REVIEW
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Enteral Nutrition and Pharmacy Practice: Evidence-Based Contributions and the Turkish Experience

ABSTRACT

Enteral nutrition (EN) plays a pivotal role in modern medical care, particularly among hospitalized and critically ill patients. While physicians, dietitians, and nurses traditionally lead nutritional therapy, the expanding complexity of EN has underscored the critical contribution of clinical pharmacists. This narrative review aims to highlight the evolving role of pharmacists in EN, from nutritional assessment and care planning to monitoring, complication management, and interdisciplinary collaboration. It also explores the current situation in Türkiye and future directions in the field. A comprehensive literature review was conducted using national and international guidelines, recent studies, and expert consensus documents to outline the pharmacist's scope in EN management. Particular attention was given to pharmacist-led interventions, decision-making processes, and contributions to clinical outcomes. Pharmacists contribute significantly to individualized nutrition care by assessing nutritional requirements, managing drug–nutrient interactions, ensuring formula compatibility, and monitoring biochemical parameters. Evidence supports their role in improving adherence to clinical nutrition guidelines, reducing complications, and optimizing patient outcomes. In Türkiye, although national organizations recognize this role, integration into clinical practice remains limited due to insufficient curricular emphasis and systemic barriers. Pharmacists are essential members of the nutrition support team, offering a unique perspective that enhances the safety, efficacy, and personalization of EN. Their systematic involvement is vital for advancing interdisciplinary care and achieving high-quality patient outcomes. Further research and educational integration are needed to fully realize the potential of pharmacists in this domain.

Keywords: Enteral nutrition, clinical pharmacy, nutrition support pharmacist, multidisciplinary care

INTRODUCTION

Nutrition is a fundamental determinant of clinical outcomes across diverse healthcare environments. Sufficient and tailored nutritional support has been consistently associated with a reduction in medical complications, shortened duration of hospitalization, enhanced tolerance to therapeutic interventions, and a marked decrease in both morbidity and mortality rates. Despite its vital importance, malnutrition—encompassing both nutrient deficiencies and excesses—continues to be a prevalent yet frequently underrecognized challenge in contemporary clinical practice, especially among hospitalized individuals and those in critical care settings.[1,2] Medical nutrition therapy comprises a spectrum of interventions, including oral nutritional supplementation, enteral nutrition (EN), and parenteral nutrition (PN). Enteral nutrition refers to the administration of nutrients directly into the distal gastrointestinal tract through a feeding tube or stoma. This method is typically indicated in cases where oral intake is insufficient to fulfill the patient's metabolic and nutritional demands.[1] Due to its efficacy, safety profile, lower risk of complications, and cost-effectiveness, EN is preferred over PN.[3,4] Population aging, the rise of comorbidities, and advances in EN technology have made clinical nutrition increasingly complex, thereby underscoring the importance of pharmacists' integration into interdisciplinary nutrition teams. Nutrition support pharmacy has emerged as a specialized field ensuring that nutritional therapies are delivered safely, effectively, and in a personalized manner. Nutrition support

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pharmacists contribute to EN by evaluating patients, calculating nutritional requirements, monitoring drug–nutrient interactions, and developing individualized nutrition care plans. Their pharmacological expertise complements the roles of physicians, dietitians, and nurses, resulting in more precise, safer, and cost-effective nutritional interventions.[5-7] This review aims to highlight the current and potential roles of pharmacists in the assessment, planning, and delivery of EN, with an emphasis on interdisciplinary collaboration and evolving practice areas.

