

Strategies to Improve Outcomes in Nursing Home Residents with Modifiable Risk Factors for Respiratory Tract Infections

Sharon Bradley, RN, CIC
Senior Infection Prevention Analyst
Pennsylvania Patient Safety Authority

ABSTRACT

Pneumonia and other lower respiratory tract infections (LRTIs) are the second most common infections among nursing home residents and the leading cause of death from infections in the long-term care setting. From January through June 2011, the monthly average number of reported LTRIs in Pennsylvania nursing homes increased by 6.4%, and the number of influenza-like illnesses (ILIs) increased by 28.2%, compared to the first 6 months of 2010. Poor oral care, aspiration due to swallowing difficulty, and inadequate vaccination programs are modifiable risk factors for ILI and LRTI. Pennsylvania Patient Safety Authority analysis found that Pennsylvania nursing homes with mandatory programs in place showed 21.5% lower combined seasonal LRTI/ILI infection rates and 42% lower mortality rates than nursing homes without mandatory programs. Approaches to integrate evidence-based strategies into clinical practice include a structured prevention program that targets intensive oral hygiene, identification of dysphagia, implementation of aspiration prevention protocols, and a commitment to implement a universal influenza vaccination program. (Pa Patient Saf Advis 2011 Dec;8[4]:131-7.)

LOWER RESPIRATORY TRACT INFECTION IN LONG-TERM CARE FACILITIES

Pneumonia and lower respiratory tract infections (LRTIs) are the second most common infections among nursing home residents and the leading causes of death from infections in nursing homes. Smith et al. cite literature reviews describing the incidence of nursing home LRTIs ranging from 0.3 to 2.5 episodes per 1,000 resident-care days.¹ The burden of LRTI on healthcare facility operations includes the increased time and cost of additional resident care services, such as radiology and lab tests, antibiotics, multiple physician visits, nursing time, administration of medication and respiratory treatments, and hospital admissions. Residents affected by LRTI may be at additional risk for confusion, falls, and pressure ulcers.²

PENNSYLVANIA SNAPSHOT

Of the 9,929 respiratory tract infections reported by Pennsylvania nursing homes to the Pennsylvania Patient Safety Authority in 2010, 99.4% were LRTIs, a subcategory that includes pneumonia, bronchitis, and tracheobronchitis. The highest number of events was reported as occurring in skilled nursing/short-term rehabilitation units, which were also associated with the highest number of resident-care days. Overall rates of respiratory tract infection (combined LRTI and influenza-like illness [ILI]) were highest on the ventilator-dependent units (0.6 per 1,000 resident-care days).

The incidence of LRTIs and ILIs has increased in Pennsylvania nursing homes, specifically in the first three months of 2011 when compared to monthly LRTIs and ILIs reported to the Authority from June 2009 through December 2010 (see Figure). The incidence of respiratory tract infection is second only to catheter-associated urinary tract infections, except during norovirus season.

From January through June 2011, the monthly average number of reported LTRIs increased by 6.4%, and the number of ILIs significantly increased by 28.2% compared to the first 6 months of 2010 (see Table 1).

