

The North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition Position on the Role of the Registered Dietitian Nutritionist in the Care of the Pediatric Patient With Chronic Gastrointestinal Diseases

*Cassandra L. S. Walia, MS, RD, CD, †Carolina S. Cerezo, MD, FAAP, ‡Amber Smith, MBA, RD, CD, §Justine Turner, MBBS, FRACP, PhD, ||Jonathan Moses, MD, ¶Sarah Vermilyea, MS, RD, CSP, LD, CNSC, **Sandeep K. Gupta, MD, and ††Ritu Verma, MD

ABSTRACT

The optimization of nutrition is essential for the growth and development of all children, including those with gastrointestinal (GI) conditions that can variably affect nutrient intake, absorption, or metabolism. Registered Dietitian Nutritionists (RDNs) are essential partners in delivering high quality care for pediatric GI disorders, but limited evidence is available to support the role of the RDN in the care of these patients. This position paper outlines the evidence supporting the role of the RDN in the management of chronic pediatric GI issues in both inpatient and outpatient settings. Gaps in the literature, opportunities for future research, and barriers to RDN access are discussed.

Key Words: enteral nutrition, malnutrition, obesity, parenteral nutrition

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The optimization of nutrition is essential for the growth and development of all children, including those with gastrointestinal (GI) conditions that can variably affect nutrient intake, absorption, or metabolism. Registered Dietitian Nutritionists (RDNs) are essential partners in delivering high quality care for pediatric GI disorders. Adult and pediatric studies demonstrate that RDNs provide safe and cost-effective care (1,2). Pediatric patients have improved outcomes with nutrition screening, assessment, intervention, and education provided by RDN, including decreased rate of hospitalization (3). Parents report increased knowledge and behavior change given RDN education (3). However, care may not be consistently delivered due to issues with access, payor agreement, and available evidence.

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From *Children's Wisconsin, Milwaukee, WI, †Hasbro Children's/Rhode Island Hospital, Providence, RI, ‡UCSF Medical Center, San Francisco, CA, §University of Alberta, Edmonton, AB, Canada, ||UH Rainbow Babies and Children's Hospital, Cleveland, OH, ¶St. Joseph Home, Cincinnati, OH, #Riley Hospital for Children/Indiana University, Indianapolis, IN, **Community Hospital Network, Indianapolis, IN, and ††UChicago Medicine, Comer Children's Hospital, Chicago, IL.

Address correspondence and reprint requests to Cassandra L. S. Walia, MS, RD, CD, Children's Wisconsin, 8915 W. Connell Ct, Milwaukee, WI 53226 (e-mail: cwalia@childrenswi.org).

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What Is Known

- Adult and pediatric studies have demonstrated that dietitians provide safe and cost effective care.
- Pediatric gastrointestinal (GI) diseases may result in poor nutrient intake and poor nutrient absorption, and disease treatment may include the elimination of specific foods from the diet.
- Expert opinion supports the role of the Registered Dietitian Nutritionist (RDN) in many pediatric GI diseases.

What Is New

- There is evidence to support the role of the RDN in only a small number of pediatric GI diseases.
- This report summarizes the available evidence to support the role of the RDN in pediatric GI diseases, identifies gaps in the literature, and highlights areas of research that need to be promptly addressed to improve access to RDNs specializing in pediatric GI diseases.

Entry-level RDNs have completed a bachelor's degree, internship, and passed the certification examination. Additional degrees completed by RDNs can include masters or doctorate

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degrees in nutrition, healthcare administration, public health, and others. Experience- and exam-based board certified nutrition specialties available to eligible RDNs include pediatrics, pediatric critical care, renal, obesity and weight management, sports, enteral (EN) and parenteral nutrition (PN), advanced practice in clinical nutrition, diabetes education, and eating disorders. These additional certifications add value to the care provided by the dietitian. While pediatric clinical nutrition is a specialty requiring additional training and education for proficiency, pediatric GI nutrition is a subspecialty that requires additional knowledge and expertise. Despite the extensive education requirements and board certifications available to RDNs, the role of the RDN in the care of pediatric patients with GI diseases is not well defined. The objective of this position paper is to outline the evidence supporting the role of the RDN in management of chronic pediatric GI issues in both inpatient and outpatient settings. We hypothesize that RDN involvement in the care of pediatric GI patients improves disease-specific outcomes and decreases overall costs. Gaps in the literature, opportunities for future research, and barriers to RDN access are discussed.

