2-2020

Dysphagia Screening for Pneumonia Prevention in a Cancer Hospital: Results of a Quality/Safety Initiative.

Barbara Ebersole

Miriam Lango

John Ridge

Elizabeth Handorf

Jeffrey Farma

See next page for additional authors

Recommended Citation

Ebersole, B., Lango, M., Ridge, J., Handorf, E., Farma, J., Clark, S., & Jamal, N. (2020). Dysphagia Screening for Pneumonia Prevention in a Cancer Hospital: Results of a Quality/Safety Initiative. Otolaryngology--head and neck surgery : official journal of American Academy of Otolaryngology-Head and Neck Surgery, 162(2), 220–229. https://doi.org/10.1177/0194599819889893

HHS Public Access

Author manuscript

Otolaryngol Head Neck Surg. Author manuscript; available in PMC 2021 February 01.

Published in final edited form as:

Otolaryngol Head Neck Surg. 2020 February ; 162(2): 220–229. doi:10.1177/0194599819889893.

Dysphagia Screening for Pneumonia Prevention in a Cancer Hospital: Results of a Quality/Safety Initiative.

Barbara Ebersole, MA CCC-SLP[1,2], **Miriam Lango, MD**[1,3], **John Ridge, MD, PhD**[1,3], **Elizabeth Handorf, PhD**[4], **Jeffrey Farma, MD**[3], **Sarah Clark, MS CCC-SLP**[1,2], **Nausheen Jamal, MD**[5]

[1]Department of Otolaryngology-Head & Neck Surgery, Temple University School of Medicine, 3440 N. Broad St., Kresge West #300, Philadelphia, Pennsylvania, 19140 USA

[2]Department of Speech Pathology, Fox Chase Cancer Center, Temple University Health System, 333 Cottman Avenue, Philadelphia, Pennsylvania 19111 USA

[3]Department of Surgical Oncology, Fox Chase Cancer Center, Temple University Health System, 333 Cottman Avenue, Philadelphia, Pennsylvania, 19111 USA

[4]Department of Biostatistics, Fox Chase Cancer Center, Temple University Health System, 333 Cottman Avenue, Philadelphia, Pennsylvania, 19111 USA

[5]Department of Surgery, University of Texas Rio Grande Valley School of Medicine, University of Texas Health, 1210 West Schunior Street, Edinburg TX 78541 USA

Abstract

Objective—Hospital-acquired aspiration pneumonia remains a rare but potentially devastating problem. The best means by which to prevent aspiration in a cancer hospital population has not been evaluated. The aim of this study was to evaluate the impact of dysphagia screening on aspiration pneumonia rates in an acute care oncology hospital.

Methods—A prospective single-institution quality-improvement dysphagia screening protocol at a comprehensive cancer center. Effect of dysphagia screening implemented in 2016 on hospital acquired aspiration pneumonia rates coded “aspiration pneumonitis due to food/vomitus” were compared with rates from 2014-15, prior to implementation. Screening compliance, screening outcomes, patient demographics, and medical data were reviewed as part of a post hoc analysis.

Results—Of 12,392 admissions in 2014-16, 97 patients developed aspiration pneumonia during their hospitalization. No significant change in aspiration pneumonia rate was seen during the dysphagia screening year when compared to prior years (baseline- 7.36 and screening year- 8.78 per 1000 discharges p=0.33). Sixty-eight of the cases (66%) were associated with emesis/ gastrointestinal obstruction or perioperative aspiration and only 15 (15%) with oropharyngeal

Corresponding Author: Barbara Ebersole, MA, CCC-SLP, Assistant Research Professor & Director, Speech Pathology, Fox Chase Cancer Center & Jeanes Hospital, Assistant Director, Temple Head and Neck Institute, Lewis Katz School of Medicine, Temple University, Department of Otolaryngology–Head and Neck Surgery, Fox Chase Cancer Center, 333 Cottman Avenue, Philadelphia, PA 19111, Phone: 215-728-0568, Barbara.ebersole@fccc.edu.

This article was accepted for poster presentation at the 26th Annual Dysphagia Research Society Meeting: March 15-17 2018, Baltimore, Maryland.

dysphagia. Multivariate analysis found that patients admitted to GI surgery had an aspiration risk equivalent to patients admitted to head and neck, thoracic and pulmonary services (OR 0.65, p= 0.2).

Discussion: Nursing-initiated dysphagia screening did not decrease aspiration pneumonia rates. The causes of aspiration-associated pneumonia were heterogeneous. Aspiration of intestinal contents is a more common source of hospital-acquired pneumonia than oropharyngeal dysphagia.

Keywords

PS/QI; dysphagia; swallow screening; aspiration; hospital acquired pneumonia; cancer

Introduction

Hospital acquired pneumonia (HAP) remains one of the leading nosocomial infections in hospitalized patients[1]. HAP is associated with increased need for intensive care, mechanical ventilation, healthcare costs, prolonged hospital stay and an increased risk of death[2, 3]. Research efforts, primarily focused on pneumonia associated with mechanical ventilation, or ventilator associated pneumonia (VAP), have resulted in the establishment of prevention guidelines. Implementation of VAP prevention guidelines, standard practice in most intensive care units (ICUs), led to the decline in the incidence of VAP over the last decade[4, 5]. However, only one-third of HAP are associated with ventilator use[2]. Furthermore, non-ventilator associated HAP has a comparable mortality rate and higher total costs when compared with VAP[6]. More than one-quarter of HAP cases are attributable to aspiration, which is considered a modifiable risk factor[7]. The prevalence and etiology of hospital acquired aspiration pneumonia (HAAP) in hospitalized cancer patients is not well described or understood.

The introduction of bacteria into the lungs is a necessary condition for the development of HAP. Oropharyngeal dysphagia, or impaired oropharyngeal swallowing, a risk factor for aspiration, has been reported in up to 30% of patients who are 65 years of age and older[8, 9] and up to 55% in those aged 85 and older[10]. The prevalence of dysphagia among patients with advanced cancer has been estimated at greater than 50%[11]. Dysphagia appears to be more common among patients with advanced cancer than in age-matched controls, possibly as a result of mucositis and frailty[12]. HAP development is also influenced by a patient's immune response and ability to fight infection. Patients with cancer have an increased vulnerability to developing pneumonia due to their immunocompromised status, or underlying malignancy[13, 14]. A recent epidemiological study examining clinical correlates of HAP reported that 48.2% of patients with HAP also had malignancy, and another 29.6% were immunocompromised[7]. Thus a number of factors may potentially contribute to the development of hospital acquired aspiration pneumonia (HAAP).