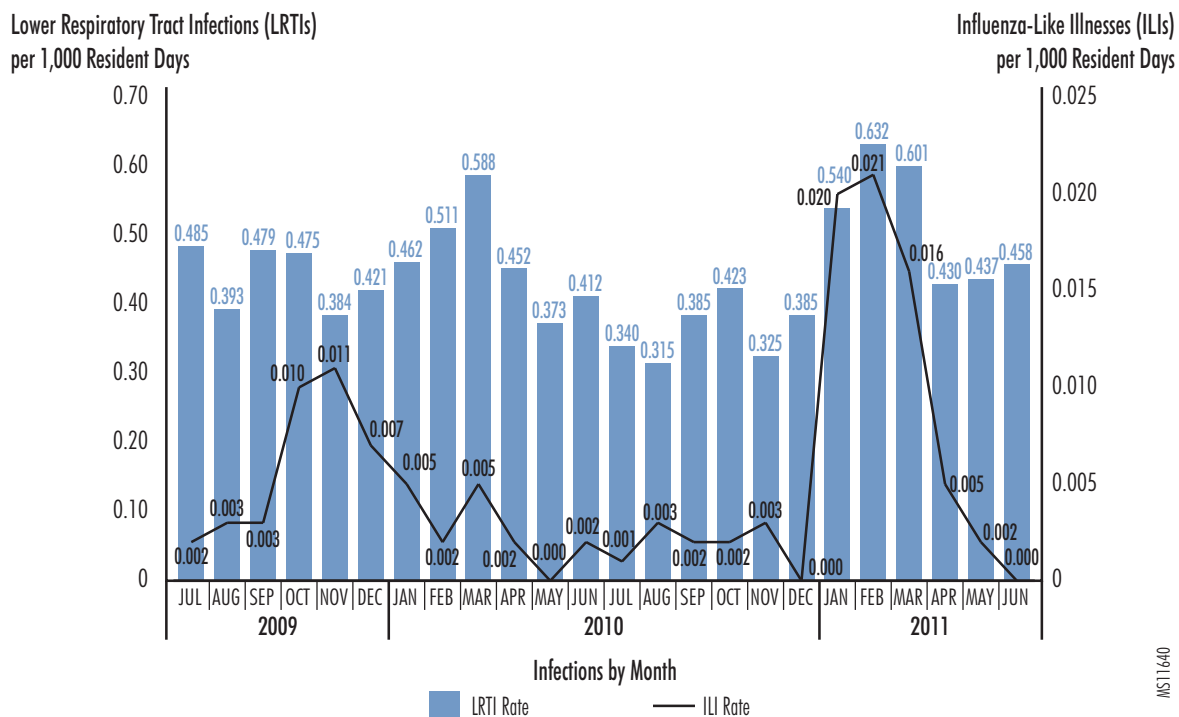
MODIFIABLE RISK FACTORS

Risk factors must be considered in the development of a framework for a targeted prevention strategy for pneumonia and other LRTIs in long-term care facilities. Elderly long-term care facility residents are predisposed to LRTI because of defects in host defenses and risk factors, including the following:^{1,3}

- swallowing difficulty
- smoking
- lack of influenza and pneumococcal vaccination
- immobility
- decreased clearing of bacteria from the airway
- altered throat flora
- poor functional status
- presence of feeding tubes
- poor oral care
- underlying disease

The pathophysiology of LRTIs results from the combination of pathogen adherence to the oro- or nasopharynx, an immune system unable to eradicate the pathogen, as well

Figure. Respiratory Tract Infections in Pennsylvania Nursing Homes, by Month, July 2009 through June 2011



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as an easy path to the lower respiratory tract in residents with a tendency to aspirate.⁴ For example, in a 2-year cohort study of 613 residents from 5 nursing homes in Connecticut, Quagliarello et al. calculated that 21% of all cases of pneumonia could have been avoided with adequate oral care and swallowing difficulty interventions.⁵ Loeb et al. and Quagliarello et al. describe major modifiable risk factors that predispose elderly nursing home residents in the United States and Canada to LRTIs, including (1) inadequate oral care, (2) difficulty swallowing, and (3) lack of influenza vaccination.^{3,5}

Inadequate Oral Care

Residents at high risk for pulmonary infections associated with inadequate oral care include residents with natural teeth, swallowing disorders, poor ability to self-perform good oral hygiene, and diminished salivary flow, as well as mechanically ventilated residents with no

ability to clear oral secretions by swallowing or by coughing.⁶ A 2008 American Geriatric Society systematic review of the preventive effect of oral hygiene on pneumonia and LRTI concluded that daily attention to oral hygiene reduces the occurrence of nursing-home-acquired pneumonia and LRTIs among high-risk elderly people living in long-term care settings.⁷ Nursing home residents often have difficulty accessing frequent professional dental care. The U.S. surgeon general's May 2000 report on oral healthcare specifically stated that older adults living in long-term care settings where dental care is problematic are among those individuals who suffer the worst oral healthcare and hygiene.⁸

Xerostomia, or dry mouth, is a common side effect experienced by the elderly who take multiple medications. The inhibition of salivary flow increases the risk for oral disease because saliva contains antimicrobial components as well as minerals that

can help rebuild tooth enamel after attack by acidic, decay-causing bacteria.⁸

The oral cavity is a rich source of bacteria.⁹ Higher plaque scores, bacterial presence in saliva, or colonization in the oropharynx seem to influence the incidence of pulmonary infections in elderly nursing home patients. Dental plaque is a tooth-borne biofilm that initiates infections of the oral cavity, such as periodontitis and dental caries. One cubic millimeter of dental plaque contains approximately 100 million bacteria. Teeth and gingival margins are places that favor bacterial colonization, and periodontal pockets may serve as persistent reservoirs for potential pathogens for pneumonia. It is likely that oral and respiratory bacteria in the dental plaque are shed into the saliva and then aspirated into the lower respiratory tract and the lungs causing infection.⁸ Residents with natural teeth have been found to develop aspiration pneumonia more often than residents

