

CADTH RAPID RESPONSE REPORT: REFERENCE LIST

Routine Monitoring of Gastric Residual Volume During Enteral Feeding of Adult Inpatients: Clinical Utility and Guidelines

Service Line: Rapid Response Service
Version: 1.0
Publication Date: August 15, 2019
Report Length: 13 Pages

Authors: Deba Hafizi, Suzanne McCormack

Cite As: *Routine Monitoring of Gastric Residual Volume During Enteral Feeding of Adult Inpatients: Clinical Utility and Guidelines*. Ottawa: CADTH; 2019 Aug. (CADTH rapid response report: reference list).

Disclaimer: The information in this document is intended to help Canadian health care decision-makers, health care professionals, health systems leaders, and policy-makers make well-informed decisions and thereby improve the quality of health care services. While patients and others may access this document, the document is made available for informational purposes only and no representations or warranties are made with respect to its fitness for any particular purpose. The information in this document should not be used as a substitute for professional medical advice or as a substitute for the application of clinical judgment in respect of the care of a particular patient or other professional judgment in any decision-making process. The Canadian Agency for Drugs and Technologies in Health (CADTH) does not endorse any information, drugs, therapies, treatments, products, processes, or services.

While care has been taken to ensure that the information prepared by CADTH in this document is accurate, complete, and up-to-date as at the applicable date the material was first published by CADTH, CADTH does not make any guarantees to that effect. CADTH does not guarantee and is not responsible for the quality, currency, propriety, accuracy, or reasonableness of any statements, information, or conclusions contained in any third-party materials used in preparing this document. The views and opinions of third parties published in this document do not necessarily state or reflect those of CADTH.

CADTH is not responsible for any errors, omissions, injury, loss, or damage arising from or relating to the use (or misuse) of any information, statements, or conclusions contained in or implied by the contents of this document or any of the source materials.

This document may contain links to third-party websites. CADTH does not have control over the content of such sites. Use of third-party sites is governed by the third-party website owners' own terms and conditions set out for such sites. CADTH does not make any guarantee with respect to any information contained on such third-party sites and CADTH is not responsible for any injury, loss, or damage suffered as a result of using such third-party sites. CADTH has no responsibility for the collection, use, and disclosure of personal information by third-party sites.

Subject to the aforementioned limitations, the views expressed herein do not necessarily reflect the views of Health Canada, Canada's provincial or territorial governments, other CADTH funders, or any third-party supplier of information.

This document is prepared and intended for use in the context of the Canadian health care system. The use of this document outside of Canada is done so at the user's own risk.

This disclaimer and any questions or matters of any nature arising from or relating to the content or use (or misuse) of this document will be governed by and interpreted in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein, and all proceedings shall be subject to the exclusive jurisdiction of the courts of the Province of Ontario, Canada.

The copyright and other intellectual property rights in this document are owned by CADTH and its licensors. These rights are protected by the Canadian *Copyright Act* and other national and international laws and agreements. Users are permitted to make copies of this document for non-commercial purposes only, provided it is not modified when reproduced and appropriate credit is given to CADTH and its licensors.

About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

Questions or requests for information about this report can be directed to requests@cadth.ca

Research Questions

1. What is the comparative clinical utility of monitoring gastric residual volume versus no monitoring gastric residual volume in patients who require enteral feeding?
2. What are the evidence-based guidelines regarding monitoring gastric residual volume for patients who require enteral feeding?

Key Findings

Two systematic reviews (one with meta-analysis), one randomized controlled trial, and two non-randomized studies were identified regarding the clinical utility of monitoring gastric residual volume versus no monitoring gastric residual volume in patients who require enteral feeding. In addition, two evidence-based guidelines were identified regarding monitoring gastric residual volume for patients who require enteral feeding.

Methods

A limited literature search was conducted by an information specialist on key resources including Medline, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused Internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. The main search concepts were gastric volume and enteral feeding. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2014 and August 8, 2019. Internet links were provided, where available.