METHODS

An outline of this position paper was developed by the authors who are members of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) Clinical Care and Quality Committee or the Council for Pediatric Nutrition Professionals (CPNP). English language literature from 2010 to 2021 was searched for terms including: dietitian, nutritionist, pediatrics, and specific disease states discussed in this paper, using PubMed and CINAHL (see Table 1, Supplemental Digital Content 1, <http://links.lww.com/MPG/D44> for complete list of search terms). The specific diseases discussed in this paper are the most common pediatric GI conditions where complex diet therapy

is used as treatment or where the disease affects nutrient intake or absorption. Each article was reviewed independently by 2 authors to determine eligibility for inclusion in the final manuscript. Criteria for inclusion in the manuscript included:

- Nutrition care provided by a RDN
- Comparison of objective outcomes (nutrition outcomes, changes in knowledge, or adherence) before and after RDN intervention or to patients without RDN intervention

For diagnoses without available objective evidence, alternative evidence, including position papers and consensus recommendations, were considered.

RESULTS

Enteral and Parenteral Nutrition

Nutrition support is the provision of nutrients via the enteral or parenteral route. Several studies have suggested that most physicians are insufficiently trained in nutrition support provision, which is a critical component of patient care (4–6). The American Society for Parenteral and Enteral Nutrition (ASPEN) supports the primary role of the RDN to conduct nutrition screening and assessment, and to develop, implement, and monitor response to a nutrition care plan (7). Studies showing improved outcomes when an RDN participates in EN and PN are summarized in Table 1.

In critical care settings, the RDN role has been shown to be crucial in meeting nutrition targets. In a 2013 critical care study, RDN documentation of caloric requirement within 48 hours of critical care admission was associated with higher total daily energy intake (15). Similarly, a multicenter, prospective cohort study of critically ill children showed that dedicated RDN written prescription for protein intake led to improved protein delivery that is

TABLE 1. Summary of studies demonstrating improved outcomes with RDN participation in pediatric enteral and parenteral nutrition support

Study/author	Area of study	Intervention/investigation	Outcome
Daniel et al (8)	Malnutrition	Malawi hospital compared a program of RDN-led therapeutic oral and enteral feeding compared to physician only nutrition intervention	Decreased length of stay and readmission rates for hospitalized children in the RDN led program
Tang et al (9) Faruque et al (10)	Enteral home programs	Compliance to prescribed home enteral nutrition compared between hospitals with an RDN-led and coordinated home enteral program versus those without	Higher rates of compliance to prescribed diet for programs coordinated and/or led by an RDN-led programs more likely to have policies and procedures in place outlining appropriate patient selection, monitoring parameters, and enteral nutrition termination
Chandrasekar et al (11)	Blenderized tube feeding	Comparison between blenderized tube feeding and complete nutrition formulas, looking at role of RDNs	RDN designed nutrition plan resulted in improved weight gain, feeding tolerance, patient and family satisfaction
Mehta et al (12)	Critically ill pediatric patients on PN – multicenter prospective cohort study	Association of adequate protein intake with 60-day mortality in ventilated children compared in 59 Pediatric Intensive Care Unit (PICU)	PICUs with dedicated RDN had higher rates of protein delivery, led to decreased 60-day mortality in critically ill children
Gentles et al (13)	Enteral feeding practices in the Intensive Care Unit (ICU)	Nutrition intake and EN practices compared in 2 periods: 1 without and 1 with use of EN practice guidelines and RD attended daily rounds in PICU	RDN developed enteral feeding guidelines and enhanced RD participation in rounds led to significant increase in median daily energy intake per patient in the medical cohort
Garg et al (14)	PN prescription	Errors in PN prescription compared between groups with and without RDN involvement	1.5 times higher rates of inappropriate PN use and errors if RDN not involved; reduced PN related complications with RDN involvement

PN = parenteral nutrition; RDN = Registered Dietitian Nutritionist.

inversely associated with 60-day mortality in critically ill children (12).

Garg et al (14) highlighted the involvement of RDNs in PN prescriptions and its impact on in-hospital mortality, reducing PN-related complications, and reducing inappropriate PN use. The RDN's impact on these variables results in lower healthcare costs, fewer errors which can contribute to higher mortality or prolonged LOS, and lower provider or pharmacy labor costs (14).

Providing EN and PN at home has major benefits to patient quality of life, lower risk of malnutrition-related complications, and decreased healthcare cost and utilization. A recent study (9) of 59 hospitals showed improved compliance when home EN as supervised by an RDN, and increased use of EN protocols (Table 1). EN protocols are associated with improved nutrient intake (16). Recently, use of blenderized tube feeding has increased, with potential for malnutrition and specific nutrient deficiencies without optimal design and monitoring; the role of the RDN in blenderized tube feeding management has been suggested to be crucial (11).

Malnutrition

In a multicenter prospective cohort study, 60 of 307 (19.8%) children aged 1 month to 18 years were malnourished on hospital admission but only half of these malnourished children were seen by a RDN. The percentage of patients who met the parameters for meaningful weight loss or lack of weight gain during hospitalization was significantly greater in the group not seen by a RDN (76.5% vs 23.5%, $P < 0.01$) (17). In another study, malnutrition prevalence upon hospitalization was 19.7% and RDN-performed physical examination predicted hospital length of stay and need for nutrition intervention. Children with hypermetabolism had significant improvements in weight/length or Body Mass Index (BMI)/age z score if seen by a RDN (18).