Table 1. Lower Respiratory Tract Infections in Pennsylvania Nursing Homes, January through June 2010 and 2011

	YEARS	MONTHS						MONTHLY AVERAGE	PERCENTAGE INCREASE
		January	February	March	April	May	June		
No. of lower respiratory tract infections	2010	1,119	1,137	1,434	1,060	903	968	1,103.5	NA
	2011	1,264	1,361	1,415	974	1,012	1,019	1,174.2	6.4%
No. of influenza-like illnesses	2010	13	5	11	4	1	5	6.5	NA
	2011	47	46	37	12	4	0	8.3	28.2

without teeth.⁶ The protective extracellular slime matrix of oral biofilm makes bacteria extremely resistant to antibiotics, antimicrobial agents, and host defense mechanisms. Mechanical removal is the most effective treatment currently available for the control of dental plaque biofilms.¹⁰

Oral care may not always be implemented correctly or consistently in long-term care facilities. Staffing issues, absence of protocols and monitoring, as well as perceived time barriers, knowledge deficits, and uncooperative residents, may make oral care a low priority.¹¹ The 1987 Omnibus Reconciliation Act mandates long-term care facilities that receive Medicare or Medicaid funds to annually assess the oral health of residents using the Minimum Data Set (MDS) questionnaire and to provide or arrange for the provision of routine and emergency dental treatment to meet resident's needs.¹² A sample of the MDS 3.0 questionnaire can be accessed at <http://www.geronet.ucla.edu/centers/borun/MDS%203.0%20Recommended%20Form.pdf>.

Coleman and Watson describe a 2003 observational study in 5 New York State nursing homes that evaluated oral care provided by 47 nursing assistants to 67 residents. Oral care standards were developed and validated by an expert panel of dentists and clinicians. Observers noted that standards that were never met included brushing teeth for at least two minutes, flossing, oral assessment, rinsing with mouthwash, and wearing clean gloves during oral care.¹¹

The oral care of older and disabled residents can be improved by incorporating the following strategies:

Leadership approaches. Long-term care facility administrators can promote oral health as an institutional value by standardizing methods to document daily oral care, monitoring practice, removing barriers, and ensuring provision of adequate oral hygiene supplies, including toothbrushes, fluoride toothpaste, mouthwashes, moisturizing gels, denture cleaning tablets, and storage containers. Resident care conferences can include planning for a diligent, documented, daily regimen of oral hygiene. Administrators can make expectations of oral care clear and hold staff accountable.¹³

Education and assessment. Recommendations for successful educational programs include providing instruction in small groups on oral diseases, oral assessment, the methods and importance of oral care, and hands-on training for delivery of oral care, particularly to care-resistant patients.¹³ The Kayser-Jones Brief Oral Health Status Examination is a simple screening tool that can be used by nursing personnel in long-term care settings to rule out problems with the tongue, teeth, dentures, or oral mucosa and to establish criteria for referral for a dental evaluation, examination, and follow-up. It is available online at http://consultgerirn.org/uploads/File/trythis/try_this_18.pdf.¹⁴

Handling resistance to care. Resistance to receiving care is a significant barrier to good oral care among long-term care

residents. Staff can communicate what is happening, use a pleasant facial expression, encourage self-care, pantomime appropriate actions, and provide distractions to promote cooperation.¹³ The Southern Association of Institutional Dentists provides specific guidelines and self-study modules on oral hygiene in residents with mental and developmental disabilities on its website at <http://www.saident.org/modules.asp>.

Providing tooth brushing and alternatives. Mechanical removal of oral bacteria by tooth brushing is the gold standard of oral hygiene.¹³ The Hartford Institute of Geriatric Nursing recommends morning and evening oral care, preceded by hand washing and donning gloves, then brushing teeth and tongue, and applying lip moisturizer.¹⁵ A small minority of severely debilitated residents (e.g., residents with mouth ulcerations, clotting issues, gingival hemorrhages, or who are ventilator dependent) may require an alternative to tooth brushing. In these instances, swabbing all tooth surfaces for two minutes with a gently abrasive, disposable, soft-foam swab soaked in alcohol-free mouth rinse can be effective in reducing plaque.¹³