Selection Criteria

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Q1-2: Adult inpatients with gastric or nasogastric feeding tubes who require enteral feeding Sub groups: <ul style="list-style-type: none"> • Mechanically ventilated patients • Severe alcohol withdrawal patients
Intervention	Q1-2: Monitoring of gastric residual volume
Comparator	Q1: No monitoring of gastric residual volume (or gastric residual volume evaluation) Q2: Not applicable

Outcomes	Q1: Clinical utility (e.g., malnutrition, delayed feedings, electrolyte imbalances, weight gain, full enteral feedings, length of stay) Safety (e.g., harm/risk, complications such as aspiration and hence infection [i.e. pneumonia or VAP]) Q2: Evidence-based guidelines
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, evidence-based guidelines

Results

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and evidence-based guidelines.

Two systematic reviews (one with meta-analysis)¹⁻², one randomized controlled trial³, and two non-randomized studies⁴⁻⁵ were identified regarding the clinical utility of monitoring gastric residual volume versus no monitoring gastric residual volume in patients who require enteral feeding. No relevant health technology assessments were identified.

In addition, two evidence-based guidelines⁶⁻⁷ were identified regarding monitoring gastric residual volume for patients who require enteral feeding.

Additional references of potential interest are provided in the appendix.

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

Critically-Ill Burn Patients

1. Pham CH, Collier ZJ, Garner WL, Kuza CM, Gillenwater TJ. Measuring gastric residual volumes in critically ill burn patients - a systematic review. *Burns*. 2019 05;45(3):509-525.

[PubMed: PM29914737](#)

PURPOSE: Measuring gastric residual volumes (GRV) is common in intensive care units (ICU) in patients receiving enteral nutrition (EN) and are a common source of feeding interruptions. Interruptions in EN yield adverse outcomes and are an area of improvement in burn care. **The objectives of this study are to summarize the literature's ICU GRV practices and offer practical suggestions to GRV management in the burn patient.**

METHODS: PubMed, SCOPUS, and OvidSP Medline were systematically reviewed using the keywords: burns; thermal injury; gastric residual volume; enteral feeding; tube feeding; enteral nutrition; gastric intolerance; ICU; critical illness. Reviews, case reports, and consensus and opinion papers were excluded.

RESULTS: 26 articles were identified. Six burn-specific studies were identified. GRV practices vary widely and are a common cause of EN interruption. Elevated GRVs do not equate to gastrointestinal intolerance and do not always reflect aspiration risk.

CONCLUSIONS: We advocate a GRV threshold of 500mL should be used to optimize the benefits of EN in burn ICUs. A single incident of elevated GRVs should not mandate immediate EN rate reduction or cessation but should prompt a thoughtful examination of secondary causes of gastrointestinal intolerance. Randomized controlled trials are needed to define the ideal GRV threshold and re-evaluate its role in burn care.

Mechanically Ventilated Patients

2. Wang Z, Ding W, Fang Q, Zhang L, Liu X, Tang Z. Effects of not monitoring gastric residual volume in intensive care patients: a meta-analysis. *Int J Nurs Stud.* 2019 Mar;91:86-93.

[PubMed: PM30677592](#)

BACKGROUND: Monitoring gastric residual volume has been a common practice in intensive care patients receiving enteral feeding worldwide. Recent studies though, have challenged the reliability and necessity of this routine monitoring process. Several studies even reported improvements in the delivery of enteral feeding without monitoring gastric residual volume, while incurring no additional adverse events. However, the benefit of monitoring gastric residual volume remains controversial in intensive care patients.

OBJECTIVE: The aim of this review is to identify the effects of not monitoring gastric residual volume in intensive care patients through a meta-analysis of the data pooled from published studies that meet our inclusion criteria.

DESIGN: A systematic review **DATA SOURCES:** An electronic search of Embase, Pubmed, and the Cochrane Library was completed up to April 2018. The data included basic population characteristics, related complications, mortality, duration of mechanical ventilation and intensive care unit length of stay.

REVIEW METHODS: Eligibility and methodological quality of the studies were assessed by two researchers independently according to the Joanna Briggs Institute guidelines. The Review Manager Software was used to calculate the pooled risk ratio (RR), weighted mean difference, and the corresponding 95% confidential interval (95% CI). Sensitivity analyses were done by excluding each study. Publication bias analyses were conducted to avoid the exaggerated effect of the overall estimates.

