Hospital-acquired pneumonia (HAP) is the most common hospital-acquired infection in a health care setting. Mortality rate of HAP can be very high. Oral colonization of bacteria is the leading cause of pneumonia as the pathogenesis of pneumonia is by the invasion of causative agents to the lower respiratory tract.

In the target medical unit of a public hospital, over 90% of patients admitted are aged 65 or above and with a high degree of dependent activity of daily living. The chance of HAP among inpatients is estimated to be 50% and the oral hygiene status is poor among these elderly patients. Although oral colonization of bacteria is a leading cause of HAP and good oral hygiene can help to prevent it, there has been no
specific guideline on oral care to prevent HAP in the target setting. Also, there has been no related systematic review and protocol available for health-care providers in Hong Kong. Thus, this dissertation aims to systematically review the available evidence on oral care to prevent pneumonia, develop an evidence-based guideline on oral care practice, assess the implementation potential of the programme, and finally plan for a pilot study and evaluation.

A systematic search of PUBMED and CINAHL PLUS identified four randomized controlled trials (RCTs) on the evaluation of oral hygiene, which were then evaluated using the Scottish Intercollegiate Guidelines Network (SIGN) checklist for RCTs. Two studies were graded 1+ and two were graded 1-. The studies showed an improvement in the Dental Plaque Index (DPI) by providing oral care to participants. The identified studies show sufficient support on oral care to prevent hospital acquired pneumonia.

Types of clients in the reviewed studies shared similar characteristics with patients in the target ward setting and the philosophy of care of the hospital supports any innovations to be implemented with evidences. Moreover, there is a research club in the target hospital to encourage regular reviews of studies to improve nursing practice. Staff and administrators are supportive in implementing new guidelines. The set-up cost of the programme is estimated to be $5,280 and the annual running
cost is estimated to be $50,590. Thus the innovation is proven feasible and transferable. An evidence-based guideline was developed.

A 12-months implementation programme including communication plan, pilot study plan and evaluation plan has been developed. The initiation stage took two months to form a communication team and to seek approval from the hospital. 4 months would be taken for the pilot study to assess the feasibility of the programme. 6 months would be taken for the evaluation plan to determine whether the innovation should be put in place.

Patients’ outcome, healthcare providers’ outcome and system outcome will be monitored throughout the implementation process. Patients’ outcome would need to be a decrease in the DPI score by 0.4 to show an improvement in oral hygiene. Healthcare providers’ outcome would be staff satisfaction with the programme. A reduction in HAP rate and length of stay in hospital would be the system outcome.
An Evidence-based Guideline on Oral Care to Prevent Pneumonia in Hospitalized Elderly

By

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A thesis submitted in partial fulfillment of the requirements for

the Degree of Master of Nursing

at The University of Hong Kong

July 2016
Declaration

I declare that this dissertation represents my own work, except where due
acknowledgement is made, and that is 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.

______________________
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Acknowledgement

I would like to express my deepest gratitude to my supervisor, Dr. Daniel Fong Yee Tak, Associate Professor, for his generous guidance, enlightenment and patience throughout the whole dissertation progress. Without him, I could not have accomplished the work.

I would also like to express my utmost thanks to Dr. Janet Wong Yuen Ha, Dr. Chan Siu Ling, Polly and all the staff of the School of Nursing for their teaching and assistance in my master study.

Also, I must express my greatest thanks and appreciations to my husband, my family and my friends, for their unconditional support and love in my life. Without them, I surely could not have completed the study.

Last but not least, I offer my sincere blessings to my classmates, who supported each other in the study.
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Chapter 1

Introduction

1.1 Background

Hospital-acquired infection (HAI) is defined as an event meeting the NHSN (National Health Safety Network) site-specific infection criterion which happens on or after the 3rd calendar day of admission to an inpatient with the day of admission considered as day one (Centers for Disease Control and Prevention, 2015). According to a survey conducted in the United States, the percentage of inpatients having at least one of the HAIs among 183 acute care hospitals in the States was 4.0% in 2011, giving an estimation of 648,000 inpatients with around 721,800 HAI episodes (Magill et al., 2014). Among all the HAIs surveyed, pneumonia and surgical site infection were the most common infections. Non-ventilator-associated pneumonia accounted for 60.9% of the hospital-acquired pneumonia (Magill et al., 2014). Pneumonia can be defined based on “clinical and radiological criteria which are readily available but non-specific: recent and progressive radiological opacities of the pulmonary parenchyma, purulent sputum, and recent onset of fever. Diagnosis is more specific when quantitative microbiological samples are obtained using specialized protected bronchoscopy methods” (World Health Organization, 2002). Hospital-acquired pneumonia is defined as patients with a first positive bacterial respiratory culture
finding after day 2 from admission which does not meet the definition of ventilator-associated pneumonia (Kollef et al., 2005). Patients aged from 65 to 84 are the most common age group to be affected by HAIs (Magill et al., 2014). And the mortality rate of hospital-acquired pneumonia is 20-33% (CDC and the Healthcare Infection Control Practices Advisory Committee, 2003).

The pathogenesis of pneumonia is by the invasion of causative agents to the lower respiratory tract through micro or bolus aspiration of oropharyngeal organisms or by the inhalation of aerosols containing bacteria (CDC and the Healthcare Infection Control Practices Advisory Committee, 2003). Therefore, oral colonization of respiratory pathogens is the leading cause of pneumonia in the elderly (Ortega et al., 2015). And the most common pneumonia causing bacteria are Staphylococcus aureus of both methicillin-sensitive and methicillin-resistant type, followed by Pseudomonas species and non-group Streptococcus (Kollef et al., 2005).

HAIs, including hospital-acquired pneumonias, impose a huge financial burden to the health care system. HAIs can cause prolonged hospital stay, increased resistance of microorganisms to antimicrobials, high costs for patients and their families, and excess deaths and long-term disabilities (World Health Organization, 2011). In the year 2004, the financial impact of HAIs was estimated to be US$ 6.5 billion in the United States, with prolonged hospital stay from 5 to 29.5 days (World Health
Organization, 2011). Therefore, reducing nosocomial pneumonia is of high importance to both patients and society.
1.2 Affirming the Need

The target setting of this project is a medical ward in an acute care hospital. By unpublished data, more than 90% of the patients admitted to the ward are aged 65 or above with nearly all the patients either chair-bound or bed-bound and with a high degree of dependent activity of daily living (ADL-D). Although there is no local published data about the rate of hospital-acquired pneumonia, pneumonia of this kind often does happen in this setting with a rate of about 50%. Moreover, the Dental Plaque Index (DPI) of patients, which is an index used to reflect the level of oral hygiene from a range of 0-2, is estimated to be 1.5. This shows that the oral hygiene of patients in the target ward setting is poor according to the observed DPI.

Reducing oral colonization of bacteria and improving oral health status can help in reducing the rate of hospital-acquired pneumonia as dental plaque can be a reservoir of respiratory pathogens (Morino, Ookawa, Haruta, Hagiwara and Seki, 2014). However, according to a study conducted among institutionalized elderly in Hong Kong, their oral health status is very poor (Lo, Luo and Dyson, 2002).

In Hong Kong’s situation, pneumonia accounts for 14.7% of the death rate of all Hong Kong residents (Department of Health, 2011-2012). Although no local data concerning the rate of hospital-acquired pneumonia are available, pneumonia of both hospital-acquired and non-hospital-acquired remains the 3rd leading cause of
death in Hong Kong (Department of Health, 2011/2012). In the year 2011, a total of 6,211 patients died of pneumonia, of which 5,824 were aged 65 or above (Department of Health, 2011). With the increasing percentage of citizens aged 65 or above rising from 12.1% in 2004 to 14.7% in 2014 (Census and Statistics Department, 2015), the incidence of hospital-acquired pneumonia is also on an increasing trend.