Clinically significant dysphagia is not always apparent and often undetected. Therefore, recent HAP prevention measures have attempted to standardize assessment and referral using nursing-administered screening tools. Improving the timeliness of formal speech language pathology (SLP) evaluation and management could potentially decrease the frequency of aspiration pneumonia in hospitalized cancer patients. Several studies have

established that nursing-administered aspiration screening tools reduce the incidence of HAAP in acutely hospitalized stroke patients[15, 16]. It is unclear whether these findings can be generalized to other hospitalized populations and there are no studies examining the value of a formal aspiration screening process in an acutely hospitalized oncology population.

The primary aim of this study was to determine whether a nursing-administered aspiration screening protocol at a NCI-designated comprehensive cancer hospital would lead to a reduction in the rate of HAAP. This protocol was implemented as part of a patient safety and quality improvement (PSQI) initiative. We hypothesized that implementation of a formal aspiration screening protocol would lead to a reduction in HAAP by improving the accuracy and timeliness of dysphagia consultation requests. In addition, we sought to identify possible risk factors for HAAP by describing the population of patients who developed aspiration pneumonia during their stay.

Methods

We conducted a prospective single-institution quality-improvement dysphagia screening protocol at a comprehensive cancer center over a 3-year period. January 2014 – December 2015 represented our baseline data. January 2016 – December 2016 represented the time during which our PSQI aspiration screening trial was implemented. All patients admitted to the hospital during this period were included in the study, except those with a diagnosis of pneumonia at the time of admission, who were excluded. Patients re-admitted to the hospital at any point during the study period were included, so long as they did not have pneumonia at the time of re-admission. Approval from the Fox Chase Cancer Center Institutional Review Board was obtained. Twelve thousand, five hundred fifty-five admissions occurred during the three-year study period. Of these, 163 were excluded based upon study criteria, leaving 12,392 admissions included in the final analysis.

The aspiration screening protocol was implemented by a multidisciplinary team consisting of staff from nursing and speech pathology, with advice from the surgical and medical staff and the institution's performance improvement department. The Yale Swallow Protocol (YSP) was the dysphagia-related aspiration screening tool selected for implementation. The YSP describes exclusionary (e.g. no/low risk for dysphagia) and deferral criteria for a 3-ounce water challenge with criteria for pass/fail[17]. Additionally, those with a history of H&N cancer were referred directly to SLP for instrumental swallowing evaluation, due to their high risk for dysphagia and potential for laryngeal sensory deficits. This protocol has demonstrated high sensitivity (100%) with moderate specificity (64%), a positive predictive value of 78%, and a negative predictive value of 100%, validating it as a tool that effectively identifies possible aspirators in a heterogeneous population[17]. It has also been validated for nurse administration[18]. The nursing staff on each unit were trained to identify risk factors for dysphagia and to perform the screening via in-person demonstrations conducted by the PSQI clinical nurse specialist and a speech pathologist. Each unit also identified an "aspiration champion" who provided support and training to the rest of the unit on an ongoing basis. The aspiration screening was performed as a part of the nursing admission assessment and/or prior to initiating an oral diet. Figure 1 depicts the dysphagia screening process. During the screening year, a systematic sampling approach was used to monitor process

outcomes. We collected data for all admissions for 60-90 consecutive days across two separate time points during the screening year. A total of 1510 charts were included, and the following data was collected: whether the screening was performed, reasons for exclusion or deferral, whether the water test was administered, pass/fail status from water test, and diet status. The screening outcome of patients who developed HAAP were also collected for the screening year (2016).

We utilized our institution's Vizient Clinical Database Resource Manager™ (CDB/RM™) to procure data elements in a single report for pre/post-intervention analysis. Vizient, Inc. (Irving, Texas) is a healthcare performance improvement company providing expedited clinical analytics to member institutions. All clinical data contained within the report come directly from our hospital's data warehouse, primarily from billing, coding, and medical record documentation. Several ICD-10 codes for identifying pneumonia that was not present on admission (i.e. acquired during hospital stay) were collected for this review. The outcome of interest for this study was ICD-10 code J69.0 "aspiration pneumonitis due to food/vomit" because it specifically encompasses pneumonia as a result of food or liquid entering the lungs from the oropharynx or as a result of "reverse" aspiration emanating from the gastrointestinal (GI) tract in adults. We also collected general pneumonia codes J18.0, J18.1, J18.2, J18.8, J18.9 and J69. We did not use code J95.851 for ventilator associated pneumonia because this study assessed non-ventilator-associated hospital-acquired pneumonia. All cases underwent manual chart review to confirm diagnosis. We used criteria similar to those established in prior studies[1, 19, 20]: (a) radiographic evidence of pneumonia suggestive of aspiration (e.g. lower lobe consolidation or infiltrates) in connection with (b) clinical symptoms of fever and shortness of breath and physician documentation of a diagnosis of aspiration pneumonia. Any patient who met the above criteria for pneumonia within 48 hours of admission was excluded based on the assumption that pneumonia was present on admission. Anyone with HAAP identified during or within 48 hours of extubation from mechanical ventilation for respiratory failure was also excluded from the study due to presumed ventilator associated pneumonia. Over the 3-year period, 173 patients had a diagnosis of pneumonia not present on admission. Of these, 31 were excluded following manual chart review because they did not meet the diagnostic criteria for HAP. Ninety-seven of the remaining 142 cases were coded as J69.0 not present on admission, and underwent additional manual chart review to identify a documented source of aspiration (if present), oral diet prior to pneumonia symptoms, screening status (in 2016 only), and presence and timing of dysphagia consultation. Perioperative HAAP was defined as the development of pneumonia symptoms within 24 hours of surgery. Oropharyngeal dysphagia (OPD) was confirmed via either instrumental swallowing evaluation or with a bedside SLP assessment that reported severe OPD with a recommendation of nil per os (NPO). Emesis within eight hours of the development of symptoms of pneumonia and/or radiographic/endoscopic evidence of acute gastrointestinal obstruction suggested a GI source of aspiration. HAAP cases with no documented source of aspiration, or where more than one of the above sources of possible aspiration were present, were recorded as "unclear".

