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ORIGINAL COMMUNICATION

Barriers to nutrition therapy in the critically ill patient with COVID-19

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Abstract

Background: Coronavirus disease 2019 (COVID-19) has created challenges for intensivists, as high ventilatory demands and prolonged hypermetabolism make it difficult to sustain nutrition status. The purpose of this survey was to determine current practices in nutrition therapy and identify barriers to its delivery.

Methods: A survey about delivering nutrition therapy to critically ill patients with COVID-19 was sent to clinicians at academic and community hospitals from September to December 2020.

Results: Of 440 who viewed the survey, 199 (45%) completed the questionnaire. Respondents were composed of 30%, physicians and 70% registered dietitians, with 51% representing community programs, 43% academic institutions, and 6% Veterans Affairs centers. Half (49%) had protocols for managing critically ill patients with COVID-19, and 21% had a protocol for nutrition therapy. Although most respondents (83%) attempted to feed by the intragastric route, only 9% indicated that energy/protein needs were met. The biggest barriers to delivery of enteral nutrition (EN) involved the patients unpredictable clinical course and fear of aspiration given the lack of respiratory reserve. Intensivists were reluctant to add supplemental parenteral nutrition (PN) because of perceived lack of benefit.

Conclusion: The survey results would suggest that strategies for nutrition therapy based on the intragastric infusion of EN are unsuccessful in meeting the energy/protein needs of critically ill patients with COVID-19. It is likely these barriers exist in providing nutrition to non-Covid-19 critically ill patients. Intensivists need protocols that optimally deliver intragastric EN, consider early postpyloric infusion, and address adding supplemental PN in a deteriorating nutrition status.

KEYWORDS
barriers, COVID-19, enteral nutrition, nutrition therapy, parenteral nutrition, SARS-CoV-2 viral infection, tube feeding

CLINICAL RELEVANCY STATEMENT

This article highlights clear barriers to providing adequate nutrition therapy to critically ill patients infected with the SARS-CoV-2 virus and indicates a continued need to address shortcomings in nutrition that may be affecting long-term outcomes during this pandemic.

The findings presented in this article will encourage the development of much needed meaningful protocols for prescribing nutrition therapy in critically ill patients with and without coronavirus disease 2019. Such recommendations may lead to improved outcomes and an opportunity to redefine the role of supplemental parenteral nutrition in critical illness.

INTRODUCTION

The emergence of the SARS-CoV-2 virus and subsequent global pandemic of coronavirus disease 2019 (COVID-19) has imposed considerable challenges for patient care and strained healthcare systems worldwide. The disease primarily affects the respiratory system to variable degrees and can lead to catastrophic clinical deterioration often requiring intensive care and mechanical ventilation to support the patient through an overwhelming inflammatory cascade.[1] Unlike other acute respiratory viral illnesses, those with severe or critical COVID-19 often experience extended stays in the intensive care unit (ICU), prolonged mechanical ventilation and may need extracorporeal oxygenation strategies, which may result in an increased risk of morbidity and mortality.[2,3] Given the significant complications associated with COVID-19, there has been a focus on better understanding and protocolizing the management of these critically ill patients. However, little attention has been paid to nutrition therapy as part of this holistic supportive care. Guidelines developed by the Society of Critical Care Medicine (SCCM) in 2020,[4] in response to the pandemic, failed to adequately address the complex needs of patients and the hesitancy on the part of clinicians surrounding nutrition therapy in this population, necessitating a need to revise the paradigm. We, therefore, designed a survey to better understand the barriers incurred by these healthcare providers and to provide insights into a more effective approach to nutrition therapy in critically ill patients with COVID-19.

METHODS

Study design

This is an observational, survey-based study approved by the Institutional Review Board at the University of Louisville School of Medicine. Over a 4-month period, from September to December 2020, a survey was sent to participants across the US. The survey was sent out via three separate resources: direct email link, social media website (Facebook), and the monthly newsletter to members of the American Society for Parenteral and Enteral Nutrition (ASPEN).

Suvey engagement

The survey link was posted on a Facebook page and in the monthly ASPEN newsletter. A total of 330 people engaged the link (ie, read the survey), with 174 participating (a response rate of ~53%). We also sent the survey link directly, via email, to 110 people, of which 25 reponded (a reponse rate of ~23%).

Setting and participants

Intended recipients of the survey included registered dietitians (RDs), nurses, and intensive care physicians. Although not directly a target, pharmacist members of ASPEN would have had the opportunity to respond via the link in the newsletter. All data responses regarding meeting nutrition goals were self-reported, and all data responses were anonymous and collected through the secure Research Electronic Data Capture database at the University of Louisville School of Medicine.

Variables

The survey was composed of 39 questions grouped into seven sections: Demographics (questions 1–8), ICU proning and treatment schedule (question 9–14), volitional oral diet (questions 15–17), enteral tube feeding (questions 18–24), parenteral nutrition (PN) (questions 25–28), additional ICU data (questions 29–32), and design of a nutrition regimen (questions 33–39) (Table 1). For each variable, participants were asked to choose from a range of responses provided. All questions had to be answered for the survey to be considered complete. More than half the questions allowed for further free-text elaboration, and the final question allowed for free-text comments.

Data sources measurement

The purpose of the survey was to ask participants specific questions regarding the nutrition support practices offered to patients with severe SARS-CoV-2 infection being treated in their ICU. In addition to demographic data, participants were asked about the use of enteral nutrition (EN) and PN, design of a COVID-19–specific nutrition regimen, and barriers to delivering adequate nutrition to these patients who were often undergoing treatment for acute respiratory distress syndrome (ARDS) with severe hypoxia.

Statistical analyses

Only descriptive analysis of the results were performed. In areas in which comparisions are made, large numerical differences are reported.

