



Position paper

Safety, quality, and care of nutritional access routes and education of patients/healthcare givers: consensus report from KEPAN



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ABSTRACT

Background/Aim: Nutritional care also encompasses the evidence-based care of enteral and parenteral nutrition access routes and patient/caregiver education, aiming to minimize nutrition-related complications and optimize outcomes. Turkish Enteral Parenteral Nutrition Society (KEPAN) aimed to develop a consensus report to provide concise, clear, and practical recommendations for all healthcare givers to improve the care of nutritional access routes and ensure safety.

Methods: This consensus report was developed by a 12-member working group through a five-phase process conducted over 18 mo (February 2024 to August 2025), involving 6 face-to-face and 18 online meetings. Eighteen questions were identified across 4 sections: 1) Safety of the patient and caregiver and ensuring standard patient care, 2) Care of access routes in enteral nutrition, 3) Care of access routes in parenteral nutrition, and 4) Patient/caregiver education. Recommendations and comments were developed through a systematic literature review, meta-analyses, and randomized controlled trials published after 2010 in the EMBASE, PubMed, and Cochrane databases. Finally, the recommendations were sent to KEPAN extended consensus group, comprising 43 members, using a Delphi methodology. All 18 recommendations were accepted in the first Delphi round, with no items rejected; only minor comments were raised during the first and second rounds. The final report was approved by all 43 panelists without further revision.

Results: The consensus report emphasizes standardized protocols and patient safety practices in nutritional care. Key recommendations address safe management of nutritional access routes, including feeding tube positioning and patency, gastrostomy/jejunostomy and catheter/port care, prevention and management of access-related complications, safe medication administration, and structured patient/caregiver education for home nutritional therapy. **Conclusions:** This consensus report offers a practical and standardized reference for healthcare professionals involved in clinical nutritional therapy. These recommendations are intended to complement international guidelines and to be applied in consideration of individual patient characteristics, available resources, and local clinical practices.

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Introduction

Nutritional care is a patient-centered, interdisciplinary process that comprises comprehensive nutritional assessment and the implementation of individualized nutrition therapy. It also encompasses the evidence-based care of enteral and parenteral nutrition (PN) access routes and the education of patients and caregivers, with the aim of minimizing nutrition-related complications and optimizing clinical outcomes [1–3]. Among these components, the safe and effective management of nutritional access routes plays a critical role, as it directly determines the successful delivery of nutrition therapy and the prevention of access-related complications [4–6].

Coordinated interdisciplinary teamwork is essential for safe and efficient nutritional care [7]. Consistent implementation of evidence-based practices by all healthcare professionals is the cornerstone for minimizing nutrition-related complications and ensuring high-quality, standardized care [8–10]. It is expected that practical, clear, and concise recommendations on the safety, quality, and care of nutritional access routes, along with the education of healthcare providers, will increase the success of nutritional care. In this regard, a working group comprising physicians, dietitians, nurses, and clinical pharmacists was convened to develop a consensus report in this field. This consensus report addresses the care of both enteral and parenteral access routes in an integrated manner within a comprehensive guideline, encompassing the care and safety of access routes, management of complications, and the education of patients and caregivers.

Study groups and methodology

This report was initially developed by the working group and presented to the extended consensus group. The working group was comprised of 12 experts: 1 Internal Medicine/Geriatrics (MGH), 1 Internal Medicine/Gastroenterologist (NO), 2 General Surgery (OA, MD), 1 Pediatrics/Gastroenterology (ZK), 1 Anesthesiology and Reanimation/Intensive Care (HU), 1 Clinical Pharmacist (BKC), 4 Nurses (KA, RES, DS, EK), and 1 Dietitian (PT). The group leader was MGH. In addition to serving as the group chair, OA is the group chair for the KEPAN extended consensus report. The extended consensus group consisted of 43 members who had previously contributed to the KEPAN consensus reports on oral nutritional supplements, parenteral nutrition, and enteral nutrition (EN) [11–13]. All the participants filled the International Committee of Medical Journal Editors (ICMJE) conflict of interest forms.