The following data elements were collected on all admissions for the purposes of HAAP risk analysis: age, gender, racial group, admission status (elective, urgent, emergency), 3M™ All Patients Refined Diagnosis Related Groups (APR-DRG) risk of mortality at the time of

admission (minor, moderate, major, extreme), 3M™ APR-DRG severity of illness at the time of admission (minor, moderate, major, extreme), attending service line (DRG-based), observed length of stay (LOS), and expected LOS. We summarized patient characteristics from the two different periods, and tested differences using Chi-squared tests, Fisher's exact tests, and t-tests, as appropriate. We used a Poisson regression model with an offset for length of stay to model the change in rates of HAAP before and after the intervention, and logistic regression models to determine the effect of intervention period on rate of swallowing evaluations. These models adjusted for mortality risk, illness severity, service line, and patient age, and used Generalized Estimating Equations with robust standard errors to account for repeated admissions within patient. We conducted a power analysis for our primary study aim. This defined a need for 6,926 patients pre- and post- implementation (each) to have power of 80% to detect a difference of 50% difference in the rate of HAAP at the p=0.05 level.

Results

Hospital Acquired Aspiration Pneumonia (HAAP) rates

We analyzed 12, 392 admissions to Fox Chase Cancer Center from 2014-16. Fifty-two percent of the patients were female, and 80% were Caucasian. The mean age was 64 years (18 – 95 years). Over the 3-year period and after exclusions following manual chart review, 142 patients met criteria for HAP, constituting 1.1% of admissions. Ninety-seven patients (68% of those with HAP) had HAAP that was explicitly attributed to aspiration, accounting for 0.78% of admissions. From 2014 through 2016, the rate of HAAP did not significantly change, despite the implementation in 2016 of a dysphagia screening protocol. In 2016, 39 cases of HAAP were identified yielding a HAAP rate of 8.78 per 1000 discharges. The HAAP rate for 2014-15, during which no screening was performed, was not significantly different (7.36 per 1000 discharges: relative risk 1.22, 95% confidence interval 0.82-1.83, p=0.33). Thus, implementation of the dysphagia screening protocol during this period had no apparent effect on HAAP rates. HAAP patients had significantly longer LOS than non-HAAP patients (mean and median LOS 18 and 13 days versus 5 and 4 days for admissions without and with HAAP, respectively, p=0.0001), Figure 2.

Risk factors for HAAP

Factors associated with the development of HAAP are listed in Table 1. Factors tracked by the Vizient database were investigated for associations with the development of HAAP. Patients considered to have extreme comorbidities on admission (APR-DRG Illness Severity), and extreme risk of mortality on admission (APR-DRG Mortality Risk) were more likely to develop HAAP during hospitalization than those with lesser comorbidities. Almost four percent of patients with extreme comorbidities on admission developed HAAP, compared with 1.1% of patients with major comorbidities and 0.2% of patients with minor comorbidities (Table 1). The strongest independent risk factor for developing HAAP after adjusting for patient age, admitting service and dysphagia screening, was extreme severity of illness at admission (RR 7.59, 95% CI 2.3-25.08, p=0.0009), increasing the risk of HAAP over seven-fold relative to those with minor severity of illness on multivariable analysis. Major severity of illness was also associated with the development of HAAP but the

association did not reach statistical significance after adjusting for other factors (RR 2.66, 95% CI 0.91-7.80, p=.07). However, the number of patients with extreme comorbidities or extreme risk of mortality represented a small subset of patients with HAAP. In contrast, 50% of HAAP cases had major comorbidities (APR-DRG Illness Severity) on admission, due to the far greater number of admissions with major, rather than extreme comorbidities (Table 1).

Patients admitted to specific services were also more likely to develop HAAP. Pulmonary/critical care admissions (PCC) developed HAAP at higher frequencies (2.29% of admissions) compared with general medicine (0.55% of admissions) or gastrointestinal (GI) surgery (1.0% of admissions). Although PCC, head and neck surgery (HNS) and thoracic surgery admissions were disproportionately represented in the HAAP group, they nevertheless represented a small subset of patients with HAAP. A majority of patients with HAAP were admitted to GI surgery, general medicine and medical oncology (Table 1). On multivariate analysis, the risk for HAAP development in patient's admitted to GI surgery was equivalent to those admitted to HNS, Thoracic and PCC service lines (OR 0.65, CI0.336-1.257, p=0.2). Whereas, those admitted to other surgical and medical service lines had significantly less risk (Table 2). Dysphagia screening was implemented in 2016, but admission during this period was not associated with a difference in the risk of HAAP on either univariate or multivariate analysis.

Oropharyngeal dysphagia screening protocol adherence

In order to assess procedural adherence with the dysphagia screening protocol, the medical charts from 1510 admissions (of 4140 total admitted for 2016), were manually reviewed to monitor adherence with the screening protocol. Of 1510 randomly audited charts, 891 (59%) underwent the screening protocol (which was documented in the chart) while 619 (41%) were either not screened for dysphagia or had the screening deferred. One hundred sixty-three patients were deferred because they were NPO at admission through discharge or were already pending formal SLP consultation for dysphagia. For the remaining 456 patients who were not screened, reason for failure to screen was not documented in the medical record. Thus, 891 of 1347 admissions (66%) otherwise cleared for an oral diet or without a prior diagnosis of OPD underwent dysphagia screening.

Of 891 patients who underwent dysphagia screening, 670 (75.2%) passed since they were judged as "low/no-risk" (i.e. no concern for dysphagia), while 221 were flagged for additional testing, and 10 failed the 3-ounce water challenge by nursing (Figure 3). Four of 670 patients (0.6%) who passed the screening nevertheless developed HAAP while one of 221 (0.4%) patients flagged for additional testing developed an aspiration pneumonia. Passing the dysphagia screen was not associated with a decreased risk of HAAP, relative to failing the screen; the frequency of HAAP among screen failures was similar to that of those passing the initial screen (0.5% vs 0.6%, p=.803), and also not significantly different from those of unscreened or deferred admissions (Figure 3). Of the 13 patients who developed HAAP in the screening sample, only 2 (15%) had OPD-associated HAAP. One passed the screening by being judged as "low/no risk" and the other failed the water challenge,

developing HAAP despite NPO status. The majority of HAAP in the screening sample cohort was a result of emesis/GI obstruction (6, or 46%).

Clinical factors associated with the development of HAAP

In order to describe the clinical settings associated with the development of aspiration pneumonia, we reviewed additional medical records for the 97 patients who developed HAAP. The preponderance of HAAP was associated with small bowel or gastric outlet obstruction, esophageal obstruction and/or emesis (44 or 46% of cases), or related to anesthesia in the perioperative period (24 or 25% of cases). Perioperative cases were those that met the study criteria for aspiration pneumonia within 24 hours of a surgical procedure. Fourteen of these cases (58%) also had documentation in the surgical note explicitly reporting an intraoperative (e.g. during induction/emergence) aspiration event. In 13 HAAP cases (13%) the cause of aspiration could not be deduced from the medical record. The documented source of aspiration in the total HAAP cases across study years are listed in Table 3.

