses (medical ward) (mean: Point 25)</td>
<td>9,600</td>
</tr>
<tr>
<td>Seminar for all frontline staff (1 session, 30 minutes)</td>
<td>HK$360 x 0.5 x 35 medical staff (mean: Point 39) HK$160 x 0.5 x 170 nursing staff (mean: Point 20)</td>
<td>6,300+13,600 =19,900</td>
</tr>
<tr>
<td><strong>Training Program</strong></td>
<td></td>
<td><strong>39,100</strong></td>
</tr>
</tbody>
</table>
Small bowel feeding tube insertion time | 0.67 hour (40 minutes) x HK$200 x 2160 | 289,440
---|---|---
\( \text{Sub-Total} \) | 328,540 | HK$1,198,540
\( \text{Total : (A)+(B)} \) | 870,000+328,540 | HK$1,198,540

* Estimated annual eligible patients for small bowel feeding: 2160 patients
**Change frequency of small bowel feeding tube: every 6-7 weeks, i.e. 8 times/year/patient

References

ORACLE iProcurement, Hospital Authority

Master Pay Scale, Administration of the Civil Service, (http://www.csb.gov.hk/english/admin/pay/42.html)

## Appendix VII - Estimated Savings from the Small Bowel Feeding Guideline

<table>
<thead>
<tr>
<th>Items</th>
<th>Estimated Cost/Outcomes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nosocomial Pneumonia Prevention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Courses of antibiotic therapy (intravenous Augmentin 1.2g)</td>
<td>HK$84/day x 14 days x 2160 = 2,540,160</td>
<td>United Christian Hospital, 2009</td>
</tr>
<tr>
<td>Equipment and materials needed for antibiotics injection (e.g. heparin block, syringes, needles, Water for injection, Normal Saline)</td>
<td>Reduces</td>
<td>/</td>
</tr>
<tr>
<td>Medical investigations needed for diagnosis of nosocomial pneumonia (e.g. Chest X-ray, Blood test, sputum test)</td>
<td>Reduces</td>
<td>/</td>
</tr>
<tr>
<td>Mortality</td>
<td>Decreases</td>
<td>(Kortbeek et al., 1999; Hsu et al., 2009)</td>
</tr>
<tr>
<td>LOS in hospital</td>
<td>Decreases (HK$3700/day)</td>
<td>(Kortbeek et al., 1999; Hsu et al., 2009; Jose et al., 2009) Hospital Authority, 2012</td>
</tr>
<tr>
<td>Length of mechanical ventilation</td>
<td>Decreases</td>
<td>(Kortbeek et al., 1999; Hsu et al., 2009)</td>
</tr>
<tr>
<td><strong>Total Savings:</strong></td>
<td>HK$ 2,540,160 +</td>
<td></td>
</tr>
</tbody>
</table>
Appendix VIII

Small Bowel Feeding Guideline for Nosocomial Pneumonia Prevention in Critically Ill Tube-fed Patients

1. The Objectives of the Guideline

Background
Nosocomial Pneumonia, also known as hospital-acquired pneumonia (HAP), defined as all form of pneumonia with an onset 48 hours or more after admission to the hospital. It is a common and costly infection, causing considerable morbidity and mortality (Ferrara, 2006). According to the statistical report in 2011-2012 from the Hospital Authority (HA), the total number of hospitalized patients who had been diagnosed with pneumonia (all form) was 50,716 which accounted for the second leading cause of admission in Hong Kong. The number of registered deaths from pneumonia was 6,211.

From January 2013 to June 2013, by clinical observation, it was estimated that 50% of critically-ill patients with nasogastric tube feeding eventually developed nosocomial pneumonia during hospitalization. High incidence of pneumonia in this group of patients required increase in antibiotic use and length of inpatient stay. Standard nursing care on nasogastric tube feeding (e.g. head of bed elevation, continuous pump feeding) are implemented to tube-fed patients in order to prevent aspiration and subsequent pneumonia. However, the incidence of nosocomial pneumonia remains high.