In Phase 1, the consensus group leader (MGH) and KEPAN extended consensus report group chair (OA) conducted a face-to-face meeting to determine the content of the guideline, including the topics and questions. The content was aimed to include the questions and subjects confronted in clinical nutrition practice. During this meeting, 18 PICO-formatted (Population, Intervention, Comparison, Outcome) clinical questions were developed across four sections (Section 1: Safety of the patient and caregiver and ensuring standard patient care; Section 2: Care of access routes in enteral nutrition; Section 3: Care of access routes in parenteral nutrition; and Section 4: Patient/caregiver education) to enhance clinical applicability (Table 1).

In Phase 2, the group leader allocated the 18 questions among the 12-member working group, with each question being independently reviewed by two members. This approach ensured that each question was supported by evidence-based recommendations derived from a systematic literature review conducted by members with expertise in the relevant clinical field. All the members were asked to constitute a “recommendation” and a “comment”

for each question. Members were also sent instructions on how to conduct the literature review. The content was asked to be created via a review of the meta-analysis, systematic review, and randomized controlled studies published in English in the EMBASE, PubMed, and Cochrane databases, after 2010. When these publications were insufficient or absent, observational studies (prospective or retrospective) were considered. International clinical nutrition guideline reports were also included whenever needed. The major keyword was “nutritional care,” and this keyword was co-used with the corresponding question title, including EN, gastrostomy, jejunostomy, tube feeding, PN, central venous catheter (CVC), safety, quality, education, enteral access, parenteral access, drug administration. The group members sent the summaries of all studies they used when constituting the recommendations and comments. All recommendations were stated as follows: 1) Should be performed, 2) can be performed, and 3) no clear evidence.

In Phase 3, the response to each question was evaluated by the group leader, the extended consensus group chair, and the two members responsible for that question until consensus was achieved. Following the evaluation of all questions, the draft recommendations were circulated to the entire 12-member working group in Phase 4 for review and feedback.

In Phase 5, a total of 18 questions and recommendations were sent to the 43 extended consensus group members via email. We used the modified Delphi consensus methodology. Delphi is a method of eliciting and refining group judgments [14] and is designed to facilitate structured group communications with a view to reaching a consensus in expert opinions in the face of complex problems, expensive endeavors, and uncertain outcomes, and has been used in similar studies with success [15–17]. We used the SurveyMonkey software as an established computerized process to achieve consensus via conducting Delphi rounds online. During the Delphi rounds, we asked each member (Delphi panelists) to indicate to what extent they agreed or disagreed with each recommendation for the questions/subjects, considering the available evidence and their own experience. We used a Likert scale to assess agreement on the recommendation, scored as follows: 1 = strongly agree; 2 = agree; 3 = neither agree nor disagree; 4 = disagree; and 5 = strongly disagree. Recommendations with >75–90% agreement among participants were considered to have achieved consensus, whereas those with >90% agreement were considered to have achieved strong consensus.

The panelists were provided the opportunity to comment on each recommendation and add suggestions to the recommendations by referring to literature data. We calculated the median and interquartile range values for each recommendation in each iteration of the Delphi round. Criteria with median value of 1 or 2 and 75th centile value of 1 or 2 were accepted. Accepted criteria were included in the final consensus report. Criteria with median value >2 were rejected and removed. Criteria with median value 1 or 2 but 75th centile value >2 were reserved to be assessed in the next round. Henceforward, neither rejected nor accepted criteria composed the content of the next Delphi round to be reconsidered by the panelists. The suggestions that were provided by the Delphi panelists were evaluated by the consensus report group leader and chair, and the recommendations were modified, provided that those suggestions were according to the current evidence. We provided the scores, 75th centile values, and the comments of the panelists related to those recommendations. Subsequently, we proceeded to the next Delphi round, once again inviting the panelists to score for agreement and comment on each criterion. Panelists rescored the criteria using the Likert scale in the next Delphi rounds, considering the prior scoring values related to those reserved recommendations. This approach was applied to reject,