HAAP was specifically attributable to OPD in 15% of all HAAP cases. During the screening year, 6 patients (15%) developed dysphagia-related HAAP. One underwent the water challenge and one passed as “no/low risk” (as seen in the screening sample). Additionally, 2 had no screening documented and 2 were deferred due to being NPO with feeding tubes. Across all three years, all of the patients whose aspiration pneumonia was attributed to OPD and were not already NPO underwent a full dysphagia evaluation that included speech language pathology (SLP) assessment. However, the majority of these consultations were made after the diagnosis of HAAP, including during the screening year (Table 4). Among patients with OPD, NPO status did not prevent the development of HAAP. Thirty percent of patients with dysphagia-related aspiration were NPO at the time of the aspiration event (Table 5).

Discussion:

Hospital-acquired pneumonia (HAP) is an uncommon, complex, expensive and potentially deadly nosocomial infection. The incidence of nonventilator-associated HAP at our institution was similar to that reported by other acute care hospitals in the United States[6]. The incidence of HAP due to aspiration is not well described in the literature. In a retrospective review of multicenter acute care centers, See and colleagues reported that 26% of HAP cases were documented to be aspiration-related[7]. This contrasts with the 68% frequency of aspiration-related (HAAP) cases identified in our study. Excluding those whose source of aspiration was unclear and also those with perioperative aspiration without a documented event provides a more conservative HAAP estimate. Even so, this yields a frequency of 52%, twice what has been previously reported. The reasons for these differences are unclear, but could be related to differing study populations or variations in coding practices. Patients who developed HAAP at our institution had prolonged hospitalizations and greater mortality than those without HAAP, consistent with other studies[1, 3, 20-23]. This study suggests that frank aspiration may be the source of HAP in the majority of cases in a cancer hospital.

Understanding the mechanism for pathogens entering the lower airway is a prerequisite for designing effective HAAP prevention programs. Aspiration pneumonia most frequently develops after seeding of the lower respiratory tract by bacteria in an individual with suboptimal host resistance to infection. Dysphagia plays an important role in predisposing to HAAP in some debilitated cancer patients, and is known to be underreported and under-recognized in the cancer population[24]; these observations provided the rationale for implementing a dysphagia screening program at our institution. Aspiration may also occur in the absence of dysphagia, when protective airway reflexes are overwhelmed, such as during unexpected or protracted emesis. Additionally, aspiration may occur during induction or emergence from anesthesia as a result of altered sensorium.

Implementation of a dysphagia screening protocol in 2016 had no apparent effect on HAAP rates, which remained constant throughout the period. The HAAP rate among patients who passed dysphagia screening was not significantly different from that of those who did not. Further medical record review revealed that only 15% of HAAP cases were ultimately attributable to dysphagia, a frequency that was consistent across all 3 years. Furthermore, despite the adoption of a dysphagia screening tool in 2016, most cases of OPD-associated HAAP still did not undergo SLP evaluation until after HAAP development because they either didn’t get screened, passed the initial screening, or were NPO.

Screening for oropharyngeal dysphagia has been tested and found effective in other settings. The YSP is a screening tool for OPD-related aspiration, is quick to administer, simple to interpret, and is associated with reduced HAAP in acutely hospitalized stroke patients[15]. However, in our study, utilization of the YSP did not lead to a reduction in our HAAP rates. The disappointing performance of the screening test could be attributable to insufficient adherence, inadequate training of nursing staff, and the relatively low prevalence of dysphagia-related aspiration pneumonia in our population. In fact, the patients judged to be at the highest risk for OPD-related aspiration were excluded from the screening process and referred directly for instrumental swallowing evaluation. In a setting where SLP involvement is already well-integrated for those at high risk for OPD, screening a large and lower-risk heterogeneous population for dysphagia may not an effective model.

The frequency of HAAP attributable to dysphagia was lower than anticipated, despite high rates of chemotherapy-related mucositis, and a high prevalence of cancers associated with dysphagia with or without limited pulmonary reserve. This suggests that current management strategies to minimize aspiration risk associated with OPD are already quite effective, and not meaningfully enhanced by use of additional screening. Nevertheless, 30% of patients with dysphagia-related HAAP were NPO prior to aspiration, highlighting the difficulty in preventing HAAP in this population. Ceasing an oral diet is not equivalent to eliminating HAAP risk. Aspiration of secretions, microaspiration of oropharyngeal bacteria and refluxing of tube feeds remain sources of HAAP risk irrespective of diet status[21, 25].

An analysis using the Vizient database revealed that extreme severity of illness at the time of admission and admission to certain service lines were independent risk factors for the development of HAAP. Patients with extreme severity of illness at the time of admission had a 7-fold increased risk of HAAP compared with those with mild severity of illness. Factors

related to general health and immune status, such as malnutrition, anemia, depressed consciousness, multiple co-morbidities, and chronic renal failure, have been previously associated with hospital acquired pneumonia outside the ICU[1, 7, 21, 26]. Nevertheless, patients with major, rather than extreme severity of illness comprised the highest proportion of patients with HAAP. Although patients with extreme severity of illness were at greatest risk for HAAP, an overwhelming majority of patients who developed HAAP had major (but not extreme) severity of illness.

HNS, PCC, and thoracic service lines were independently associated with a greater risk for HAAP, consistent with prior studies[1, 22, 26]. Patients admitted to the GI surgery service line had a HAAP risk that was equivalent to these previously established high-risk groups. Nevertheless, patients on these high risk services represented less than half of patients with HAAP. Analysis using the Vizient database did not provide sufficiently granular information for insight leading to actionable risk stratification. Manual chart reviews revealed that for the majority of patients with HAAP, aspiration was attributable to GI obstruction or was anesthesia-related.