NUTRITIONAL ASSESSMENT, NEEDS ANALYSIS, AND CARE PLANNING

Nutrition Risk Screening

The core aim of nutrition risk screening is to systematically evaluate and record key nutritional indicators, identify potential risk factors and specific micronutrient or macronutrient deficiencies, and estimate the individual's nutritional needs. Additionally, this process seeks to uncover underlying medical conditions, psychosocial dynamics, and socioeconomic barriers that may affect the selection, initiation, and continuation of appropriate nutritional support strategies.[8] Hospitals and healthcare systems are encouraged to adopt standardized, evidence-based protocols to proactively identify individuals at nutritional risk and ensure the timely initiation of appropriate nutritional interventions. As outlined in the 2017 guidelines of the European Society for Clinical Nutrition and Metabolism (ESPEN), all individuals interacting with the healthcare system should undergo validated nutrition risk screening within the first 24 to 48 hours of admission, followed by periodic reassessments. Patients classified as at risk based on this initial screening must subsequently receive a thorough and individualized nutritional evaluation.[1] Various validated screening tools—some designed to predict clinical outcomes and others to identify individuals likely to benefit from nutritional intervention—are available. These tools typically assess BMI, weight loss, food intake, disease severity, and age.

Different screening tools have been developed for varied patient cohorts and care settings: the Malnutrition Universal Screening Tool (MUST) for adults in hospital or community settings;[9] NRS-2002 for hospitalized adults;[10] the Mini Nutritional Assessment (MNA) for older adults in diverse care environments;[11] the Short Nutritional Assessment Questionnaire (SNAQ) for broad care settings;[12] the Malnutrition Screening Tool (MST), especially in inpatient settings;[13] NUTRIC for critically ill patients;[14] the Nutritional Risk Index (NRI) for surgical, chemotherapy, or intensively treated hospital patients;[15] and the Subjective Global Assessment (SGA), commonly used in hospitalized cancer patients.[16]

ESPEN recommends NRS-2002 and MUST for adults, and MNA for older individuals, while the American Society for Parenteral and Enteral Nutrition (ASPEN) endorses MUST, NRS-2002, SGA, and MNA.[1,17]

Nutritional Requirements

Nutritional requirements denote the daily intake of energy and essential nutrients needed to sustain optimal physiological function and promote healthy growth and development. These requirements are influenced by a range of individual factors, including age, sex, body composition, physical activity level, and underlying physiological or pathological conditions. In clinical and public health contexts, they are generally represented as population-based averages to guide nutritional planning and assessment.[18] Research has produced numerous equations for estimating basal energy expenditure, with the Harris–Benedict equation still widely used.[19] On average, adult males require 2600-2800 kcal/day and adult females 2000-2200 kcal/day, though these values vary depending on activity and physiological status.[20]

In clinical care settings, international guidelines provide specific requirements for patient groups frequently needing nutritional support. Critically ill patients require 25-30 kcal/kg/day, with low-calorie EN initiation (12-25 kcal/kg) followed by gradual titration to target over 3-10 days, and protein needs of approximately 1.3 g/kg/day—up to 1.7 g/kg/day in those undergoing renal replacement therapy.[21,22] Cancer patients have similar energy needs (25-30 kcal/kg/day) with protein requirements of 1.2-1.5 g/kg/day, adjustable per disease progression and treatment phase.[23] Geriatric patients require about 30 kcal/kg/day and 1.0 g/kg/day of protein, which may increase to 1.5 g/kg/day during acute illness or trauma.[24] Renal failure patients nutritional needs vary depending on whether they experience acute kidney injury (AKI) or chronic kidney disease (CKD), and whether they receive dialysis. AKI patients generally need 20-30 kcal/kg/day, with protein requirements ranging from 1.0 g/kg/day to 1.3 g/kg/day (non-dialysis), 1.3-1.5 g/kg/day (intermittent dialysis), and 1.5-1.7 g/kg/day (continuous renal replacement therapy). Chronic kidney disease patients require a different strategy: 30-35 kcal/kg/day with a reduced protein intake of 0.55-0.6 g/kg/day, increased to AKI-levels in those also receiving dialysis[25] (Table 1).