RESULTS: Five studies involving 998 patients were included in this meta-analysis. Compared with monitoring gastric residual volume, not monitoring gastric residual volume decreased the rate of feeding intolerance in critically ill patients (RR = 0.61, 95%CI 0.51-0.72), and did not result in an increment in the rate of mortality (RR = 0.97, 95%CI 0.73-1.29, P = 0.84) or the rate of ventilator-associated pneumonia (RR = 1.03, 95%CI 0.74-1.44, P = 0.85). There were also no differences in the duration of mechanical ventilation (MD = 0.09, 95%CI, -0.99 to 1.16, P = 0.88) or intensive care unit length of stay (MD=-0.18, 95%CI, -1.52 to 1.17, P = 0.79).

CONCLUSION: Except for an increased risk of vomiting, the absence of monitoring gastric residual volume was not inferior to routine gastric residual volume monitoring in terms of feeding intolerance development, mortality, and ventilator-associated pneumonia in intensive care patients. There is encouraging evidence that not measuring gastric residual volume does not induce additional harm to the patients. More multicenter, randomized clinical trials are required to verify these findings.

Randomized Controlled Trials

Mechanically Ventilated Patients

3. Ozen N, Tosun N, Yamanel L, Altintas ND, Kilciler G, Ozen V. Evaluation of the effect on patient parameters of not monitoring gastric residual volume in intensive care patients on a mechanical ventilator receiving enteral feeding: a randomized clinical trial. *J Crit Care.* 2016 06;33:137-144.

[PubMed: PM26948254](#)

PURPOSE: This study aimed to evaluate the effects of not measuring gastric residual volume (GRV) in intensive care patients on a mechanical ventilator and receiving enteral feeding on the feeding intolerance, gastroesophageal reflux (GER) risk, and nutritional adequacy.

METHODS: This randomized clinical study was performed in 2 medical intensive care units of 2 university hospitals in Ankara, Turkey. The patients were randomized into 2 groups. In the group with GRV monitoring, GRV was measured 3 times a day, and the GRV threshold was accepted as 250 mL. In addition, 24-hour pH monitoring was used in this group to assess the risk of GER. In the group without GRV monitoring, GRV was not measured. The patients were followed-up for 5 days.

RESULTS: The feeding targets were reached more quickly in the group without GRV monitoring (n = 26) with no increase in the complication rate (P < .05). No significant relationship was found between GRV and GER in the group with GRV monitoring (n = 25) (P > .05).

CONCLUSION: The discrepancies in GRV measurement make it unreliable for monitoring feeding intolerance and GER. The use of GRV measurements may therefore be discontinued as part of the standard care protocol in medical intensive care units.

Non-Randomized Studies

Mechanically Ventilated Patients

4. Wiese AN, Rogers MJ, Way M, Ballard E. The impact of removing gastric residual volume monitoring and enteral nutrition rate titration in adults receiving mechanical ventilation. *Aust Crit Care.* 2019 Jan 14;14:14.

[PubMed: PM30655035](#)

BACKGROUND: Monitoring gastric residual volume (GRV) and titrating enteral nutrition (EN) towards goal rate are common practices in the intensive care unit (ICU) despite limited supportive evidence. **We investigated the effect of removal of GRV monitoring and commencing EN at goal rate had on EN provision in mechanically ventilated ICU patients.**

METHODS: We conducted a **single-centre, pre-post implementation study**, in a 10-bed ICU comprising **181 patients with ventilation \geq 48 h and given EN within 24 h of intubation**. EN adequacy, expressed as the proportion of patients receiving \geq 90% of the prescribed volume during the first 24 h of feeding, was compared before and after implementation. Secondary outcomes included EN adequacy over entire ICU stay; incidence of gastrointestinal intolerance in terms of vomiting, abdominal distension, and GRV >200 ml; prokinetic use; onset of a ventilator-associated condition; ventilation duration; length of stay; and mortality.

