The prevalence of post-extubation dysphagia in critically ill adults: an Australian data linkage study

Melanie L McIntyre, Timothy Chimunda, Joanne Murray, Trent W Lewis and Sebastian H Doeltgen

Post-extubation dysphagia is a recognised and frequent complication following endotracheal intubation of critically ill adult patients.[1-4] The term "post-extubation dysphagia" refers to swallowing impairments that occur at the oral or pharyngeal stage of swallowing in critically ill patients who have required a period of endotracheal intubation. It is associated with increased rates of pneumonia, prolonged enteral feeding, and increased health care expenditure, and has been found to be an independent predictor of 60- and 90-day all-cause mortality.[2,5-8]

Pathophysiological causes of post-extubation dysphagia are commonly believed to be dynamic and multifactorial, including trauma to the oral cavity, pharynx or larynx, intensive care unit (ICU)-acquired weakness, altered sensation, dyssynchronous respiratory swallow patterns, and impaired or altered cognition after extubation.[9-12] Identification and diagnosis processes for post-extubation dysphagia are not standardised across health services.[10,13,14] Diagnosis may occur following an instrumental assessment, such as fibreoptic endoscopic evaluation of swallowing (FEES) or a videofluoroscopic swallowing study. Post-extubation dysphagia may also be diagnosed after a clinical swallowing evaluation at the patient's bedside. In recognition of this, the intensive care medicine research agenda on ICU-acquired weakness acknowledges the need for validation of dysphagia screening tools as well as systematic screening for dysphagia in survivors of critical illness as a current research priority.[14]

At present, the evidence base is limited in that most of the post-extubation dysphagia prevalence research has been conducted at single sites with relatively small sample sizes. Meta-analyses have been hampered by clinical and statistical heterogeneity.[1,15,16] In addition, previous research has predominately focused on populations with prolonged periods of endotracheal intubation. Limited data exist to quantify the extent of post-extubation dysphagia in ICU populations, which are representative of routine clinical care and therefore include both short and prolonged durations of intubation.

ABSTRACT

Objective: To define the prevalence of dysphagia after endotracheal intubation in critically ill adult patients.

Design: A retrospective observational data linkage cohort study using the Australian and New Zealand Intensive Care Society Adult Patient Database and a mandatory government statewide health care administration database.

Setting: Private and public intensive care units (ICUs) within Victoria, Australia.

Participants: Adult patients who required endotracheal intubation for the purpose of mechanical ventilation within a Victorian ICU between July 2013 and June 2018.

Main outcome measures: Presence of dysphagia, aspiration pneumonia, ICU length of stay, hospital length of stay, and cost per episode of care.

Results: Endotracheal intubation in the ICU was required for 71 124 patient episodes across the study period. Dysphagia was coded in 7.3% (n = 5203) of those episodes. Patients with dysphagia required longer ICU (median, 154 [interquartile range (IQR), 78–259] *v* 53 [IQR, 27–107] hours; $P < 0.001$) and hospital admissions (median, 20 [IQR, 13–30] *v* 8 [IQR, 5–15] days; $P < 0.001$), were more likely to develop aspiration pneumonia (17.2% *v* 5.6%; odds ratio, 3.0; 95% CI, 2.8–3.2; $P < 0.001$), and the median health care expenditure increased by 93% per episode of care ($73 586 *v* $38 108; $P < 0.001$) compared with patients without dysphagia.

Conclusions: Post-extubation dysphagia is associated with adverse patient and health care outcomes. Consideration should be given to strategies that support early identification of patients with dysphagia in the ICU to determine if these adverse outcomes can be reduced.

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Identifying the prevalence of post-extubation dysphagia across health services in populations that reflect routine clinical care will enable health services to quantify the associated adverse patient outcomes. This knowledge is crucial for informing resource allocation, such as multidisciplinary staffing, and for guiding decision making on the risks, benefits and costs of clinical practice changes at the point of care. Therefore, the first aim of this study was to determine the prevalence of post-extubation dysphagia in critically ill adult patients within a statewide context. The second aim was to describe the outcomes of patients with post-extubation dysphagia across the state of Victoria, Australia, including rates of aspiration pneumonia, hospital and ICU length of stay (LOS), and cost per episode for the health service. We hypothesised that patients with dysphagia would present with higher rates of aspiration pneumonia, longer LOS and higher cost per episode.

