Al-Rafidain J Med Sci. 2026;10(2):137-141.
DOI: https://doi.org/10.54133/ajms.v10i2.2872

AJMS

Online ISSN (3219-2789)

Research Article

Evaluating a Bundled Protocol to Reduce Aspiration Pneumonia in Critically Ill Tube-Fed Patients

Khulood Batarseh[1]*, Mona Abdulhamid Al Nsour[1], Haneen George Zureikat[2], Mohammad Hazza Bani Khaled[3]
[1]*Faculty of Nursing, Al-Ahliyya Amman University, Al Sero Street, Amman 19111, Jordan;* [2]*Al-Hussein Medical City, King Abdullah II Street, Amman, Jordan;* [3]*Faculty of Nursing, Jerash University, Jerash, Jordan*

Received: 27 February 2026; Revised: 15 April 2026; Accepted: 20 April 2026

Abstract

Background: Patients who are severely ill and receive nasal tube feeding primarily experience aspiration pneumonia. ***Objective***: To evaluate the degree to which an exploratory, evidence-based, and multifaceted method lowered the aspiration pneumonia in critically ill tube-fed patients. ***Methods***: A historical observation group study was carried out by the Critical Care Unit at a tertiary care hospital. For the period of January to December 2021, a control group consisting of 415 individuals got usual care. This group was compared to an experimental group consisting of 2,120 individuals who received additional help for the period of January 2022 to December 2024. As part of the combining method, 30–50 mL of water was flushed after each enteral dose, drugs were given as normal (crushing, decreasing, and flushing between doses), and overnight fasting was strictly limited to six hours. The main effect was incidents of aspiration pneumonia. ***Results***: The intended surgery reduced aspiration pneumonia from 14.7% to 7.8%. After controlling for other factors, the method reduced aspiration pneumonia by 52% (OR=0.48, 95% CI=0.35–0.66). Bundling adherence (≥90%) was linked to decreased incidence (5.2% *vs*. 13.3% for poor adherence). Reduced median ICU stay (7.0 days *vs*. 9.0 days) and 22% fewer antibiotic days were noteworthy advantages. ***Conclusions***: Placing forward a cohesive aspiration prevention plan approach led to fewer incidents of aspiration pneumonia and favorable secondary clinical outcomes in critically ill patients who received nutrition by tube. In critical care, this practical procedure assists in making enteral nutrition safer and superior.

Keywords: Aspiration pneumonia; Critical care, Bundled protocol; Enteral feeding; Nasogastric tube; Quality improvement.

تقييم بروتوكول مرفق لتقليل الالتهاب الرئوي الأستنشاقي لدى مرضى الحالات الحرجة الذين يتغذون بواسطة انبوب الأنف

الخلاصة

الخلفية: المرضى الذين يعانون من أمراض شديدة ويتلقون التغذية عبر أنبوب أنف يعانون بشكل أساسي من التهاب رئوي استنشاقي. **الهدف**: تقييم مدى انخفاض الالتهاب الرئوي الاستنشاقي في المرضى الذين يتغذون بأنابيب في الحالات الحرجة والقائمة على الأدلة والمتعددة الأوجه. **الطرائق**: أجريت دراسة جماعية للمرضى بواسطة وحدة العناية الحرجة في مستشفى رعاية ثالثية. خلال الفترة من يناير إلى ديسمبر 2021، تلقت مجموعة ضابطة مكونة من 415 شخصا الرعاية المعتادة. تمت مقارنة هذه المجموعة بمجموعة تجريبية تضم 2,120 فردا تلقوا مساعدة إضافية للفترة من يناير 2022 حتى ديسمبر 2024. كجزء من طريقة الجمع، تم اعطاء 30–50 مل من الماء بعد كل جرعة معوية، وأعطيت الأدوية كالمعتاد (سحق، تقليل، وغسل بين الجرعات)، وتم تقييد الصيام الليلي بشكل صارم بست ساعات. كان التأثير الرئيسي هو حالات الالتهاب الرئوي الشفطي. **النتائج**: الجراحة المقصودة خفضت الالتهاب الرئوي الشفطي من 14.7٪ إلى 7.8٪. بعد السيطرة على عوامل أخرى، قللت الطريقة من الالتهاب الرئوي الشفطي بنسبة 52٪ (OR=0.48، 95٪ CI=0.35–0.66). كان الالتزام بالربط (≤90٪) مرتبطا بانخفاض الحدوث (5.2٪ مقابل 13.3٪ للالتزام الضعيف). كان انخفاض متوسط مدة الإقامة في وحدة العناية المركزة (7.0 أيام مقابل 9.0 أيام) وتقليل 22٪ من أيام المضادات الحيوية من الفوائد الملحوظة. **الاستنتاجات**: أدى وضع خطة متماسكة للوقاية من الشفط إلى تقليل حالات الالتهاب الرئوي الشفطي ونتائج سريرية ثانوية إيجابية لدى المرضى في حالات حرجة تلقوا التغذية عن طريق الأنبوب. في العناية الحرجة، يساعد هذا الإجراء العملي في جعل التغذية المعوية أفضل وأكثر أمانا.