Managing dry mouth. An atomizer or spray bottle can be used to mist the oral tissues with water or a water-based hydrating rinse. In addition, a moisturizing gel may be applied periodically to oral mucosa. Mouth rinses that contain alcohol are to be avoided because alcohol is drying and can exacerbate xerostomia; similarly, lemon and glycerin swabs are to be avoided.¹³

Difficulty Swallowing (Dysphagia)

Nursing-home-acquired aspiration pneumonia has the highest mortality rate of any healthcare-acquired infection. It is estimated that 30% of pneumonia in long-term care facilities is caused by aspiration.¹⁶ Singh and Hamdy state that dysphagia carries a sevenfold increased risk of aspiration pneumonia.⁹ Aspiration develops after the inhalation of colonized oropharyngeal material into the lower respiratory tract, often because of impaired swallowing (dysphagia) or ineffective cough. Infection occurs when the inhaled pathogenic secretions create an acute inflammatory reaction.¹⁶

The Quagliarello et al. study found that cough during swallowing represents the best bedside predictor of aspiration; however, residents may also aspirate oropharyngeal contents silently.⁵ Oropharyngeal and esophageal dysphagia is often related to stroke, inadequate oral care, or multiple chronic illnesses.¹⁶ Conditions predisposing the elderly for oropharyngeal and esophageal aspiration include dementia, inability to perform activities of daily living, neurologic dysphagia, medication-induced dysphagia, tracheostomy and tube feedings, and gastroesophageal reflux diseases. Feeding tubes offer no protection from colonized oral secretions.¹⁷ Eisenstadt describes a correlation between the use of proton pump inhibitors (PPIs) used to treat residents with gastric reflux and associated aspiration pneumonitis. PPIs have been found to block gastric acid production, resulting in bacterial overgrowth and an increase in the number of bacteria in the oral cavity.¹⁶

It is important to identify and implement aspiration-prevention strategies because difficulty swallowing has been shown to be a modifiable risk factor.⁵ Evidence-based preventive strategies can be outlined in feeding protocols, aspiration risk reduction algorithms, clinical triggers, care pathways, or checklists that contain the following elements:

Assessment. Residents admitted with pulmonary problems are to be assessed very carefully and monitored frequently for subtle changes in condition that can be addressed immediately. Being proactive instead of reactive is critical to avoiding unplanned discharges to the hospital from the nursing home. Implementing timely and individualized interventions is crucial to improved clinical outcomes. Identification of residents at risk for aspiration and the potential development of pneumonia requires awareness of early indications of swallowing difficulty.¹⁸ Clinical indicators of swallowing difficulty include the following:¹⁸

- Food remaining on the resident's tongue after swallowing, or pocketing of food on side of mouth
- Coughing or choking while eating or drinking and gargled sounding voice changes after eating or drinking
- Excessive drooling

Relevant history and physical taking.

Assess the resident for past and present eating habits, any history of aspiration pneumonia, poor appetite, fear of choking, broken or ill-fitting dentures, and neglected oral care.¹⁸

Comprehensive diagnostics. Evaluate the resident's medical and family history, surgical procedures, and lifestyle. Identify conditions that impair the ability to protect the airway.¹⁶

Pharmacology. Employ agents that facilitate gastric emptying or folic acid supplements that have been shown to improve swallowing reflex; avoid sedatives and hypnotics.¹⁶

Swallowing therapy. Supervise the resident's oral feeding with altered textures, such as nectar- and honey-thick liquids. Supervise positioning with a chin-tuck posture in an upright 90-degree-angle sitting position. Conduct a noninvasive bedside swallowing evaluation and speech/language pathology to strengthen and improve swallowing muscles. Provide rest periods for the resident.¹⁶ Educate and

monitor family members' participation in feeding the resident to ensure that they abide by the liquid thickness ordered for the resident.

Enteral feeding. Raise the head of the resident's bed up to 30 degrees. The angle can be marked with tape for visual assessment of correct positioning. Assess for signs of gastric stasis, such as nausea and bloating. Measure gastric residual volumes routinely and before feedings. Establish continuous pump feedings.¹⁶ Ensure the use of proper feeding devices and the education of nurse aides on appropriate adaptive equipment.