Methods

This study was conducted as a large-scale retrospective observational data linkage cohort study over a 5-year period (July 2013 – June 2018), analysing linked data from the Victorian Admitted Episodes Database (VAED) and the Australian and New Zealand Intensive Care Society (ANZICS) Adult Patient Database (APD), maintained by the ANZICS Centre for Outcome and Resource Evaluation (CORE). Both datasets contain complementary and rich clinical information and have strict reporting criteria and auditing processes in place to ensure quality and integrity. The 5-year time frame was selected after consultation with a clinical coding expert to minimise changes to the mandatory reporting and clinical coding requirements during the study period. This article was prepared in line with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[17]

For the purpose of this study, each patient's VAED and ANZICS data per episode of care were linked using deterministic linkage for matching across variables, with names being the exception, where a probabilistic name-matching algorithm was used that allows for variations and errors in spelling. To ensure stringent confidentiality, the raw data collation and removal of directly identifiable patient level data were performed by the Centre for Victorian Data Linkage. Directly identifiable individual patient level data were not included in the dataset released to the research team. This enabled a population focus, while ensuring protection of individual confidentiality.

Eligibility criteria

We included patients who were intubated and received mechanical ventilation in a Victorian private or public ICU between July 2013 and June 2018. Patients were excluded from the study if they were younger than 18 years at the time of admission to hospital. To reduce confounding variables and ensure a focus on patients who required endotracheal intubation and presented with an oropharyngeal dysphagia, patients who required a tracheostomy, underwent an upper gastrointestinal procedure during the admission, or were diagnosed with a malignancy of the upper gastrointestinal tract were excluded from the study. Further, due to the focus of this study on adverse outcomes including aspiration pneumonia, patients who received palliative management were excluded due to likely variations in dysphagia management approaches and goals of care.

Outcome definitions

Following consultation with clinical coding specialists and clinicians, International Classification of Diseases, tenth revision, Australian Modification (ICD-10-AM) diagnosis codes were used to identify the presence of dysphagia, which was defined as difficulty with swallowing using code R13. Aspiration pneumonia was defined by using code J69, "pneumonitis due to solids and liquids". All patients coded with dysphagia in our study required management for dysphagia and had a period of endotracheal intubation within an ICU during their inpatient admission. However, we were unable to confidently exclude patients with pre-existing dysphagia. Therefore, from here on we will refer to this group as patients with dysphagia rather than post-extubation dysphagia. LOS for the acute episode of care, ICU LOS, age, sex, invasive mechanical ventilation hours in the ICU, and cost per episode were identified from the VAED dataset and were mandatory reporting items during the study period. The Acute Physiology and Chronic Health Evaluation (APACHE) III score was identified from the ANZICS APD, and all analyses were based on a patient's initial APACHE III score on first presentation to the ICU per episode of care. Admission diagnosis grouping was based on the Australian refined diagnosis-related groups, all codes used can be found in the Online Appendix, section 1.

Statistical analysis

All data were analysed using SPSS statistics version 27 (IBM). Dysphagia prevalence is reported as a frequency of the overall study population. Relevant demographic, clinical and health care-related outcome data are presented as descriptive statistics, including total number of patients and frequency of occurrence. The median and interquartile range (IQR) are reported due to non-normal distribution of the data. Tests of difference were performed for demographic and outcome variables using independent samples Mann–Whitney U for continuous variables or χ^2 test for categorical

variables. The prevalence of aspiration pneumonia in patients with and without dysphagia was determined using binary logistic regression and is presented as odds ratio (OR) with 95% confidence interval (CI). An α significance value of $P < 0.01$ was used.[18]

Ethics approval

This study was approved by the appropriate Human Research and Ethics Committee (Bendigo Health Care Group Human Research Ethics Committee, Reference No. 50129) and by the data custodians at the Centre for Victorian Data Linkage and the ANZICS CORE.