* ***Corresponding author***: Khulood Batarseh. Faculty of Nursing, Al-Ahliyya Amman University, Al Sero Street, Amman 19111, Jordan; Email: k.batarseh@ammanu.edu.jo

Article citation: Batarseh K, Al Nsour MA, Zureikat HG, Bani Khaled MH. Evaluating a Bundled Protocol to Reduce Aspiration Pneumonia in Critically Ill Tube-Fed Patients. *Al-Rafidain J Med Sci.* 2026;10(2):137-141. doi: https://doi.org/10.54133/ajms.v10i2.2872

INTRODUCTION

Aspiration pneumonia continues to be an important factor of fatalities and illness in exceptionally ill people, especially those who are receiving enteral nourishment through a nasogastric tube (NGT) [1]. This eliciting hyperinflammatory pulmonary condition is caused by drawing in oropharyngeal or gastrointestinal contents. It has been associated with extended hospital stays and greater medical expenses, as well as increased pharmacotherapies [2,3]. Patients in the intensive care unit (ICU) are more vulnerable to contracting infections because they are less conscious, their breathing responses are less robust, and they have gastric tubes in their digestive tracts [4]. Aspiration in NGT-fed recipients may be triggered by an array of issues, including gastroesophageal reflux, a delay in stomach emptying, and physical as well as chemical effects of formula or prescription drugs that don't pass via the pyloric gateway effectively [5,6]. Standard but adaptable clinical practices contribute to this risk. For example, not flushing the NGT properly after feeding may plug the tube and trigger residue to build up; giving medications improperly can cause blockages and irritation; and fasting overnight for extended periods might render stomach acidity and stasis worse [7,8]. Bundled medical strategies, which consolidate multiple interventions backed by evidence into a

single, manageable plan, have been documented to substantially boost patient results in areas like averting bloodstream infections from central lines and ventilator-associated pneumonia [9,10]. But there currently still doesn't exist an agreed-upon set of steps for keeping NGT-fed people from experiencing aspiration pneumonia. The goal of this study was to seek out how effectively a new packed protocol was executed. The protocol included three key measures that could be altered: 1) thorough flushing after enteral intake; 2) coordinated drug delivery methods; and 3) an abrupt overnight fasting period. We were convinced that if these precautions were taken consistently, they would substantially decrease the number of cases of aspiration pneumonia in a high-risk critical care cohort.

METHODS

Study design and setting

This historical observational cohort study was conducted at the critical care unit of a tertiary care center. The study utilized electronic medical records (EMRs) and patient charts to compare outcomes between a historical control group (pre-protocol implementation) and an intervention group (post-protocol implementation). The bundled care protocol was introduced as a standard quality improvement initiative.

Study participants

The study included patients aged 18 years and older admitted to the ICU who received enteral feeding via an NGT for a minimum of 48 hours. The pre-protocol cohort consisted of 415 patients admitted from January to December 2021. The post-protocol cohort consisted of 2,120 patients admitted from January 2022 to December 2024.

Exclusion criteria

The same exclusion criteria were applied to both groups via EMR review: 1) Diagnosis of aspiration pneumonia at the time of admission; 2) Contraindications to enteral feeding (e.g., bowel obstruction or ischemia); 3) Exclusive receipt of parenteral nutrition; and 4) ICU stay of less than 48 hours.