Table 1

Topics (questions) in KEPAN nutritional care consensus report

Section 1: Safety of the patient and caregiver and ensuring standard patient care 1. Is there a need for standardized protocols in management of patients receiving nutritional therapy? 2. Which safety precautions are recommended for the caregivers of patients receiving nutritional therapy? 3. How should the evaluation of patient safety in healthcare institutions providing nutritional therapy be conducted? Section 2: Care of access routes in enteral nutrition 1. After inserting a (nasogastric or nasoenteral) feeding tube, how the correct position can be verified? 2. What is the appropriate hanging time for products and the frequency for changing sets in enteral feeding? 3. What strategies need to be implemented to prevent tube obstruction in enteral nutrition? 4. What should be done in case of a tube obstruction during enteral feeding? 5. In which conditions related to access routes should enteral feeding be interrupted? 6. What is the appropriate method for the care of peristomal area in patients with gastrostomy/jejunostomy? a. Which dressing should be used? b. Which solution is recommended? c. How often the dressing should be changed? 7. What is the appropriate management of complications related to gastrostomy/jejunostomy tubes? a. Peristomal leakage b. Buried bumper syndrome c. Hypergranulation tissue d. Peristomal infection e. Bleeding 8. What should be done in case of gastrostomy/jejunostomy tube dislodgement? 9. What should be considered when administering medication via a feeding tube? Section 3: Care of access routes in parenteral nutrition 1. What is the proper approach for catheter care in patients receiving parenteral nutrition through a central venous catheter? a. Which solution is recommended? b. Which dressing should be used? c. How often the dressing should be changed? 2. What is the proper approach for managing ports in patients receiving parenteral nutrition via an implanted port? a. Replacement of the implanted port needle b. Care of implanted port during parenteral nutrition 3. What precautions should be taken to prevent catheter-related infections in patients receiving parenteral nutrition via central venous catheter? a. How should be hand hygiene ensured? b. What precautions should be taken when using catheter sets and connection lines during the insertion and disconnection? c. How should be the catheter closed/locked? d. Can the catheter be used for practices other than parenteral nutrition? (Blood sampling, blood transfusion, central venous pressure measurement, medication administration, etc.) 4. What is the proper approach for managing venous access in patients receiving peripheral parenteral nutrition? a. How to choose venous access route? b. Which types of catheters should be used? c. How often should the catheters be changed? 5. What is the proper approach for managing medication administration in patients receiving parenteral nutrition? a. What precautions should be taken to ensure the stability of the nutrition solution and prevent drug-nutrient incompatibility? b. Which procedures should be implemented to avoid contamination during parenteral nutrition? Section 4: Patient/caregiver education 1. What are the essentials of education for patients/caregivers for home nutrition therapy?
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accept, or reserve the criteria for the next Delphi rounds. On the basis of this outlined concept, we planned to go on with the Delphi rounds until a consensus was reached for rejection or acceptance of each recommendation.

The consensus process was conducted over 18 mo (February 2024 to August 2025), during which a total of 6 face-to-face and 18 online meetings were held (Fig. 1). The first round of the Delphi study resulted in acceptance of all 18 recommendations. None of the criteria were rejected. Only some minor comments were recommended by the panelists during the first and second rounds of Delphi study. The final report was sent to all 43 panelists and was approved without any further suggestions.

Consensus statements

Section 1: Safety of the patient and caregiver and ensuring standard patient care

Question 1.1

Is there a need for standardized protocols in management of patients receiving nutritional therapy?

Recommendation 1.1

Standardized protocols are recommended for the effective and safe management of patients receiving nutritional therapy.

—Strong consensus (100% agreement)

Comment 1.1

Protocols are based on evidence-based guidelines to ensure patient safety, prevent complications, and optimize treatment processes [2,18]. Well-designed protocols contribute to shorter hospital stays, fewer complications, and lower mortality rates [19,20]. The literature includes studies indicating that nutrition protocols may be effective in helping patients achieve caloric targets and improving clinical outcomes [21,22]. The enteral feeding transition protocol enhance nurses' knowledge and confidence while providing nutritional assistance and facilitate the transition from tube feeding to oral intake [21,23].

