**Table 2.** Bundle Statements.

- Assess patients on admission to the intensive care unit (ICU) for nutrition risk, and calculate both energy and protein requirements to determine goals of nutrition therapy.
- Initiate enteral nutrition (EN) within 24–48 hours following the onset of critical illness and admission to the ICU, and increase to goals over the first week of ICU stay.
- Take steps as needed to reduce risk of aspiration or improve tolerance to gastric feeding (use prokinetic agent, continuous infusion, chlorhexidine mouthwash, elevate the head of bed, and divert level of feeding in the gastrointestinal tract).
- Implement enteral feeding protocols with institution-specific strategies to promote delivery of EN.
- Do not use gastric residual volumes as part of routine care to monitor ICU patients receiving EN.
- Start parenteral nutrition early when EN is not feasible or sufficient in high-risk or poorly nourished patients.

**intake is anticipated to be insufficient. High nutrition risk identifies those patients most likely to benefit from early EN therapy.**

*Rationale:* Poor outcomes have been associated with inflammation generated by critical illness that leads to deterioration of nutrition status and malnutrition.[9] However, malnutrition in the critically ill has always been difficult to define. An international consensus group modified definitions to recognize the impact of inflammation. Objective measures of baseline nutrition status have been described by A.S.P.E.N. and the Academy of Nutrition and Dietetics.[10,11] However, nutrition risk is easily defined and more readily determined by evaluation of baseline nutrition status and assessment of disease severity. All hospitalized patients are required to undergo an initial nutrition screen within 48 hours of admission. However, patients at higher nutrition risk in an ICU setting require a full nutrition assessment. Many screening and assessment tools are used to evaluate nutrition status, such as the Mini Nutritional Assessment, the Malnutrition Universal Screening Tool, the Short Nutritional Assessment Questionnaire, the Malnutrition Screening Tool, and the Subjective Global Assessment.[12] However, only the NRS 2002 and the NUTRIC score determine both nutrition status and disease severity. Although both scoring systems were based on retrospective analysis, they have been used to define nutrition risk in RCTs in critically ill patients.[13–16] Patients at "risk" are defined by an NRS 2002 >3 and those at "high risk" with a score ≥5 or a NUTRIC score ≥5 (if interleukin-6 is not included, otherwise >6).[13–18] Interleukin-6 is rarely available as a component for the NUTRIC score; therefore, Heyland et al have shown that a NUTRIC score ≥5 still indicates high nutrition risk.[19] Two prospective nonrandomized studies show that patients at high nutrition risk are more likely to benefit from early EN with improved outcome (reduced nosocomial infection, total complications, and mortality) than patients at low nutrition risk.[13,18] While widespread use and supportive evidence are somewhat lacking to date, improvement in these scoring systems may increase their applicability in the future by providing guidance as to the role of EN and PN in the ICU.

*Question:* What additional tools, components, or surrogate markers provide useful information when performing nutrition assessments in critically ill adult patients?

**A2. Based on expert consensus, we suggest that nutrition assessment include an evaluation of comorbid conditions, function of the gastrointestinal (GI) tract, and risk of aspiration. We suggest not using traditional nutrition indicators or surrogate markers, as they are not validated in critical care.**

*Rationale:* In the critical care setting, the traditional serum protein markers (albumin, prealbumin, transferrin, retinol-binding protein) are a reflection of the acute-phase response (increases in vascular permeability and reprioritization of hepatic protein synthesis) and do not accurately represent nutrition status in the ICU setting.[20] Anthropometrics are not reliable in assessment of nutrition status or adequacy of nutrition therapy.[21] Individual levels of calcitonin, C-reactive protein (CRP), interleukin-1, tumor necrosis factor (TNF), interleukin-6, and citrulline are still investigational and should not be used as surrogate markers. Ultrasound is emerging as a tool to expediently measure muscle mass and determine changes in muscle tissue at bedside in the ICU, given its ease of use and availability.[22,23] A computed tomography (CT) scan provides a precise quantification of skeletal muscle and adipose tissue depots; however, it is quite costly unless a scan taken for other purposes is used to determine body composition.[24,25] Both may be valuable future tools to incorporate into nutrition assessment; however, validation and reliability studies in ICU patients are still pending. Assessment of muscle function is still in its infancy. Its measurement, reproducibility, and applicability are still being validated for use in critically ill patients and may be of value in the future.

*Question:* What is the best method for determining energy needs in the critically ill adult patient?