The aspiration prevention bundled protocol

The exposure was carefully delivered under the "Aspiration Prevention Bundled Protocol," initiated in January 2022. The protocol consisted of three core components: 1) Systematic Post-Feeding Flushing: administration of 30 mL–50 mL of clean water immediately after each bolus feeding or every four hours during continuous feeding; 2) Standardized Medication Administration: All suitable oral medications were to be crushed and dissolved in 15 mL–30 mL of water. A flush with 15 mL–30 mL of clean water was required before, after, and between each medication; and 3) Minimized Overnight Fasting: fasting prior to procedures was limited to no more than six hours unless explicitly contraindicated, with orders to recommence enteral feeding within two hours post-procedure. The pre-protocol group received usual care, which did not systematically enforce these specific practices. Adherence within the post-protocol group was determined by reviewing nurse flow sheets and medication administration records.

Data collection and outcomes measurement

Data were extracted from the EMR system using a standardized data collection form. Collected variables included baseline characteristics: age, gender, primary diagnosis, comorbidities such as hypertension, diabetes, and chronic obstructive pulmonary disease; Glasgow Coma Scale (GCS) score at admission; and need for mechanical ventilation. Process measures (adherence): The proportion of the post-protocol group that adhered to each of the three bundle components. Primary Outcome: Incidence of aspiration pneumonia during the ICU stay, confirmed by (i) a new, persistent infiltrate on chest radiography reported by a radiologist; (ii) At least two clinical signs (fever > 38.0°C, leukocytosis > 12,000/µL or leukopenia < 4,000/µL, or purulent tracheal secretions); and (iii) A diagnosis of pneumonia by the attending physician and initiation of antibiotic therapy [11]. The secondary outcomes include ICU length of stay (LOS), duration of mechanical ventilation (MV), and antibiotic days of therapy (DOT) for pulmonary infection.

Ethical considerations

This retrospective study was approved by the Institutional Review Board of Governmental Hospitals, Amman, Jordan (Reference # 56_19/2025). The requirement for individual informed consent was waived due to the use of anonymized, pre-existing data collected as part of routine quality improvement care. The study was conducted in accordance with the ethical standards of the 1964 Helsinki Declaration.

Statistical analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were compared using the chi-square test. Continuous variables were tested for normality and compared using the independent samples t-test or Mann-Whitney U test, as appropriate. The primary analysis compared the incidence of aspiration pneumonia between groups using the chi-square test. A multiple logistic regression model was constructed to adjust for potential confounders, including age, sex, comorbidities, mechanical ventilation status, and initial GCS score. Results are presented as adjusted odds ratios (aOR) with 95% confidence intervals (CI). A subgroup

analysis within the post-protocol cohort compared outcomes between patients with "High Adherence" (≥ 90% adherence to all components) and "Lower Adherence." A $p< 0.05$ was considered statistically significant.

RESULTS

A total of 2,535 critically ill patients requiring enteral nutrition were included in the final analysis. The study included 415 patients in the pre-protocol group and 2,120 patients in the post-protocol group. At the outset, there were no significant variations between the groups in terms of demographics or clinical traits (Table 1).

Table 1: Baseline characteristics of study participants

Characteristic	Pre-Protocol (n=415)	Post-Protocol (n=2120)	*p*-value
Age (year)	64.2±12.5	63.5±13.1	0.35
Male	238(57.3)	1234(58.2)	0.75
Hypertension	188(45.3)	996(47.0)	0.54
Diabetes	149(35.9)	721(34.0)	0.46
COPD	72(17.3)	403(19.0)	0.43
Mechanical ventilation	252(60.7)	1314(62.0)	0.63
GCS at admission	9[6–12]	9[6–13]	0.41

Values are presented as frequency, percentage, median (IQR), and mean±SD.