GI obstruction and emesis, prevalent in people undergoing cancer treatment, are known risk factors for aspiration[27, 28]. Aspiration occurs after episodes of regurgitation or vomiting during which airway protective reflexes are overwhelmed, despite normal swallowing function. Established practice patterns for reducing this risk include nil per os (NPO) status until flatus, upright bed positioning, use of antiemetics and gastric acid suppressants, bedside suction set-up, nasogastric decompression and in some cases surgery[27, 29, 30]. These interventions are standard practice for aspiration prevention in patients with GI dysfunction at our hospital. Despite this, aspiration associated pulmonary infection persisted. There is scant literature evaluating the effectiveness of these interventions in reducing GI-related aspiration risk. Most of the literature evaluating nonventilator-associated HAP prevention have focused on strategies to reduce microaspiration of oropharyngeal bacteria (e.g. oral care and oral decontamination strategies) or post-operative atalectasis (e.g. deep breathing & mobilization)[31]. These strategies are important; they have been associated with reductions in HAP[31, 32]. However, frank aspiration as a result of emesis and/or GI obstruction is a potent source of hospital acquired pneumonia in a comprehensive cancer hospital and merits further investigation.

Perioperative aspiration also accounted for a quarter of HAAP cases. For the purposes of this study, HAAP was designated as anesthesia-related if symptoms of pneumonia were documented within 24 hours of the surgical procedure. In our study, 87% of these patients were NPO before developing symptoms of HAAP. Anesthesia-related HAAP cases result from altered sensorium and diminished airway protective reflexes while under, or emerging from, anesthesia. Predisposing factors include site of surgery, emergency surgery, incompetent lower esophageal sphincter, esophageal cancer, GI obstruction, hiatal hernia, previous GI surgery, and obesity[33-35]. Interventions aimed at mitigating risk include strategies for reducing gastric volume, reducing gastric acidity, preventing regurgitation, rapid sequence induction, and extubation protocols[33-36]. The effectiveness and adequacy of these interventions are beyond the scope of this study.

There are a number of limitations of this study. Administrative data, ICD-10 coding, was used to identify cases. Potentially, the use of such data could reflect improper coding. Consequently, manual review of cases coded with J69.0 not present on admission confirmed the diagnosis in all included cases. The bulk of the cases within this cohort were coded correctly, based on manual chart review. However, it is possible that cases of HAP attributable to frank aspiration were not coded as J69.0, improperly excluding such cases and thus underestimating the rate of HAAP. The causes of a hospital acquired pneumonia can be difficult to discern, even in a prospective fashion. Retrospective reviews are potentially subject to bias. Nevertheless, in this study, a careful review of medical records was performed to confirm the cause of every patient's HAAP.

Compliance with the screening protocol was not universal. Although the number of cases where the screening protocol was not performed is small, we do not know the reason for non-compliance. Selective non-compliance could potentially have had an impact on the study, although we could not find significant associations. Nonetheless, non-compliance to the screening protocol could have affected the detection rate of the screening tool, skewing our results. This study did not investigate adherence to other aspiration-preventative practices such as oral care, upright bed positioning, safe caregiver feeding (if patient cannot self-feed), and procedures aimed to reduce aspiration gastric contents. Low or variable adherence to these practices could have impacted HAAP rates during our study.

This study did not reach the predefined accrual goal, and was thus technically underpowered. The calculation required 6,926 patients both before and after screening implementation. Sample size prior to study implementation was adequate. However, the first year after implementation, 4,170 patients were accrued. Furthermore, rates of dysphagia were lower than initially anticipated. At least 8 months of screening would have been necessary to accrue an additional 2,756 patients. The results of the preliminary analysis did not sufficiently justify the use of resources for screening and compliance monitoring.

Implications for Practice

Nursing-initiated dysphagia screening did not decrease HAAP rates in an acute oncology hospital. Dysphagia-related aspiration accounts for only a small proportion of HAAP in a setting where instrumental swallow testing is already well-integrated into care for patients at high risk for OPD. Patients admitted through GI surgery have a HAAP risk equivalent to other high-risk groups (i.e. thoracic surgery, PCC and HNC). In fact, aspiration associated with GI dysfunction accounted for the majority of HAAP, suggesting a need for improved methods of preventing frank aspiration of intestinal contents. It is important to acknowledge that these findings are reflective of a comprehensive cancer center population, and may not generalize to other populations. Future HAAP research and prevention efforts should focus on gastrointestinal and perioperative sources of aspiration in patients with cancer.

Funding Acknowledgements:

This research was funded through the NIH/NCI Cancer Center Support Grant P30 CA006927 via the Biostatistics and Informatics Facility. The Devlin Fund provided additional funding support. The Devlin Fund is a chapter of the

Fox Chase Board of Associates. Fund personnel had no involvement in the study design, collection, analysis or interpretation of data, in writing or revising the manuscript or the decision for submission for publication.