**A3a. We suggest that indirect calorimetry (IC) be used to determine energy requirements, when available and**
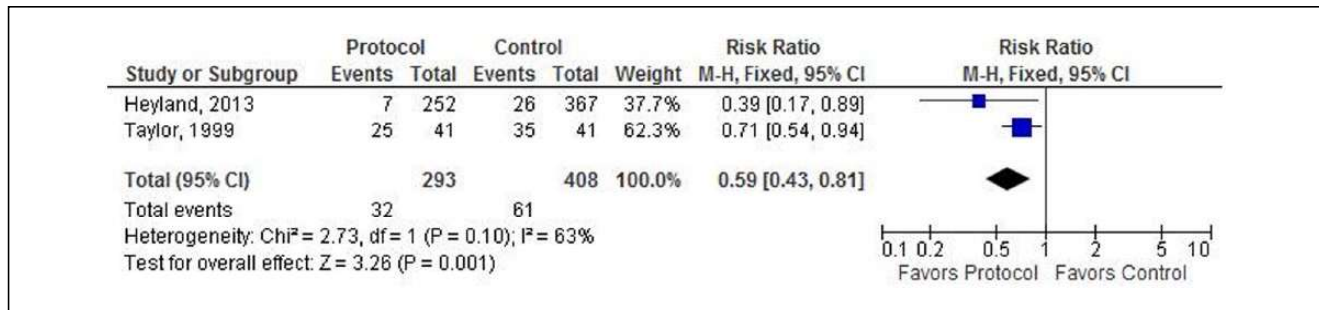
**Figure 6.** Feeding protocol vs control, infections.

GRVs does not protect the patient from these complications. Use of GRVs leads to increased enteral access device clogging, inappropriate cessation of EN, consumption of nursing time, and allocation of healthcare resources and may adversely affect outcome through reduced volume of EN delivered.[110]

Three studies have shown that eliminating the practice of using GRVs improves delivery of EN without jeopardizing patient safety.[110–112] All 3 trials—2 RCTs[110,112] and 1 prospective before/after implementation trial[111]—showed no significant difference between groups with regard to pneumonia. Two of the trials showed significantly greater EN delivery, by either increased volume of EN infused[111] or greater reduction in energy deficit.[112] One trial showed significantly more vomiting but significantly better overall GI tolerance when GRVs were eliminated,[112] while a second trial showed no difference in vomiting between groups.[111]

If the practice of GRVs is eliminated, a number of alternative strategies may be used to monitor critically ill patients receiving EN: careful daily physical examinations, review of abdominal radiologic films, and evaluation of clinical risk factors for aspiration. EN protocols should be initiated, and efforts to proactively reduce risk of aspiration pneumonia should be made (see sections D3 and D4). For those ICUs reluctant to stop using GRVs, care should be taken in their interpretation. GRVs in the range of 200–500 mL should raise concern and lead to the implementation of measures to reduce risk of aspiration, but automatic cessation of EN should not occur for GRVs <500 mL in the absence of other signs of intolerance.[80,102–104,109]

*Question:* Should EN feeding protocols be used in the adult ICU setting?

**D3a. We recommend that enteral feeding protocols be designed and implemented to increase the overall percentage of goal calories provided.**

**[Quality of Evidence: Moderate to High]**

**D3b. Based on expert consensus, we suggest that use of a volume-based feeding protocol or a top-down multistrategy protocol be considered.**

*Rationale:* Use of ICU- or nurse-driven protocols that define goal EN infusion rate, designate more rapid start-ups, and provide specific orders for handling GRVs, frequency of flushes, and conditions or problems under which EN may be adjusted or stopped has been shown to be successful in increasing the overall percentage of goal energy provided.[80,113–117] In addition, volume-based feeding protocols in which 24-hour or daily volumes are targeted instead of hourly rates have been shown to increase volume of nutrition delivered.[116] These protocols empower nurses to increase feeding rates to make up for volume lost while EN is held. Top-down protocols use multiple different strategies simultaneously at the time of initiation of EN to enhance tolerance and increase delivery of EN, removing individual strategies as tolerance improves over the first few days of infusion. Top-down multistrategy protocols typically use volume-based feeding in conjunction with prokinetic agents and postpyloric tube placement initially (among other strategies), with prokinetic agents stopped in patients who demonstrate lack of need.[116]

By aggregating the data from 2 studies that met our inclusion criteria (Figure 6), use of nurse-driven EN protocols to increase EN delivery positively impacted patient outcome by reducing the incidence of nosocomial infections as compared with controls where no protocol was used (RR = 0.59; 95% CI, 0.43–0.81; *P* = .001).[80,116]

*Question:* How can risk of aspiration be assessed in critically ill adults patients receiving EN, and what measures may be taken to reduce the likelihood of aspiration pneumonia?

**D4. Based on expert consensus, we suggest that patients receiving EN should be assessed for risk of aspiration and that steps to reduce risk of aspiration and aspiration pneumonia should be proactively employed.**

*Rationale:* Aspiration is one of the most feared complications of EN. Patients at increased risk for aspiration may be identified by a number of factors, including inability to protect the