RESULTS

Participants

Of the 440 individuals who viewed the survey link, 199 completed the survey in its entirety (45% response rate). Of the 199

FIGURE 1 Existence of specific therapeutic protocols for treating patients with COVID-19. COVID-19, coronavirus disease 2019

respondents, 30% (60/199) were physicians and 70%, (140/199) were RD's. Twenty-five percent, (50/199) of the respondents were <5 years out of training, whereas 52%, (104/199) were >10 years out of training. The majority of responses came from community programs (51%, 102/199), whereas 43%, (86/199) originated from academic institutions and 6%, (12/199) from Veterans Affairs Medical Centers or other types of healthcare organizations. Most of the physician responses were from pulmonary critical care specialists (82%, 164/199), whereas 38%, (76/199) specified trauma, emergency medicine, or anesthesia as their primary speciality. We did not ask about the type of ICU participants work in or if the RDs had a particular area of clinical interst.

Descriptive data

Forty-six (91/199) percent of respondents reported that the average daily census of patients with COVID-19 in the ICU exceeded 20 cases at the peak of the pandemic (as determined by each individual institution). However, at the time of receipt of the survey, the average daily census of COVID-19 patients in the ICU had dropped, such that only 20% (40/199) of respondents still had >20 cases and 42% (84/199) had between 5 and 20 cases. Approximately half 49%, (98/199) of the respondents indicated that a policy was in place for managing the patient with severe COVID-19 at their institution (Figure 1). Academic centers reported having a policy for managing COVID-19 patients at a higher rate than did nonacademic centers (62% vs 37%, respectively). Twenty-one percent (42/199) indicated that a specific policy for nutrition therapy for the critically ill patients with COVID-19 was in place at their institution (Figure 1), a finding no different between academic and community medical centers.

Responses related to familiarity with nutrition support practices in critical care

In an effort to determine preexisting expertise in nutrition support of the critically ill patient, practitioners were asked about their confidence or comfort level in prescribing the nutrition regimen for such patients. Seventy-one percent, (142/199) felt capable and were comfortable prescribing nutrition therapy to critically ill patients vs 29% (58/199) who indicated some reluctance (Figure 2). Additionally, 72% (144/199) of respondents expressed familiarity with ASPEN/SCCM guidelines for critical care nutrition and the use of EN and PN. Fewer intensive care physicians were confident in designing the regimen for nutrition support of their critically ill patients compared with the dietitians (54% vs 74%, respectively) (Figure 2).

Responses related to volitional oral diet

Respondents were asked which concerns or conditions resulted in ICU patients with SARS-CoV-2 infection being kept with no oral or enteral feeding for a prolonged duration. The most common reason (67%, 134/299,) for withholding nutrition therapy was fear of bowel ischemia and the need for one or more vasopressor agents. Further concern for potential ischemia (as evidenced by rising lactate levels or mean arterial pressure <60 mm Hg) and potential risk of aspiration because of gastrointestinal symptoms (nausea, vomiting, bloating, and abdominal distention) were common reasons for keeping patients orally restricted as well (Figure 3). Other reasons for withholding nutrition therapy included the use of neuromuscular blockade agents, planned invasive procedures, abdominal sepsis, or high gastric residual volumes of >300 ml. When asked how long patients were allowed to be kept orally restricted prior to the placement of a nasogastric tube, 23% (46/199) responded that nutrition therapy was never withheld for > 2 days, whereas 45% (90/199) indicated that patients were allowed to remain without oral intake for ≥ 5–7 days.

Responses related to prone positioning

Prone positioning was performed in awake and sedated patients on mechanical ventilation at both academic and community medical centers. Sixty percent, (120/199) of respondents indicated that prone positioning was used in >60% (120/199) of their patients, whereas 22% (44/199) reported that use of proning was limited to <5% (9/199) of their patients. Awake voluntary proning was ordered "as tolerated by the patient" in 42% (84/199) of responses.

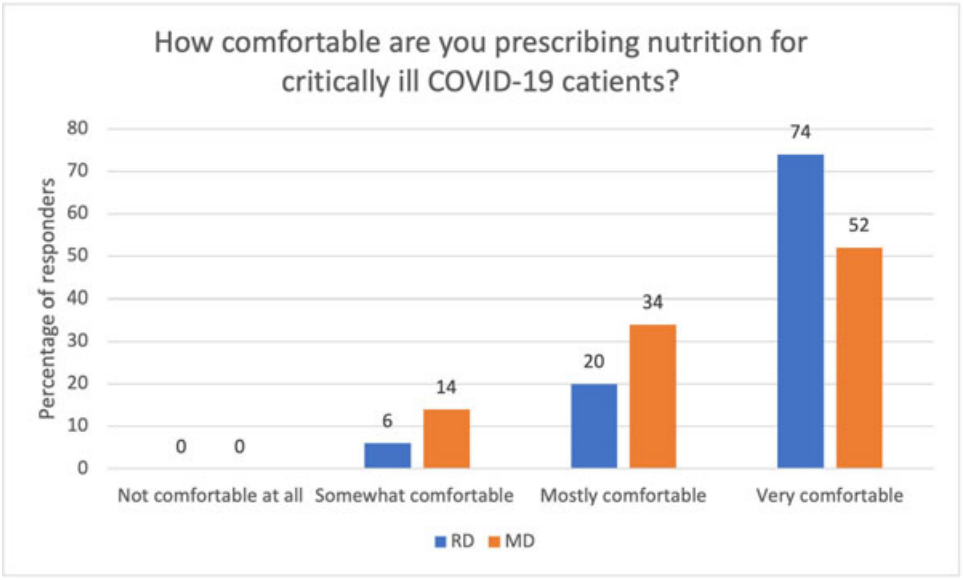

FIGURE 2 Comfort level with prescribing nutrition therapy for critically ill patients. MD, doctor of Medicne; RD, registered dietitian