With the above evidence showing that poor oral hygiene can be a cause of hospital-acquired pneumonia, improving oral hygiene can reduce the chance of pneumonia in fragile elderly. However, in the target ward setting, there is no guideline for carrying out of oral hygiene for patients. Oral hygiene is carried out by either nurses or patients’ family members in a way following their preferences or own experience. And the commonest way to perform oral hygiene is by swabbing of the oral cavity. Nonetheless, if patients do not have relatives coming to visit them, oral hygiene may not be carried out as oral care completely depends on individual nurses’ preference and availability. The lack of a guideline poses a difficulty for nurses to provide oral care to patients.

In view of this situation in the setting, an evidence-based protocol regarding oral care practice using simple tooth-brushing for the target population is needed for the prevention of hospital-acquired pneumonia.
1.3 Objectives and Significance

To establish and facilitate the development of an evidence based protocol on providing oral care to hospitalized elderly to prevent the incidence of hospital-acquired pneumonia, the following objectives were set.

1. To evaluate the current evidence on the effectiveness of oral care in reducing hospital-acquired pneumonia.

2. To critically appraise evidence in improving oral health status by various oral care methods among dependent elderly.

3. To develop an evidence-based guideline for improving oral health among elderly.

4. To assess the feasibility and transferability of the guideline into practice under the target setting.

5. To set an implementation and evaluation plan for the evidence-based guideline.

With the development of an evidence-based guideline in providing oral care for patients to reduce the occurrence of hospital-acquired pneumonia, benefits can be gained in different aspects.

For patients: With the guideline, more standard care can be received. Also, reducing the chance of developing pneumonia can reduce the use of antibiotics, the length of stay in the hospital and the mortality rate.
For medical unit nurse: A uniform way of nursing care can be provided by the guideline and the standard of nursing can be improved. Reducing the chance of pneumonia can help reduce the number of critically ill patients and thus can reduce the workload of the staff.

For society and the government: With the guideline, the rate of hospital-acquired pneumonia can be reduced therefore reducing the length of stay in hospital and mortality rate of patients. Thus, the financial burden to the health care sector and the government can be reduced.
Chapter 2

Critical Appraisal

2.1 Search and Appraisal Strategies

To search and appraise the current evidence in oral care to prevent hospital acquired pneumonia, a search strategy using P (Patient), I (Intervention), C (Comparison) and O (Outcome) format was used (Richardson, Wilson, Nishikawa and Hayward, 1995). The PICO of the study was:

P: Elderly aged≥65 with dependent activity of daily living in the unit
I: Brushing of the teeth of patients with a toothbrush and interdental brush
C: Swabbing of the oral cavity or no oral hygiene
O: Improving oral health status to reduce pneumonia

To find out related articles, a systematic literature search was carried out in two electronic data bases namely PUBMED and CINAHL PLUS using the keywords “oral hygiene”, “oral care”, “oral health”, “elderly”, “frail elderly” and “nursing” in October 2015. All the keywords were used consistently in the two data bases. The reference lists of the journals searched were also screened for any additional related articles for review.

The inclusion criteria for the search of the studies were:
1. The target population should have dependent activity of daily living or aged $\geq 65$.

2. Participants of the study should be randomized.

3. The study outcome should include oral health as a measurement.

4. Articles written in English and Chinese only

5. The study should be randomized controlled trial only

The exclusion criteria were:

1. Studies conducted on children and adults.

2. Articles that are of a systematic review in nature.

To develop an evidence based guideline, the articles searched were critically appraised in a systematic way. A checklist of the Scottish Intercollegiate Guidelines Network (SIGN) was used to assess the methodology quality and the overall performance of the studies. (Scottish Intercollegiate Guidelines Network, 2015) After the appraisal, the level of evidence was coded as: 1++, 1+, 1-, 2++, 2+, 2-, 3 and 4. (Scottish Intercollegiate Guidelines Network, 2015). The methodology checklist and the grading of articles in this study is included in Appendix 1.
2.2 Results

Using the keywords mentioned as above to search in PUBMED and CINAHL PLUS, a total of 623 articles were retrieved within the year 1973 to 2015. After reading the abstracts and titles of all the 623 studies, 46 studies were found to be of use and 577 articles were excluded because they did not mention pneumonia as their outcomes. Out of the 46 studies, only 32 studies were available for assessment as the remaining 14 did not have full-text articles. After reading the full text of the 32 studies, 28 studies were excluded because they did not meet the inclusion and exclusion criteria. The final number of articles that could be used for analysis was 4. To describe the flow of the literature search in detail, a PRISMA flow chart is shown in Appendix 1.

2.2.1 Research Characteristics

All the four studies were randomized controlled trials (RCTs) and were conducted in Japan (Adachi, Ishihara, Abe, Okuda and Ishikawa, 2002; Mori, Hakuta, Endo, Nariai, Ueno, Shinada and Kawaguchi, 2012; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Watando, Ebihara, Ebihara, Okazaki, Takahashi, Asada and Sasaki, 2004).

2.2.2 Participants’ Characteristics

Among the four studies, three were conducted on nursing home residents with the
mean age of 84 or above (Adachi et al., 2002; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Watando et al., 2004). The study participants of the remaining study were acute cerebrovascular or neuro-trauma patients (Mori et al., 2012).

2.2.3 Intervention

In three studies, the intervention used was oral care using both toothbrushes and interdental brushes (Adachi et al., 2002; Mori et al., 2012; and Morino, Ookawa, Haruta, Hagiwara and Seki, 2014) while the intervention of the remaining study was oral care done by using toothbrushes alone (Watando et al., 2004) with only one study mentioning the cleaning of dentures in the intervention group (Morino, Ookawa, Haruta, Hagiwara and Seki, 2014).

2.2.4 Control

In two studies, the participants in the control groups received oral care by simple brushing without the use of any interdental brushes (Mori et al., 2012 and Morino, Ookawa, Harata, Hagiwara, and Seki, 2014). In one of the studies, oral care in the control group was swabbing of the oral cavity on an irregular basies (Adachi et al., 2002). The remaining control group received oral care done by the participants themselves without specifying the tools for cleansing (Watando et al., 2004).

2.2.5 Outcome measurements
In one out of the four studies, outcome was measured directly by episodes of fever and death due to pneumonia (Adachi et al., 2002) while two studies measured oral microbiological parameters and oral hygiene index as the outcomes (Mori et al, 2012 and Morino, Ookawa, Haruta, Hagiwara and Seki, 2014). The Dental Plaque Index has three scores ranging from 0 to 2 with 0 showing no plaque, 1 showing plaque covers less than half of the tooth surface and 2 equals plaque covering more than half of the surface of the tooth (Abe, Ishihara, Adachi and Okuda, 2006). In the study carried out by Watando et al. (2004), the outcome measurement is cough reflex sensitivity which indirectly reflects the risk of hospital-acquired pneumonia. According to Niimi et al. (2003), reduced cough sensitivity is related to the occurrence of recurrent pneumonia.
2.3 Summary and Synthesis

2.3.1 Summary

Regarding the study design, all the articles were RCTs. However, only Mori et al. (2012) and Morino, Ookawa, Haruta, Hagiwara and Seki (2014) mentioned the randomization method.

For the calculation of sample size, only Morino, Ookawa, Haruta, Hagiwara and Seki (2014) mentioned the way of calculation while the others did not. Moreover, only Adachi, Ishihara, Abe, Okuda and Ishikawa (2002) carried out the study in two nursing homes while the others investigated the intervention in a single site (Mori et al., 2012; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Adachi et al., 2002).

For participants’ drop out, only Mori et al. (2012) did not mention the rate of drop out while the three remaining studies did (Adachi et al., 2002; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Watando et al., 2004). Nonetheless, only one study mentioned the reasons for dropping out (Morino, Ookawa, Haruta, Hagiwara and Seki, 2014). Also, only Adachi, Ishihara, Abe, Okuda and Ishikawa (2002) included the drop out data in the analysis for intention-to-treat.