RESULTS: After intervention, the proportion of patients meeting \geq 90% of their

prescribed EN volume within the first 24 h of feeding increased by 38.1% (pre: 46.4%, 95% confidence interval [CI]: 36.7-56.3; post: 84.5%, 95% CI: 75.8-91.2; p < 0.001). Over their entire ICU stay, the proportion of patients meeting >=90% of their prescribed EN volume increased by 21.4% (pre: 61.9%, 95% CI: 52.0-71.1; post: 83.3%, 95% CI: 74.4-90.2; p = 0.001). Gastrointestinal intolerance reduced by 34.0% (pre: 80.4%, 95% CI: 71.8-87.5; post: 46.4%, 95% CI: 36.0-57.1; p < 0.001) and fewer prescribed prokinetic agents (pre: 57.7%, 95% CI: 47.8-67.3; post: 23.8%, 95% CI: 15.6-33.6; p < 0.001).

CONCLUSIONS: Removal of GRV monitoring and commencing EN at goal resulted in significantly increased EN provision during the first 24 h of feeding and entire ICU stay with reduced prokinetic use and gastrointestinal complications.

5. Gately T, Lima J, Gonzalians T. Sub acute gastric residuals elimination change project. *Rehabil Nurs*. 2015 Mar-Apr;40(2):127-129.
[PubMed: PM25042016](#)

PURPOSE: The practice of checking gastric residual volumes (GRV) for patients receiving enteral tube feedings has long been a tradition in nursing based on the concern that large residuals would increase the risk of aspiration and pneumonia. However, a review of the literature suggests that the practice of checking GRV is not a reliable method for assessing risk for aspiration. **We conducted a study in our adult Sub Acute Unit to determine whether it was necessary to continue routine monitoring of GRV.**

METHOD: A retrospective chart review was conducted that included 15 patients who had received G-tube enteral feedings as their primary source of nutrition for a period of 1 year.

FINDINGS: Over 10,000 GRV were reviewed, with no instance of aspiration or pneumonia found.

CONCLUSIONS AND CLINICAL RELEVANCE: This resulted in the decision to change our facility's policy, eliminating routine GRV checks, saving over 3 hours of nursing time per patient, per week with no deleterious effects.

Guidelines and Recommendations

6. Adult enteral nutrition clinical practice guideline. Winnipeg (MB): Winnipeg Regional Health Authority; 2017: <https://www.wrha.mb.ca/extranet/eipt/files/EIPT-34-005.pdf>
See: *Gastric Residual Volumes*, page 12. Accessed 2019 Aug 14.
7. McClave SA, Taylor BE, Martindale RG, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *JPEN J Parenter Enteral Nutr*. 2016 Feb;40(2):159-211.
<https://onlinelibrary.wiley.com/doi/epdf/10.1177/0148607115621863>
See: *Table 2, Bundle Statements*, page 163. Accessed 2019 Aug 14.

Appendix — Further Information

Randomized Controlled Trials – Alternative Population

8. Parker LA, Weaver M, Murgas Torrazza RJ, et al. Effect of gastric residual evaluation on enteral intake in extremely preterm infants: a randomized clinical trial. *JAMA Pediatr.* 2019 Jun 01;173(6):534-543.
[PubMed: PM31034045](#)

Importance: Evaluating prefeed gastric residuals is considered routine care but has little supporting evidence.

Objective: To determine the effect of omitting prefeed gastric residual evaluation on nutritional outcomes in extremely preterm infants.

Design, Setting, and Participants: This single-center randomized clinical trial compared the omission of gastric residual evaluation with prefeed gastric residual evaluation. Infants were recruited from a level 4 neonatal intensive care unit and were enrolled from October 17, 2013, to October 8, 2016, and then followed up for 6 weeks after birth. Eligible participants were infants born at 32 or fewer weeks' gestation with a birth weight of 1250 g or less; they were enrolled within 72 hours after birth and within 24 hours after feeding initiation. All participants (N = 143) were included in the modified intent-to-treat analysis, which was conducted from March to July 2018.

Interventions: The residual group underwent prefeed gastric residual evaluation; the no residual group did not. Feeding decisions were made according to nutritional guidelines, and infants received only human milk.