Obesity

Numerous studies have demonstrated the positive impact of RDN interventions on pediatric patients with obesity (see Table 2, Supplemental Digital Content 2, <http://links.lww.com/MPG/D45>). Diaz et al (19) compared obesity management provided by a primary care provider alone or with a dietitian (providing both group classes and regular consultations). The primary care provider group gained 5.6 kg over 12 months, while the dietitian group lost 0.8 kg. The dietitian group also had significant improvements in blood pressure at 6 months. Kirk et al (20) completed a retrospective review of 2 designs for comprehensive weight management programs inclusive of RDNs and found each additional dietitian visit to be associated with a 28% increased odds of success (defined as BMI being stable or reduced). The probability of success exceeded 78% with >1 RD visit/month versus 43% with <1 visit per month.

Importantly, RDN interventions can also benefit obesity prevention. Tucker et al (21) studied patients identified at pediatrician office visits as at risk or overweight. Patients in the intervention group received detailed counseling from a pediatrician followed by 4 dietitian visits over 6 months. Patients in the control group received usual care from pediatrician with no RDN intervention. Overall improvements were noted in the intervention group compared to a control group in physical activity, screen time, and dietary practices.

Pediatric Bariatric Surgery

The use of bariatric surgery for adolescent patients with obesity has increased over the past decade and is known to be associated with significant risk of nutrition complications (22). Our review of the literature did not identify studies focused on RDN involvement in this patient population. However, the Academy of Nutrition and Dietetics highlighted the role of the RDN in the care

of these patients in a position paper (23). In addition to preoperative diet counseling, RDNs are uniquely qualified to provide postoperative care as part of the multidisciplinary team. The role of the RDN has been further endorsed by the American Society for Metabolic and Bariatric Surgery (22).

Intestinal Failure

Regardless of inpatient or home settings, pediatric patients with intestinal failure are high-nutrition risk, resource intensive, and costly to manage. Our review of the literature did not uncover objective evidence to support the role of the RDN in the care of these patients. However, NASPGHAN has taken the position that the care of children with intestinal failure requiring PN support for more than 3 months be under the auspices of a multidisciplinary intestinal rehabilitation team (IRT) (24). Across societies there is consensus that a RDN is an essential member of IRTs (25–27). These recommendations are supported by systematic reviews demonstrating improved overall survival and reduced sepsis for pediatric patients managed in an IRT (28). A survey of 61 European pediatric IRTs identified an RDN member in 95% of teams, second only to the pediatric gastroenterologist (100%) (29). Similarly, in North America across 71 pediatric programs over 96% reported a RDN as a member of the IRT (30).

Liver Disease and Liver Transplant

In cholestatic liver disease, malnutrition is an extremely common complication and is a recognized risk factor for death while awaiting transplantation (31). Our review of the literature did not find objective evidence to support the role of the RDN in this population. However, in a joint position statement of NASPGHAN and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN), the importance of EN and PN for children with end-stage liver disease was highlighted (32). Recommendations were to formally monitor nutritional status, including serial measurement of mid-upper arm circumference and triceps skin folds, as well as nutrition-focused examination at each clinic visit. Consideration of use of indirect calorimetry to measure energy requirements and of EN or even PN to meet the increased energy requirements were endorsed. EN and PN are no less important perioperatively at the time of liver transplantation and the joint statement recommended continued nutrition monitoring post transplantation. While not implicitly stated, all these interventions would likely require the input of an RDN.

Our review of the literature did not uncover objective evidence supporting the role of the RDN in the care of pediatric patients with nonalcoholic fatty liver disease (NAFLD). However, recent NASPGHAN Clinical Practice Guidelines for pediatric NAFLD highlighted the role of the RDN in the management of these patients (33). Given the evidence suggesting improved outcomes for pediatric patients with obesity, we propose that nutrition assessment and counseling by a RDN is essential in the care of these patients.

Pediatric Feeding Disorders and Aerodigestive Disorders

It has been estimated that 20%–33% of children with chronic diseases, including GI disorders, will have a pediatric feeding disorder (PFD) (34). Many children with PFD experience decreased dietary diversity or poor diet quality with requirement for nutrient supplementation. Severe feeding disorders can warrant EN to avoid or manage malnutrition and many children with a PFD are likely to benefit from RDN consultation.

In one systematic review of 12 successful intensive pediatric feeding programs that were effective in decreasing tube dependency,

all 12 programs included an RDN (34). Williams et al (35) compared a standard approach to PFD treatment (weekly consultation with a feeding therapist) to an intensive feeding program (that included daily consultation with a feeding therapist and weekly review by a pediatric gastroenterologist and RDN). The intensive program dramatically improved the likelihood of tube weaning. However, it is not clear which intervention, more intensive feeding therapy versus the combined medical and nutrition input, was responsible for better outcomes.