References

1. Sopena N, Heras E, Casas I, et al. Risk factors for hospital-acquired pneumonia outside the intensive care unit: a case-control study. Am J Infect Control 2014; 42:38–42. [PubMed: 24199911]
2. Pássaro L, Harbarth S, Landelle C. Prevention of hospital-acquired pneumonia in non-ventilated adult patients: a narrative review. Antimicrob Resist Infect Control. 2016; 5:43 DOI 10.1186/s13756-016-0150-3 [PubMed: 27895901]
3. Micek ST, Chew B, Hampton N, Kollef MH. A case–control study assessing the impact of non-ventilated hospital- acquired pneumonia on patient outcomes. Chest. 2016; 150(5):1008–14. [PubMed: 27102181]
4. Vincent JL, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, et al. International study of the prevalence and outcomes of infection in intensive care units. JAMA. 2009; 302: 2323–9. [PubMed: 19952319]
5. Rosenthal VD, Bijie H, Maki DG, Mehta Y, Apisarnthanarak A, Medeiros EA, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004–2009. Am J Infect Control. 2012;40: 396–407. [PubMed: 21908073]
6. Giuliano K, Baker D, Quinn B. The epidemiology of nonventilator hospital-acquired pneumonia in the United States. Am J Infect Control. 46(2018):322–327. [PubMed: 29050905]
7. See I, Chang J, Gualandi N, Buser G, et al. Clinical correlates of surveillance events detected by national healthcare safety network pneumonia and lower respiratory infection definitions-Pensylvania, 2011-2012. Infect Control Hosp Epidemiol. 2016 7; 37(7):818–824. [PubMed: 27072043]
8. Madhavan A, Lagorio LA, Crary MA, Dahl WJ, Carnaby GD Prevalence of and risk factors for dysphagia in the community dwelling elderly: A systematic review. J Nutr Health Aging. 2016; 20: 806–815. [PubMed: 27709229]
9. Roy N, Stemple J, Merrill R, Thomas L. Dysphagia in the elderly: preliminary evidence of prevalence, risk factors, and socioeconomic effects. Ann Otol Rhinol Laryngol . 2007; 116(11): 858–865 [PubMed: 18074673]
10. Cabre M, Serra-Pratt M, Palomera E, Almirall J, Pallares R, Clave P. Prevalence and prognostic implications of dysphagia in elderly patients with pneumonia. Age Ageing. 2010; 39(1):39–45. [PubMed: 19561160]
11. Mercadante S, Aielli F, Adile C et al. Prevalence of oral mucositis, dry mouth, and dysphagia in advanced cancer patients. Support Care Cancer. 2015; 23:3249–3255. [PubMed: 25832897]
12. Hathaway B, Vaezi A, Egloff AM, Smith L, Wasserman-Wincko T, Johnson JT. Frailty measurements and dysphagia in the outpatient setting. Ann Otol Rhinol Laryngol 2014; 123:629–635. [PubMed: 24707011]
13. Evans S, Ost D. Pneumonia in the neutropenic cancer patient. Curr Opin Pulm Med. 2015; 21(3): 260–271. doi:10.1097/MCP.0000000000000156. [PubMed: 25784246]
14. Vehreschild J Pneumonia and lung infiltrates in neutropenic patients: many stones unturned. Annals ATS. 2013; 10 (5): 493–494.
15. Hines S, Kynoch K, Munday J. Nurse interventions for identifying and managing acute dysphagia are effective for improving patient outcomes: a systematic review update. J Neurosci Nurs . 2016; 48(4): 215–223. [PubMed: 27224683]
16. Palli C, Fandler S, Doppelhofer K, et al. Early dysphagia screening by trained nurses reduces pneumonia rate in stroke patients: A clinical intervention study. Stroke. 2017; 48(9): 2583–2585. doi: 10.1161/STROKEAHA.117.018157. [PubMed: 28716980]
17. Suiter D, Sloggy J, Leder S. Validation of the Yale Swallow Protocol: A prospective double-blinded videofluoroscopic study. Dysphagia. 2014; 29:199–203. [PubMed: 24026519]
18. Warner H, Suiter D, Nystrom K, et al. Comparing accuracy of the Yale swallow protocol when administered by registered nurses and speech pathologists. Journal of Clinical Nursing. 201323:1908–1915.

19. Edis E, Hatipoglu O, Yilmam I, et al. Hospital-acquired pneumonia developed in non-intensive care units. Respiration. 2009; 78:416–422. [PubMed: 19648731]
20. Burton L, Price R, Barr K, McAuley S, et al. Hospital-acquired pneumonia incidence and diagnosis in older patients. Age Ageing. 2016; 45:171–174. [PubMed: 26683049]
21. Langmore S, Terpenning M, Schork A, et al. Predictors of aspiration pneumonia: How important is dysphagia? Dysphagia. 1998; 136: 69–81.
22. Lee J, Jin S, Lee C, et al. Risk factors of postoperative pneumonia after lung cancer surgery. .J Korean Med Sci. 2011 8; 26(8): 979–84. doi: 10.3346/jkms.2011.26.8.979. Epub 2011 Jul 27. [PubMed: 21860545]
23. Metani H, Tsubahara A, Hiraoka T, et al. Risk factors for patients who develop pneumonia either before or after hip fracture surgery. Jpn J Compr Rehabil Sci. 2015; 6:43–49.
24. Raber-Durlacher JE, Verdonck-de Leeuw IM, Eilers JG, et al. Swallowing dysfunction in cancer patients. Support Care Cancer. 2012; 20:433–444. [PubMed: 22205548]
25. Azarpazhooh A, Leake JL. Systematic review of the association between respiratory diseases and oral health. J Periodontol. 2006; 77:1465–82. [PubMed: 16945022]
26. Xu J, Hu J, Yu P, et al. Perioperative risk factors for post-operative pneumonia after major oral cancer surgery. PLoS One. 2017 11 14; 12(11): e0188167. doi: 10.1371/journal.pone.0188167. eCollection 2017. [PubMed: 29135994]
27. Fabbro ED. Assessment and management of nausea and vomiting In Bruera E Ed: Palliative Care. Up To Date. 1 25, 2019 https://www.uptodate.com/contents/palliative-care-assessment-and-management-of-nausea-and-vomiting. Accessed March 20, 2019.
28. Bordeianuo L, Dante Ye D. Epidemiology, clinical features, and diagnosis of mechanical small bowel obstruction in adults In Soybel D and Hockberger R, eds: Gastrointestinal Diseases. Up To Date. 11 20, 2017 https://www.uptodate.com/contents/epidemiology-clinical-features-and-diagnosis-of-mechanical-small-bowel-obstruction-in-adults Accessed March 20, 2019.
29. Bordeianuo L, Dante Ye D. Overview of management of mechanical small bowel obstruction in adults In Kao L, ed: Alimentary Tract: Small Intestine. Up To Date. 5 8, 2017 https://www.uptodate.com/contents/management-of-small-bowel-obstruction-in-adults Accessed March 20, 2019.
30. Franke AJ, Iqbal A, Starr JS, Nair RM, George TJ. Management of malignant bowel obstruction associated with GI cancers. J Oncol Pract. 2017; 13:7: 426–434. [PubMed: 28697317]
31. Lyons PG, Kollef MH. Prevention of hospital acquired pneumonia. Curr Opin Crit Care. 10 2018; 24 (5):370–378. [PubMed: 30015635]
32. Cassidy MR, Rosenkranz P, McCabe K, Rosen JE, McAneny D. I COUGH: reducing postoperative pulmonary complications with a multidisciplinary patient care program. JAMA Surgery 2013; 148:740–745. [PubMed: 23740240]
33. Robinson M, Davidson A. Aspiration under anaesthesia: risk assessment and decision-making. Anaesthesia, Critical Care & Pain. 2014; 14(4): 171–
34. Kluger MT, Short TG. Aspiration during anaesthesia: a review of 133 cases from the Australian Anaesthetic Incident Monitoring Study (AIMS). Anaesthesia. 1999; 54(1):19–26. [PubMed: 10209365] [PubMed: 10209365]
35. Nason K Acute intraoperative pulmonary aspiration. Thorac Surg Clin. 8 2015; 25(3):301–307. [PubMed: 26210926]
36. Qaseem A, Snow V Fitterman N, et al. Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: a guideline from the American college of physicians. Ann Intern Med. 2006; 144: 575–580. [PubMed: 16618955]