Main Outcomes and Measures: The primary outcome was weekly enteral nutrition intake in mL/kg for 6 weeks after birth.

Results: Of 143 infants, 74 (51.7%) were randomized to undergo gastric residual evaluation (residual group) and 69 (48.3%) to omitted gastric residual evaluation (no residual group). The residual group comprised an even number of male and female infants (37 [50.0%]) with a mean (SD) gestational age of 27.1 (2.4) weeks and a mean (SD) birth weight of 888.8 (206.6) grams, whereas the no residual group had more male infants (36 [52.17%]), a mean (SD) gestational age of 27 (1.2) weeks, and a mean (SD) birth weight of 915.2 (180) grams. The no residual group had feedings that advanced more quickly compared with the residual group (mean weekly increase, 20.7 mL/kg/d vs 17.9 mL/kg/d; P = .02) and consumed more feedings at weeks 5 (137.2 [95% CI, 128.6-145.8]; P = .03) and 6 (141.6 [95% CI, 133.2-150.0]; P = .03). Among the secondary outcomes, the no residual group had higher mean estimated log weights (7.01 [95% CI, 6.99-7.02] vs 6.98 [95% CI, 6.97-7.00]; P = .03), had fewer episodes of abdominal distention (0.59 [95% CI, 0.34-1.01] vs 1.79 [95% CI, 1.27-2.53]; P = .001), and were discharged 8 days earlier (4.21 [95% CI, 4.14-4.28] vs 4.28 [95% CI, 4.19-4.36]; P = .01). Odds for necrotizing enterocolitis (0.058 [95% CI, 0.018-0.190] vs 0.026 [95% CI, 0.006-0.109]), death (0.004 [95% CI, 0.0003-0.046] vs 0.012 [95% CI, 0.001-0.131]), late-onset sepsis (0.970 [95% CI, 0.67-1.40] vs 1.38 [95% CI, 0.97-1.94]), and ventilator-associated pneumonia (0.084 [95% CI, 0.033-0.214] vs 0.056 [95% CI, 0.019-0.168]) were similar between groups.

Conclusions and Relevance: Among extremely preterm infants, the omission of gastric residual evaluation increased the delivery of enteral nutrition as well as improved weight gain and led to earlier hospital discharge; these results may translate into evidence-based practice.

Trial Registration: ClinicalTrials.gov identifier: NCT01863043.

Non-Randomized Studies – Alternative Population

9. National Institute for Health Research. A feasibility study of no routine gastric residual volume measurement in mechanically ventilated infants and children: the GASTRIC Study. 2018; <https://www.journalslibrary.nihr.ac.uk/programmes/hta/169402/#/>. Accessed 2019 Aug 14

10. Riskin A, Cohen K, Kugelman A, Toropine A, Said W, Bader D. The impact of routine evaluation of gastric residual volumes on the time to achieve full enteral feeding in preterm infants. *J Pediatr*. 2017 10;189:128-134.

[PubMed: PM28625498](#)

OBJECTIVE: To evaluate the time to full enteral feedings in preterm infants after a practice change from routine evaluation of gastric residual volume before each feeding to selective evaluation of gastric residual volume, and to evaluate the impact of this change on the incidence of necrotizing enterocolitis (NEC).

STUDY DESIGN: Data were collected on all gavage-fed infants born at ≤ 34 weeks gestational age (GA) for 2 years before ($n = 239$) and 2 years after the change ($n = 233$).

RESULTS: The median GA was 32.0 (IQR: 29.7-33.0) weeks before and 32.4 (30.4-33.4) weeks after the change ($P = .02$). Compared with historic controls, infants with selective evaluations of gastric residual volumes weaned from parenteral nutrition 1 day earlier ($P < .001$) and achieved full enteral feedings (150 cc/kg/day) 1 day earlier ($P = .002$). The time to full oral feedings and lengths of stay were similar. The rate of NEC (stage ≥ 2) was 1.7% in the selective gastric residual volume evaluation group compared with 3.3% in the historic control group ($P = .4$). Multiple regression analyses showed that the strongest predictor of time to full enteral feedings was GA. Routine evaluation of gastric residual volume and increasing time on noninvasive ventilation both prolonged the attainment of full enteral feedings. Findings were consistent in the subgroup with birth weights of < 1500 g. Increased weight at discharge was most strongly associated with advancing postmenstrual age but avoidance of routine evaluations of gastric residual volume also was a significant factor.