Table 1. Nutritional Requirements by Patient Group in Enteral Nutrition

Patient Group	Energy Requirement	Protein Requirement
Critically ill patient	25-30 kcal/kg/day	1.3-1.7 g/kg/day
Cancer patient	25-30 kcal/kg/day	1.2-1.5 g/kg/day
Geriatric patient	30 kcal/kg/day	1.0-1.5 g/kg/day
Renal failure patient Acute kidney injury Chronic kidney disease	20-30 kcal/kg/day 30-35 kcal/kg/day	1-1.7 g/kg/day 0.55-0.6 g/kg/day

Nutrition Care Plan

Following the completion of nutrition risk screening and a thorough dietary assessment, the development of a personalized nutrition care plan becomes essential. This plan should provide a clear rationale for the selected nutritional intervention, define specific and measurable short-term and long-term goals, and delineate a structured approach for ongoing monitoring and periodic re-evaluation. Key components of the care plan should encompass: precise calculations of daily energy, macronutrient (carbohydrates, proteins, fats), and fluid requirements; the chosen route and modality of nutritional support (oral, enteral, or parenteral); comprehensive implementation guidelines; the anticipated duration of therapy; designated clinical and biochemical markers to be monitored; frequency of follow-up assessments; and detailed discharge and transition planning. Additionally, provisions for patient and caregiver education, especially in the context of home-based nutritional care, should be clearly outlined to ensure continuity and adherence.[1]

BASICS OF ENTERAL NUTRITION

Indications and Contraindications

Enteral nutrition is considered when the GI system is functional but oral intake fails to meet nutritional requirements, as either a supplementary or a complete feeding strategy. A functional and accessible GI tract is essential; conditions such as malabsorption, complete bowel obstruction, high-volume enteric fistulas, or lack of GI access constitute contraindications.[3,26]

Indications include mechanical ventilation, severe traumatic brain injury, neuromuscular disorders impairing swallowing (e.g., Parkinson's disease, multiple sclerosis, stroke), severe anorexia due to chemotherapy or sepsis, upper GI obstruction (e.g., tumors, strictures), elevated metabolic demands (e.g., sepsis, cystic fibrosis, burns), and cognitive impairment (e.g., dementia).[3,27,28]

Feeding Tubes and Routes

Various enteral feeding tubes—made of polyurethane or silicone—are measured in French (Fr) units (1 Fr = 0.33 mm) and categorized based on placement site:

- **Nasogastric (NG):** Used when safe passage to the stomach is assured; commonly 5-8 Fr.
- **Nasoduodenal/Nasojejunal (ND/NJ):** Tip positioned in the duodenum or jejunum.
- **Gastrostomy (PEG):** Endoscopically inserted through the abdominal wall into the stomach for long-term feeding.
- **Jejunostomy (PEJ):** Endoscopically placed into the jejunum for specialized cases.

Gastric feeds are easier to place and mimic physiological feeding, while jejunal feeds generally require continuous infusion due to intolerance of bolus administration.[1,3,26]

Administration Methods

Depending on tube type and feeding formula, delivery is via:

- **Bolus/intermittent feeding:** 3-6 times daily over 20-60 minutes via pump or gravity; bolus delivery over 4-10 minutes approximates physiologic feeding but increases aspiration risk and is unsuitable for post-pyloric feeds.
- **Continuous feeding:** 16-24 hours per day via pump; more tolerable but restricts mobility and requires equipment—preferred for jejunal feeds and high-calorie formulas.[3,29]

Enteral Nutrition Formulas

Formula selection is based on nutritional assessment, physical and GI status, medical history, metabolic abnormalities, and patient goals.[30] Energy density typically ranges from 1.0 kcal/mL to 2.0 kcal/mL, with diverse macronutrient and micronutrient sources.[31,32]

- **Standard formulas:** Meet general population needs (~1.5 L/day), often lactose- and gluten-free with added fiber.
- **Energy-dense formulas:**

- Normal: 0.9-1.2 kcal/mL
- High: >1.2 kcal/mL
- Low energy: <0.9 kcal/mL

- **High-protein formulas:** ≥20% calories from protein.
- **Fiber-containing:** Include soluble/insoluble fiber to support GI health.
- **Disease-specific formulas:** Tailored macronutrient and micronutrient profiles for COPD, ARDS, wound healing, CKD/dialysis, liver failure, or immunocompromised states.