By definition all children with an aerodigestive disorder and dysphagia have a PFD. A recent pediatric consensus statement indicated that RDNs are important team members for some, but not all, aerodigestive patients (36). The number of aerodigestive teams that include an RDN and their outcomes are in need of further study (37).

Mucosal Diseases

Inflammatory Bowel Disease

Nutritional interventions in the management of children and adolescents with inflammatory bowel disease (IBD) include nutrition as primary medical therapy, addressing malnutrition, and addressing micronutrient deficiencies. Exclusive enteral nutrition (EEN) for induction of remission in pediatric Crohn disease has been endorsed as a first line therapy by the European Crohn's and Colitis Organisation and the ESPGHAN (38). The success of this therapy is highly dependent on adequate health care resources, including participation of an RDN as part of a multidisciplinary team (38). The majority of centers who utilize EEN have RDNs educating and administering this therapy (39). However, El-Matary et al (40) report wide variation in the total number of RDNs per patient, ranging from 1:250 to as low as 1:450.

Although EEN remains the most commonly utilized nutrition therapy for pediatric Crohn disease, there has been a recent increase in nutrition as primary medical therapy being reported for both Crohn disease and Ulcerative Colitis (UC). These include the specific carbohydrate diet and the Crohn's Disease Exclusion Diet (41,42). Such diets are likely to be complex to administer for many patients without RDN education and may increase the risk of micronutrient deficiencies without monitoring (41). Independent of the prescribed diet, micronutrient deficiencies are highly prevalent at diagnosis (40). It is our expert opinion that RDNs play a key role in preventing and addressing these micronutrient deficiencies.

Allergic Disorders

Allergic GI disorders include eosinophilic GI diseases (EGIDs) and food-protein induced enterocolitis syndrome. Dietary interventions are one of the first-line therapies for eosinophilic esophagitis. Yet at this time there is limited evidence focused on the role of a RDN in management of patients with EGIDs. It is plausible that dietary recommendations are more often being provided by physicians than a RDN (43). Despite this reality, Venter et al cite that "dietitians are particularly well-suited to provide a comprehensive, individualized treatment plan" for patients with eosinophilic esophagitis for example, and also cite that "evidence also suggests that a dietetic consultation improves patient outcomes in terms of nutritional intake and nutritional status" (44). It is probable that better access to a RDN will improve the care of children with EGIDs. One study has shown that given appropriate dietary advice, including use of hypoallergenic formulas, vitamins, and mineral supplementation, growth parameters increased from before to after dietary elimination in infants with food protein-induced GI allergies (45).

Celiac Disease

Dietary changes are core to celiac disease management, as is the role of RDNs. Madden et al (46) examined patient preferences for diet and nutrition-related outcomes in patients with celiac disease. Three key themes highlight the role of the RDN: (i) the need for information specific to their lifestyle, (ii) RDN's celiac disease expertise, consistency of the RDN seen, and the frequency and length of appointments, and (iii) health concerns focused on risk of osteoporosis, unwanted weight gain, and the fat and sugar content of manufactured gluten-free products. Nestares et al (47) prospectively studied the micronutrient intake of children with celiac disease and found the diet nutritionally less balanced than healthy controls. Participation of RDNs is necessary to guide the gluten-free diet, to make the diet more balanced and to address micronutrients that may be deficient.

A number of studies have further examined the utility of RDNs in the management of patients with celiac disease. Johansson et al (1) followed 363 celiac disease patients under the age of 18 years over a period of several years. While dietary compliance was similar regardless of whether care was provided by a RDN or a pediatrician, RDN-led follow-up visits could provide lower long-term costs. Rashid et al (48) showed that gluten-free diet education via videoconferencing, inclusive of RDN dietary education, is feasible and as effective as in-person education, and affords convenience and savings to families by reducing travel costs. Rajani et al (49) reported high levels of patient satisfaction with RDN- and nurse-led celiac disease clinics. Isaac et al (50) reported significant improvement in patient knowledge scores concerning the gluten-free diet following visit with RDN.

Neurogastroenterology and Motility Disorders

Patients with neurogastroenterological and motility disorders may present with poor nutrient intake and/or malnutrition, but our review of the literature found limited objective evidence supporting the role of the RDN in this patient population. The NASPGHAN Consensus Statement on the Diagnosis and Management of Cyclic Vomiting Syndrome (CVS) calls out the need for nutrition counseling in a subset of patients with CVS, particularly those with weight loss (51). Nutrition counseling is specifically recommended for patients with growth failure as a result of frequent or prolonged CVS episodes. ESPGHAN highlights the need for EN and PN in patients with pediatric intestinal pseudo-obstruction (52) and recommends a multidisciplinary team management that includes a RDN. In addition to providing parenteral nutrition recommendations, the RDN should recommend strategies for optimizing oral and EN without compromising intestinal function.