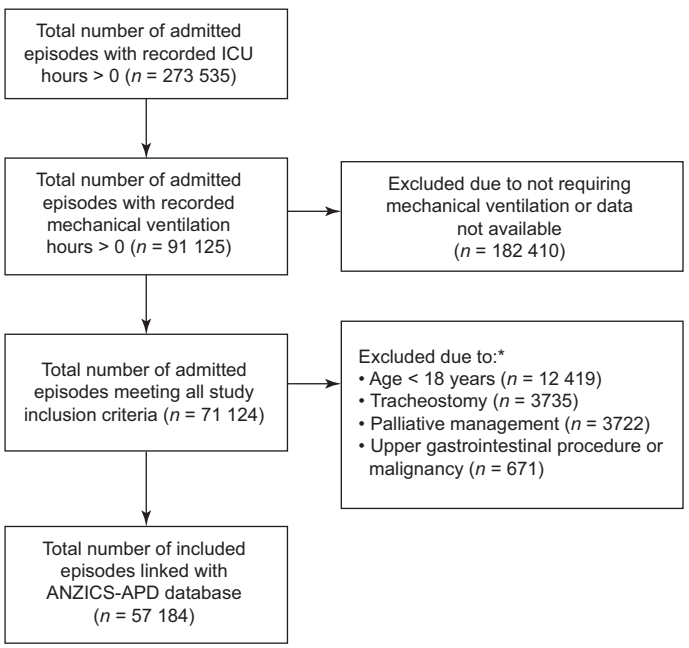
Results

A total of 273 535 patient episodes were identified from within the VAED dataset as requiring an ICU admission. Of those, 202 411 (74%) were excluded due to not meeting the inclusion criteria, leaving 71 124 patient episodes in the final study population (Figure 1). Of these, 57 184 episodes were successfully linked to ANZICS APD database (linkage success rate of 80%).

Patient demographic characteristics

Demographic and clinical characteristics for the included patient episodes as well as results of statistical analyses are provided in Table 1. Patients in the sample had a median age of 60 years (IQR, 50–74 years), a median APACHE III score of 57 (IQR, 44–76), and received a median of 16 hours (IQR, 8–43 hours) of mechanical ventilation. The prevalence of dysphagia was 7.3% ($n = 5203$; 95% CI, 7.1–7.3%). Patients with dysphagia were older (median, 68 [IQR, 55–77] *v* 64 [IQR, 50–73] years; $P < 0.001$), had a higher APACHE III score (median, 67 [IQR, 51–88] *v* 56 [IQR, 43–75]; $P < 0.001$), and required longer periods of mechanical ventilation (median, 68 [IQR, 25–150] *v* 15 [IQR, 9–45] hours; $P < 0.001$) than those without dysphagia. Of note, although patients with dysphagia had a longer median duration of intubation than those without dysphagia overall, 39.3% of all patients with dysphagia were intubated for less than 48 hours (Figure 2). Distributions of admission diagnoses are provided in Table 2. The prevalence of dysphagia was 16.8% ($n = 94$) in the ear, nose and throat cohort, 16.1% ($n = 792$) in neurology, 13.2% ($n = 165$) in trauma, 10.1% ($n = 3350$) for other diagnoses, and 2.3% ($n = 669$) for patient episodes with a cardiac reason for admission. Dysphagia prevalence rates by year of admission ranged from 6.7% in 2014 to 7.9% in 2016 and 2018 but were overall reasonably stable (Table 3).

Figure 1. Patient sample after applying exclusion criteria



ANZICS = Australian and New Zealand Intensive Care Society; APD = Adult Patient Database; ICU = intensive care unit; VAED = Victorian Admitted Episodes Database. * Individual patient episodes may have been identified in more than one exclusion category.

Clinical and health care-related outcomes

Clinical and health care-related outcomes for patients with and without dysphagia are reported in Table 4. Patients with dysphagia stayed longer in both the ICU and the hospital than those without dysphagia (median ICU LOS, 154 hours [IQR, 78–259] *v* 53 hours [IQR, 27–107]; $P < 0.001$; median hospital LOS, 20 days [IQR, 13–30] *v* 8 days [IQR, 5–15]; $P < 0.001$, respectively). The prevalence of aspiration pneumonia was higher in patients with dysphagia compared with those without dysphagia ($n = 894$ *v* $n = 3709$; proportion of group, 17.2% [95% CI, 16–18%] *v* 5.6% [95% CI, 6–6%]; OR, 3.0 [95% CI, 2.8–3.2]; $P = < 0.001$). Health care expenditure per episode of care increased by 93% when comparing patients with and without dysphagia (median cost per episode $73 586 [IQR, $46 403–$112 830] *v* $38 108 [IQR, $21 710–$60 511], respectively; $P = < 0.001$).

Discussion

Prevalence data and associated health complications provide important insights into disease burdens and inform clinical practice as well as health care resource allocation. Our study provides this information in a population that is reflective of routine clinical practice and, to our knowledge, is based on the largest, multisite sample of patients with dysphagia in a mixed ICU population to date.