To ensure the safe delivery of nutrition therapy for patients, the ALERT (*Aseptic technique, Label the enteral equipment, Elevate the head of the bed, Right patient, right formula and right tube, Trace all lines back to the patient*) protocol was established in 2009, followed by the AWARE (*Ask the pharmacist about drug-related matters, Water only, Administer the medication, Remember the rights, Establish evidence-based protocols*) protocol in 2010, and the READY

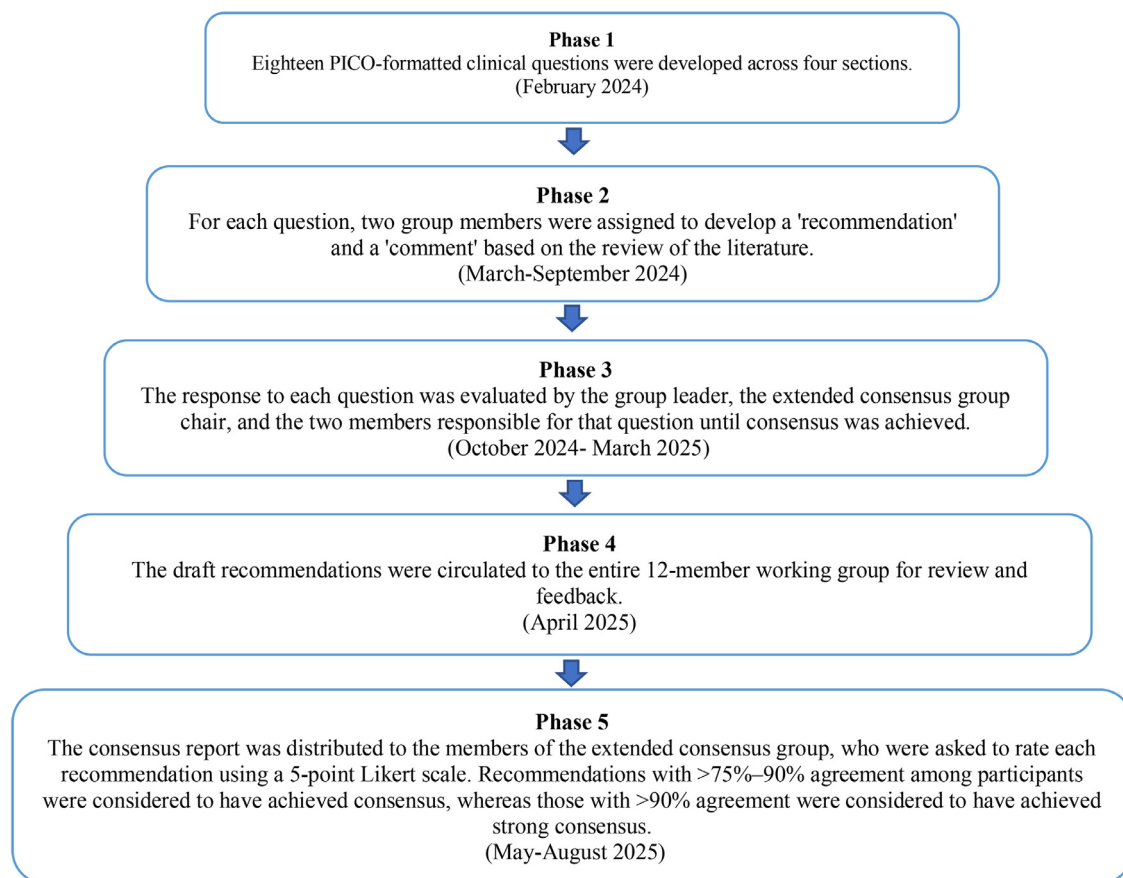


Fig. 1. Flowchart of the different stages of the study protocol.

(**R**ight patient, **r**ight product and **r**ight tube, **E**arly start to enteral feeding, **A**ssure proper preparation and handling, **D**eliver the formula appropriately, **Y**our safety checklist) protocol in 2011 [24].

Care bundles and checklists were developed by the Institute for Healthcare Improvement (IHI) in 2001. The main goal of the care bundle is to ensure the implementation of evidence-based practices by healthcare professionals, thereby establishing a standard in patient care [25]. One example is the Sezer gastrostomy care bundle, which was developed to integrate nursing practices in gastrostomy care and enhance the quality of nursing care. This bundle consists of 14 practices steps, including peristomal area care, tube feeding, and tube medication administration [25]. Additional approaches include checklists. A checklist has been developed for the administration of medications via enteral tubes. This checklist includes items related to the preparation and administration of medications in solid/liquid dosage forms via enteral tubes. The implementation of the checklist has been reported to reduce errors in the administration of medications via tubes [26].