Karagiozoglou-Lampoudi et al (53) looked at the impact of RDN involvement in the diets of patients with refractory constipation. All patients were educated on goals for water and fiber intake by a physician. The intervention group also received personalized nutrition counseling from a RDN. Patients that received RDN intervention had significantly larger increases in fiber and water intake: the physician group increased their fiber and water intake by 26%, while the dietitian group increased their fiber and water intake by 32% and 38%, respectively. The authors concluded that following a personalized diet plan managed by a RDN is more effective in increasing fiber intake compared with physician-alone instructions.

While there is some evidence to support the role of the RDN in the care of pediatric patients with CVS and pediatric intestinal pseudo-obstruction, our review of the literature did not uncover evidence for the role of the RDN in other neurogastroenterology and motility disorders such as long-segment Hirschsprung disease, or gastroparesis.

Children/Youth with Special Healthcare Needs (CYSHCN) and Individuals with Intellectual and Developmental Disabilities (IDD)

In 2015, approximately 11.2 million children in the United States had special healthcare needs and approximately 1%–3% of the pediatric population had IDD. CYSHCN typically have secondary medical problems impacting growth and nutrition status (56). GI problems are frequent, including feeding difficulties, malnutrition, dysphagia, constipation, or dysmotility. Moreover, CYSHCN and patient with IDD have almost twice the prevalence of obesity than the general pediatric population. Previously published guidelines from ESPGHAN (54) and a position statement from The Academy of Nutrition and Dietetics (55) support that nutrition assessment and management include a RDN as part of a multidisciplinary approach. Key RDN interventions include anthropometric, dietary and oral feeding assessments, dietary education, and monitoring (57–59).

RDNs are integral to various national programs supporting CYSHCN and IDD populations, including: the Early Periodic Screening, Diagnosis and Treatment Program; the WIC Program; early intervention services provided through the Individuals with Disabilities Act; and Project Head Start. Legislation (55) has supported medical nutrition therapy be provided by RDNs and reimbursed via government payors across the country.

Other Gastrointestinal Diseases

In addition to the GI diseases discussed here, there are many other GI diseases that result in nutrition risk, including, for example, protein-losing enteropathy, disaccharidase deficiency, and irritable bowel syndrome. Our review of the literature did not identify evidence regarding the role of the RDN in these diseases. Consensus reports describe the role of the RDN in pediatric cystic fibrosis (60), but not in the care of patients with pancreatic insufficiency.

DISCUSSION

To our knowledge, this is the first publication to review the evidence for the role of the RDN in the care of pediatric patients with GI diseases. While some evidence exists (Table 2), many areas for future research to better clarify the impact of the RDN on the care of patients with specific pediatric GI diseases are identified (Table 3).

There is evidence to support the role of the RDN in pediatric EN and PN (9,12,14,15), celiac disease (1,50), and pediatric obesity (19,21,63,64) (Table 2). Given the overall impact of obesity on health outcomes, there is a need to demonstrate the cost implications of RDN involvement in obesity care and on long-term health outcomes. Future research should also focus on the role of the RDN in the treatment of pediatric non-alcoholic steatohepatitis (NASH), NAFLD, and bariatric surgery, including clarifying the frequency of visits required for optimal patient outcomes.

There is some evidence to support the role of the RDN in allergic disorders, refractory constipation, and malnutrition, but we identified clear gaps in the literature. Although we identified one study showing the positive impact of dietary advice on patients with food protein induced GI allergies, there is a clear lack of evidence focused on the role of a RDN, despite literature demonstrating nutritional concerns arise from multiple food eliminations (65). Given the evidence demonstrating the RDN role in pediatric celiac disease (1,50), prompt further research into the role of the RDN in other GI conditions managed by an elimination diet is warranted. The diagnosis of pediatric malnutrition has been an area of focus in pediatric nutrition over the past few years. Bouma (67) noted that RDNs “are uniquely trained to have the necessary skills to assess dietary intake.”

They are also trained to apply standardized definitions for pediatric malnutrition and to treat pediatric patients with malnutrition. Future research should focus on objective outcomes of RDN interventions for pediatric malnutrition, in both inpatient and outpatient settings. While there is consensus about the role of the RDN in GI disorders known to be associated with a high risk of malnutrition, including intestinal failure and liver disease, the specific impact of the RDN on patient outcomes remains poorly described.

While there are position papers and societal guidelines to recommend the role in many GI diseases, there is a lack of primary research into the role of the RDN in pediatric patients with intestinal failure, cholestatic liver disease, PFD, IBD, neurogastroenterology and motility disorders, and CYSHCN. Given that >95% of IRTs include a RDN, objective outcomes demonstrating the benefit of RDN involvement will be difficult to obtain. However, future research could compare outcomes of programs with and without a RDN or focus on the financial benefit of RDN involvement in the IRT, including cost savings to the patient.