Mean age was 64.2 ± 12.5 *vs*. 63.5 ± 13.1 years, $p= 0.35$) and gender distribution (57.3% male vs. 58.2% male, $p= 0.75$) were non-statistically significant. The prevalence of hypertension was 45.3% *vs*. 47.0%, ($p= 0.54$), diabetes (35.9% *vs*. 34.0%, $p= 0.46$), and chronic obstructive pulmonary disease (17.3% *vs*. 19.0%, $p= 0.43$); all were comparable. The proportion requiring invasive mechanical ventilation was 60.7% *vs*. 62.0% ($p = 0.63$), and median GCS scores (9 [IQR 6–12] vs. 9 [IQR 6–13], $p= 0.41$) were not significantly different. The incidence of aspiration pneumonia decreased significantly following protocol implementation. The incidence was 14.7% (61/415) in the pre-protocol group versus 7.8% (165/2,120) in the post-protocol group ($p< 0.001$). This represents an absolute risk reduction of 6.9% and a relative risk reduction of 47%. In multivariate analysis, care during the post-protocol period remained independently associated with a reduced risk (aOR 0.48, 95% CI 0.35–0.66, $p< 0.001$), indicating a 52% reduction in the adjusted odds of aspiration pneumonia Table 2.

Table 2: Logistic regression analysis for the association between bundle implementation and aspiration pneumonia

Variable	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)	*p*-value
Post-protocol period	0.49 (0.36 – 0.67)	0.48 (0.35 – 0.66)	<0.001

*Adjusted for age, sex, comorbidities, MV status, and GCS score.

Adherence to the bundle components in the post-protocol group was high: post-feeding flushing (92%), medication administration (89%), and minimized fasting (85%). Subgroup analysis revealed a dose-response relationship. Among patients with "high adherence" (n= 1,442), the incidence of aspiration pneumonia was 5.2% (75/1,442). Among those with "Lower Adherence" (n= 678), the incidence was 13.3% (90/678). The difference between high- and low-adherence groups was statistically significant ($p< 0.001$) (Figure 1).

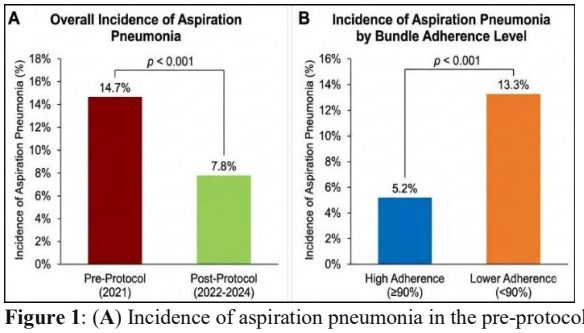

Figure 1: (**A**) Incidence of aspiration pneumonia in the pre-protocol and post-protocol cohorts. (**B**) Incidence of aspiration pneumonia stratified by bundle adherence level within the post-protocol cohort.

Significant improvements were observed in all secondary outcomes (Figure 2). Regarding the ICU Length of Stay, the median ICU LOS decreased from 9.0 days (IQR 6.0–12.0) to 7.0 days (IQR 5.0–10.0) ($p< 0.001$). For the duration of mechanical ventilation, the median MV duration decreased from 144 hours (IQR 72–240) to 120 hours (IQR 72–192) ($p= 0.012$). Concerning the antibiotic days of therapy: The median antibiotic DOT for pulmonary infections decreased from 7 days (IQR 4–11) to 5 days (IQR 3–9) ($p< 0.001$), representing a 22% reduction.

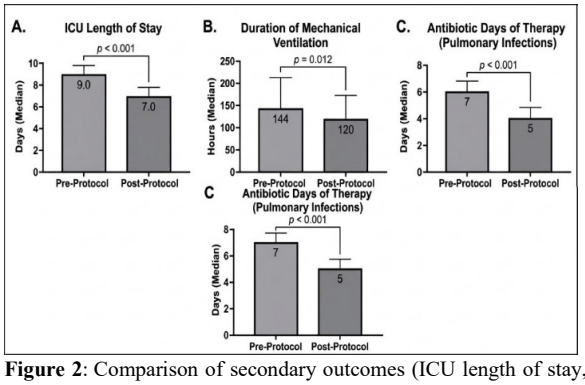

Figure 2: Comparison of secondary outcomes (ICU length of stay, duration of mechanical ventilation, and antibiotic days of therapy) between the pre-protocol and post-protocol cohorts.