Individualized patient care plan. Address the resident's specific problem; develop realistic and measurable goals, specific actions, and interventions. Review and assess the resident's progress, educating the resident and the family in approaches to prevent aspiration.¹⁸

Oral and dental hygiene. Intensive oral care may reduce the incidence of aspiration pneumonia in residents not only by reducing oropharyngeal colonization, but also by improving both swallowing and cough reflex sensitivities.¹⁹ In a healthy individual, the respiratory tract is able to mount a defense against aspirated bacteria.⁶ Daily gum and tooth brushing is known to stimulate sensory nerves in the oral cavity and enhance release of a salivary hormone believed to play a major role in both cough and swallowing sensory pathways.²⁰

Lack of Influenza Vaccinations

Vaccination of healthcare workers against influenza has been shown to reduce illness and absenteeism and to reduce transmission of influenza to healthcare workers, their families, and their residents.²¹ Vaccination of both residents and their contacts (e.g., visitors, clinicians) is the foundation of efforts to prevent influenza transmission. Vaccination of healthcare workers serves to prevent transmission to residents who have a lower

Table 2. Seasonal LRTI/ILI rates in Pennsylvania Nursing Homes—Mandatory versus Nonmandatory Vaccination Programs—October 2010 through March 2011

LONG-TERM CARE PROGRAM	LRTI/ILI RATE
Voluntary (n = 203)	0.64 (95% CI = 0.62 - 0.66)
Mandatory (n = 18)	0.50 (95% CI = 0.44 - 0.57)

$p = 0.0001$ by z-test

likelihood of vaccination responses themselves and to create “herd immunity” that protects both the healthcare worker and residents who are unable to receive vaccine or who are unlikely to respond with a sufficient antibody response.²²

A 2005 study in 301 long-term care facilities noted that high rates of both healthcare workers’ and residents’ vaccinations substantially altered the rate and impact of nosocomial influenza outbreaks.²³ Carman and Lemaitre cited several cluster randomized controlled trials that found that vaccination of healthcare workers in a long-term care setting was associated with significant reductions in patient mortality.^{24,25} The results of a 2008 mathematical model to estimate the effects of healthcare worker vaccination found that approximately 60% of influenza virus infections in residents can be prevented when 100% of staff are vaccinated.²⁶

The Society for Healthcare Epidemiology of America views influenza vaccination of healthcare workers as a “core patient and healthcare professional safety practice with which noncompliance should not be tolerated.”²² A Centers for Disease Control and Prevention survey of healthcare worker influenza vaccination coverage during the 2010-2011 seasons found that in facilities with mandatory healthcare worker vaccination programs, 98.1% of healthcare workers were vaccinated, compared to 58.9% in nonmandatory settings. Greater coverage in facilities without a vaccination requirement was associated with personal reminders and free vaccine available for more than one day.²¹

Authority analysts examined event report data and nursing home responses from

the Authority’s 2010 annual survey to assess the effect of healthcare worker vaccination on the reduction of LRTI and ILI in Pennsylvania nursing homes. Eighteen (8.1%) of the 221 nursing homes that responded to the survey reported having mandatory annual healthcare worker vaccination programs in place. This analysis found that mandatory healthcare worker influenza vaccination programs in Pennsylvania nursing homes have shown 21.5% lower combined seasonal LRTI/ILI infection rates from October 2010 through March 2011 (see Table 2). Extrapolating from the difference in rates between mandatory and nonmandatory facilities, a projection of 616 potential respiratory tract infections could have been prevented among the remaining 203 respondent facilities. Taken a step further, 1,991 RTIs could have been prevented among all Pennsylvania nursing homes.

Reducing transmission of influenza from healthcare workers to residents and patients is a top priority in Pennsylvania. During the summer of 2011, the Pennsylvania Department of Health, in collaboration with the Authority, the Center for Vaccine Ethics and Policy at the University of Pennsylvania, the Hospital and Health System Association of Pennsylvania, and the Pennsylvania Immunization Coalition, conducted an educational campaign across the state to encourage influenza vaccination among healthcare personnel in Pennsylvania hospitals and health systems including nursing homes to implement an influenza healthcare personnel vaccination program for the 2012-2013 influenza season. The campaign home page can

be accessed at <http://pahcwfluvax.org>. Campaign materials include a commitment form due by the end of December 2011 and a best practices guide and toolkit. The pledge form is available at <http://www.haponline.org/quality/resources/flu-campaign>, and the toolkit can be accessed at http://www.haponline.org/downloads/Universal_Flu_Immunization_Programs_for_Health_Care_Personnel-HAP_Quality_Best_Practice_Series_Sept2011.pdf.