The role of the RDN in both diagnosis and management of pediatric feeding and aerodigestive disorders should be clarified. There seems to be a clear gap, given the known risks for malnutrition in this population and the frequent use of nutritional interventions, such as modified textures and EN. The care of these patients is increasingly multidisciplinary and expensive and justification of the inclusion of a RDN and the impact on cost of care and patient quality of life is needed. Similarly, given the paucity of data for improved outcomes with involvement of a RDN for pediatric IBD, further studies are urgently needed to provide evidence based justification for financial support. Future studies could focus on objective markers of nutrition (ie, z scores), markers of disease severity and improvement (clinical, biochemical, and endoscopic), health care-based metrics (ie, inpatient length of stay, reduction in post-operative length of stay), and quality of life.

Consensus statements and recommendations from expert committees specifically call out the role of nutrition assessment in neurogastroenterology and motility disorders, including cyclic vomiting syndrome and pediatric intestinal pseudo-obstruction. Other motility disorders, including gastroparesis and long-segment Hirschsprung disease, affect nutrient intake and may present with malnutrition (68). These patients may require EN or PN and may benefit from RDN intervention. Future research should also focus on the appropriate RDN to patient ratios required for optimal outcomes in patients with specific pediatric GI diagnoses.

Although some of the disease states we discussed have limited published evidence to support RDN involvement, the author group feels that the RDN has an important role to play in the care of patients with each of these GI diseases. The author group has come to a consensus as to why RDN involvement is essential in the care of each disease state, which is listed in the expert opinion column of Table 2.

This position paper is limited by the paucity of data available in the current literature to support the role of the RDN. Lack of evidence on the impact of RDN intervention in patients with specific pediatric GI diseases is only one barrier to RDN involvement. There are also access-related issues and payor barriers. Medical Nutrition Therapy provided by a RDN is covered by government-funded insurance for specific diagnoses, including diabetes and certain kidney diseases (<https://www.eatrightpro.org/payment/medicare/mmt>). Reimbursement from private insurance varies by carrier and by patient diagnosis. In addition to variable insurance reimbursement, patients may have difficulties accessing an appropriate RDN. Pediatrics in itself is a nutrition specialty, and pediatric GI is an additional subspecialty that requires training and experience for proficiency. Many pediatric GI RDNs work in large pediatric hospitals, which may be difficult to access for patients in specific geographic areas and patients with

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TABLE 2. The role of the RDN in pediatric GI diseases

Pediatric GI disease	Expert opinion on the role of the RDN	Published evidence for the role of RDN	Societal guidelines that endorse role of RDN
Nutrition support	<p>Enteral</p> <ul style="list-style-type: none"> • Pediatric patients require frequent EN adjustment to promote growth • Many pediatric patients are working towards oral feedings, requiring frequent EN adjustment • Specific GI conditions may require the use of specialty formulas • RDN are trained in pediatric nutrient needs, feeding patterns, and pediatric enteral formulas <p>Parenteral</p> <ul style="list-style-type: none"> • Pediatric parenteral formulas are complex • Pediatric patients require frequent PN adjustments to normalize electrolytes, promote growth, prevent complications resulting from long-term PN usage, and accommodate increasing enteral tolerance • RDNs are trained in PN and additional specialty certifications are available 	<ul style="list-style-type: none"> • Higher compliance with prescribed home enteral nutrition (9) • Increased energy and protein delivery in pediatric ICU patients (12,15) • Decreased error rate in parenteral nutrition prescriptions with RDN orders (14) 	<p>ASPEN (7)</p>
Malnutrition	<ul style="list-style-type: none"> • Associated with increased length of stay (61) • Associated with increased morbidity and mortality (62) • RDNs are trained to design nutrition plans that account for cultural and economic factors to help increase compliance • RDNs utilize pediatric malnutrition diagnostic criteria and nutrition-focused physical exam 	<ul style="list-style-type: none"> • Percentage of hospitalized patients demonstrating weight loss during admission was lower if they saw an RDN during the admission (17) 	
Intestinal failure	<ul style="list-style-type: none"> • Vulnerable patient population with significant risk of nutritional complications • Complex balance between enteral, parenteral, and oral nutrition • Nutritional interventions are key to advance enteral autonomy • RDN are trained in pediatric nutrient needs, feeding patterns, and pediatric enteral and parenteral formulations 	<ul style="list-style-type: none"> • Systematic reviews demonstrating improved overall survival and reduced sepsis for pediatric patients managed in an IRT (28). 	<p>NASPGHAN (24) ESPGHAN (25) Intestinal Failure Alliance of Australia (26)</p>
Obesity, bariatric surgery, and NASH/NAFLD	<ul style="list-style-type: none"> • Pediatric obesity is a significant risk factor for adult obesity and comorbidities in both childhood and adulthood (23) • Motivational interviewing and frequent follow-up are important components of pediatric obesity treatment • RDNs are trained to design nutrition plans that account for cultural and economic factors to help increase compliance • RDNs can provide nutrition assessment and education pre- and post-bariatric surgery to improve compliance and ensure patient is meeting essential nutrient needs 	<ul style="list-style-type: none"> • Obesity & weight management outcomes improved with RDN intervention (19) • Increased frequency of RDN visits for weight management was associated with increased odds of success (20) 	<p>The Academy of Nutrition and Dietetics (23) American Society for Metabolic and Bariatric Surgery (22)</p>
Liver disease & liver transplant	<ul style="list-style-type: none"> • Pediatric liver diseases may result in decreased oral intake and malabsorption • Specialty formulas may be required to meet nutrient needs • RDN are uniquely trained in pediatric nutrient needs, feeding patterns, nutrition supplements, and infant and pediatric formulas 		<p>NASPGHAN & ESPGHAN (32)</p>
Pediatric feeding disorders & aerodigestive diseases	<ul style="list-style-type: none"> • Patients may require EN and/or modified oral diet • Pediatric patients require frequent nutrition adjustments to promote growth • Many patients on EN are working towards oral feedings, requiring frequent EN adjustment • RDNs are well-versed in pediatric nutrient needs, feeding patterns, and pediatric enteral formulas 		<p>American Academy of Pediatrics (36)</p>