Last but not least was the time for outcome measurements. Three out of the four studies measured the outcomes at 4 weeks after the intervention, which is a
relatively short period (Mori et al., 2012; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Watando et al., 2004). The remaining study measured the outcome within 24-month intervals (Adachi et al., 2002).

To summarize, all the studies supported the intervention in that oral care by mechanical brushing has a positive effect on the oral hygiene of the elderly and those who have a dependent level of daily living. The age of eligible participants of the innovation can therefore be elderly aged 65 or above with dependent activity of living. Improving the oral health status of these frail people can reduce their chance of getting pneumonia as good oral health status indicates a lesser pneumonia-causing bacterial load in saliva.

However, in one study, there was no significant difference between the intervention and control group for the first 6 months of the intervention. A difference was observed starting from the 7th month of intervention only (Adachi et al, 2002). In all the other three studies, significant differences occurred immediately after 4 weeks of intervention (Mori et al., 2012; Morino, Ookawa, Haruta, Hagiwara and Seki, 2014; and Watando et al., 2004).

Also, the effect size of oral care on the oral hygiene index differed. For the study by Morino, Ookawa, Haruta and Seki (2014), the effect size was -0.9 (p<0.05) at 4 weeks while that of Mori et al. (2012) was -0.4 (p=0.009).
2.3.2 Synthesis

Of the four articles retrieved, two were graded a level of evidence of 1+ (Mori et al., 2012 and Morino, Ookawa, Haruta, Hagiwara and Seki, 2014). The remaining two could reach a level of evidence of 1- (Adachi et al., 2002 and Wantando et al., 2004).

With such a high level of evidence for the reviewed studies, it is worthy to put the intervention of the studies into daily nursing practice as all the studies showed a positive effect of oral care on reducing the chance of pneumonia.

To account for the difference in results of the study carried out by Adachi et al. (2002) compared to the other three studies, sample sizes should be taken into consideration. The sample size of the study by Adachi et al. (2002) was relatively larger than the others as it had a total of 141 study participants, whereas there were only 30 participants in the study by Morino, Ookawa, Haruta, Hagiwara and Seki (2014), 40 participants in Mori et al. (2012) and 59 participants in Watando et al. (2004).

Also, the background medical illness of the participants can result in the diversity of the study result. Mori et al. (2012) recruited inpatients of a neurosurgical unit who were undergoing rehabilitation while the other three recruited participants in nursing homes without specifying the medical history of the participants (Watando et al., 2004; Adachi et al., 2002; and Morino, Ookawa, Haruta Hagiwara and Seki, 2014).
The differences in effect size between the studies by Mori et al. (2012) and Morino, Ookawa, Haruta, Hagiwara and Seki (2014) can be explained by the time of oral care being carried out. For Morino, Ookawa, Haruta, Hagiwara and Seki (2014), oral care was carried out within two hours of participants getting up while for Mori et al. (2012), the time for oral care was not mentioned.

Although the intervention mentioned in the studies was professional oral care performed by a dental hygienist, mechanical cleansing of the teeth in the intervention was simply brushing by a toothbrush and interdental brush. The technique can be easily learnt by nurses who have professional nursing knowledge and thus make the application of the innovation more feasible.

For the frequency of cleaning of teeth, Watando et al. (2004) investigated the effect of daily cleansing of teeth on the oral health of the elderly while Adachi et al. (2002) and Morino, Ookawa, Haruta, Hagiwara and Seki (2014) studied the intervention with a frequency of once per week. Mori et al. (2012) investigated the intervention with a frequency of twice a week. This indicated that the range of frequency of performing oral care can be from daily to once per week in order to achieve the desired result. To reduce the workload and to avoid the reluctance of nurses in implementing the intervention, the care can be provided at less frequent intervals, for example, on alternate days or twice per week. This is to ensure that
patients can benefit from the new protocol and nurses will not be put under an enormous work burden due to the intervention. As the instruments used in the intervention are only a toothbrush and interdental brush, the items can be bought easily and will not cause a very huge burden on the financial budget of the unit. This further makes the implementation of the intervention feasible.

Lastly, Mori et al. (2012) mentioned in their conclusion that supplying appropriate information about oral care to nurses who take care of these fragile patients would improve the oral hygiene status of those patients. And with improved oral hygiene status, hospital-acquired pneumonia can be reduced. With such benefit and easy handling of the brushing technique, a protocol regarding oral care of patients to reduce hospital-acquired pneumonia would be of great use in the unit setting.

To conclude, there is adequate evidence to support oral care by brushing to improve oral hygiene which in turn reduces the chance of HAP. The innovation would be oral care performed by nurses in the target setting with the use of toothbrushes and interdental brushes for approximately 5 minutes and the target clients would be hospitalized elderly aged 65 or above with dependent activity of daily living.
Chapter 3

Implementation Potential

3.1 Transferability

3.1.1 Types of target clients

The nature of the target populations considered in the identified studies and that in the setting are of moderate similarity. The target setting is an acute medical ward of a local hospital in which more than 90% of the in-patients are aged 65 or above. This is similar to the target populations considered in three out of the four studies (Morino T., Ookawa K., Hagiwara Y., and Seki M., 2014; Watando A. et al., 2004; Adachi M. et al., 2002). Only one of the target population of the study involved neuro-trauma patients (Mori C. et al., 2012). All of the study populations were dependent in their daily living activities, which is similar to that of the target setting.

3.1.2 Philosophy of care

For philosophy of care of the organization, the target setting is a ward of a public hospital managed under the Hospital Authority. The Hospital Authority’s philosophy of care includes providing patients with the best possible services (Hospital Authority, 2016). Both registered and enrolled nurses are licensed by the Nursing Council and nurses’ behaviour is guided under the “Code of Ethics and Professional Conduct for Nurses in Hong Kong”. According to the conduct, nurses are committed
to promote personal growth and advancement by maintaining the highest standards of nursing care possible and to seek improvement in current practice. Also, nurses have to value research and development for the promotion of nursing knowledge and skills (Nursing Council of Hong Kong, 2015). Furthermore, the target hospital supports the promotion of evidence-based practice by setting up a research club in which journals are reviewed regularly by different specialties to improve their practices. As the philosophy of care of the target ward setting and the organizations are on the same track, the innovation can be implemented with support.

**3.1.3 Number of target individuals to be benefited**

Approximately 2,000 patients are admitted annually in the target medical unit, of which more than 90% of the patients are aged 65 or above and around 70% of them have dependent activity of daily living, which means they depend on other people to provide basic care for them, including hygiene care. Moreover, there is an increasing proportion of elderly living in Hong Kong, and thus the chance of admitting elderly patients is also on an increasing trend. Therefore, the implementation of the evidence-based protocol should be beneficial to a substantial number of individuals in the target ward setting.

**3.1.4 Duration of implementation and evaluation**
For the implementation of the protocol, a pilot testing programme would be needed. Before the pilot testing programme, a preparation stage would have to take place first. The stage would take about two months to form a communication team to review the available evidence and to seek approval from administrative level. Also, training of staff and purchase of materials would take another two months. After the preparation stage, a three-month pilot testing programme would be carried out in the target ward setting and another 1 month would be used for data collection. After that, a 3-month interval would be used to gather and evaluate the findings and staff feedback about the pilot testing programme. Finally, one month would be used to generate a modified evidence-based protocol to promote a better nursing practice in the target ward setting. This would amount to a total of 10 months for the implementation and evaluation of the guideline.
3.2 Feasibility

3.2.1 Freedom to carry out the protocol

In the target hospital, there is a research club and journal reviews are conducted regularly to improve nursing practice. For example, nurses in the paediatric department once reviewed studies about the confirmation of nasogastric tubes inserted in newborn babies and they presented the findings in the research club meeting for discussion. Nurses in the meeting were free to provide feedback and ask questions regarding the findings. Eventually, an evidence-based guideline was developed for the insertion of nasogastric tubes in the paediatric department. This proves that nurses in the hospital have freedom to carry out evidence-based protocols. Furthermore, the proposed protocol is an additional nursing intervention that does not need doctors’ prescription and it does not involve other disciplines. This further empowers nurses’ freedom in the implementation. Also, nurses are patients’ advocates. Nurses spend a lot of time taking care of patients and understand their needs so that nurses are believed to best act in patients’ interests.