CONCLUSION

Recent evidence indicates that the morbidity and mortality associated with ILI and LRTI in nursing homes can be substantially improved with prevention programs that target modifiable risk factors, including inadequate oral care, aspiration due to swallowing difficulty, and inadequate employee vaccination programs. Several components are crucial to structuring a targeted prevention program. First, an effective oral hygiene program includes education and assessment, handling resistance to care, providing tooth brushing and alternatives, and managing dry mouth. Second, dysphagia and aspiration risk factors can be modified with a structured history and physical assessment; an individualized care plan; the use of comprehensive diagnostics, pharmacologic agents, swallowing therapy, and enteral feeding; and the stimulation of hormones that affect swallowing by daily gum and tooth brushing. Finally, research indicates that vaccination of healthcare workers can reduce the transmission of influenza to residents by 60%. Translation of these evidence-based interventions into actionable facility practices has been shown to have a significant impact on respiratory tract infection outcomes.

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NOTES

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LEARNING OBJECTIVES

- Identify strategies considered effective to improve the oral care of nursing home residents.
- Select the interventions necessary to modify risk factors for lower respiratory tract infections (LRTIs) and aspiration pneumonia.

SELF-ASSESSMENT QUESTIONS

The following questions about this article may be useful for internal education and assessment. You may use the following examples or come up with your own.

While making rounds to monitor compliance with resident oral hygiene practices, the nursing supervisor noticed multiple inadequacies with resident oral care, including presence of thick oral and tongue plaque, inadequate teeth brushing, no use of mouthwash rinse, and lack of gloves and hand hygiene. The nursing assistant reported a lack of oral care supplies, as well as caring for multiple dependent and combative residents. A family member was seen feeding a dysphasic resident in a semi-reclining position. Review of

(continued)

- Recognize influenza vaccination program strategies most likely to reduce transmission of influenza to nursing home residents and their contacts.

the medical record and care on several of these residents indicated diagnoses of recurring aspiration pneumonia, inconsistencies in assessments and documentation of oral health and care, and use of medications inducing dry mouth. Surveillance for respiratory tract infection found that the facility's influenza-like illness infection rates have not decreased over several years. The resident influenza vaccination rate remains high, but employee vaccination rates are consistently below 50% acceptance.

1. Review the following strategies to improve the oral care of nursing home residents. Which strategy would be the *least* effective in improving the oral care of the combative and dependent residents discussed in the case scenario above?
 - a. Monitor daily oral care practices and availability of supplies (toothbrushes/paste, foam swabs, mouthwash and moisture gel supplies).
 - b. Discourage resistance to care with communication, modeling, expression, distraction, and interventions found in self-study modules.
 - c. Manage dry mouth with hydrating spray or moisturizing gel.
 - d. Provide web-based in-services as needed to all facility staff about the importance of oral care to residents.
2. All of the following practices exemplify adequate oral care EXCEPT:
 - a. Wash hands and don clean gloves prior to giving oral care.
 - b. Clean the oral cavity of ventilator-dependent residents with lemon-glycerin swabs.
 - c. Complete oral care twice daily (i.e., once during the morning and once during the evening).
 - d. Brush teeth and tongue for two minutes and, if needed, apply lip moisturizer.
3. Based on the case scenario above, which of the following risk factors for LRTIs would be modifiable?
 - a. Inability to perform activities of daily living and neurologic- and medication-induced dysphagia
 - b. Multiple chronic illnesses, dementia, and smoking
 - c. Dysphagia, inadequate oral care, and inadequate vaccination compliance
 - d. Tracheostomy, tube feedings, and gastroesophageal reflux diseases
4. All of the following actions are associated with evidence-based strategies to prevent aspiration in the above resident with dysphagia EXCEPT:
 - a. Supervise oral feeding and position with a head-up posture in a 30-degree angle sitting position.
 - b. Provide intensive oral care with daily tooth and gum brushing.
 - c. Complete a proactive assessment to identify residents with clinical indicators of dysphagia aspiration.
 - d. Measure gastric residual volumes routinely and before feedings.
5. Which of the following influenza vaccination program strategies is *most* likely to reduce transmission of influenza in the facility in the case scenario above?
 - a. Vaccinate all consenting residents to increase herd immunity.
 - b. Achieve high vaccination rates for all healthcare workers, residents, and contacts (i.e., family members, visitors).
 - c. Mandate a vaccination program for all clinicians.
 - d. Vaccinate all residents and family members.

PENNSYLVANIA PATIENT SAFETY ADVISORY

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