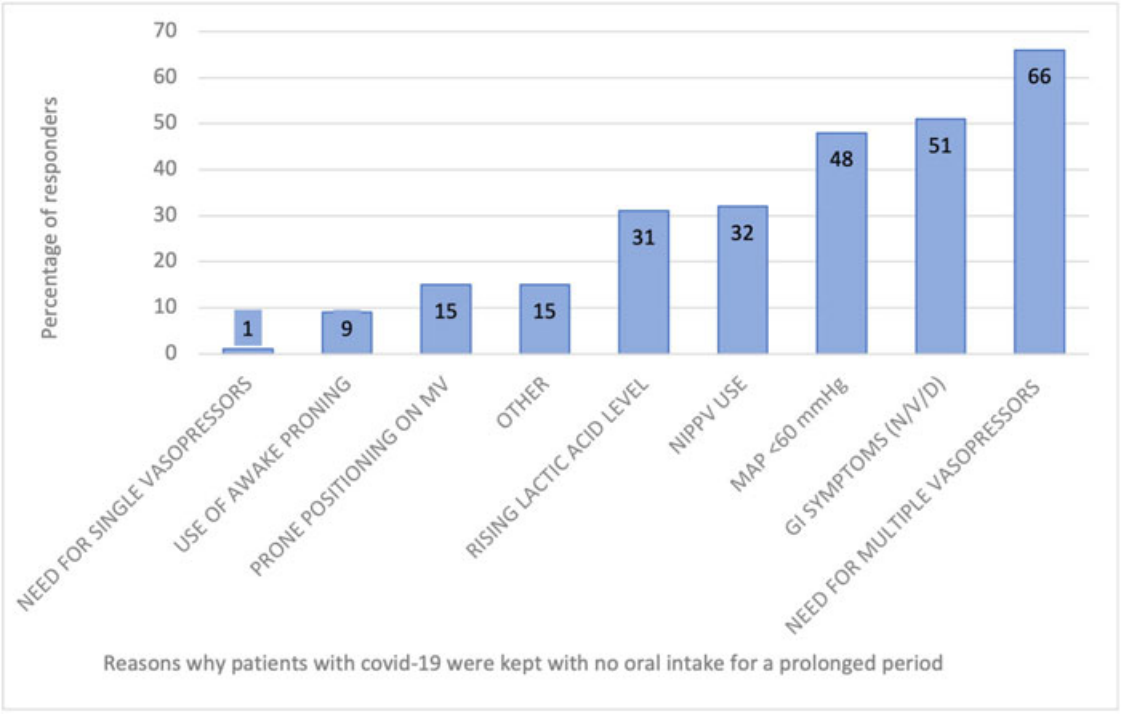

FIGURE 3 Reasons why patients with COVID-19 are kept on prolonged NPO status. COVID-19, coronavirus disease 2019; D, diarrhea; GI, gastrointestinal; MV, mechanical ventilation; N, nausea; NIPPV, noninvasive positive pressure ventilation; NPO, no oral diet; V, vomiting

Only 18% (36/199), however, indicated that patients were able to tolerate >12h of awake proning per day. Those patients on mechanical ventilation tolerated longer periods of prone positioning, with a duration of >13–18 h reported in 65% (130/199) of responses. Of note, 55% (110/199) of respondents documented that more than half of their patients failed awake prone positioning and ultimately required intubation with placement on mechanical ventilation.

When asked about efforts to maintain oral diet or provide EN via a feeding tube during awake voluntary proning, 18% (36/199) of respondents indicated that patients were placed on a regular diet "as tolerated" with solid food. Another 58% (116/199) reported that patients were placed on a regular diet with oral supplements, but the intake or tolerance by these patients was not clear. The remaining 24% (48/199) of respondents provided patients with tube feeding only, oral supplements only, clear liquids, or just kept patients orally restricted.

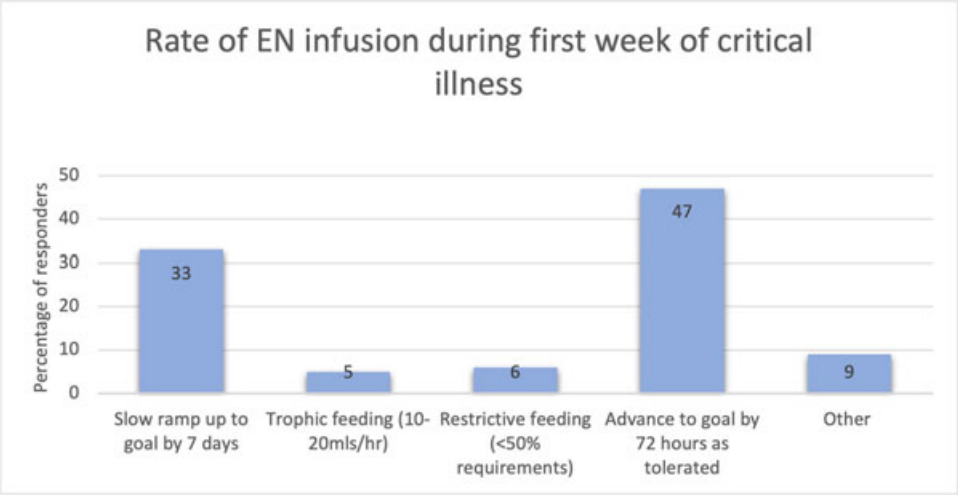

FIGURE 4 Rate of infusion of enteral nutrition during the first week of critical illness

Responses related to provision of nutrition therapy via an enteral access device

Eighty-three percent, (166/199) of respondents indicated that EN was infused initially into the stomach, with 30%, (60/199) switching to postpyloric if intolerant to gastric feeds. Initial postpyloric placement was utilized by only 11%, (22/199). The most common type of enteral access device placed by 58%, (116/199) of respondents was a smaller-gauge nasogastric tube, followed by a large-bore plastic sump tube in 17%, (34/199) and to a lesser extent, either an electromagnetic (Cortrak) or optic vision-guided (Kangaroo with IRIS technology) feeding tube in 11% (22/199) and 2%, (4/199), respectively. For patients infected with SARS-CoV-2, placement of feeding tubes was performed most often by nurses (as indicated by 49%, 98/199 of respondents). Others responsible for tube placement included intensivists in 15%, (30/199) dietitians in 4%,(8/199) or another healthcare provider, as suggested by the remaining 31%, (62/199) of respondents. The situation was no different for patients without COVID-19 because as nurses, similarly, were the most likely members of the healthcare team to place feeding tubes, as indicated by 47%, (94/199) of respondents.