Standard formulas are preferred in patients requiring EN due to expense, insurance coverage, and varying evidence for specialized products. Energy-dense products are useful for fluid-restricted states (e.g., heart failure, CKD, SIADH), with bolus or nocturnal feeding as practical options. High-protein formulas support dialysis patients and those with pressure ulcers, while fiber formulas address diarrhea or constipation. Renal formulas are suitable for patients with fluid or electrolyte imbalances.[31]

Complications of Enteral Nutrition

Enteral nutrition-related complications fall into 4 categories: gastrointestinal (diarrhea, constipation, nausea/vomiting), mechanical (tube obstruction), infectious (aspiration pneumonia), and metabolic (refeeding syndrome).

Diarrhea: Diarrhea is clinically defined as the passage of more than 3-5 liquid or semi-liquid stools per day, exceeding a total volume of 200-250 g daily (Sobotka et al., 2012). It affects approximately 15-18% of critically ill patients receiving EN, in contrast to a 6% incidence among those not on EN.[33] Although its precise pathophysiology remains incompletely understood, alterations in gastrointestinal transit time and shifts in gut microbiota composition are believed to play contributory roles. Common pharmacological triggers include antacids, magnesium- or phosphate-containing supplements, hyperosmolar solutions such as those containing sorbitol, and broad-spectrum antibiotics. When diarrhea persists despite discontinuation of these agents, clinical management typically involves the use of fiber-enriched EN formulas, transitioning from bolus or intermittent to continuous feeding regimens, or reducing the rate of nutrient infusion. Importantly, EN should not be discontinued solely due to diarrhea unless absolutely warranted by the patient's clinical condition.[3,29,34]

Constipation: Constipation is a relatively less common complication in patients receiving EN and must be carefully differentiated from mechanical bowel obstruction. It is frequently associated with factors such as reduced physical activity, impaired gastrointestinal motility, inadequate fluid intake, and insufficient dietary fiber. Management typically begins with ensuring optimal hydration and the administration of fiber-enriched enteral formulas, which are often sufficient to restore normal bowel function. In cases where constipation persists despite these measures, pharmacologic interventions such as stool softeners or stimulant laxatives may be warranted to facilitate bowel movements.[29,35]

Nausea/Vomiting: Nausea and vomiting are observed in approximately 20% of patients receiving EN and are clinically significant due to their strong association with an increased risk of aspiration pneumonia.[35] The predominant underlying mechanism is delayed gastric emptying, a condition particularly prevalent in intensive care settings. Effective management involves a multifaceted approach, including a thorough review of the patient's pharmacotherapy regimen, incorporation of fiber-enriched formulas, reduction of the nutrient infusion rate, and, when indicated, the initiation of prokinetic agents to enhance gastric motility.[26,29]

Tube obstruction: Feeding tube occlusion is a commonly encountered mechanical complication in EN, typically resulting from formula coagulation, insufficient flushing practices, or precipitation of administered medications. When such obstruction occurs, clinical management generally prioritizes tube salvage over replacement. The recommended first-line intervention involves the application of gentle pressure using warm water aspiration to dislodge the blockage, thereby preserving tube integrity and minimizing patient discomfort.[29]

Aspiration: Aspiration is a serious and potentially life-threatening complication of EN, most commonly presenting in the later phases of therapy. Its etiology is multifactorial, with contributing factors such as inadequate tube flushing, coagulation of enteral formulas, the use of high-energy or fiber-enriched feeds, and administration of medications with a high risk of precipitation.[29,36] Several clinical risk factors have been identified, including mechanical ventilation, advanced age (>70 years), reduced levels of consciousness, poor oral hygiene, neurological impairments, gastroesophageal reflux disease (GERD), and the use of bolus feeding techniques.[37] Preventive strategies center on reducing aspiration risk through head-of-bed elevation, transitioning to post-pyloric or percutaneous endoscopic gastrostomy (PEG) feeding routes when appropriate, and initiating prokinetic agents to facilitate gastric emptying and improve feeding tolerance.[37,38]