Many studies demonstrated that small bowel feeding can reduce incidence of pneumonia or ventilator-associated pneumonia among tube-fed patients (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009; Kortbeek et al., 1999). However, small bowel feeding is not a common practice in Hong Kong. The insertion skill of small bowel feeding tube is different from that of nasogastric tube and it requires several techniques such as auscultation and manipulation during bedside-blind placement (Appendix X). Auscultation is used to verify tube progression toward the small intestine and not pulmonary placement of tube. Endoscopy and ultrasonography have been used to improve placement success rates. Therefore, it is commonly inserted by physicians or well-trained nurses. In view of this, it is inevitable to establish an evidence-based guideline for guiding and standardizing the indication and tube placement procedures of small bowel feeding.

The objectives of this guideline are to:
1. summarize the clinical evidence for the small bowel feeding in prevention of nosocomial pneumonia among critically ill tube-fed patients,
2. formulate clinical instructions for small bowel feeding and its nursing care based on current evidence for best practice in the prevention of nosocomial pneumonia,
3. standardize the initiating process of small bowel feeding in tube-fed patients in medical units.

2. Who the guideline is for
This clinical guideline is developed for nurses to guide their decision-making on initiating of small bowel feeding and its related nursing care.

3. Target patient population covered
Patients aged 60 or above who are admitted to medical ward and require nasogastric tube feeding.
4. Recommendations with supporting evidence

Five recommendations were generated as the essential steps in this small bowel feeding guideline. These recommendations guide nurses to perform basic assessment, planning, intervention and evaluation on initiating small bowel feeding. Each recommendation was rated according to SIGN Grading System of Recommendation (Appendix V).

**Recommendation 1**

*Description:* For patients who have inserted small bowel feeding tube, an abdominal radiograph should be taken to confirm tube placement and prevent gastric displacement.

*Grade of Recommendation:* A

*Available Evidence:*

- Nasal or oral-small bowel feeding tube access was achieved either blindly or endoscopically. Position was initially confirmed with an abdominal radiograph before diet administration and subsequently whenever there was a question about tube placement e.g. pH < 7 and unclear auscultation sound (Acosta-Escribano et al., 2010; Heyland et al., 2001; Kortbeek et al., 1999). (Evidence level 1+, 1++ & 1++ respectively)

- Small bowel feedings usually generate a negligible residual volume. If a large residual was too large (i.e. >100 ml), an abdominal radiograph was performed to confirm that gastric migration had not occurred (Hsu et al., 2009). (Evidence level 1++)

**Recommendation 2**

*Description:* After placement of small bowel feeding tube, continuous pump feeding should be started.

*Grade of Recommendation:* A

*Available Evidence:*

- As soon as the small bowel feeding tube was inserted, continuous tube feeding using enteral feeding pumps was started to prevent gastroesophageal regurgitation and pulmonary aspiration (Acosta-Escribano et al., 2010; Heyland et al., 2001; Hsu et al., 2009). (Evidence level 1+, 1++ & 1++ respectively)

- Pumps are used to regulate the rate of continuous enteral feeding that helps to control the gastric or duodenal residuals. Once the residual volume was lower than 200ml and the risk of aspiration was low, patients did not have distended abdomen and witnessed aspiration (Hsu et al., 2009). (Evidence level 1++)

**Recommendation 3**

*Description:* All tube-fed patients should avoid supine position and they should be maintained their head of bed elevation at 30 to 45 degree.

*Grade of Recommendation:* A
Available Evidence:
- All the patients were fed with their head elevated to at least 30 degrees to avoid aspiration (Heyland et al., 2001; Hsu et al., 2009). (Evidence level 1+ & 1++ respectively)
- Rates of gastroesophageal regurgitation and aspiration are increased in the supine position and by the presence of a nasogastric tube whereas the semirecumbent position (i.e. 30-45 degrees) has been demonstrated to reduce regurgitation of gastric contents (Heyland et al., 2001). (Evidence level 1+)
- According to the evidence-based guideline issued by the Centers for Disease Control and Prevention, it recommended elevating head of bed position to at least 30 degrees to reduce risk for aspiration pneumonia (Tablan et al., 2004). (Evidence level 2+)
- There is widespread agreement that an elevation of head of bed position is an effective strategy in preventing aspiration and pneumonia (Tablan et al., 2004; Grap et al., 2005). (Evidence level 2+ & 2+ respectively)

Recommendation 4
Description: Nasogastric tube should be kept in current position. Gastric residual volume should be monitored regularly (e.g. Q4H) during small bowel feeding.