DISCUSSION

This large historical cohort study demonstrates that a standardized, multi-component aspiration prevention bundled protocol significantly reduced the incidence of aspiration pneumonia in critically ill tube-fed patients. Given a 52% decline in adjusted likelihood, the number of episodes had been reduced in half. Along with these main benefits, important secondary outcomes got better as well. For example, the length of stay in the intensive care unit (ICU) was shortened by two days, and drug use for pulmonary conditions declined by 22%. Our results are more likely to be valid because the two groups had similar traits from the outset. This renders it less probable that the positive outcomes we

experienced were because the patients were healthier. Also, the clear dose-response relationship, which demonstrated that complying with the daily schedule more closely contributed to better results, is strong, convincing evidence that the intervention functions and illustrates how important it is to be in accordance with its implementation. Our results are in alignment with what other investigations have demonstrated about the manner in which bundled care may mitigate additional challenges in critical care [12,13]. This approach to addressing issues seems particularly relevant to preventing desired outcomes because an assortment of regularly used evidence-based treatments is more effective in dealing with the matter's many causes than one approach alone. Some preliminary research has already been done [14], but our results add to their validity by thoroughly looking at and showing how matters like maintenance and regulation of drug instillation via the NG tube affect outcomes. Several studies have found greater proof for certain procedures (like raising the head of the bed) than others. However, our study shows how important maintenance of NG tube patency is, while nutritional and pharmacotherapy scheduling provisions are associated with lowering the risks associated with tubes [15,16]. Our study's high rate of completion (85%–92%) was probably an essential component of its success. They addressed a problem that many similar quality efforts encountered [17,18]. Less time spent in the ICU and less utilization of antibiotics have direct clinical and cost effects. By avoiding problems attributed to the iatrogenic factors, the procedure helps patients get better sooner and uses fewer resources [19]. The decline in antibiotic DOT is in accordance with global antimicrobial surveillance goals and assists in combating bacteria that are resistant to multiple drugs [20].

Study Limitations

A couple of things are problematic with this study. Its single-center, retrospective cohort design can be skewed by variables that don't belong to quantified and long-term patterns. Even though the circumstances appeared comparable at the start, things like ongoing quality efforts or changes in the nurse staff could have had an impact on the results. An example of the Hawthorne effect is when a historical control group is used. Even though there are accepted guidelines for diagnosing aspiration pneumonia, it can be hard to determine the diagnosis in seriously ill individuals. Lastly, multi-center studies are needed to make us confident our results can be applied to other hospitals with different patient groups and resources.

Conclusion

In conclusion, the implementation of a practical, multifaceted aspiration prevention bundle was associated with a significant reduction in aspiration pneumonia and improvements in other important clinical outcomes. This protocol offers a viable strategy for enhancing the safety of enteral feeding in critically ill patients.

ACKNOWLEDGMENTS

The authors thank the nursing and medical staff of the Critical Care Unit at Governmental Hospitals, Amman, for their dedication and cooperation in implementing this protocol and diligently collecting the data.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author based on a reasonable request.