Table 1. Demographic and clinical characteristics

	Total sample	Dysphagia-positive	Dysphagia-negative	Significance
Total number of patient episodes	71 124	5203	65 921	
Proportion of total sample (95% CI)		7.3% (7.1–7.3%)	92.7% (92.5–92.9%)	–
Age (years), median (IQR)	60 (50–74)	68 (55–77)	64 (50–73)	< 0.001
Sex (men)	42 582	3306	39 276	0.047
Proportion of group (95% CI)	60% (64–65%)	63.5% (62.2–64.8%)	59.6% (64.9–65.6%)	
Mechanical ventilation (hours), median (IQR)	16 (8–43)	68 (25–150)	15 (9–45)	< 0.001
VAED–ANZICS APD linkage analysis				
Total number of patient episodes	57 184	4242	52 942	
APACHE III score, median (IQR)*	57 (44–76)	67 (51–88)	56 (43–75)	< 0.001

ANZICS = Australian and New Zealand Intensive Care Society; APACHE = Acute Physiology and Chronic Health Evaluation; APD = Adult Patient Database; IQR = interquartile range; VAED = Victorian Admitted Episodes Database. * Based on first admission to the intensive care unit.

Prevalence of dysphagia

Consistent with an Australian regional single site study,[8] the prevalence of dysphagia following extubation in our cohort was 7.3%, and the median intubation duration of all included patients was 16 hours (IQR, 8–43 hours). We note that similar prevalence rates have been reported internationally in prospective studies with similar median intubation durations, such as Switzerland (dysphagia prevalence, 12.4%; study population, *n* = 1304; median duration of intubation, 16.8 hours),[2] Canada (dysphagia prevalence, 5.6%; study population, *n* = 909; median duration of intubation, 6.9 hours),[19] and New Zealand (dysphagia prevalence, 12%; *n* = 106; median duration of intubation, 12 hours).[20] Similarly, the median duration of intubation in the present study of 16 hours is consistent with an ANZICS point prevalence study that reported the median duration of mechanical ventilation across 55 ICUs in Australia and New Zealand as 21.6 hours (IQR, 9.6–108 hours).[21] Taken together, these data support the clinical relevance of our findings within similar Australian and global contexts.

We acknowledge that a dysphagia prevalence rate of 7.3% is lower than what has been reported in several previous studies, as evidenced by a recent systematic review and meta-analysis, which demonstrated a post-extubation dysphagia prevalence rate of 41% (95% CI, 33–50%).[1] However, it is pertinent to consider that only three studies included within that systematic review described populations with short durations of intubation (< 48 hours). It is likely that included studies with higher intubation durations increased the overall prevalence rate.

Clinical and health care-related outcomes

Patients with dysphagia in this study stayed three times longer in the ICU and hospital and their health care expenditure doubled, compared with patients who did not present with dysphagia. They were also over three times more likely to develop aspiration pneumonia, a potentially preventable complication of dysphagia. These findings are

Figure 2. Proportion of patient episodes by dysphagia diagnosis and duration of intubation