The regimen for delivery of EN during the first week of illness prescribed advancement to goal by 72 h in less than half (47%, 94/199) of respondents. The remainder of the respondents indicated more cautious feeding, slowing the ramp up to goal out to 7 days, restricting feeds to <50%, or providing only trophic feeding over the first week (Figure 4). The most commonly prescribed formulas used to initiate EN was a high-protein hypocaloric formula in 39%, (78/199) or a standard isosmotic polymeric formula in 34%, (68/199). Probiotics were used infrequently by only 16% , (64/199) of respondents. During the second week of critical illness from COVID-19, 91%, (182/199) indicated that patients were advanced to full-goal therapy as tolerated.

When asked how energy requirements were determined, 66%, (132/199) of respondents indicated that they used a simple weight-based equation, whereas 34%, (68/199) used a published predictive equation. Not one respondent indicated that indirect calorimetry was utilized to measure energy requirements on patients being kept in a COVID-19–dedicated ICU. Similarly, protein requirements were calculated using a simple weight-based equation by 93%, (186/199) of respondents. During the first week of critical illness, most respondents (83%) set the goal for nutrition therapy at 70–80% of energy requirements, whereas only 11%, (22/199) sought to provide 100% of energy requirements. Over the same time period (the first week of critical illness), 66% (136/199) of respondents prescribed 100% of protein requirements, whereas 31%, (62/199) set lower protein goals at 70–80% of estimated requirements. By the second week of hospitalization in the ICU, there was a shift in responses to more closely meet both energy and protein requirements (90%,180/199, prescribing full energy requirements and 74%, 148/199full protein requirements).

Only 9%, (18/199) of respondents reported that their patients received full nutrition therapy (81–100% of prescribed), meeting both energy and protein requirements. In contrast, 63%, (126/199) indicated that their patients received <60% of their energy/protein goals throughout their ICU stay.

Responses related to PN

Twenty-three percent, (46/199) of these practitioners responded that they believed the benefit, or value, of PN was equal to EN. Twenty percent (40/199) reported concern that PN might be associated with worse outcomes and a higher infection risk compared with EN, and another 20%, (40/199) associated PN with worse control of serum triglycerides and hyperglycemia. Twelve percent (24/199) of respondents indicated that PN was not a high enough priority in which a central-line access could be dedicated. A frequent comment was that physicians hesitated to initiate PN in critically ill patients because of perceived lack of benefit seen in the current literature. Academic centers were more likely to delay initiating PN compared with nonacademic centers. Respondents from community medical centers were twice as likely to prescribe additional micronutrients, such as vitamin

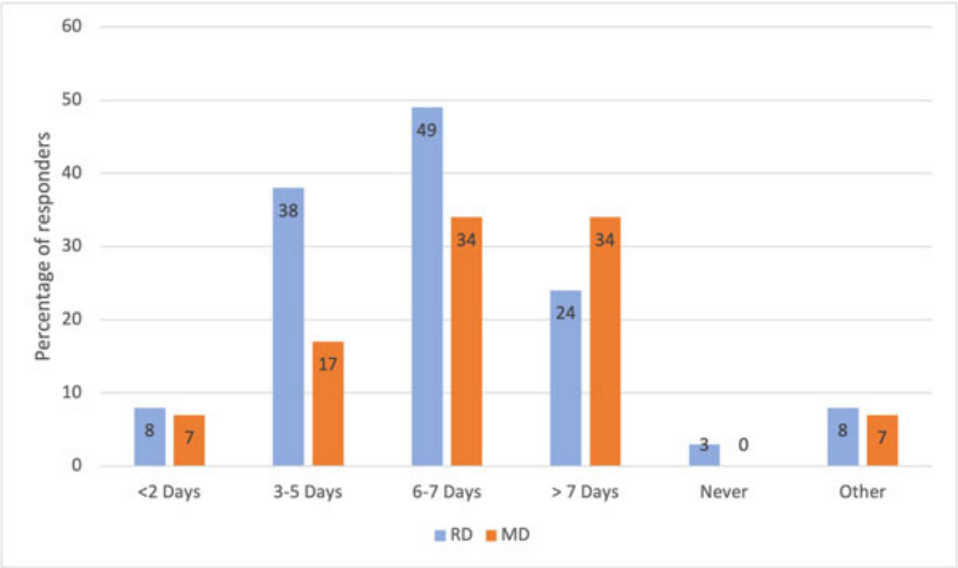

FIGURE 5 Duration of time after ICU admission that exclusive PN would be initiated. MD, Doctor of Medicine; PN, parenteral nutrition; RD, registered dietitian

C (57%, 114/199 vs 27%, 54/199), vitamin D (60%, 120/199 vs 25%, 50/199), and zinc (61%, 122/199 vs 27%, 54/199), and provide probiotics (22%, 44/199 vs 10%, 20/199), respectively, than those from academic centers.

The addition of supplemental PN in patients already receiving insufficient EN was typically done after 1 whole week after admission to the ICU by 57%, (114/199) of respondents, with 17%, (34/199) waiting >2 weeks. In 24%, (48/199) of responses, supplemental PN was started only if there was evidence of malnutrition, weight loss, or high degree of disease severity. Seventeen percent, (34/199) of respondents indicated that they would not use supplemental PN under any circumstances in patients who were already receiving EN.

For those patients for whom EN was not feasible, most respondents (65%, 130/199) indicated they would start exclusive PN within the first 7 days following admission to the ICU, whereas 25%, (50/199) would delay initiation until after the first week (Figure 5). The reason to initiate exclusive PN for those patients in which EN was not feasible was based on the duration of time patients were kept without oral intake with the inability to start any EN (95%, 190/199), followed by clear evidence of malnutrition (66%, 132/199) or documented weight loss (34%, 68/199).

Responses related to barriers in the delivery of nutrition therapy

Respondents identified a number of significant barriers to the provision of adequate nutrition therapy in critically ill COVID-19 patients (Figure 6). Unpredictability of the patient's clinical course was seen as the most common obstacle to providing good nutrition, reported by 75%, (150/199) of respondents, in which patients who seemed to be stable receiving some nutrition support suddenly underwent an abrupt and profound deterioration, leading to excessive energy and protein deficits. Reluctance to perform additional procedures for enteral access (24%, 48/199) , ventilatory demands (30%, 60/199), and concern about harmful effects of PN (23%, 46/199) ultimately contributed to difficulty delivering adequate energy for more than half (53%, 106/199) of respondents.