Refeeding syndrome: A potentially fatal state characterized by electrolyte and fluid shifts—especially hypophosphatemia and hypokalemia—occurring 4 days after initiating nutrition in malnourished patients. It is common among those with anorexia, alcoholism, short bowel syndrome, or hyperemesis. Prevention includes gradual refeeding and thiamine supplementation.[39,40]

When Enteral Nutrition is Insufficient: Total Parenteral Nutrition and Supplemental Parenteral Nutrition Strategies

If EN is contraindicated or fails to meet >60% of energy and protein needs, consideration of total parenteral nutrition (TPN) or supplemental parenteral nutrition (SPN) is warranted. Guidelines recommend tapering and discontinuing PN when EN exceeds 60% of requirements.[21,38]

THE PHARMACIST'S ROLE IN ENTERAL NUTRITION

Effective EN management—spanning formula selection, stability issues, drug administration, and tube complications—requires multidisciplinary coordination.[3,6] Optimal care involves collaboration among physicians, nurses, pharmacists, and dietitians,[41] with pharmacists playing essential roles in ensuring nutritional adequacy.[7] International literature emphasizes pharmacists' integration at every phase of clinical nutrition. Pharmacists review patient records to assess medical conditions, concurrent medication use, and laboratory results; collaborate in determining energy, protein, vitamin, and mineral requirements; support risk assessment alongside the multidisciplinary team; and contribute to personalized nutrition care planning, including formula selection, route of administration, and timing. They ensure formulation safety, efficacy, and cost-effectiveness, developing protocols for stability and compatibility monitoring. Throughout monitoring, pharmacists oversee treatment effectiveness and metabolic parameters (e.g., glucose, liver and renal function, electrolytes), detecting and mitigating potential complications. They manage drug–nutrition interactions, ensuring proper timing of medications, evaluating nutrient impact on drug pharmacokinetics, verifying PN–medication compatibility, and reviewing patient data to prevent lab-detected interactions. Moreover, pharmacists provide education to healthcare professionals and caregivers about nutrition therapy objectives, side effects, and management strategies, while also contributing to the organization, delivery, and protocol development of nutrition support services.[5-7,42]

Numerous studies have demonstrated the impact of pharmacist intervention through participation in nutrition teams or improved guideline adherence. Zhou et al reported an 85% acceptance rate for 247 pharmacist recommendations in an ICU setting, across PN prescriptions (33%), EN formula and route (13%), nutrition indications (13%), and supplementation (12%).[43] Özgan et al significantly improved energy and protein intake in ICU patients with renal dysfunction through interventions involving EN formula adjustments, infusion rate changes, and vitamin supplementation, achieving a 96.2% acceptance rate.[44] Çakır et al documented clinical nutrition contributions including initiation of feeding (9.86%), dose adjustments (28.17%), protein modifications (35.21%), and complication management (15.49%), leading to higher caloric and protein intake.[45] Cerulli and Malone found that 85% of drug-related problems identified in 30% of nutrition support patients were resolved by pharmacist intervention.[46] In another study, Giancarelli and Davanos reported 84% acceptance of pharmacist recommendations spanning fluid/electrolyte management, glucose control, lab monitoring, vitamin/mineral supplementation, and drug changes.[47] Moreover, studies have shown that pharmacists play a key role in optimizing medication administration techniques for patients receiving drugs via enteral feeding tubes. Their contributions not only improve the competence of physicians and nurses but also help reduce medication error rates and enhance the overall safety of enteral pharmacotherapy.[48-51] These studies demonstrate that pharmacist interventions in clinical nutrition are not merely theoretical contributions but have tangible, measurable impacts on patient outcomes. The examples provided highlight how pharmacists offer individualized support through patient-specific assessments, including dose adjustments, formula modifications, complication management, and enhancement of nutritional support adherence. Moreover, the high acceptance rates of pharmacist recommendations reflect the extent to which multidisciplinary teams value and incorporate their expertise into clinical decision-making. In this regard, case-based evidence not only documents effective interventions but also serves as a guide for the advancement of clinical pharmacy practice. Clearly defining and supporting the active role of pharmacists in this field is essential for improving the quality and consistency of clinical nutrition services.