Question 1.2

Which safety precautions are recommended for the caregivers of patients receiving nutritional therapy?

Recommendation 1.2

Planning and programs for caregivers should be organized by an interdisciplinary team of healthcare professionals. Caregivers should be instructed on potential challenges they may face in practice and strategies for addressing them. Multifaceted solution suggestions are feasible when patients are incorporated into the

treatment and discharge planning process, afforded time to acclimate and learn, and a checklist is utilized at the conclusion of the educational phase. Caregivers are advised to safeguard their physical and emotional well-being, receive assistance in cultivating problem-solving abilities, and undergo frequent assessments of their quality of life.

—Strong consensus (95% agreement)

Comment 1.2

Caregivers are responsible for administering medication, avoiding and managing problems, maintaining the access route, and initiating and monitoring nutritional therapy [27]. As the patient's condition deteriorates, family caregivers exhibit a decline in their physical health, alongside an escalation in detrimental behaviors such as smoking, tiredness, and sleep disturbances [28–30]. A follow-up is necessary postdischarge, and caregivers must receive education on nutritional care [31]. In a research examining caregivers who deliver PN at home, 73% indicated they had not received training on basic practices, including PN connections and catheter care [30]. Caregivers should be informed about crucial scenarios and preventive strategies to safeguard their physical health, including injuries from sharp or pointed instruments, as well as exposure to allergic, cytotoxic, and teratogenic substances via contact or inhalation of crushed or compromised drugs. Alongside the technical aspects of operating the feeding pump, it is crucial to elucidate the integration of nutritional therapy into daily life, potential practical challenges, and strategies for addressing these challenges. It is essential to address their experiences, provide support, and allow self-expression [28,32,33]. The European

Society for Clinical Nutrition and Metabolism (ESPEN) advocates for the routine evaluation of the quality of life of patients and caregivers to assess the impact of home nutrition therapy on their lives [33,34]. Using a postdischarge education checklist can help identify caregivers' educational needs, the challenges they may have once returning home, and facilitate further predischARGE education.

Question 1.3

How should the evaluation of patient safety in healthcare institutions providing nutritional therapy be conducted?

—Strong consensus (95% agreement)

Recommendation 1.3

A safety culture should be developed for the healthcare institutions providing nutritional therapy. Safety culture can be audited by relevant committees within healthcare institutions or by a national patient safety organization. Accreditation programs may help to implement safe and effective nutritional therapy and improve patient care.

Comment 1.3

Safety culture is characterized by an emphasis on recognizing and addressing the root causes of errors, rather than attributing blame to individuals. The establishment and maintenance of a safety culture requires the identification of potential risks at every stage of the process and the systematic documentation of all errors. Safety culture can be audited by relevant committees within healthcare institutions or by a national patient safety organization. Healthcare institutions may promote a safety culture by ensuring that professionals are not penalized for reporting errors or near misses, and instead are provided with opportunities for learning [2,33]. Accreditation programs are essential for developing a safety culture, as they evaluate and improve the quality of healthcare services. The Turkish Enteral and Parenteral Nutrition Society (KEPAN) has established the first accreditation program for nutritional support teams, aimed to improve the quality of nutritional care and patient outcomes. The accreditation program includes a total of 22 standards under 13 sections: "goals and objectives," "structure and management," "nutrition support unit training program," "competencies and training of the nutrition support unit members," "facilities and resources for learning," "patient safety," "health and safety of healthcare professionals," "assessment and care of patients," "patient and family education and feedback," "quality improvement," "material and equipment management," "management of information" and "management of document." These standards include 61 criteria. To be accredited, each of the 22 standards must score over 70, and each of the 13 sections must score over 80 according to the special scoring system [35].

Section 2: Care of access routes in enteral nutrition

Question 2.1

After inserting a (nasogastric or nasoenteral) feeding tube, how the correct position can be verified?

Recommendation 2.1

The location of the feeding tube should be verified before starting feeding. The most reliable method is direct radiography. When direct radiography is not feasible, ultrasonography can be used. Verifying tube placement via auscultation is not an evidence-based practice and is not recommended.