Use of noninvasive positive pressure ventilation (NIPPV), including high-flow oxygen, was a clear deterrent to the provision of nutrition therapy. Thirty-nine percent, (78/199) of respondents indicated that patients were simply kept without oral intake. Attempts to infuse EN into the stomach were made in 23%, (46/199) postpyloric in 17%, (34/199). Only 5%, (10/199) of respondents indicated that patients were automatically switched to PN.

DISCUSSION

The COVID-19 pandemic has now been present in the US for >20 months, affecting >45 million Americans and >736,000 deaths. Those who have experienced severe disease with critical illness are having increasingly prolonged hospital and ICU admissions, often requiring mechanical ventilation, heavy sedation, and the use of neuromuscular blockers. Those surviving often need significant rehabilitation because of profound weakness and loss of muscle mass. Increasing data are emerging, highlighting the prevalence of inadequate nutrition therapy and malnutrition, which is likely contributing to these long-lasting effects.[5,6] Gaining a more comprehensive understanding of the challenges surrounding nutrition therapy in critically ill COVID-19 patients remains crucial to providing adequate care and ensuring the best possible recovery from a prolonged and often complicated ICU stay.

Results of this survey indicate that traditional nutrition therapy, derived from ASPEN/SCCM guidelines[7] and based on intragastric

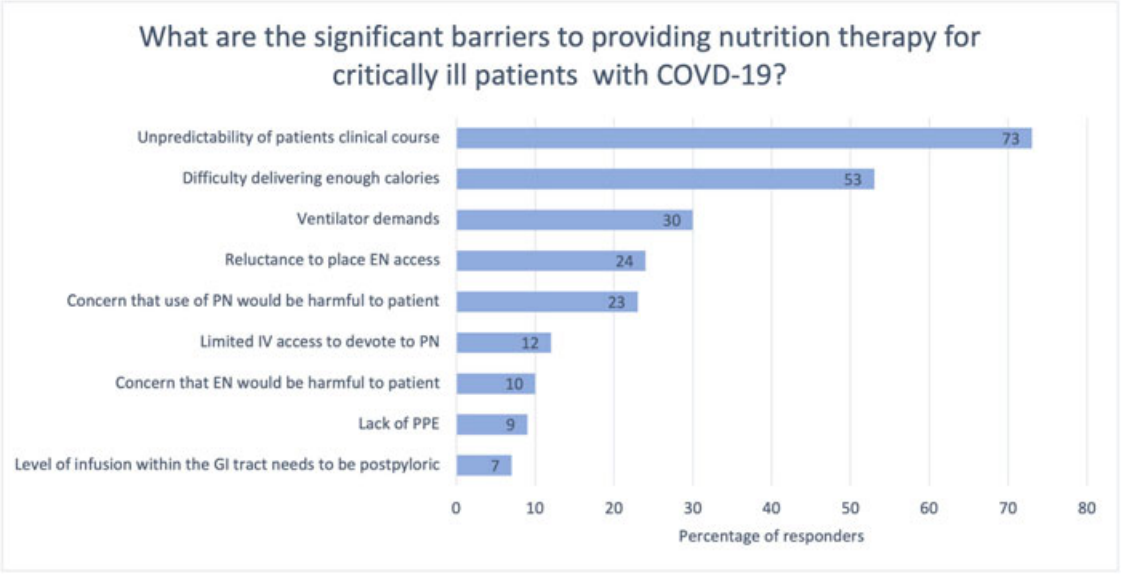

FIGURE 6 Barriers to providing nutrition therapy for critically ill patients with coronavirus disease 2019. EN, enteral nutrition; GI, gastrointestinal; PPE, XXX; PN, parenteral nutrition

infusion of EN, has been largely unsuccessful in meeting the energy/protein needs of patients with COVID-19. Although the data from the survey are self-reported, only 9% of respondents reported that full needs were met, with 63% indicating that patients received <60% of goal feeds. In the face of intolerance to gastric EN, only 30% responded that a postpyloric tube would be placed. A posthoc analysis of 15,918 ICU patients from the International Nutrition Survey found 24% of the patients had at least one episode of EN intolerance. In these patients, those fed with gastric EN were more likely to develop intolerance (odds ratio 1.45; 95% CI, 1.27–1.66). Regardless of feed tolerance, patients received an approximate average of 51% (intolerant) and 58% (tolerant) of both prescribed energy and protein.[8] This suggests both patients with and without COVID-19 are likely to be underfed in the ICU. There was reluctance to utilize any PN over the first week of hospitalization in the ICU, regardless of circumstances or nutrition risk. Only after 7 days would 57% of respondents add supplemental PN to insufficient EN, and if EN was not feasible at all, only 65% would start exclusive PN. With increased use of awake proning to avoid intubation and mechanical ventilation, 76% of respondents expected patients to tolerate oral diet with or without supplements despite loss of taste and smell, poor appetite, and aerophagia from high-flow oxygen therapy. There was a disconnect between recommendations by dietitians who were knowledgeable with societal guidelines and comfortable with designing the nutrition regimen for COVID-19 patients and the leadership of the ICU by intensivists who were less confident in their nutrition expertise and often worked in ICU's that had no formal protocol for nutrition therapy. Failure to use EN more aggressively was attributed to fear of bowel ischemia or aspiration in patients who were hypercoagulable, required vasopressor therapy, and had no respiratory reserve. Failure to use PN more readily was attributed to concerns for worse outcomes, greater hyperglycemia/hypertriglyceridemia,[9] and perceived lack of benefit, as extrapolated from previous studies in the literature in non–COVID-19 ICU patients.[10–12] A recently published systematic review and meta-analysis by Hill et al looked at 12 trials with 5543 patients comparing the effects of EN alone vs EN with PN in the acute phase of critical illness. Although patients receiving EN with PN did receive a greater percentage of macronutrients, there was no statistically significant differences in terms of mortality, hospital length of stay (LOS), ICU LOS, and ventilation days. Of the four trials looking at physical outcomes, two demonstrated a trend toward improvement.[13]