CONCLUSIONS: Avoiding routine evaluation of gastric residual volume before every feeding was associated with earlier attainment of full enteral feedings without increasing risk for NEC.

11. Tume LN, Bickerdike A, Latten L, et al. Routine gastric residual volume measurement and energy target achievement in the PICU: a comparison study. *Eur J Pediatr*. 2017 Dec;176(12):1637-1644.

[PubMed: PM28921175](#)

Critically ill children frequently fail to achieve adequate energy intake, and some care practices, such as the measurement of gastric residual volume (GRV), may contribute to this problem. We compared outcomes in two similar European Paediatric Intensive Care Units (PICUs): one which routinely measures GRV (PICU-GRV) to one unit that does not (PICU-noGRV). An observational pilot comparison study was undertaken. Eighty-seven children were included in the study, 42 (PICU-GRV) and 45 (PICU-noGRV). There were no significant differences in the percentage of energy targets achieved in the first 4 days of PICU admission although PICU-noGRV showed more consistent delivery of median (and IQR) energy targets and less under and over feeding for PICU-GRV and PICU-noGRV: day 1 37 (14-72) vs 44 (0-100), day 2 97

(53-126) vs 100 (100-100), day 3 84 (45-112) vs 100 (100-100) and day 4 101 (63-124) vs 100 (100-100). The incidence of vomiting was higher in PICU-GRV. No necrotising enterocolitis was confirmed in either unit, and ventilator-acquired pneumonia rates were not significantly different (7.01 vs 12.531 per 1000 ventilator days; $p = 0.70$) between PICU-GRV and PICU-noGRV units.

CONCLUSIONS: The practice of routine gastric residual measurement did not significantly impair energy targets in the first 4 days of PICU admission. However, not measuring GRV did not increase vomiting, ventilator-acquired pneumonia or necrotising enterocolitis, which is the main reason clinicians cite for measuring GRV.

What is known: * The practice of routinely measuring gastric residual volume is widespread in critical care units * This practice is increasingly being questioned in critically ill patients, both as a practice that increases * The likelihood of delivering inadequate enteral nutrition amounts and as a tool to assess feeding tolerance **What is new:** * Not routinely measuring gastric residual volume did not increase adverse events of ventilator acquired pneumonia, necrotising enterocolitis or vomiting. * In the first 4 days of PICU stay, energy target achievement was not significantly different, but the rates of under and over feeding were higher in the routine GRV measurement unit.

Guidelines and Recommendations

Methodology Not Specified

12. McClave SA, DiBaise JK, Mullin GE, Martindale RG. ACG Clinical Guideline: nutrition therapy in the adult hospitalized patient. *Am J Gastroenterol.* 2016 Mar;111(3):315-334; quiz 335.

[PubMed: PM26952578](#)

The value of nutrition therapy for the adult hospitalized patient is derived from the outcome benefits achieved by the delivery of early enteral feeding. Nutritional assessment should identify those patients at high nutritional risk, determined by both disease severity and nutritional status. For such patients if they are unable to maintain volitional intake, enteral access should be attained and enteral nutrition (EN) initiated within 24-48 h of admission. Orogastric or nasogastric feeding is most appropriate when starting EN, switching to post-pyloric or deep jejunal feeding only in those patients who are intolerant of gastric feeds or at high risk for aspiration. Percutaneous access should be used for those patients anticipated to require EN for >4 weeks. Patients receiving EN should be monitored for risk of aspiration, tolerance, and adequacy of feeding (determined by percent of goal calories and protein delivered). Intentional permissive underfeeding (and even trophic feeding) is appropriate temporarily for certain subsets of hospitalized patients. Although a standard polymeric formula should be used routinely in most patients, an immune-modulating formula (with arginine and fish oil) should be reserved for patients who have had major surgery in a surgical ICU setting. Adequacy of nutrition therapy is enhanced by establishing nurse-driven enteral feeding protocols, increasing delivery by volume-based or top-down feeding strategies, minimizing interruptions, **and eliminating the practice of gastric residual volumes.** Parenteral nutrition should be used in patients at high nutritional risk when EN is not feasible or after the first week of hospitalization if EN is not sufficient. Because of their knowledge base and skill set, the gastroenterologist endoscopist is an asset to the Nutrition Support Team and should participate in providing optimal nutrition therapy to the hospitalized adult patient.