Additional recommendation for the pediatric age group: Providing a definitive recommendation for verifying tube placement in pediatric patients is challenging. Measuring the pH in stomach aspirate

is advised; if this method is inconclusive, a direct radiography is recommended.

—Strong consensus (93% agreement)

Comment 2.1

Misplacement of enteral feeding tubes can lead to serious complications such as pneumonia, pneumothorax, hemothorax, and esophageal perforation [36–38]. There are no randomized-controlled studies to verify the placement of a feeding tube after insertion. The majority of recommendations are supported by expert opinions and observational studies [36].

Direct radiography is the recommended gold standard for verifying tube placement [2,37,39–42]. After the tube placement is confirmed with direct radiography, marking the exit point of the tube from the nose (or from the mouth for an orogastric tube) with indelible ink or adhesive tape can be useful for determining subsequent tube displacement. In cases where the marker's position is shifted or unclear, the direct radiography should be repeated [43–45].

Ultrasound alone is not reliable for determining tube placement [37,46], but it can be useful when direct radiography is not possible. The reliability of ultrasonography can be increased by administering air or water during imaging. In addition to these two methods, auscultation, pH measurement, and capnography are used to confirm tube placement [39]. Auscultation is not an evidence-based method and does not always correlate with direct radiography in determining the anatomical position of the tube tip; accordingly, confirmation of tube placement via auscultation is not included as an evidence-based practice in the guidelines [2,47,48]. pH measurement is the determination of the tube's position by dropping aspirated stomach contents onto pH strips [47]. In a study comparing pH measurement and auscultation methods for determining tube placement with direct radiographs, pH measurement was found to have a sensitivity of 78.4% and a specificity of 85.7%, while the auscultation method was found to be unreliable [49]. Capnography is a method based on measuring carbon dioxide from inside a tube; it is expensive and impractical. It does not show the tube's position in the gastrointestinal system, but it can help if the tube accidentally deviates toward the trachea during the insertion process [42].

There are different methods to confirm tube placement in children. Although direct radiography is the most reliable method, it is not recommended for every patient due to radiation exposure [50]. Auscultation-based confirmation performed by injecting air into the tube is also unreliable [51]. In its consensus report published in 2018, the American Society for Parenteral and Enteral Nutrition (ASPEN) recommends using gastric aspirate pH testing as the first-line choice for verifying tube placement. However, it is also emphasized that the pH test in children can be misleading due to gastroesophageal reflux or the buffering effect of milk [51]. There are studies reporting that bedside ultrasonography is 100% sensitive, but its reliability can vary depending on the person performing it [52]. It has been reported that capnography accurately shows the tube's position 98% of the time, but it is not widely used [51].

Question 2.2

What is the appropriate hanging time for products and the frequency for changing sets in enteral feeding?

Recommendation 2.2

Enteral feeding sets should be changed every 24 h. The hanging time of ready-to-hang EN products should not exceed 24 h. This period is 8 h for the products placed in the feeding bag at bedside.

Additional recommendation for the pediatric age group: Breast milk, pasteurized donor breast milk, powdered formulas, and

enteral feeding products with additives or dilutions should not hang for more than 4 h.

—Strong consensus (95% agreement)

Comment 2.2

EN sets can be used safely for up to 24 h [2]. To reduce the risk of contamination, it is important that the sets are single-use, that intermediate connections are minimized, and that aseptic techniques are applied during connections [53]. The hang time is the duration from the preparation or opening of the nutritional products, delivery into the body, to the finishing the bags and bottles [53]. In a study on the hanging time of EN products, it was shown that bacterial growth can begin if the hanging time of products prepared at the bedside exceeds 6.5 h. This study also reported that the risk of contamination could be reduced by storing the products at 4–8°C between bolus feedings [54]. The American Society for Parenteral and Enteral Nutrition (ASPEN) recommends that the suspension time for powdered products, EN products with additives or dilutions, breast milk, and pasteurized donor breast milk should not exceed 4 h [2]. Although there are studies showing this duration can extend up to 12 h, in common practice 8 h is considered safer [13].

Question 2.3

What strategies need to be implemented to prevent tube obstruction in EN?