Grade of Recommendation: A
Available Evidence:
- A high gastric residual volume had been considered to predispose to gastroesophageal reflux and aspiration and be associated with a higher incidence of nosocomial pneumonia. Critically ill patients regurgitate and aspirate gastric contents more frequently; they may be a higher risk for developing pneumonia (Hsu et al., 2009; Metheny, Schallom, Oliver, & Clouse, 2008). (Evidence level 1++ & 2+ respectively)
- Feeding tolerance must be continually assessed, particularly when poor gastric motility is suspected and there is an increased risk of gastroesophageal reflux. Increased gastric residuals are checked periodically and a volume higher than 200 ml is considered as a risk of aspiration and requiring temporary discontinuation of the diet (Acosta-Escribano et al., 2010; Metheny et al., 2008). (Evidence level 1++ & 2+ respectively)

Recommendation 5
Description: Physicians should be informed to prescribe motility agents when patients have persistent increase in gastric residual volume during tube feeding.

Grade of Recommendation: A
Available Evidence:
- A high gastric residual volume had been considered to predispose to gastroesophageal reflux and aspiration and be associated with a higher incidence of nosocomial pneumonia. Critically ill patients regurgitate and aspirate gastric contents more frequently; they may be a higher risk for developing pneumonia (Hsu et al., 2009; Metheny et al., 2008). (Evidence level 1++ & 2+ respectively)
- Increased gastric residuals are checked periodically and a volume higher than 200 ml is considered as a risk of aspiration (Acosta-Escribano et al., 2010; Metheny et al., 2008). (Evidence level 1++ & 2+ respectively)
The prokinetic can enhance the gastrointestinal motility by increasing the contraction frequency in small intestine. It was used for the high risk patients who had had two more major risk factors of aspiration e.g. vomiting, persistent high gastric residual volume, repeated aspiration, etc. (Acosta-Escribano et al., 2010; Hsu et al., 2009). (Evidence level 1++ & 1++ respectively)
Appendix IX - Algorithm
Small Bowel Feeding Guideline for Nosocomial Pneumonia Prevention in Critically Ill Tube-fed Patients

Patient admission

Eligible
✓ Age ≥ 60, with multiple illnesses
✓ Require nasogastric tube feeding
✓ Patients who have a functional gut

Aspiration risk factors:
- Mechanical ventilation
- Previous episode of aspiration
- Vomiting
- Persistent high GRV (200-500 ml)
- Supine position

Written medical orders & Nursing documentation of initiating small bowel feeding

Enteral nutrition is administered continuously via an infusion pump (Recommendation 2)

*Monitor GRV every 4 hours (Recommendation 4)

GRV ≤ 200ml
* Continue feeding

**GRV > 200 ml (Risk of aspiration ↑)

Withhold feeding and recheck GRV 1 hour later

Motility agents are given as physician prescribed (Recommendation 5)

Aspiration risk factors:
- Mechanical ventilation
- Previous episode of aspiration
- Vomiting
- Persistent high GRV (200-500 ml)
- Supine position

Keep gastric tube
Placement of small bowel feeding tube (Appendix X)
An abdominal radiograph is taken to confirm tube placement (Recommendation 1)

Maintain HOB elevation at 30-45°, unless medically contraindicated (Recommendation 3)

LOC – Level of Consciousness
GRV – Gastric Residual Volume

*Monitor tube condition and record the GRVs accordingly.
* If persistent GRV > 200 ml sustain for 4 hours, inform physician for further management.

Remark: Flush the small bowel feeding tube Q4H to maintain tube patency if the feeding is stopped.
Appendix X

**Manual Nasoduodenal Feeding Tube Placement Guideline**

**Equipment:**
- Fr 14 EFT
- Stethoscope
- Gloves
- Lubricant jelly
- pH paper
- Multipurpose tubing adaptor
- 50ml feeding syringe
- Adhesive tape
- Kidney dish

**Preparation:**
1) Assess the patient; confirm indication and rule out contraindication.
2) Inform physician and initiate insertion of Entriflex Feeding TubeTM (EFT)
3) Review chest X-ray to ensure sump tip in optimal gastric position for decompression; reposition as required*.
4) Place sump on suction for 5 minutes while gathering supplies.
5) Explain procedure to patient.
6) Place patient supine*.
7) Prepare EFT (secure side port with multipurpose adapter); flush main port with 10 mL water.
8) Apply lubricant jelly to EFT tip.