Review Articles

13. Diamond SJ, Medici V, Rice TW, Miller K. Should we stop using gastric residual volumes? *Curr Nutr Rep.* 2015;4(3):236-241; <https://link.springer.com/article/10.1007%2Fs13668-015-0129-3>. Accessed 2019 Aug
14. Blot SI, Poelaert J, Kollef M. How to avoid microaspiration? A key element for the prevention of ventilator-associated pneumonia in intubated ICU patients. *BMC Infect Dis.* 2014 Nov 28;14:119. [PubMed: PM25430629](https://pubmed.ncbi.nlm.nih.gov/25430629/)

Microaspiration of subglottic secretions through channels formed by folds in high volume-low pressure poly-vinyl chloride cuffs of endotracheal tubes is considered a significant pathogenic mechanism of ventilator-associated pneumonia (VAP). Therefore a series of prevention measures target the avoidance of microaspiration. However, although some of these can minimize microaspiration, benefits in terms of VAP prevention are not always obvious. Polyurethane-cuffed endotracheal tubes successfully reduce microaspiration but high quality data demonstrating VAP rate reduction are lacking. An analogous conclusion can be made regarding taper-shaped cuffs compared with classic barrel-shaped cuffs. More clinical data regarding these endotracheal tube designs are needed to demonstrate clinical value in addition to in vitro-based evidence. The clinical usefulness of endotracheal tubes developed for subglottic secretions drainage is established in multiple studies and confirmed by meta-analysis. Any change in cuff design will fail to prevent microaspiration if the cuff is insufficiently inflated. At least one well-designed trial demonstrated that continuous cuff pressure monitoring and control decrease the risk of VAP. Gel lubrication of the cuff prior to intubation temporarily hampers microaspiration through sludging the channels formed by folds in high volume-low pressure cuffs. As the beneficial effect of gel lubrication is temporarily, its potential to reduce VAP risk is probably nonsignificant. A minimum positive end-expiratory pressure of at least 5 cmH₂O can be recommended as it reduces the risk of microaspiration in vitro and in vivo. One randomized controlled study demonstrated a reduced risk of VAP in patients ventilated with PEEP (5-8 cmH₂O). Regarding head-of-bed elevation, it can be recommended to avoid supine positioning. Whether a 45degree head-of-bed elevation is to be preferred above 25-30degree head-of-bed elevation remains unproven. Finally, the routine monitoring of gastric residual volumes in mechanically ventilated patients receiving enteral nutrition cannot be recommended.

Alternative Population

15. Parker L, Torrazza RM, Li Y, Talaga E, Shuster J, Neu J. Aspiration and evaluation of gastric residuals in the neonatal intensive care unit: state of the science. *J Perinat Neonatal Nurs.* 2015 Jan-Mar;29(1):51-59; quiz E52. [PubMed: PM25633400](https://pubmed.ncbi.nlm.nih.gov/25633400/)

The routine aspiration of gastric residuals (GR) is considered standard care for critically ill infants in the neonatal intensive care unit (NICU). Unfortunately, scant information exists regarding the risks and benefits associated with this common procedure. This article provides the state of the science regarding what is known about the routine aspiration and evaluation of GRs in the NICU focusing on the following issues: (1) the use of GRs for verification of feeding tube placement, (2) GRs as an indicator of gastric contents, (3) GRs as an indicator of feeding intolerance or necrotizing enterocolitis, (4)

the association between GR volume and ventilator-associated pneumonia, (5) whether GRs should be discarded or refed, (6) the definition of an abnormal GR, and (7) the potential risks associated with aspiration and evaluation of GRs. Recommendations for further research and practice guidelines are also provided.