With background medical knowledge and nursing knowledge, nurses certainly can have the freedom to carry out the innovation as well as to terminate the innovation if it is considered undesirable.

3.2.2 Support from staff and administrators
To successfully implement a new innovation, supports from both the nursing staff and the administrator are essential. In the target ward hospital, some of the nursing guidelines have been developed using evidenced-based methods. For example, the protocol for weaning of urinary catheters by community nurses was evidence-based. They once presented it in the research club meeting. This shows that the administrator is in support of evidence-based nursing practice. For the target ward setting, staff work in a harmonious environment and they are supportive of the works done by their colleagues. Also, nurses of the target ward setting have a consensus that there is a lack of evidence-based guidelines in the current nursing practice and that introduction of innovations that help standardize current practices will benefit both the patients and staff.

3.2.3 Resistance and interference with the current working environment

Implementation of the protocol creates a certain degree of resistance and interference with the target ward setting. Because it is additional work to the current nursing practice, nurses have to spend extra time following the protocol. This will interfere with current staff functions by increasing the workload of colleagues as staff have to provide at least 5 minutes of oral care to each patient. Moreover, training of nurses is needed before carrying out the protocol in order to standardize the care given to patients so nursing staff have to be released from their nursing work for the
training. This also causes interference with the working environment. However, the implementation of the protocol will not cause friction with other disciplines as the protocol relates to individual nursing work. The only resistance would be from the target ward staff as the new protocol will increase nurses’ workload and thus cause resistance to the new guideline.

3.2.4 Availability of human and material resources

The human resources required would be the nursing staff and patients of the target ward setting. Nurses have to be trained for a short period of time only and then they are readily available to carry out the protocol. For participants, the majority of patients in the target ward setting can be benefited by the new protocol as most of them are elderly who need help in their daily living activities. The material resources for the implementation of the protocol would be brushes and interdental brushes and these can be bought easily.
3.3 Cost/Benefit ratio of the innovation

The potential benefit of the protocol would be preventing pneumonia in hospitalized elderly to reduce the chance of lengthened hospital stay due to complications of pneumonia. Reducing the length of stay in hospital can reduce the medical expenditure of the government and therefore medical resources of the community can be well made use of. Moreover, patients’ quality of life can be improved if they can be discharged early. Also, improving patients’ outcome can have positive effects on staff morale as well as their job satisfaction. With the establishment of this evidence-based protocol, nursing care can be standardized and staff can find it easier to take care of patients in a more uniform way. The success in implementing the protocol can also motivate evidence-based practice in the target ward as well as in other ward settings of the hospital. Furthermore, implementing this evidence-based practice in the nursing profession can help to encourage other disciplines to also develop evidence-based guidelines in their practices.

However, there is risk in carrying out the new proposed guideline. As the proposed guideline is the use of mechanical cleansing of the oral cavity to prevent pneumonia in hospitalized elderly, the risk of practising the new guideline would be injuring the oral cavity if a patient struggles or when the skill of nurses is not good enough.

Nonetheless, the benefits of the protocol outweigh the risk of carrying out the
Moreover, there are a few drawbacks of not changing the current practice. In the current setting, there is no standard way to perform oral care on elderly patients in the target ward setting. Nurses perform oral care according to their own experiences and preferences. This creates inequality in patient care. Also, patients’ family members would question the hygienic care provided to patients which makes it difficult for nurses to answer as there is no standard way of care. This would cause trust issues between patients’ families and nurses. Moreover, nurses in the ward find it difficult to provide oral care to patients in a uniform way as there is no nursing guideline regarding this aspect. This affects nurses’ confidence in taking care of patients as well as their job satisfaction. To promote better nursing practice, an evidence-based guideline in oral care should be established.

The cost of implementing the proposed evidence-based protocol can be divided into set up cost ($5,280) and running cost ($50,590), which can be further divided into material and non-material cost. The calculation of the costs is shown step by step on the following pages.

Approximately 2,000 patients are admitted into the target ward annually, of which 90% are aged 65 or above. Of those 90%, around 70% are eligible for the guideline, giving a total of 1,260 patients who can benefit from the protocol each year (2,000
patients x 90% x 70% = 1,260 patients/year

Given the monthly salary of a registered nurse being $31,000 and the number of working hours per month is 176, the hourly salary of a nurse is $176 and the salary per minute is $2.93 ($31,000/month ÷ 176 hour = $176/hour ÷ 60 minutes = $2.93/minutes).

The duration of the training workshop would be 1.5 hours (including 1 hour of theory lecture and 0.5 hours of practical skill training and feedback session).

The total number of nurses to participate in the guideline would be 20.

The average time spent for each patient for oral care and assessment would be 10 minutes.

Set up costs and running costs of the evidence-based protocol are shown in Appendix 3.
3.4 Evidence-based Practice Guideline

To develop an evidence-based practice guideline, all the results and suggestions of the eligible research were summarized and studied to produce recommendations for the protocol. The quality of the research was graded from 1++ to 4 according to the SIGN rating checklist (Scottish Intercollegiate Guidelines Network, 2015).

Recommendations were then made from the suggestions of the graded research. Gradings from A to D were given to those recommendations according to the SIGN standard (SIGN 100, 2015). Since all the research studies were RCTs, the recommendations were given high grading points, that is either A or B. The evidence-based practice guideline and the recommendations as well as their grading are shown in Appendix 7.
Chapter 4

Implementation Plan

4.1 Communication plan

4.1.1 Identification of stakeholders

Stakeholders are people who will be affected by the proposed intervention. In this programme, stakeholders can be divided into three levels, namely administrative level, frontline level and patient level.

The Chief of Service (COS) of the hospital, the Department Operation Manager (DOM) of the medical unit and the Ward Manager (WM) of the medical ward are the stakeholders at administrative level. Both COS and DOM are the ones who decide the allocation of resources of the department and make final decisions for the intervention to be carried out. WM can help in the coordination of the running of the programme from administrative level to frontline level.

Frontline level involves all nurses from the target medical setting. The two Advanced Practice Nurses (APN) of the unit may help supervise and facilitate the implementation of the intervention, using their clinical experiences as well as management skills. Commitment of all Registered Nurses (RN) and Enrolled Nurses (EN) are essential to the success of the intervention.
Patients are also important stakeholders of the intervention. One of the objectives of the proposed intervention is to improve patients’ outcome. Therefore, without participation of the target population, success of the intervention cannot be achieved.

4.1.2 Communication Process

To make the implementation of the intervention possible, a communication process involving three stages is needed. The three stages are initiation stage, facilitation stage and sustaining stage. The whole implementation plan will last for 12 months.