*UNLESS CONTRAINDICATED

**Tube Insertion:**

**STEP 1: PROXIMAL ESOPHAGUS (approximately 25 cm)**
- Confirm tip position:
  - Auditory: Air injection: “burp” emitted from mouth. Note: If burp absent – remove EFT immediately.

**STEP 2: GASTRIC POSITION (approximately 55 cm)**
- Confirm tip position:
  - Other: pH 1 – 5 (Note: pH not applicable if receiving PPI).

**STEP 3: PYLORIC POSITION (approximately 70 - 75 cm)**
- Insert EFT at 5 cm intervals (55 cm, 60 cm, etc)
- Confirm tip position: (at each 5 cm interval).
  - Auditory: Air injection/auscultation - increasing clarity as tube moves right of midline into pylorus.
• Tactile: a) Constant very gentle resistance as EFT inserted; EFT does not “spring back” when hand removed. b) Manual draw on plunger - increasing resistance as EFT tip moves right of midline into pylorus.
• Visual: Liquid returns – brighter yellow; returns may be difficult to obtain.
• Other: pH > 7 (Note: pH not applicable if receiving PPI).

**STEP 4: DUODENAL POSITION (>85 cm) > Confirm tip position (initial):**
- Auditory: Air injection/auscultation - high-pitched “squeal” followed by “tinkling” bowel sounds at left of midline.
- Tactile: Manual draw on plunger – some resistance; able to obtain liquid returns.
- Visual: Liquid returns – very bright clear yellow.
- Other: pH > 7. (Note: pH not applicable if receiving PPI).

**STEP 5: CONFIRM TIP POSITION**
- Confirm final tube position by abdominal radiography.
  (See Diagram A)

![Diagram A](image-url)

-Revised from Dieticians Association of Australia, Guidelines on Enteral Nutrition (Kreyman et al., 2006; Nicola R, 2007)
Appendix XI

Project Working Schedule

<table>
<thead>
<tr>
<th>Task / Timeline</th>
<th>Preparation</th>
<th>Pilot Test</th>
<th>Implementation and Evaluation</th>
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Appendix XII

Small Bowel Feeding Assessment & Observation Chart

Date of insertion: ___________________  
Size of SBFT: Fr_____________  
Tube Marking: _______________cm  
Tube Location: ________________  

Please put a “√” in the appropriate box

<table>
<thead>
<tr>
<th>Date &amp; Time</th>
<th>Marking (cm)</th>
<th>pH value &gt;7</th>
<th>Auscultation: “tickling” bowel sound at left of midline</th>
<th>Color of Aspirate</th>
<th>°HOB elevation at 30-45°</th>
<th><strong>GRVs</strong> (ml)</th>
<th>Signature</th>
<th>***Remark (if any)</th>
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#Add supplementary sheets if needed.
Color of Aspirate:
Y: Yellow  G: Green  R: Red  B: Bright  P: Pale  BS: Blood stained  CG: Coffee ground
e.g. BY (Bright Yellow)

* -Maintain Head of bed (HOB) elevation at 30 - 45°, unless medically contraindicated.

** -Gastric Residual Volume (GRVs) should be monitored at least every 4 hours after small bowel feeding tube insertion. Continue feeding if GRV ≤ 200 ml
-If exact amount cannot be specified, please indicate: large (+++)/ moderate (++)/ small (+)
-If feeding is stopped, flush small bowel feeding tube Q4H to maintain tube patency if the feeding is stopped.

Remark: If persistent GRVs × 200 ml sustain for 4 hours, inform physician for further management.
Appendix XIII

Evaluation Form of the Pilot Test of Small Bowel Feeding Clinical Guideline

Thank you for your support in the pilot test of the small bowel feeding clinical guideline. Your feedback is very important to us to further improve the clinical guideline. Please circle as appropriate.