(Continued)

TABLE 2.
(Continued)

Pediatric GI disease	Expert opinion on the role of the RDN	Published evidence for the role of RDN	Societal guidelines that endorse role of RDN
Inflammatory bowel disease	<ul style="list-style-type: none"> At risk of malnutrition and micronutrient deficiencies due to malabsorption and decreased nutrient intake Nutrition may be used as primary therapy for IBD Medications and surgical interventions to treat IBD may impact nutrient intake/utilization and growth RDN assessment is essential in patients with impaired nutrient intake, malabsorption, and poor growth 		
Celiac disease	<ul style="list-style-type: none"> The current treatment for celiac disease is a gluten-free diet RDNs are uniquely trained to provide education on the gluten-free diet to improve compliance to the prescribed treatment RDNs are trained to design nutrition plans that account for cultural and economic factors to help increase compliance 	<ul style="list-style-type: none"> RDN-led visits for celiac diseases result in similar compliance at lower cost (1) Significant improvement in patient knowledge of gluten-free diet following visit with RDN (50) 	
EGIDs & other allergic disorders	<ul style="list-style-type: none"> Patients following food elimination diets are at risk of nutrient deficiencies and poor growth (65) RDN are uniquely trained to provide education on the elimination diet and recommend tailored interventions to meet the patient and family's needs, including cultural and economic factors 	<ul style="list-style-type: none"> With appropriate dietary advice, growth parameters increased from before to after dietary elimination in patients with food protein induced GI allergies (45) 	
Neurogastroenterology & motility disorders	<ul style="list-style-type: none"> Elimination diets may be prescribed as treatment of these conditions. These conditions may result in impaired nutrient intake Enteral and parenteral nutrition may be required to meet nutrient needs RDN are uniquely trained to provide education on elimination diets (including the low-FODMAP diet) and recommend tailored interventions to meet the patient and family's needs, including cultural and economic factors 	<ul style="list-style-type: none"> Evidence-based recommendations from ESPGHAN and NASPGHAN recommend normal fluid and fiber intake for patients with constipation (66) Improved fluid and fiber intake in patients with refractory constipation (53) 	
Other malabsorptive disorders (including non-cystic fibrosis pancreatic insufficiency and protein-losing enteropathy)	<ul style="list-style-type: none"> At risk of malnutrition, macronutrient deficiencies, and micronutrient deficiencies due to malabsorption and decreased nutrient intake RDN assessment is essential in patients with impaired nutrient intake, malabsorption, and poor growth 		

ASPEN = American Society for Enteral and Parenteral Nutrition; EN = enteral nutrition; ESPGHAN = European Society for Paediatric Gastroenterology Hepatology and Nutrition; FODMAP = fermentable oligosaccharides, disaccharides, monosaccharides and polyols; GI = gastrointestinal; IBD = inflammatory bowel disease; ICU = intensive care unit, IRT = intestinal rehabilitation team; NASPGHAN = North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition; PN = parenteral nutrition; RDN = Registered Dietitian Nutritionist.