4.1.2.1 Initiation Stage

The initiation stage will take 2 months. To initiate a change in practice of nursing care, the proposer of the programme will first discuss the issue of oral care to reduce hospital acquired pneumonia among nursing colleagues during lunch time or breakfast time to gain their consensus. After approval is granted for the proposed programme, the proposer and two senior RNS would approach the APNs in ward to introduce the change and discuss with them the benefits of initiating the change. After that, a communication team consisting of the proposer of the intervention, the two APNs and the two senior RNS will be formed, and this will take two weeks. The
The communication team is then responsible for reviewing the related studies and generate evidence from them to prepare an innovation plan of change. This is estimated to take another two weeks. After that, the communication team will present the programme to WM as she can help to facilitate implementation of the programme. In the presentation, the proposer will illustrate the current condition of the target ward setting by providing data about hospital-acquired pneumonia of the target ward. Also, evidence of the studies identified will be presented and the intervention to be proposed will be introduced. After gaining consensus and support from the WM and APNs, the proposed programme will be presented to the DOM and COS with a written proposal as well as an oral presentation. In order to prepare a comprehensive proposal, one week will be used for the preparation. In the proposal, the prevalence of hospital-acquired pneumonia of the target ward setting will be mentioned. Also, the proposal will be used to affirm the need for change and to provide evidence-based support for the intervention. To persuade the administrators, a cost-benefit ratio and the expected outcome of the programme will be included in the proposal. The proposal will then be presented to the DOM and COS in a monthly departmental meeting. During the presentation, the transferability as well as the feasibility of the proposed intervention will be discussed to further persuade the administrators to give their support.
4.1.2.2 Facilitation Stage

After gaining approval and support from the administrative level, the programme would go into its facilitation stage. A brief meeting of three sessions held on different dates will be arranged with the frontline staff to ensure that every nurse in the ward can get to know about the programme. In the meeting, the rationale for the intervention will be given and a brief introduction of how the programme will be run will also be presented. Staff members are encouraged to express concerns about the programme and reassurances will be given. Through the briefing sessions, opinions about the programme can be gained and will be useful for evaluating the programme. To minimize interruptions to the ward routine, each briefing sessions will last for half an hour only. Two weeks of time is needed for the briefing sessions. After getting all the staff to know about the intervention, training will be provided to them. A total of three training sessions of 1.5 hours each will be provided for staff to choose and this can make sure that all the staff can attend the training workshop to get to know about the innovation programme. To ensure the quality of the intervention, staff will be required to do return demonstrations during the training. In order to reduce the stress of staff and interruption to the ward routine, participants of the training workshop will be free from being a case nurse of the ward on the day of training. The facilitation stage is expected to last for 1.5 months.
4.1.2.3 Sustaining Stage

To maintain the sustainability of the intervention, the APNs and the proposer will act as collaborators of the programme to provide continuous supervision as well as encouragement to the staff. With the experienced clinical and management skills of the APNs and the understanding of the intervention by the proposer, questions and barriers of the programme will be addressed to minimize staff unwillingness towards the programme. Moreover, a mini feedback session of 5-10 minutes will be held every week during staff handover to obtain opinions and feedback about the programme. All the opinions will be considered seriously for the improvement of the programme.
4.2 Pilot Study Plan

A pilot study is an important step for the success of implementing a new intervention as it can test the feasibility of a new innovation. The time for the pilot study plan will be 4 months.

4.2.1 Objectives

The objectives of carrying out a pilot study are as follows:

1. To determine the feasibility of carrying out the intervention in the target ward setting

2. To estimate the time and cost of the innovation

3. To examine the flaws and difficulties of implementation

4. To assess staff acceptability towards the intervention.

4.2.2 Preparation

To prepare for the pilot study, all staff will be equipped with the skills for the intervention. Training of staff will be done in the facilitation stage as mentioned before. The training workshop will last for 1.5 hours. Affirming the needs of the intervention in the current ward setting, evidence for carrying out the intervention and the potential benefits to patients and staff will be presented in the first hour of the training workshop. A copy of the intervention guideline will also be distributed to
the staff. Demonstration on the use of toothbrushes and interdental brushes will be
given in the next 10 minutes of the workshop. Return demonstrations will then be
done by the staff in the following 10 minutes. As the intervention is a very simple act
that can even be done by trained caregivers, the duration of demonstrations and
return demonstrations will be relatively short. The remaining 10 minutes of the
workshop will be a question and answer session for staff to raise any concerns about
the intervention. The intervention requires the use of toothbrushes, interdental
brushes and disclosing gel which are not usual stock items in the ward. Two weeks
will be needed to gain approval from the finance department of the hospital for
purchase and delivery of the materials to the ward.

4.2.3 Subjects Recruitment

The recruitment criteria for the pilot study will be the same as that of the
proposed guideline in Appendix. Two senior RNs of the communication team will be
assigned for the screening of eligible participants of the intervention as they will
have been given a copy of the intervention guideline already. Because recruitment of
participants is based on admission of patients every day, the sampling method of the
intervention will be convenience sampling.

4.2.4 Intervention
The oral hygiene status of the participants will be assessed on admission to the target ward setting by either the two APNs or the proposer using the Dental Plaque Index, which ranges from 0-2, with the use of disclosing gel applied to the tooth of patients. The score will then be documented in a chart made for this purpose for easier comparison of the scores.

Oral care will then be performed on the participants every day according to the guideline until they are discharged. Oral care practice will also be taught to participants’ caregivers to maintain the oral care habit of patients after discharge from the target unit. The intervention will be carried out for 3 months.

4.2.5 Data Collection

The Dental Plaque Index of the eligible participants will be scored by the two APNs and the proposer at the beginning of the intervention. They are also responsible for the assessment of the DPI after intervention by going to visit those participants. The data collection process will take one month.

4.2.6 Data Analysis and Guideline Review

To analyze the data and review the guideline, 1 month will be needed. A debriefing session will be held by the communication team after the 3rd month of the intervention trial. During the session, feedback and difficulties about the running of
the guideline will be encouraged. The problems will then be addressed seriously and amendments to the guideline will be made by the communication team members to improve the practice.

4.3 Evaluation Plan

Evaluation is a crucial process in implementing an innovation. A timeline of the whole implementation plan is included in Appendix 9.

4.3.1 Objectives

The objectives of an evaluation plan are to:

1. Monitor the progress of implementation
2. Assess the effectiveness of the intervention
3. Determine the benefits of the intervention in different aspects.
4. Determine whether the innovation should be implemented.

4.3.2 Nature and Number of Clients

The nature of clients is the same as the target population and the clients will be identified by convenience sampling. In-patients in the target ward setting aged 65 or above with dependent activity of daily living will be the target audience. To calculate the sample size for the programme, the Russ Lenth’s sample size calculator will be used (Lenth 2006-9). For the programme, one sample t-test will be used for
calculations as the evaluation of programme is to compare the DPI before and after the intervention. In the studies identified, standard error was given as 0.2 and the sample population in the study was 30. This gave the standard deviation as 1.10. Taking into account the evidences from the studies and the situation of the target ward setting, the effect size is 0.4. The power will be 0.8 and the level of significance will be 0.05. This gives the sample size of 61. With an attrition rate of 30% taken into consideration (Morino et al, 2014), the desired sample size would be 90.

4.3.3 Patients’ Outcomes

The primary patients’ outcome of the programme is to reduce the Dental Plaque Index (DPI) among programme participants. Opportunistic respiratory pathogens can be isolated from dental plaques of hospitalized or bedridden elderly (Tada and Hanada, 2010). Therefore, reducing the dental plaque of the susceptible elderly reduces the chance of contracting pneumonia causing pathogenic bacteria. Visual examination of teeth using the DPI can be used to ascertain the bacteria load of the oral cavity (Abe, Ishihara, Adachi and Okuda, 2005), thus reflecting the chance of contracting respiratory bacteria. The DPI ranges from 0 to 2, with 0 meaning no plaque, 1 meaning plaque covering less than half of the surface of teeth and 2 meaning plaque covering more than half of the surface of teeth. The area with the thickest plaque will be chosen to be the assessment site (Abe, Ishihara, Adachi and
Okuda, 2005). The DPI scores of participants will be collected before and after the intervention to assess the effectiveness of the program.

The secondary outcome for patients will be the rate of contracting hospital-acquired pneumonia, which can be traced from patients’ records.