<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The guideline was useful.</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>2. The guideline was user-friendly.</td>
<td>4</td>
<td>3</td>
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<tr>
<td>3. The proposed clinical guideline was well organized.</td>
<td>4</td>
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<tr>
<td>4. The promotion of the guideline was enough.</td>
<td>4</td>
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<td>5. The content of educational class was appropriate and adequate.</td>
<td>4</td>
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<td>6. The content of skill training workshop was appropriate and adequate.</td>
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<td>7. I was able to access the information of guideline easily.</td>
<td>4</td>
<td>3</td>
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<tr>
<td>8. The project coordination team provided enough support to me when I had difficulties.</td>
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<td>3</td>
<td>2</td>
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<tr>
<td>9. I support the full implementation of small bowel feeding clinical guideline in the future.</td>
<td>4</td>
<td>3</td>
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<tr>
<td>10. Could you give some suggestions to improve the guideline?</td>
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Could you give some suggestions to improve the guideline?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Ward: ____________________  Position: ________________

-Thank You-
Appendix XIV

Audit Form on Small Bowel Feeding Tube Insertion

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<th>Remarks</th>
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<td>1. Prepare all equipment needed for tube insertion.</td>
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<td>2. Identify patient and explain procedure to patient.*</td>
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<tr>
<td>3. Place patient in supine position.</td>
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<td>4. Prepare EFT (secure side port with multipurpose adapter— see equipment list); flush main port with 10 ml water.</td>
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<td>5. Apply lubricant jelly to EFT tip.</td>
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**Tube Insertion**

6. Insert tube to reach proximal esophagus region (~25cm). (Auditory: Air injection: “burp” emitted from mouth.)

7. Insert tube to reach gastric position (~55cm)

- Auscultation: muffled “swoosh” lower upper quadrant.
- Aspirate: pale yellow/light green
- Confirm pH: 1-5*

8. Insert tube to reach pyloric position (~70-75cm), manual draw on plunger to move the tube tip from right of midline into pylorus.

- Auscultation: muffled “swoosh” from right of midline into pylorus.
- Aspirate: brighter yellow (difficult to obtain)
- Confirm pH: >7*

9. Insert tube to reach duodenal position (>85cm)

- Auscultation: high-pitched “squeal” then “tinkling” bowel sounds at or left of midline.
- Aspirate: very bright clear yellow
- Confirm pH: >7*

10. Confirm final tube position by abdominal radiography.*

After tube insertion

11. Maintain patient in semi-recumbent position.*

12. Start feeding by connecting the continuous feeding pump.*

13. Monitor the tube position and the GRVs regularly, inform physician if any abnormalities.*
**Critical item**

- **EFT:** *Entriflex Feeding Tube™*
- **GRVs:** *Gastric Residual Volumes*
- *Semi-recumbent position: Head of bed elevation 30 - 45°*

Auditor’s Name & Signature:

_________________________  Ward: ___________  Date: ______________
Appendix XV

Staff Self-Evaluation Questionnaire on Evidence-Based Small Bowel Feeding Clinical Guideline

Date: _____________  Ward: _______________

Position: ______________

Please circle the best description listed below, which indicate your impression during the implementation of small bowel feeding clinical guideline.


<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 I was clear about the algorithm of the guideline.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.2 The guideline’s instruction was clear.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.3 The guideline’s content was well-organized.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.4 The guideline was user-friendly.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.5 The guideline was useful.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.6 The equipment and materials required in small bowel feeding were available and were obtained easily during implementation.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.7 The content of training program was useful and adequate.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1.8 I was able to cope with the workload and problems during implementation.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.1 I understood the procedures of small bowel feeding tube insertion.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.2 I understood the risk factors of aspiration that contribute to nosocomial pneumonia.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.3 I was clear the small bowel feeding clinical guideline.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.4 I understood the benefits of small bowel feeding.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.5 I was clear the nursing care for small bowel feeding. (e.g. GRVs monitoring, HOB elevation)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3.1 I felt confident in inserting small bowel feeding tube.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3.2 I felt confident in caring patients with small bowel feeding tube.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3.3 I was able to use the equipment and materials to perform small bowel feeding tube insertion.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
3.4 I had developed skills and knowledge which enable me to implement guideline fluently.

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
</table>

-GRVs: Gastric Residual Volumes
-HOB: Head of Bed

Comment (if any):
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

End of Questionnaire
-Thank you -
References