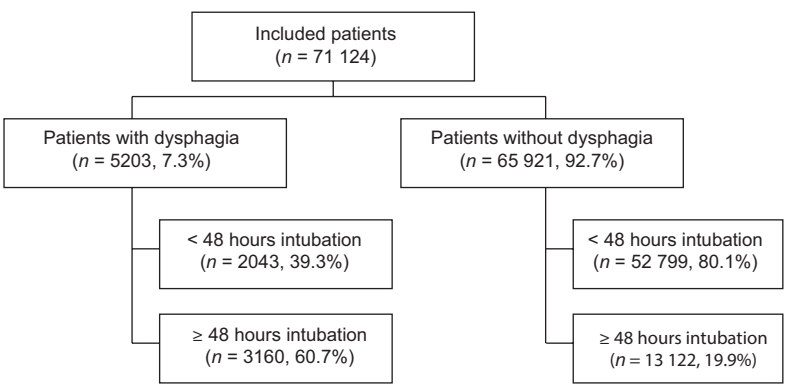


Table 2. Dysphagia prevalence by admission diagnosis

Admission diagnoses grouping	Total sample	Dysphagia-positive	Dysphagia-negative
Total number of patient episodes	71 124	5203	65 921
Neurology	4934	792	4142
Proportion of sample [95% CI]	6.9% [6.8–7.1%]		
Proportion of group (95% CI)		16.1% (15.0–17.1%)	83.9% (82.9–85.0%)
Stroke*	76	18	58
Proportion of sample [95% CI]	1.0% [1.0–1.0%]		
Proportion of group (95% CI)		23.7% (14.7%–34.8%)	76.3% (65.2–85.3%)
Progressive neurological condition*	40	8	32
Proportion of sample [95% CI]	1.0% [0.0–1.0%]		
Proportion of group (95% CI)		20% (9.1–35.6%)	80% (64.4–90.9%)
Cardiac	28 763	669	28 094
Proportion of sample [95% CI]	40.4% [40.1–40.8%]		
Proportion of group (95% CI)		2.3% (2.2–2.5%)	97.7% (97.5–97.8%)
Respiratory	3599	298	3301
Proportion of sample [95% CI]	5.1% [4.9–5.2%]		
Proportion of group (95% CI)		8.3% (7.4–9.2%)	91.7% (90.8–92.6%)
ENT	561	94	467
Proportion of sample [95% CI]	0.7% [0.7–0.9%]		
Proportion of group (95% CI)		16.8% (13.8–20.1%)	83.2% (79.9–86.2%)
Trauma	1247	165	1082
Proportion of sample [95% CI]	1.6% [1.7–1.9%]		
Proportion of group (95% CI)		13.2% (11.4–15.2%)	86.8% (84.8–88.6%)
Other	33 267	3350	29 917
Proportion of sample [95% CI]	46.8% [45.7–45.4%]		
Proportion of group (95% CI)		10.1% (9.6–10.3%)	89.9% (89.7–90.4%)

ENT = ear, nose and throat. * Included as a subgroup of neurology and, therefore, cases are included in both categories.

in line with previous research showing adverse outcomes for patients with dysphagia after a period of endotracheal intubation, including prolonged hospital and ICU LOS, prolonged enteral nutrition, reintubation, and increased mortality.[2,5,7,19,22,23]

When considering adverse patient and health care-related outcomes, it is vital to consider the potential for these outcomes to be reduced or mitigated in the future. Of particular relevance, routine dysphagia screening after extubation in an ICU setting has been shown to reduce rates of all cause pneumonia by 80% and hospital LOS by 25%.[24] Similarly, in studies using routine FEES before patients commence oral intake after extubation, rates of aspiration pneumonia are not increased for patients with dysphagia following extubation compared with those without.[25,26] It is possible that the early identification of dysphagia via FEES, and the subsequent implementation of dysphagia management strategies, contributed to lower rates of aspiration pneumonia in these studies.

These findings suggest that the burden of dysphagia including aspiration pneumonia, prolonged hospital LOS, and the associated cost per episode are potentially modifiable outcomes. Therefore, despite a dysphagia prevalence rate of only 7.3% across a mixed adult ICU population, the introduction of care pathways supporting early dysphagia identification and management after extubation and before commencing oral intake may reduce adverse patient outcomes in the future and provide a high value approach for the health care system. Further research is required to determine the optimal method to support

Table 3. Dysphagia prevalence by year

Year	Dysphagia present	Dysphagia not present
2013	822/11 452	10 630/11 452
Proportion of group (95% CI)	7.2% (6.7–7.7%)	92.8% (92.3–93.3%)
2014	803/12 032	11 229/12 032
Proportion of group (95% CI)	6.7% (6.2–7.1%)	93.3% (92.9–93.8%)
2015	881/12 132	11 251/12 132
Proportion of group (95% CI)	7.3% (6.8–7.7%)	92.7% (92.3–93.2%)
2016	924/11 768	10 844/11 768
Proportion of group (95% CI)	7.9% (7.4–8.4%)	92.1% (91.6–92.6%)
2017	919/11 915	10 996/11 915
Proportion of group (95% CI)	7.7% (7.2–8.2%)	92.3% (91.8–92.8%)
2018	467/5948	5481/5948
Proportion of group (95% CI)	7.9% (7.2–8.6%)	92.1% (91.4–92.8%)