Future Perspectives and Research Needs

Technological innovations and evolving models of care have rapidly expanded the pharmacist's role in nutrition support. Integration with electronic health records and intelligent infusion systems enhances dosing accuracy and traceability; pharmacists play a pivotal role in embedding these digital tools within clinical workflows.[52] As home-based care increasingly replaces inpatient care, pharmacists have assumed greater responsibility in coordinating enteral support outside hospital walls by training caregivers, monitoring patients, and ensuring treatment continuity.[53]

Furthermore, artificial intelligence (AI) has transformative potential in clinical nutrition. Artificial intelligence can accelerate nutritional assessments, analyze complex data to inform personalized interventions, and facilitate pharmacists in providing evidence-based nutrition recommendations. Pharmacists are vital for ensuring these tools are securely integrated into clinical practice and adhere to patient safety standards.[52]

Current Situation in Türkiye

The Turkish Society for Clinical Enteral and Parenteral Nutrition acknowledges pharmacists' roles in nutrition comprehensively, clearly defining their duties, authorities, and responsibilities (https://www.kepan.org.tr/icerik.php?id=348, Accessed June 1, 2025). Pharmacists act as integral members of nutrition support teams, contributing to the development and implementation of national guidelines. Yet, only 2 of 51 pharmacy schools in Türkiye offer clinical nutrition as an elective.[54] With the establishment of specialist training in 2017, clinical pharmacists have actively engaged in EN, contributing significantly to its practice; these contributions are documented in national and international journals.[44,45,48]

However, several barriers continue to limit the active involvement of pharmacists in nutrition care in Türkiye. These include the limited number of pharmacists with clinical experience in nutrition, the absence of clinical pharmacy positions in many hospitals, the lack of fully functional nutrition support teams or the restricted institutional integration of clinical pharmacists into such teams, the lack of clearly defined pharmacist roles in many healthcare institutions, and inconsistent institutional support for pharmacist-led nutritional care services. Furthermore, variability in the inclusion of clinical nutrition topics across pharmacy school curricula remains a limiting factor in terms of professional readiness. These challenges emphasize the need for stronger structural integration of pharmacists into multidisciplinary nutrition teams.

To strengthen Turkish pharmacists' integration into EN processes, it is essential to expand educational curricula and specialist training programs. While current studies are promising, more robust, long-term clinical outcomes research is needed. Enhancing pharmacists' visibility and systematic participation in nutrition support teams will strengthen multidisciplinary clinical care and improve patient outcomes. Consequently, supporting research documenting pharmacists' contributions and promoting their active roles in clinical nutritional practice should be prioritized as strategic goals in national health policy and scientific advancement.

CONCLUSION

Enteral nutrition has become an indispensable, high-value intervention in modern medicine that directly influences clinical outcomes. As shown in this review, EN requires not only implementation but also accurate indication assessment, needs analysis, complication management, and personalized care planning. Throughout this continuum, pharmacists—with their expertise in pharmacotherapy, nutrition science, and patient safety—have become integral to nutrition support teams.

Pharmacists' roles extend well beyond formula preparation or stability monitoring; they involve preventing drug-nutrition interactions, tailoring nutrition plans to individual needs, tracking monitoring parameters, and educating healthcare professionals. National and international literature demonstrates that pharmacists' involvement in clinical nutrition enhances treatment efficacy, reduces complications, and improves adherence to guidelines.

In conclusion, the contributions of pharmacists to EN are not merely supportive but play a central role in enhancing the quality of patient care and ensuring patient safety. Effective clinical nutrition requires interdisciplinary collaboration, and the systematic integration of pharmacists into the nutrition care process is essential for the sustainability of EN programs. This integration also supports the achievement of optimal clinical outcomes, cost-effectiveness, and the prevention of nutrition-related complications. As healthcare systems increasingly shift toward personalized, value-based care, pharmacists' involvement in nutrition therapy becomes even more critical to delivering comprehensive, safe, and efficient patient-centered services.

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