16. Li YF, Lin HC, Torrazza RM, Parker L, Talaga E, Neu J. Gastric residual evaluation in preterm neonates: a useful monitoring technique or a hindrance? *Pediatr Neonatol*. 2014 Oct;55(5):335-340.
[PubMed: PM25129325](#)

It is routine practice in most neonatal intensive care units to measure the volume and color of gastric residuals (GRs) prior to enteral bolus feedings in preterm very low birth weight infants. However, there is paucity of evidence supporting the routine use of this technique. Moreover, owing to the lack of uniform standards in the management of GRs, wide variations exist as to what constitutes significant GR volume, the importance of GR color and frequency of GR evaluation, and the color or volume standards that dictate discarding or returning GRs. The presence of large GR volumes or green-colored residuals prior to feeding often prompts subsequent feedings to be withheld or reduced because of possible necrotizing enterocolitis resulting in delays in enteral feeding. Cessation or delays in enteral feeding may result in extrauterine growth restriction, a known risk factor for poor neurodevelopmental and growth outcomes in preterm very low birth weight infants. Although some neonatal intensive care units are abandoning the practice of routine GR evaluation, little evidence exists to support the discontinuation or continuation of this practice. This review summarizes the current state of GR evaluation and underlines the need for a scientific basis to either support or refute the routine evaluation of GRs.

Additional References

17. Tume LN, Arch B, Woolfall K, Latten L, Deja E, Roper L et al. Gastric residual volume measurement in U.K. PICUs: a survey of practice. *Pediatr Crit Care Med*. 2019 Aug;20(8):707-713.
https://journals.lww.com/pccmjournals/Abstract/2019/08000/Gastric_Residual_Volume_Measurement_in_U_K_PICUs_2.aspx. Accessed 2019 Aug 14.
18. Ozen N, Blot S, Ozen V, et al. Gastric residual volume measurement in the intensive care unit: an international survey reporting nursing practice. *Nurs Crit Care*. 2018 Sep;23(5):263-269.
[PubMed: PM30039544](#)

BACKGROUND: Gastric residual volume measurement is routinely used to evaluate the feeding tolerance and gastro-oesophageal reflux in patients receiving enteral feeding therapy in the intensive care unit. However, little supportive evidence for this intervention is available as the usefulness of gastric residual volume measurements in patients receiving enteral feeding therapy in the intensive care is controversial.

AIM: The aim of this study was to assess the practice of intensive care unit nurses related to gastric residual volume measurement in patients receiving enteral nutrition.

METHODS: A survey was conducted among a sample of intensive care unit nurses (n = 832) from four hospitals in Turkey (n = 182) and attendees of the Annual Congress of the Flemish Society for Critical Care Nurses in Flanders, Belgium (n = 650). The survey instrument was developed by the researchers based on the related literature.

RESULTS: A total of 480 nurses completed the questionnaire (response rate = 73%). Gastric residual volume is measured by 98.0% of respondents, with wide variations in the frequency of measuring. A 50-200 mL gastric residual volume is considered problematic by 45.5% (n = 183) of the participants, and only 18.4% (n = 81) reported their practice to be based on a current guideline. Strikingly, more experienced intensive care unit nurses appear to perform gastric residual volume measurements more commonly than their less experienced colleagues (p = 0.004), while the practice is more often reported to be performed in Belgium than in Turkey (p < 0.001).

CONCLUSION: Gastric residual volume management could be improved by applying current evidence to daily nursing practice.

RELEVANCE TO CLINICAL PRACTICE: Our results show that increased awareness of these guidelines by nurses is needed to reduce inefficient use of working time and resources, streamline clinical practices and improve patient outcomes. Current gastric residual volume measurement guidelines and up-to-date, relevant training should be provided to nurses.

19. Heydari A, Zeydi AE. Is gastric residual volume monitoring in critically ill patients receiving mechanical ventilation an evidence-based practice? *Indian J Crit Care Med.* 2014;18(4):259-260: <https://www.ijccm.org/doi/pdf/10.4103/0972-5229.130588>. Accessed 2019 Aug 14.