Table 4. Clinical and health care related outcomes

	Total sample	Dysphagia-positive	Dysphagia-negative	Odds ratio (95% CI)	Significance
Total number of patient episodes	71 124	5203	65 921		
ICU LOS (hours), median (IQR)	58 (32–113)	154 (78–259)	53 (27–107)		< 0.001
Hospital LOS (days), median (IQR)	10 (6–16)	20 (13–30)	8 (5–15)		< 0.001
Aspiration pneumonia	4603	894	3709	3.0 (2.8–3.2)	< 0.001
Proportion of sample [95% CI]	6.5% (6.3–6.7%)				
Proportion of group (95% CI)		17.2% (16.2–18.2%)	5.6% (5.5–5.8%)		
Cost per episode, $, median, (IQR)	$40 161 ($23 320–$65 606)	$73 586 ($46 403–$112 830)	$38 108 ($21 710–$60 511)		< 0.001

ICU = intensive care unit; IQR = interquartile range; LOS = length of stay.

early dysphagia identification and the cost and benefit for the patient and health care system.

We propose that identification approaches for dysphagia after a patient has been extubated may include multidisciplinary dysphagia screening, routine referrals to speech pathologists for a clinical swallowing examination, or routine instrumental assessment of swallowing such as FEES. Speech pathologists play a crucial role within the ICU multidisciplinary team for the assessment and management of dysphagia. However, as with many areas of health care, demand for services is not always matched by staffing capacity to service that demand. A survey of Australian speech pathologists working within ICU settings found that three-quarters of health care sites had no dedicated speech pathology ICU funding, and less than a third of sites routinely used a multidisciplinary screen for dysphagia in the ICU.[27] Low rates of protocolised dysphagia screening in Australia are consistent with an international study involving 528 intensive care physicians from 69 countries, which identified that only 32% of ICUs used a protocol to support dysphagia identification.[13] The current staffing models for speech pathologists in ICUs, in combination with

low rates of dysphagia screening, further highlight the need to identify high value and evidence-based approaches to dysphagia identification and management in the ICU.

Future directions

We suggest that the development and introduction of multidisciplinary clinical practice guidelines with a focus on early identification of dysphagia is warranted. Ideally, the development and implementation of such guidelines would include three factors:

- a multidisciplinary input;
- an evidence-based approach to identifying multivariate risk factors for dysphagia after a period of endotracheal intubation; and
- a prospective validation process to ensure that the implementation of any recommendations results in a reduction of adverse outcomes and associated costs.

In this study, 39.3% of patients with dysphagia were intubated for less than 48 hours. Therefore, we encourage careful consideration of how this population is addressed in care pathways that aim to support early dysphagia identification following extubation. Due to the likely multifactorial pathophysiological causes of dysphagia, we propose that further research focusing on multivariate risk factor analysis is required.

Limitations

We acknowledge the following limitations of our study. First, our study uses retrospective observational clinical data and, as such, not all patient episodes within the study were formally screened or assessed for dysphagia, which may have resulted in either under- or overestimation of the dysphagia prevalence rates. The use of clinical coding data relies on the accuracy of clinician documentation and extraction of this information into the coding database. The primary dataset used within this study was subject to strict national mandatory reporting criteria, and all coding staff had completed an accredited course demonstrating knowledge of the Australian Classification of Health Interventions (ACHI) and the Australian Coding Standards (ACS).[28] We have adhered to the ACHI definitions for each outcome throughout the study. In support of using coding data, we note previous research showing the accuracy of dysphagia coding in the Australian mandatory reporting health care system.[29] Based on the ACS regulations and definitions, we were unable to confidently exclude patients with pre-existing dysphagia and, therefore, have included all patients who were identified with and received management for dysphagia during their hospital admission. We acknowledge that this may have resulted in a higher prevalence; however, all these patients experienced dysphagia as an active medical diagnosis during their admission. We believe the impact of these limitations is not significant, as reflected by the consistency of dysphagia prevalence rates with other prospective studies of similar populations.[2,20]

Conclusions

This study highlights the burden of dysphagia in patients who required a period of endotracheal intubation to both the patient and the health care system. We have demonstrated across a statewide health system that patients with dysphagia stayed three times longer in the ICU, health care expenditure doubled, and the risk of developing an aspiration pneumonia tripled compared with patients without dysphagia. We propose that future research should focus on prospective, multicentre, multidisciplinary and evidence-based approaches to the early identification and management of dysphagia after extubation with the aim of reducing the burden to both the patient and the health care system.

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Competing interests

All authors declare that they do not have any potential conflict of interest in relation to this manuscript.

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