REFERENCES

1. Alkhawaja S, Martin C, Butler RJ, Gwadry-Sridhar F. Post-pyloric versus gastric tube feeding for preventing pneumonia and improving nutritional outcomes in critically ill adults. *Cochrane Database Syst Rev*. 2015;(8):CD008875. doi: 10.1002/14651858.CD008875.pub2.
2. Jiyong J, Tiancha H, Huiqin W, Jingfen J. Effect of gastric versus post-pyloric feeding on the incidence of pneumonia in critically ill patients: observations from traditional and Bayesian random-effects meta-analysis. *Clin Nutr*. 2013;32(1):8-15. doi: 10.1016/j.clnu.2012.07.002.
3. Deane AM, Guy S, Koopmans R, Page K, Regli A. Routine monitoring of gastric residual volume not recommended. *Intensive Care Med*. 2023;49(1):81-84. doi: 10.1007/s00134-022-06938-6.
4. Poulard F, Dimet J, Martin-Lefevre L, Bontemps F, Fiancette M, Lemiale V, et al. Impact of not measuring residual gastric volume in mechanically ventilated patients receiving early enteral feeding: a prospective before-after study. *J Parenter Enteral Nutr*. 2010;34(2):125-130. doi: 10.1177/0148607109344745.
5. McClave SA, Gualdoni J, Nagengast A, Dietsche C, Gott A, Guenter P, et al. Gastric feeding tubes in the critically ill patient. *Gastroenterol Clin North Am*. 2022;51(4):703-721. doi: 10.1016/j.gtc.2022.07.004.
6. Blaser AR, Deane AM, Fruhwald S, van Zanten ARH. Gastrointestinal function in the critically ill: a systematic scoping review and research agenda proposed by the Section of Metabolism, Endocrinology and Nutrition of the European Society of Intensive Care Medicine. *Crit Care*. 2020;24(1):224. doi: 10.1186/s13054-020-02937-7.
7. Boullata JI, Carrera AL, Harvey L, Hudson L, Mays A, McGinnis C, et al. ASPEN safe practices for enteral nutrition therapy. *J Parenter Enteral Nutr*. 2017;41(1):15-103. doi: 10.1177/0148607116673053.
8. Reignier J, Boisramé-Helms J, Brisard L, Lascarrou JB, Ait Hssain A, Anguel N, et al. Enteral versus parenteral early nutrition in ventilated adults with shock: a randomised, controlled, multicentre, open-label, parallel-group study (NUTRIREA-2). *Lancet*. 2018;391(10116):133-143. doi: 10.1016/S0140-6736(17)32146-3.
9. Klompas M, Branson R, Cawcutt K, Crist M, Eichenwald EC, Greene LR, et al. Strategies to prevent ventilator-associated pneumonia, ventilator-associated events, and nonventilator hospital-acquired pneumonia in acute-care hospitals: 2022 Update. *Infect Control Hosp Epidemiol*. 2022;43(6):687-713. doi: 10.1017/ice.2022.88.

10. O'Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, et al. Guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis*. 2011;52(9):e162-e193. doi: 10.1093/cid/cir257.
11. Metheny NA, Frantz RA. Head-of-bed elevation in critically ill patients: A review. *Crit Care Nurse*. 2013;33(4):53-66. doi: 10.4037/ccn2013572.
12. Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med*. 2006;355(26):2725-2732. doi: 10.1056/NEJMoa061115.
13. Resar R, Pronovost P, Haraden C, Simmonds T, Rainey T, Nolan T. Using a bundle approach to improve ventilator care processes and reduce ventilator-associated pneumonia. *Jt Comm J Qual Patient Saf*. 2005;31(5):243-248. doi: 10.1016/s1553-7250(05)31031-2.
14. Metheny NA, Davis-Jackson J, Stewart BJ. Effectiveness of an aspiration risk-reduction protocol. *Nurs Res*. 2010;59(1):18-25. doi: 10.1097/NNR.0b013e3181c3ba05.
15. McClave SA, DeMeo MT, DeLegge MH, DiSario JA, Heyland DK, Maloney JP, et al. North American Summit on Aspiration in the Critically Ill Patient: consensus statement. *J Parenter Enteral Nutr*. 2002;26(6 Suppl):S80-S85. doi: 10.1177/014860710202600612.
16. Blot SI, Poelaert J, Kollef M. How to avoid microaspiration? A key element for the prevention of ventilator-associated pneumonia in intubated patients. *BMC Anesthesiol*. 2014;14:92. doi: 10.1186/1471-2253-14-92.
17. Davies AR, Morrison SS, Bailey MJ, Bellomo R, Cooper DJ, Doig GS, et al. A multicenter, randomized controlled trial comparing early nasojejunal with nasogastric nutrition in critical illness. *Crit Care Med*. 2012;40(8):2342-2348. doi: 10.1097/CCM.0b013e318255d87e.
18. Mandell LA, Niederman MS. Aspiration pneumonia. *N Engl J Med*. 2019;380(7):651-663. doi: 10.1056/NEJMra1714562.
19. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock, 2012. *Intensive Care Med*. 2013;39(2):165-228. doi: 10.1007/s00134-012-2769-8.
20. Metheny NA, Mills AC, Stewart BJ, Oliver D, Clouse RE. A comprehensive algorithm to detect aspiration in enterally fed critically ill patients. *Am J Crit Care*. 2021;30(5):371-379. doi: 10.4037/ajcc2021789.