4.3.4 Healthcare Providers’ Outcome

Nurses of the target ward setting are very important stakeholders of the programme as they can help facilitate the smooth running of the intervention. Therefore, their opinions about the programme are of great use to its improvement. To evaluate the effectiveness of the programme, staff satisfaction with and perception of the programme will be assessed by an Evaluation Survey (Appendix 8). In the survey, marks will be assigned to the statements where higher marks mean a more positive attitude towards the programme. Scores will then be counted to see the effectiveness of the programme in terms of healthcare providers’ outcome. Also, staff will be welcomed to express their suggestions in the survey as there is an open-ended question to gather their opinions for improvement of the programme.

4.3.5 System Outcome

The reduction in the numbers of hospital-acquired pneumonia and the cost of implementation will be the system outcomes. By improving the DPI of eligible
patients using the proposed intervention, the amount of respiratory bacteria in the oral cavity can be reduced and therefore decrease the rate of hospital-acquired pneumonia in the target ward setting. With the reduction in such kind of hospital-acquired infection, the amount of antibiotics used and the length of hospitalization of patients can be decreased. The cost of implementing the innovation can be obtained from the account department with the approval of the hospital. The cost of implementation of the programme should be compensated by the reduction in medical expenditure of hospital-acquired pneumonia.

4.3.6 Timing and Frequency of Data Collection

Consents have to be obtained from either eligible patients or their caregivers before the implementation of the programme. After obtaining their approvals, the baseline DPI of the participants will be scored and recorded before the intervention. The post pilot test DPI score will be obtained at the 4th month of the pilot test.

The staff evaluation survey concerning staff satisfaction will be collected and evaluated after the 3-month pilot testing period.

All the data regarding patients’ outcome and health-care providers’ outcome will be evaluated at the end of the implementation.

4.3.7 Statistical Analysis
For patients’ outcome, the DPI will be used to assess the oral hygiene of the participants at 0 and 3 months. The score ranges from 0 to 2, with a lower score meaning better oral health. Paired t-test will be used for evaluating the DPI score. The length of hospitalization will be compared by using the mean.

For healthcare providers’ outcome, satisfaction with the intervention will be calculated using a 95% confidence interval and all the comments in open-ended questions will be collected and analyzed.

For system outcome, the rate of hospital-acquired pneumonia before and after the intervention will be compared using a two-tailed z-test. And the cost of implementing the intervention will be added up to compare with last year’s expenditure.
4.4 Basis for Implementation

To put the intervention into implementation, the objectives of the programme should be fulfilled.

According to the identified studies, the DPI score reduction ranged from -0.4 (Mori et al., 2012) to -0.9 (Morino et al., 2014). Thus, the programme will be considered successful if the DPI of participants can be reduced by 0.4. This estimation is based on the clinical experience of the communication team members as well as evidence from reviewed studies.

The programme cannot be considered useful if frontline staff are not satisfied with it as they are the important stakeholders of the programme. Therefore, the average score of the staff Evaluation Survey should be at least 35 to have the programme put into practice.

Finally, for system outcome, 30% of the hospital-acquired pneumonia rate reduction will be expected for the full implementation of the intervention. With such percentage of reduction, the length of hospitalization is expected to be decreased. According to the Hospital Authority, the average inpatient cost is $4,680 per day (Hospital Authority, 2013). This gives an estimated saving of $884,520 annually by the 30% reduction in hospital-acquired pneumonia.

Finally, results of the pilot study would be reviewed by the communication team.
members and recommendations to implement the innovation on a permanent basis should be made.
References


CDC and the Healthcare Infection Control Practices Advisory Committee (2003) *GUIDELINES FOR PREVENTING HEALTH-CARE-ASSOCIATED PNEUMONIA* (pp 7-12)

Center Centers for Disease Control and Prevention


Department of Health Annual Report (2011-2012) Department of Health, Hong Kong Special Administrative Region


Hong Kong Annual Digest of Statistics (2015) Census and Statistics Department, Hong Kong Special Administrative Region


Lo ECM, Luo Y, Dyson JE (2002). Oral health status of a Hong Kong institutionalized elderly population. 80th General Session and Exhibition of the International Association for Dental Research (81) A-343


Mori C., Hakuta C., Endo K., Nariai T., Ueno M., Shinada K., Kawaguchi Y. (2012). The effects of professional oral health care on patients in the subacute stage of emergent neurosurgical disorders. Special Care Dentistry Association and Wiley Periodicals 32(6), 259-264


Tables on Health Status and Health Services 2011. (2012) Department of Health. Hong Kong Special Administrative Region

Tada A., Hanada N. (2010) Opportunistic respiratory pathogens in the oral cavity of the elderly. FEMS Immunology and Medical Microbiology (60), 1-17


http://www.who.int/emc
Appendix 1

PRISMA Flow Chart

Records identified through database searching (n=623)

Additional records identified through other sources (n=0)

Records after duplicates removed (n = 623)

Records screened by title and abstract (n = 623)

Records excluded (n = 591)

Full-text articles assessed for eligibility (n =32)

Full-text articles excluded as they did not meet the inclusion and exclusion criteria (n =28)

Studies included in qualitative synthesis (n = 4)

Appendix 2

Scottish Intercollegiate Guidelines Network (SIGN) Checklist

**Methodology Checklist 2: Controlled Trials**

<table>
<thead>
<tr>
<th>Study identification</th>
<th>Include author, title, year of publication, journal title, pages</th>
</tr>
</thead>
</table>

**Guideline topic:**

<table>
<thead>
<tr>
<th>Key Question No:</th>
<th>Reviewer:</th>
</tr>
</thead>
</table>

**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>Does this study do it?</th>
</tr>
</thead>
</table>

1.1 The study addresses an appropriate and clearly focused question.

Yes. It stated that professional oral health hygiene is important in the controlling of respiratory pathogens
<table>
<thead>
<tr>
<th></th>
<th>The assignment of subjects to treatment groups is randomised.</th>
<th>Yes. The participants were randomized by using their identity card number.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>An adequate concealment method is used.</td>
<td>Yes. The sample examiner was blinded</td>
</tr>
<tr>
<td>1.4</td>
<td>The design keeps subjects and investigators ‘blind’ about treatment allocation.</td>
<td>Can’t say. As only the sample examiner was blinded</td>
</tr>
<tr>
<td>1.5</td>
<td>The treatment and control groups are similar at the start of the trial.</td>
<td>Yes. The baseline characteristics were studied and no differences were found.</td>
</tr>
<tr>
<td>1.6</td>
<td>The only difference between groups is the treatment under investigation.</td>
<td>Yes.</td>
</tr>
<tr>
<td>1.7</td>
<td>All relevant outcomes are measured in a standard, valid and reliable way.</td>
<td>Yes. The DPI is a standard way of measuring oral hygiene.</td>
</tr>
<tr>
<td>1.8</td>
<td>What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>Control: 5.88% Intervention: 17.65%</td>
</tr>
<tr>
<td>1.9</td>
<td>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. Only those who completed the trial were analyzed.</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.</td>
<td>Not applicable.</td>
</tr>
</tbody>
</table>
### SECTION 2: OVERALL ASSESSMENT OF THE STUDY

<p>| | | |</p>
<table>
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<tr>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>2.1</td>
<td><strong>How well was the study done to minimise bias?</strong>&lt;br&gt;Code as follows:</td>
<td>Acceptable (+)</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>
<td>Yes.&lt;br&gt;Except it does not mention the blinding method. And the only difference was the intervention provided.</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>
<td>Yes.&lt;br&gt;The target group was the elderly aged &gt;65 which is the same as those in the study.</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>
<td>1. The score in DPI was followed until 5 months of the intervention with a negative correlation with oral hygiene done&lt;br&gt;2. The improvement in oral hygiene was due to simple brushing only.</td>
</tr>
</tbody>
</table>
Methodology Checklist 2: Controlled Trials

**Study identification** *(Include author, title, year of publication, journal title, pages)*
Mori C., Hakuta C., Endo K., Nariai T., Ueno M., Shinada K., Kawaguchi Y. (2012). The effects of professional oral health care on patients in the subacute stage of emergent neurosurgical disorders. Special Care Dentistry Association and Wiley Periodicals 32(6), 259-264

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**Before** completing this checklist, consider:

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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>Does this study do it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes.</td>
</tr>
</tbody>
</table>

1.1 The study addresses an appropriate and clearly focused question.

Yes.
The study mentioned that periodontal disease is associated with pneumonia and cardiovascular disease and that poor oral hygiene has an adverse effect on people with existing systematic disease.