One of the most notable comments from the survey was the unpredictability of the clinical course in those infected with SARS-CoV-2. This has remained a significant issue throughout the pandemic despite some advances in therapeutic interventions and is likely the principal barrier to providing adequate nutrition to these patients. This uncertainty has led to an unstructured atmosphere in the ICU with no standardized protocol for providing nutrition therapy. Furthermore, the unpredictability and everchanging landscape in caring for COVID-19 patients results in nutrition therapy being an afterthought, and often leads to prolonged periods of starvation, weight loss, and increases in the risk of refeeding syndrome.[14]

The significant degree of hypoxia experienced by these patients is a unique characteristic of the infection, often termed "happy hypoxia" and is a major barrier to volitional oral diet and EN based on several comments from our survey. Over the course of the pandemic, the therapeutic approach to this hypoxia has evolved. Initially, physicians were quick to rely on mechanical ventilation as the sole intervention, whereas now the majority of intensivists try to use alternative therapies where possible, such as NIPPV and high-flow oxygen, to avoid mechanical ventilation.[15,16] As a result, patients are often left on NIPPV or high-flow oxygen per nasal cannula for extended periods of time because of significant oxygen demands. With such little respiratory reserve, the idea of initiating nutrition therapy becomes an

added burden of concern for physicians. Based on the results of our survey, many of these intensivists feel that the initiation of nutrition therapy is associated with its own unique set of risks and so is often intentionally withheld. Clinicians are adopting a "hope for the best, plan for the worst" mentality, which may be restricting full delivery of the nutrition support regimen and contributing to worsening complications. Among those perceived risks appears to be significant concern for aspiration pneumonia, which would be considered catastrophic in patients with such severe hypoxia. Therefore, nutrition is withheld in the hopes of avoiding mechanical ventilation and poorer outcomes. Several comments from our survey indicate that the risk of aspiration was also a reason to restrict both volitional oral intake and EN via an enteral access device, despite most studies showing reduced risk of aspiration pneumonia with enteral feeding[17] in non–COVID-19 critically ill patients.[18]

Infection with SARS-CoV-2 appears to cause a unique disease process, leading to severe ARDS in many patients, who then require placement in the ICU. Early in the pandemic, it was thought that placement on mechanical ventilation led to poorer outcomes and increased risk of death, and so practices such as awake proning were adopted to avoid intubation.[19] This again led to an increase in reluctance to feed patients because of aspiration concerns. Our survey revealed that up to 44% of responders adopted an "as tolerated" approach to feeding when it came to awake proning. Such practice highlights the lack of clear societal guidelines and results in periods of up to 7–10 days without adequate nutrition.[20] Furthermore, a frequent lack of proning beds occurred because of the sheer number of critically ill patients. In their place, most ICU teams adopt a manual proning policy with standard beds, which often leads to facial edema, neck torticollis, inadvertent dislodgement of endotracheal tubes and other lines, and an increase in oral secretions, as commented on by several responders in our survey. In a small trial of 33 prone patients with COVID-19, the most common complication was facial edema (26 of 33 of patients), with only two patients inadvertently removing their nasogastric tube. EN was generally well tolerated, except in two patients requiring increased maneuvers, which resulted in vomiting and withholding of EN.[21] In a systematic review of feeding intolerance of non–COVID-19 prone patients in six studies, the need to stop EN and vomiting episodes were primarily higher in only one study.[22] These additional problems continue to push nutrition therapy down the list of priorities when approaching critically ill patients with COVID-19.

The profound cytokine storm caused by the virus results in severe insulin resistance. This development, combined with the introduction of glucocorticoids as the mainstay of therapy later in the pandemic, has led to clinically noticeable unpredictability surrounding glycemic control, which was reported to be a significant concern for ICU providers in the survey. This appears to influence the ICU providers, having direct consequences on the initiation and continuation of nutrition therapy, as well as the route and volume of delivery, again highlighting the unstructured approach to nutrition support in critically ill patients with COVID-19.

A surprising finding was reluctance on the part of physicians to initiate PN in critically ill patients. This indicated a significant misconception or personal bias about the risks associated with use of PN.[7,11,23] According to the survey, respondents often felt that prolonged trophic enteral feeding was adequate, despite evidence for ongoing deterioration of nutrition status in these COVID-19 patients with prolonged hypermetabolism.[24] Other reasons for such hesitancy included the lack of dedicated intravenous access and, in particular, a fear that placing a patient in Trendelenburg position to place a dedicated central line would cause aspiration or worsening hypoxia. Interestingly, there was a higher likelihood of withholding PN in academic centers compared with community hospitals, despite a push from dietitians to be more aggressive. Such responses from the survey show a fundamental lack in adopting recent guidelines surrounding the safety of PN and demonstrate a need for the ASPEN guidelines to create a new paradigm for PN to truly address these concerns.

An overarching message from the findings of this survey, and the literature, is that gastric feeding alone is not enough. Prolonged attempts at gastric feeding may lead to dramatic underfeeding and a decline of nutrition status. As a result, each institution should perform a self-evaluation of its ICU practices and determine its access to nutrition expertise. If gastric feeding is not sufficient early, it may be more fruitful to transition to smallbowel feeding sooner or add in supplemental PN to ensure adequate nutrition support and work around the concerns of providers.[25]

As with any study, limitations exist. Clearly, the questionnaire is not a validated survey instrument, but it does allow us to gauge some common clinical practices associated with providing nutrition therapy in critically ill patients with COVID-19 across various healthcare organizations throughout the US. Although we had a good response rate (45%), the data were gathered more from dietitians than physicians. This relatively low response rate from physicians may indicate that the answers were not reflective of the entire physician population or the general practice among this group. In addition, the survey requested an opinion of the practitioner, as opposed to defined measurements of nutrition therapy received or complications experienced by the patient. Lastly, participants were selected from groups whose members likely have a higher interest in critical care nutrition, such as ASPEN members. As such, they may be more likely to follow published guidelines compared with general ICU providers, and so again, responses may not accurately reflect common ICU practices. In contrast, this could highlight an underrepresentation of the extent of the knowledge gap in critical care nutrition.