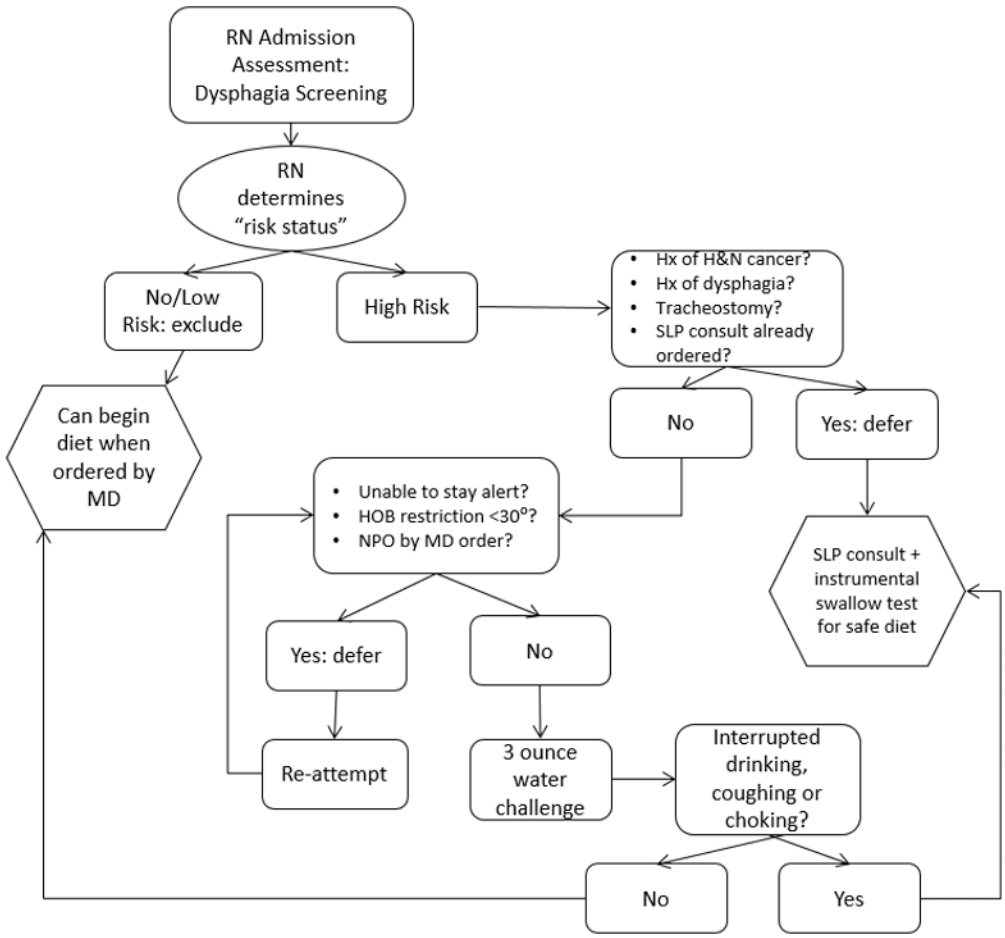

Figure 1.

Flow diagram depicting dysphagia screening process. Abbreviations: History (Hx), speech-language pathologist (SLP), head of bed (HOB), nil per os (NPO), physician (MD), nurse (RN).

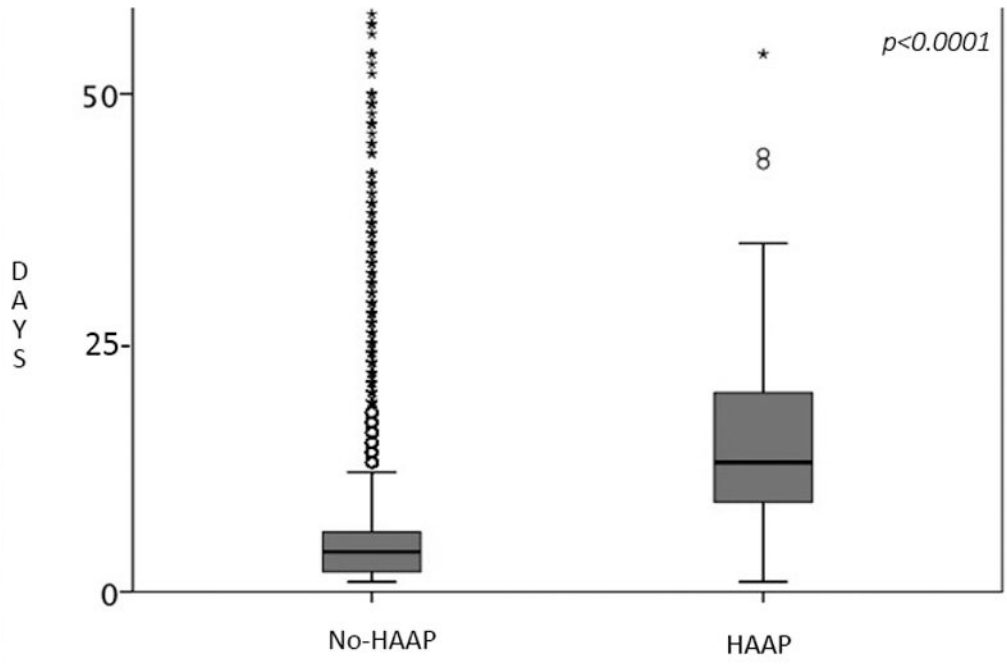

Figure 2.

Observed length of stay. The box represents the interquartile range (first – third). Horizontal line inside the box represents the median, the whiskers extend to distant values. Points beyond these whiskers: outliers (o), extreme values (*).