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TABLE 3. Key areas of future research

Nutrition support

- Comparison of outcomes (growth, nutrient intake, duration of EN or PN, complications) from patients with EN/PN managed by a RDN compared to patients without a RDN
- Frequency of RDN visits associated with best outcomes for patients on home EN/PN based on age and specific medical conditions

Malnutrition

- Time to resolution of malnutrition for patients seen by RDN compared to patients without RDN intervention
- Hospital length of stay for patients with malnutrition seen by RDN

Intestinal Failure

- Comparison of outcomes (growth, time to enteral autonomy, complications) between centers with RDN involvement to centers without RDN involvement
- Cost savings (to patient and to the health care institution) with RDN involvement in IRT

Obesity

- Frequency of RDN visits most likely to promote success for patients with obesity, NASH/NAFLD, and pre-bariatric surgery

Liver disease

- Comparison of outcomes for patients with RDN involvement (growth, serum vitamin/mineral levels, transplant outcomes) to patients without RDN involvement

Pediatric feeding disorders & aerodigestive diseases

- Time to resolution of PFD in patients seen by RDN compared to patients without RDN intervention

Inflammatory bowel disease

- Objective markers of nutrition, disease severity, health care costs, and quality of life for patients with IBD receiving nutrition intervention by RDN

Celiac disease

- Compliance to gluten-free diet for patients receiving education from RDN
- Quality of life for patients receiving RDN intervention

EGIDs & other allergic disorders

- Evaluation of nutrition risk (including impaired growth, malnutrition, and inadequate nutrient intake) for patients on elimination diet
- Comparison of nutrient intake and compliance for patients receiving RDN intervention pre- and post-intervention

Neurogastroenterology & motility disorders

- Evaluation of nutrition risk (including impaired growth, malnutrition, and inadequate nutrient intake) for patients with specific disorders
- Compliance and nutrition outcomes for patients following low FODMAP diet with and without nutrition assessment and education by a RDN

Other

- Role of RDN in management of patients with disaccharidase deficiency and non CF-pancreatic insufficiency
- RDN to patient ratios required for optimal outcomes in patients with specific pediatric GI diagnoses
- Prospective studies looking at impact of RDN intervention for patients with micronutrient deficiencies, including time to normalization and sustained improvement of biochemical parameters
- Prospective studies looking at the impact of the RDN on the patient/family understanding of diet and disease, quality of life, and dietary adherence to elimination diets

CF = cystic fibrosis; EN = enteral nutrition; FODMAP = fermentable oligosaccharides, disaccharides, monosaccharides and polyols; GI = gastrointestinal; IBD = inflammatory bowel disease; IRT = intestinal rehabilitation team; NASH = nonalcoholic steatohepatitis; NAFLD = nonalcoholic fatty liver disease; PFD = pediatric feeding disorder; PN = parenteral nutrition; RDN = Registered Dietitian Nutritionist.

transportation difficulties. The increased use of telemedicine can help decrease this barrier, but requires careful evaluation of outcomes. Additional evidence supporting the role of the RDN in pediatric GI can help demonstrate value and increase access.

Many pediatric GI providers do not have access to a RDN that specializes in pediatric GI diseases. Although payor issues continue to be a barrier, providers should advocate for RDN involvement. RDNs can save the provider time, promote value-based care, and can decrease health care costs in both inpatient and outpatient settings through prevention of malnutrition or preventing complications of chronic diseases (ie, celiac, NASH/NAFLD).

CONCLUSIONS

There is evidence to support the role of the RDN in the care of patients with specific pediatric GI conditions, including patients with

EN and PN, celiac disease, and obesity. Further, expert opinion published in position papers and guidelines support the role of the RDN in intestinal failure, cholestatic liver disease, PFD, IBD, neurogastroenterology and motility disorders, and CYSHCN. Many other pediatric GI diagnoses increase the risk of poor nutrient intake and growth, yet there is limited to no data on the role of the RDN in their care. This is despite that fact that, when evaluated, RDN involvement can be shown to be cost effective and to improve adherence (1,2). There is an urgent need for research to focus on further objective outcomes of RDN interventions in the care of patients with many such pediatric GI diseases, to demonstrate the cost benefit of RDN involvement in the care of these patients, and to advocate for inclusion of RDN services in care of pediatric patients with chronic GI disorders. Evidence that demonstrates cost effectiveness and improved outcomes with RDN involvement will ultimately lead to improved access to RDN services, enhanced reimbursement for RDN services, and improved patient outcomes.

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ABBREVIATIONS:

ASPEN	American Society for Enteral and Parenteral Nutrition
CVS	cyclic vomiting syndrome
CYSHCN	children and youth with special health care needs
EEN	exclusive enteral nutrition
EGID	eosinophilic gastrointestinal diseases
EN	enteral nutrition
GI	gastrointestinal
IBD	inflammatory bowel disease
IDD	intellectual and developmental disabilities
IRT	intestinal rehabilitation team
NASH	non-alcoholic steatohepatitis
NAFLD	non-alcoholic fatty liver disease
PFD	pediatric feeding disorder
PN	parenteral nutrition
RDN	Registered Dietitian Nutritionist

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