Lastly, we have not made any recommendations based on these findings. This survey has highlighted some real gaps in the approach to nutrition therapy in critically ill patients with COVID-19. We suggest a more methodical approach to nutrition support in this patient population and revision of earlier recommendations that were made at the start of the pandemic. There is an obvious need to provide physicians with a clear and meaningful set of recommendations for prescribing nutrition therapy in critically ill COVD-19 patients. Such guidelines would allay any apprehension surrounding complications related to providing adequate nutrition therapy and may lead to improved outcomes in patients after a prolonged hospitalization. The unfortunate arrival of the COVID-19 pandemic raises new challenges

for nutrition therapy and has shown a need to reacquire skills for the sufficient delivery of EN, as well as an opportunity to redefine the role of supplemental PN in critical illness both during the pandemic and in the post pandemic era.

CONFLICT OF INTEREST

None declared.

FUNDING INFORMATION

None declared.

AUTHOR CONTRIBUTIONS

Sally Suliman, Stephen A. McClave, Beth E. Taylor, Jayshil Patel, Endashaw Omer, and Robert G. Martindale equally contributed to the conception and design of the research. All authors drafted the manuscript, critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

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APPENDIX

SURVEY QUESTIONS

Demographics

1. What is your discipline?
☐ MD ☐ RD ☐ RN ☐ PA ☐ NP ☐ Other

1. Describe your institution/hospital.

☐ Academic ☐ Community ☐ Veterans Affairs Med Center ☐ Other

1. What is your time out from training?

☐ ≤ 5 yrs ☐ 6-10 yrs ☐ > 10 yrs

1. What is your specialty or the specialty of your lead ICU attending (check all that apply)?
☐ Medicine/Critical Care ☐ Trauma/Critical Care
☐ Anesthesia/Critical Care ☐ Emergency Medicine/Critical Care

☐ Other

1. How comfortable are you prescribing nutrition therapy for critically ill patients?

☐ Not comfortable at all ☐ Somewhat comfortable
☐ Mostly comfortable ☐ Very comfortable

1. How familiar are you with guidelines for critical care nutrition and the use of enteral and parenteral nutrition?

☐ Not familiar at all ☐ Somewhat familiar ☐ Mostly familiar ☐ Very familiar

1. Do you have an institutional policy for managing the patient with COVID-19 disease?
☐ Yes ☐ No

1. Do you have a specific policy for nutrition therapy for the patient with COVID-19 disease?
☐ Yes ☐ No

Proning Schedule (provide your best estimate for the questions below)

1. What would you estimate to be the average daily census in your ICUs dedicated to COVID-19 patients (include dedicated wards with awake proning patients) since the pandemic began in early April 2020?
☐ < 2 ☐ 3-5 ☐ 5-10 ☐ 11-15 ☐ 16-20 ☐ >20

1. What would you estimate to be the average daily census in your ICUs dedicated to COVID-19 patients (include dedicated wards with awake proning patients) during the **peak** of the pandemic?
☐ < 2 ☐ 3-5 ☐ 5-10 ☐ 11-15 ☐ 16-20 ☐ >20

1. What percent of COVID-19 disease patients are placed in a prone position for management of hypoxemia?
☐ 100% ☐ 80% ☐ 60% ☐ <50%
☐ Other

1. How many consecutive hours per day does a patient maintain awake voluntary prone positioning?
☐ 4-6 hrs ☐ 6-12 hrs ☐ 12-18 hrs ☐ >18 hrs ☐ As tolerated
☐ Other

1. What percent of patients in your COVID-19 ICU fail awake proning with high flow NC and are placed on mechanical ventilation?
☐ 50-80% ☐ 30-50% ☐ 10-30% ☐ <10% ☐Other

1. In the patient on mechanical ventilation, how long is the proning interval?
☐ 4-6 hrs ☐ 6-12 hrs ☐ 12-18 hrs ☐ >18 hrs ☐ As tolerated
☐ Other

Volitional PO Diet

1. When are ICU patients with SARS-CoV-2 infection kept NPO with no oral or enteral feeding (check all that apply)?
☐ Need for single vasopressor Rx ☐ Need for multiple vasopressors
☐ Use of awake prone positioning ☐ Rising lactate level
☐ MAP < 60 mmHg ☐ Gastrointestinal symptoms (N/V, diarrhea)
☐ NIPPV
☐ Prone positioning
☐ Other

(Continues)

1. How long is an ICU COVID-19 patient allowed to be NPO or continue with insufficient volitional intake before a nasogastric tube is inserted preventilation?

☐ ≤ 2 days ☐ 2-4 days ☐ 5-7 days ☐ > 7 days

1. What enteral diet do you provide during awake prone positioning?
☐ None ☐ Regular diet as tolerated (solid food)
☐ Oral supplements
☐ Regular diet and oral supplements
☐ Clear liquids only
☐ Tube feeding only

Enteral Tube Feeding

1. How is the rate of EN infusion prescribed during the first week of critical illness?

☐ Slow ramp-up to goal by 7 days ☐ Trophic feeding (10-20 mL/hr)☐ Restrictive feeding (hypocaloric permissive underfeeding < 50% of requirements)☐ Advance to goal by 72 hours as tolerated☐ Other

1. How is the rate of EN infusion changed beginning the second week of ICU stay?
☐ Continued Trophic feeding
☐ Restrictive feeding (hypocaloric < 50% of requirements)
☐ Advance to goal as tolerated
☐ Other

1. Do you use probiotics in your critically ill patient with SARS-CoV-2 infection?
☐ Yes ☐ No

1. What level of infusion within the GI tract is EN routinely delivered for the COVID-19 patient in your ICU?
☐ Gastric to start ☐ Post-pyloric to start ☐ Post-pyloric if intolerant of gastric feeds

1. What type of feeding tube is utilized to enterally feed critically ill patients with SARS-CoV-2 infection?
☐ Nasogastric (Dobhof) 10-12 Fr ☐ Large-bore Salem sump
☐ GPS electromagnetic (Cortrak) ☐ Optic vision-guided (Iris)
☐ Other