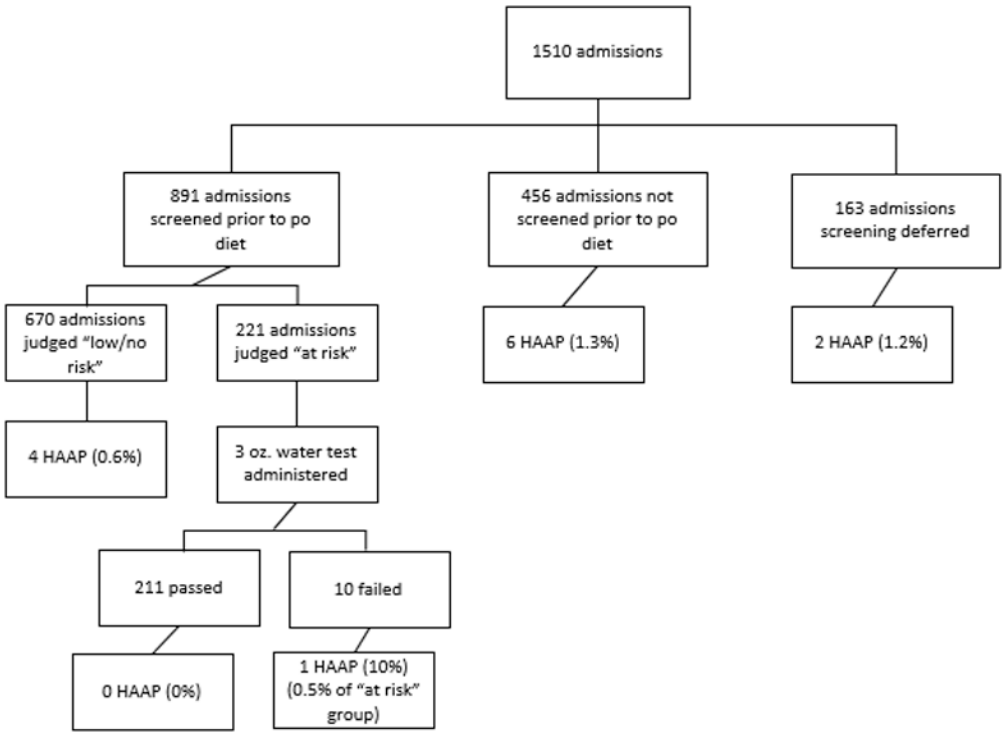

Figure 3.

Flow diagram depicting dysphagia screening outcomes and associated HAAP occurrence's based on a random sample collected during the screening year.

Table 1.

Factors associated with hospital acquired aspiration pneumonia (HAAP): univariate analysis

	HAAP count	Percent of HAAP group	Total number admissions	Percent of total count	p-value
3M™ [a]APR-DRG Illness Severity at Admission					**<0.001**
Extreme	18	18.5%	478	3.77%	
Major	49	50.5%	4358	1.12%	
Moderate	26	26.8%	5216	0.50%	
Minor	4	4.2%	2340	0.17%	
3M™ APR-DRG Mortality Risk at Admission					**<0.001**
Extreme	6	6.2%	315	1.90%	
Major	43	44.3%	3009	1.43%	
Moderate	34	35.0%	5176	0.66%	
Minor	14	14.5%	3892	0.36%	
Service Line					**<0.001**
General Medicine	17	17.5%	3100	0.55%	
[b]GI Surgery	21	21.6%	2100	1.00%	
Medical Oncology	20	20.6%	2467	0.81%	
Thoracic Surgery	11	11.3%	578	1.90%	
Urology	8	8.3%	1797	0.45%	
Head and Neck	7	7.2%	330	2.12%	
Pulmonary/ Critical Care	3	3.1%	131	2.29%	
Readmission	3	3.1%	384	0.78%	
Gynecology	3	3.1%	906	0.33%	
Breast	2	2.1%	353	0.57%	
Other surgery	2	2.1%	246	0.81%	
	Patients with HAAP				**p-value**
Mean Age (in years)	66.39				**0.0001**
Mean [c]LOS (in days)	17.94				**0.0001**

[a]All Patients Refined Diagnosis Related Groups

[b]CDB/RM= clinical database resource manager

[c]Gastroenterology

[d]LOS= length of stay

Table 2:

Division of service line groupings used on multivariate analysis[a]

Service Line	N	%	Odds Ratio	95% Confidence Interval	p-value
Upper Airway/Chest	**1039**	**8%**	**1**	**Reference**	
Head and Neck	330				
Pulmonary/Critical Care	131				
Thoracic	578				
Gastrointestinal Surgery	**2100**	**17%**	**0.65**	**0.336 – 1.257**	**0.2**
Gastrointestinal Surgery	2100				
Other Surgery	**3686**	**30%**	**0.454**	**0.234 – 0.88**	**0.019**
Breast	353				
Urology	1797				
Gynecology	906				
Other Surgery	246				
Readmission	384				
Medicine	**5567**	**45%**	**0.355**	**0.193 – 0.653**	**0.001**
General Medicine	3100				
Medical Oncology	2467				

[a]Multivariate analysis includes service line, 3M™APR-DRG Illness Severity at Admission and patient age.

[b]HAAP, hospital acquired aspiration pneumonia

Table 3

Documented source of aspiration in all hospital acquired aspiration pneumonia (HAAP) cases

Documented aspiration source	2016** n (%)	2015 n (%)	2014 n (%)	TOTAL n (%)
ǂSBO, °GOO, ǂEO, emesis	19 (49)	10 (40)	15 (45)	44 (46)
Perioperative	7 (18)	9 (36)	8 (24)	24 (25)
Unclear	7 (18)	1 (4)	5 (15)	13 (13)
Oropharyngeal dysphagia	6 (15)	4 (16)	5 (15)	15 (15)
Bronchogastric fistula	0	1 (4)	0	1 (1)
HAAP Total	39	25	33	97

** The screening year

ǂ small bowel obstruction

° gastric outlet obstruction

ǂ esophageal obstruction

Table 4

Timing/presence of dysphagia consult in patients with oropharyngeal dysphagia-related [a]HAAP

Consult Timing	**2016 n (%)	2015 n (%)	2014 n (%)	Total n (%)
Oropharyngeal dysphagia	6	4	5	15
Before [a]HAAP	1 (17)	1 (25)	2 (40)	4 (27)
After HAAP	5 (83)	3 (75)	3 (60)	11 (73)
No Consult	0	0	0	0

** screening year

[a] hospital acquired aspiration pneumonia

Table 5

Diet status for patients who developed hospital acquired aspiration pneumonia (HAAP) by documented HAAP cause

Diet Status	2016**	2015	Total (%)
Oropharyngeal Dysphagia	6	4	10
[b]NPO	2	1	3 (30)
[ǂ]**SBO,** [°]**GOO,** [ǂ]**EO, emesis**	19	10	29
NPO	9	6	15 (52)
Unclear	7	1	8
NPO	2	0	2 (25)
Perioperative	7	9	16
NPO	5	9	14 (87)
Bronchogastric fistula	0	1	1
NPO	0	0	0 (0)
Total	39	24	64
NPO	18	15	34 (53)

[*] Diet data was unable to be collected in 2014 as it was not documented in the electronic medical record at that time

[**] The screening year

[ǂ] Small bowel obstruction

[°] gastric outlet obstruction

[ǂ] esophageal obstruction

[b] nil per os.