1.2 The assignment of subjects to treatment groups is randomised.

Yes.
The subjects were randomized using a computer program.
<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>As the examiner was blinded.</td>
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<td>The design keeps subjects and investigators ‘blind’ about treatment allocation.</td>
<td>Can’t say.</td>
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<td>As only the examiner was blinded.</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>The treatment and control groups are similar at the start of the trial.</td>
<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>The differences of the characteristics were not statistically significant</td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td>The only difference between groups is the treatment under investigation.</td>
<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>The groups differed only in the intervention.</td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td>All relevant outcomes are measured in a standard, valid and reliable way.</td>
<td>Yes.</td>
</tr>
<tr>
<td></td>
<td>Periodontal pocket depth and OHI-DI are standard measures of oral health status.</td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>1.9</td>
<td>All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).</td>
<td>Not applicable.</td>
</tr>
<tr>
<td></td>
<td>Because it does not mention the number of drop outs.</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.</td>
<td>Not applicable.</td>
</tr>
</tbody>
</table>

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

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<tr>
<th>2.1</th>
<th>How well was the study done to minimise bias? Code as follows:</th>
<th>Acceptable(+)</th>
</tr>
</thead>
</table>
2.2 | 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? | Yes. As the baseline of the subjects is not significantly different. And only the examiner was blinded. |

2.3 | Are the results of this study directly applicable to the patient group targeted by this guideline? | Yes. As the study subjects had dependent activity of daily living. |

2.4 | **Notes.** 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. |

1. Although the study population is not elderly aged>65, they also have dependent activity of daily living and are prone to contracting pneumonia.

2. The effects of oral care appeared even within one month of the intervention

3. It would be better if the study was carried out for a longer period of time to see the long term effects of the intervention.
Methodology Checklist 2: Controlled Trials

Study identification  
*Include author, title, year of publication, journal title, pages*

Guideline topic: Key Question No: Reviewer:

Before completing this checklist, consider:

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<th>Does this study do it?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.1</strong></td>
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<tr>
<td><strong>1.2</strong></td>
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<tr>
<td><strong>1.3</strong></td>
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<td>1.4</td>
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<td>1.5</td>
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<tr>
<td>1.6</td>
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<tr>
<td>1.7</td>
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<tr>
<td>1.8</td>
</tr>
<tr>
<td>1.9</td>
</tr>
<tr>
<td>1.10</td>
</tr>
</tbody>
</table>

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

<p>| 2.1 | <em>How well was the study done to minimise bias?</em> Code as follows: | Low quality(-) |
| 2.2 | Taking into account clinical considerations, your evaluation of the methodology used, and | Yes. As the only difference was the treatment under investigation. |</p>
<table>
<thead>
<tr>
<th><strong>2.3</strong></th>
<th>Are the results of this study directly applicable to the patient group targeted by this guideline?</th>
<th>Yes. Because the participants were aged &gt;65 and ADL dependent</th>
</tr>
</thead>
</table>
| **2.4** | **Notes.** 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. | 1. It does not mention any concealment or blinding of the patients  
2. Oral care by mechanical brushing can improve cough sensitivity of elderly. |
**Methodology Checklist 2: Controlled Trials**

**Study identification**  
*Include author, title, year of publication, journal title, pages*


**Guideline topic:**  
**Key Question No:**  
**Reviewer:**

**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...*  
**Does this study do it?**

<table>
<thead>
<tr>
<th>Key</th>
<th>Question</th>
<th>Reviewer</th>
</tr>
</thead>
</table>
| 1.1 | The study addresses an appropriate and clearly focused question. | Yes.  
It clearly mentioned that the question is the relationship between oral care and the prevalence of fever |
| 1.2 | The assignment of subjects to treatment groups is randomised. | Yes. |
| 1.3 | An adequate concealment method is used. | Can’t say.  
Not mentioned |
|   | The design keeps subjects and investigators ‘blind’ about treatment allocation. | Can’t say.  
Not mentioned. |
|---|---|---|
| 1.5 | The treatment and control groups are similar at the start of the trial. | Can’t say.  
Not mentioned. |
| 1.6 | The only difference between groups is the treatment under investigation. | Yes.  
The only difference in oral hygiene was the treatment under investigation. |
| 1.7 | All relevant outcomes are measured in a standard, valid and reliable way. | Yes.  
The degree of fever was standard at 37.8°C and the outcomes were measured as the number of bacteria. |
| 1.8 | What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed? | Intervention: 25%  
Control: 31.25% |
| 1.9 | All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis). | Yes.  
It mentioned that data from the drop-out subject were included. |
| 1.10 | Where the study is carried out at more than one site, results are comparable for all sites. | Yes.  
The two sites are both nursing homes in Tokyo. |

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

| 2.1 | How well was the study done to minimise bias?  
Code as follows: | Low quality (-) |
| 2.2 | 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? | Yes. |
| 2.3 | Are the results of this study directly applicable to the patient group targeted by this guideline? | Yes.  
Because the mean age of the participants was >65. |
| 2.4 | Notes. 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. |  
1. It does not mention the concealment and blinding methods.  
2. The intervention was investigated for 24 months, which is a long period.  
3. Oral care can reduce episodes of fever among the elderly. |
### Costs of implementing the evidence-based guideline per year

<table>
<thead>
<tr>
<th></th>
<th>Set up costs</th>
<th>Running costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-material cost</strong></td>
<td>Training cost of nurses</td>
<td>Nursing Power for the protocol</td>
</tr>
<tr>
<td></td>
<td>= $176 \times 1.5 \times 20</td>
<td>= $2.93 \times 10 \times 1260</td>
</tr>
<tr>
<td></td>
<td>= $5,280</td>
<td>= $3,6918</td>
</tr>
<tr>
<td><strong>Material cost</strong></td>
<td></td>
<td>Toothbrushes = $4 \times 1,260 = $5,040</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interdental brushes = $2 \times 1,260 = 2,520</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disclosing gel = $145 \times 30 \times 1,260 = 6,112</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td>$5,280</td>
<td>$50,590</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$55,870</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix 4

**Key to Evidence Statement and Grades of Recommendations from Scottish Intercollegiate Guidelines Network (SIGN) (2012)**

**LEVELS OF EVIDENCE**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ++</td>
<td>High quality meta-analyses, systematic reviews of RCTs, or 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 casual</td>
</tr>
<tr>
<td>2+</td>
<td>Well-conducted case control or cohort studies with a 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>