1. Who places the majority of post-pyloric tubes in your critically ill patients with SARS-CoV-2 infection?
☐ Nurse ☐ Dietitian ☐ Intensivist ☐ No one ☐ Other

1. Who places the majority of post-pyloric tubes in your critically ill patients who do not have SARS-CoV-2 infection?

☐ Nurse ☐ Dietitian ☐ Intensivist ☐ No one ☐ Other

Parenteral Nutrition

1. How do you regard use of PN in the critically ill patient with SARS-CoV-2 infection?
☐ PN is equal to EN
☐ PN is associated with worse outcome, higher infection risk compared to EN
☐ PN is associated with worse control of serum triglycerides and hyperglycemia
☐ Not a high enough priority to dedicate central line access
☐ Other

1. How soon after ICU admission would you initiate exclusive PN in a SARS-CoV-2 patient for whom EN is not feasible?
☐ ≤ 2days ☐ 3-5 days ☐ 6-7 days ☐ > 7 days ☐ Never ☐ Other

1. What is your decision to initiate exclusive PN based on (check all that apply)?
☐ Duration NPO where EN cannot or will not be provided
☐ Evidence of malnutrition ☐ Disease severity
☐ Documented weight loss ☐ Reduced enteral delivery
☐ Other

1. When would you consider adding supplemental PN for a patient already receiving EN (check all that apply)?
☐ After 1 week if EN insufficient
☐ After 2 weeks of insufficient EN
☐ Only if there is evidence of malnutrition, greater disease severity, weight loss
☐ Would not use supplemental PN in patient already on EN
☐ Immediately if EN intolerance suspected
☐ Other

Additional Information

(Continues)

1. Which micronutrients do you give routinely to critically ill COVID-19 patients (check all that apply)?
☐ Vit C ☐ Vit D ☐ Zinc ☐ Selenium
☐ Chromium ☐ Vit A ☐ Melatonin ☐ Other
☐ None

1. How is nutrition therapy provided on ECMO?
☐ Kept NPO ☐ Gastric EN ☐ Post-pyloric EN
☐ PN only ☐ Other
☐ ECMO is not done at our facility

1. How is nutrition therapy provided on NIPPV-CPAP/BIPAP (high flow NC excluded)?

i.☐ Kept NPO ☐ Gastric EN ☐ Post-pyloric ENii. ☐ PN only ☐ Other

1. What are the more significant barriers to providing nutrition therapy for the critically ill patient with SARS-CoV-2 infection compared to a non-SARS-CoV-2 patient (check all that apply)?
☐ Difficulty delivering enough calories
☐ Level of infusion within the GI tract needs to be post-pyloric
☐ Ventilatory demands
☐ Unpredictability of patient's clinical course
☐ Limited IV access to devote to PN
☐ Concern that use of EN would be harmful to patient
☐ Concern that use of PN would be harmful to patient
☐ Reluctance to place enteral access feeding tube (need for endoscopy, radiology, transport, additional procedure)
☐ Lack of PPE, limited resources

Design of Nutrition Regimen (may need to be answered by dietitian)

1. How are energy requirements determined?
☐ Indirect calorimetry ☐ Simple weight-based equation ☐ Published equation
☐ Maximum volume ☐ Other

1. How are protein requirements determined?
☐ Simple weight-based equation ☐ Nitrogen balance ☐ Percent total calories
☐ Other

1. What are the goals of feeding during the first week of critical illness?
Energy (calories) ☐ 70-80% of requirements ☐ 100% of requirements ☐ Other
Protein ☐ 70-80% of requirements ☐ 100% of requirements ☐ Other

1. How do feeding goals change beginning the second week of critical illness?
Energy (calories) ☐ No change ☐ 100% of requirements ☐ Other
Protein ☐ No change ☐ 100% of requirements ☐ Other

1. What formula do you typically use for initiation of EN in the patient with COVID-19 disease?
☐ Standard isosmotic polymeric ☐ High protein hypocaloric
☐ Immune-modulating (arg, fish oil) ☐ Small peptide/MCT
☐ Diabetic ☐ Fiber-containing
☐ Other

1. What percentage of critically ill patients with COVID-19 achieved 100% delivery of their nutritional goals?
   a. ☐ <20 ☐ 20 - 40 ☐ 41 - 60 ☐ 61 - 80 ☐ 81 - 100

1. **Additional Comments**

ASPEN Journal-Based Continuing Education (CE) Activity

Journal Article Title and Citation:
Novel Multinutrient Human Milk-Based Human Milk Fortifier Promotes Growth and Tolerance in Premature Infants, *JPEN*, May 2022

Journal-Based CE Activity Overall Goal:
The JPEN Editor, in concurrence with ASPEN's Education and Professional Development Committee, selected this article to be offered for CE credit to fill an observed learning need in the arena of clinical nutrition and metabolism. This CE activity serves to promote the process of life-long learning for physicians, dietitians, pharmacists, and nurses by providing peer-reviewed journal articles that fully qualify for continuing education credits.

Goal and Target Audience:
This educational activity is directed toward clinical nutrition and metabolism professionals and others who wish to update their knowledge of clinical nutrition and metabolism. By participating in this educational activity, the learner may expect to:

- Acquire knowledge in the area of clinical nutrition and metabolism research.
- Update or confirm your understanding of appropriate clinical nutrition and metabolism practices.
- Identify further learning needs as they relate to the subject matter.

Learning Objectives:

1. Identify the potential benefits of a human milk-based human milk fortifier
2. Identify key differences between donor milk and mother's own milk
3. Calculate growth velocity for a preterm infant
4. Compare nutritional composition of bovine and human milk-based fortifiers

Successful Completion:
To obtain CE credit for this activity, attendees must read the journal article in its entirety, complete an online assessment for each article and achieve a score of 100%, and complete an online activity evaluation. All are located in ASPEN's eLearning Center (www.nutritioncare.org/elearning). All CE credit must be claimed prior to the expiration date, no exceptions. Pharmacists must provide their birthday (MMDD) and NABP e-PID. Details are available at http://www.nutritioncare.org/Continuing_Education/Claim_CE_Credit/Continuing_Education_Credit/.

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