(Scottish Intercollegiate Guidelines Network, 2012)
## Appendix 5

### Table of Evidence

<table>
<thead>
<tr>
<th>Article</th>
<th>Study Objects</th>
<th>Intervention</th>
<th>Control</th>
<th>Outcomes</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morino T. Ookawa K. Haruta N. Hagiwara Y. Seki M. (2014) RCT(++)</td>
<td>1. Nursing home residents 2. With at least one tooth 3. Mean age: 85.5</td>
<td>1. Simple brushing by dental hygienist using tooth brush and interdental brush 2. Ultrasonic cleansing apparatus and tablet denture cleaner for dentures (n=14)</td>
<td>1. Oral care by nursing home staff using toothbrush 2. Ultrasonic cleansing apparatus and tablet denture cleaner for dentures (n=16)</td>
<td>1. Oral microbiological parameters (log 10 CFU/swab) 2. Presence of opportunistic pathogens in saliva (numbers) at 0 and 4 weeks 3. Oral hygiene DPI (0-2) at 0, 4, 12, 20 weeks</td>
<td>At 4 weeks: 1. Mean: 0.0 (SE 6.0), p&lt;0.05 2. Number: -1, p&lt;0.05 3. Mean: -0.9 (SE 0.2), p&lt;0.05 At 12 weeks: 3. Mean: -0.65, p&lt;0.05 At 20 weeks: 3. Mean: -0.1, p&lt;0.05</td>
</tr>
<tr>
<td>Mori C et al (2012) RCT (++)</td>
<td>1. Acute cerebrovascular or neuro-trauma patients 2. With at least one tooth</td>
<td>Oral care by dental hygienist using toothbrush, interdental brush and dental floss (n=21)</td>
<td>Oral care by ward nurse using toothbrush only (n=19)</td>
<td>Oral hygiene OHI-DI (0-3) at 0 and 4 week</td>
<td>At 4 weeks: Mean: -0.4 (SD 0.6),p=0.009</td>
</tr>
<tr>
<td>Watando A. et al (2004) RCT (+)</td>
<td>1. Nursing home residents 2. Dependent ADL Mean age: 86.1</td>
<td>Oral care using tooth brush after each meal (n=30)</td>
<td>Oral care done irregularly (n=29)</td>
<td>Cough reflex sensitivity Threshold (log mg /ml) at 0,3,10 and 30 days</td>
<td>At 3 days: Mean: +0.1, p&lt;0.05 At 10 days: Mean: -0.15, p&gt;0.05 At 30 days: Mean: -0.3, p&lt;0.05</td>
</tr>
<tr>
<td>Adachi M. et al (2002) RCT(++)</td>
<td>1. Nursing home residents 2. Mean age: 84</td>
<td>Oral care done by dental hygienist using toothbrush, interdental brush and sponge brush weekly (n=77)</td>
<td>Oral care by sponge swabbing on an irregular basis (n=64)</td>
<td>1. Infection Episodes of fever (temp&gt;37.8) 2. Death due to aspiration pneumonia (number) (within 104 weeks)</td>
<td>1. Percentage: -3%,p&lt;0.05 2. Number: -6, p&lt;0.05</td>
</tr>
</tbody>
</table>
## Appendix 6

### Grade of Recommendations

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

(Scottish Intercollegiate Guidelines Network, 2012)
Appendix 7

An Evidence-based Guideline on Oral Care to Prevent Pneumonia in Hospitalized Elderly

An Evidence-based Guideline on Oral Care to Prevent Pneumonia in Hospitalized Elderly
Background:

Non-ventilator-associated pneumonia accounted for 60.9% of the hospital-acquired pneumonia in the United States (Magill et al., 2014) while in Hong Kong, pneumonia was the 3rd leading cause of death in 2011, accounting for 14.7% of the death rate of all Hong Kong residents (Department of Health, 2011/2012). Out of the 6,211 patients who died of pneumonia, 5,824 were aged 64 or above (Department of Health, 2011). Moreover, the percentage of Hong Kong citizens aged 65 or above increased from 12.1% in 2004 to 14.7% in 2014 (Census and Statistics Department, 2015). This means that the incidence of pneumonia is also on an increasing trend.

Hospital-acquired infections pose a huge burden to society. It causes prolonged hospital stay, increased resistance of microorganisms to antimicrobials, high costs for patients and their families, and excess deaths and long-term disabilities (World Health Organization, 2011). The amount of money that the United States spent on hospital-acquired infections was $6.5 billion in 2004 (World Health Organization, 2011). In view of such a large impact of hospital-acquired pneumonia on health care systems, an evidenced-based guideline on the prevention of it is developed.

To develop the evidence-based protocol, data were searched in PUBMED and CINAHL PLUS using the key terms “oral hygiene”, “oral care”, “oral health”, “elderly”, “frail elderly” and “nursing. Through screening of abstracts and content of the
searched findings, four randomized control trials (RCTs) were found to be of use. The quality of the four RCTs was then critically appraised and recommendations were extracted from the studies and were also graded using the SIGN checklist (Scottish Intercollegiate Guidelines Network, 2015). By detailed study of the suggestions from high-quality research findings, an evidence-based guideline for nursing practice was developed to prevent pneumonia in hospitalized elderly patients in the hospital.

Objectives:

To prevent hospital-acquired pneumonia in elderly patients aged 65 or above with dependent activity of daily living.

Target group:

The target population is dentate hospitalized elderly aged 65 or above with dependent activity of daily living and the intended user are nurses in medical units.

Recommendation:

**Recommendation 1**

*Assess eligibility for the oral care guideline using the Barthel index with a cut-off of 80.*
Grade: A

Evidence: The Barthel Index, which is an index of ordinal scale consisting of ten activities of daily living, has been recommended by the Royal College of Physicians in the assessment of the elderly. It scores from 0-100, with 0 being the most dependent elderly and 100 being independent elderly. The lower the score, the more care the elderly need in their daily living activities. (Sainsbury A, Seebass G, Bansal A and Young JB, 2005, 1++). Those who scores 80 or below will be eligible for the protocol.

Recommendation 2

*Perform oral care with the use of toothbrushes.*

Grade: A

Evidence: In all the eligible studies, oral care was performed using either toothbrushes or electric toothbrushes. Three out of the four studies used manual toothbrushes for brushing of the teeth of participants. (Morino T, Ookaa K, Haruta N, Hagiwara Y and Seki M, 2014 (1+), Mori C et al., 2012(1+) and Watando et al., 2004(1-).

Recommendation 3

*Perform oral care with interdental brushes in addition to toothbrushes.*
Grade: A

Evidence: Three out of the four eligible studies used interdental brushes in addition to toothbrushes when carrying out oral care for participants to obtain a more thorough cleaning of the oral cavity. (Morino T, Ookaa K, Haruta N, Hagiwara Y and Seki M, 2014(1+), Mori C et al., 2012(1+) and Adachi et al., 2002(1-)).

Recommendation 4

*The duration of oral care should be approximately 5 minutes.*

Grade: B

Evidence: Oral care performed in an eligible study lasted for 5 minutes every time.

(Watando A et al., 2004(1-)).

Recommendation 5

*Oral care without the use of a toothpaste.*

Grade: B

Evidence: The cleansing agent that the studies used was only water, without any mouth rinse or toothpaste. (Mori C et al., 2012(1+) and Adachi M, 2002(1-)).
References:


Appendix 8

Evaluation Survey on the Oral Care to Prevent Hospital-acquired Pneumonia Programme

Please give the marks as appropriate.

(1= Totally Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Totally Agree)

1. I am able to understand the rationale behind the intervention.  

2. The programme is well organized.

3. The evidence-based guideline for oral care is useful.

4. The intervention is easy to be carried out.

5. The extra workload of the programme is acceptable.

6. I think the intervention can improve patients’ outcome.

7. I am well supported to carry out the intervention for the programme.

8. I am satisfied with the programme.

9. I agree that the intervention should be implemented in the future.

10. Other suggestions:

_____________________________________________________________________

_____________________________________________________________________

_____________________________________________________________________

Your opinions are very important to us. Thank you for your kind participation!!
Appendix 9

Project Calendar

<table>
<thead>
<tr>
<th>Item</th>
<th>Initiation Stage</th>
<th>Pilot Test</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Month</td>
<td>1 2</td>
<td>3 4 5 6</td>
</tr>
<tr>
<td>Communication team formation &amp; Study review</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Seeking approval from DOM &amp; COS</td>
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<td></td>
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<tr>
<td>Training &amp; preparation of materials</td>
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<tr>
<td>Pilot test</td>
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<td></td>
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<tr>
<td>Data collection</td>
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<tr>
<td>Evaluation of patient outcome</td>
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<tr>
<td>Evaluation of health care provider outcome</td>
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<tr>
<td>Evaluation of system outcome</td>
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<tr>
<td>Status report</td>
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