Recommendation 2.3

The optimal approach to prevent tube obstruction is to flush the tube with water regularly. The tube should be flushed with 15–30 mL of drinking-quality water at least every 4 h during continuous feeding, and before and after intermittent feedings. Large-diameter tubes that do not compromise patient comfort can be preferred. Polyurethane tubes can preferentially be used.

—Strong consensus (97% agreement)

Comment 2.3

The most important causes of tube obstruction are inadequate flushing of the tubes and the accumulation of particles from drugs within the tubes [55]. Flushing the tube is a routine practice to prevent obstruction. Water was found to be superior to other methods in terms of effectiveness, accessibility, and cost [56,57]. Acidic and carbonated beverages can cause the proteins in the enteral feeding solution to precipitate inside the tube [58].

Frequent assessment of gastric residual volume may also contribute to feeding tube obstruction by promoting the formation of protein plugs within the tube [59].

The tube should be flushed with 15–30 mL of drinking-quality water at least every 4 h during continuous feeding. In patients receiving intermittent feeding, flushing should be performed before and after each feeding. If gastric residual volume measurements are performed, the tube should also be flushed before and after each measurement. Likewise, when medications are administered via the feeding tube, flushing with at least 15–30 mL of drinking-quality water should be performed both before and after medication administration [60,61].

It is generally recommended to use 20 mL of drinking water quality water for flushing the tubes in children, but smaller volumes should be used in infants or children at risk of fluid overload [62]. Sterile water is recommended for newborns, patients in intensive care units, and individuals with impaired immunity [2]. In the case of feeding tube obstruction, the structural properties of the tube (material, diameter, length, etc.) and the position of the distal end of the tube (stomach, duodenum, jejunum) should be

evaluated [33]. Medications or high-viscosity enteral formulas increase the risk of tube blockage. This risk is lower in large-bore (12–14 Fr) tubes [60,63,64]. However, it should be kept in mind that patient comfort decreases as the tube diameter increases, and the risk of pressure injury related to the tube may increase. There are studies showing that polyurethane tubes are superior to silicone tubes in maintaining tube patency [65]. A randomized controlled trial revealed that tube obstruction is more common with silicone tubes rather than polyurethane tubes [63].

Question 2.4

What should be done in case of a tube obstruction during enteral feeding?

Recommendation 2.4

In case of tube obstruction during enteral feeding, the most efficient and secure approach is to flush the tube with warm water. If the tube cannot be opened with warm water, combinations of bicarbonate and pancreatic enzymes can be utilized.

—Strong consensus (93% agreement)

Comment 2.4

The rate of enteral feeding tube obstruction varies between 12.5% and 45% [66,67]. If the tube is obstructed, the most efficient and secure approach is to unblock it with warm water. The tube is attempted to be opened by applying gentle pressure, pushing and pulling the plunger of a 30–60 mL syringe. Unblocking the tube may need more than 30 min [33,68]. This procedure can be repeated intermittently until the tube opens [33]. When tube obstruction cannot be resolved with warm water, formulations comprising both bicarbonate and pancreatic enzymes can be used [2,69]. In the administration of pancreatic enzymes, powdered or microsphere pancreatic enzyme preparations are integrated into a solution of water and sodium bicarbonate (1–1.5 teaspoons of sodium bicarbonate are mixed together in 100 mL of water, equivalent to 1 teacup, to which 1 capsule or tablet of pancreatic enzyme preparation is added) and this mixture can be left in the tube for 5–10 min, then flushed again with water to try to open the tube [70]. While studies indicate that frequently executing this treatment may avoid tube obstruction, it is essential to acknowledge its potential detrimental effects on the tube material [65,71]. The use of pancreatic enzymes depending on the prescription from a physician. Carbonated and acidic beverages are anticipated to disrupt the structural integrity of proteins in enteral feeding solutions, increasing the risk of obstruction and perhaps harming the inner wall of the tube; thus, their consumption is not recommended [68,72,73]. In situations where the tube is still obstructed, replacement is unfeasible, or replacement causes a higher risk to the patient, an experienced physician can try to clean the tube in a hospital setting by using cleaning brushes or guide wires specifically designed for caring for feeding tubes [33,68,69,74]. If the measures mentioned above prove ineffective, the tube should be replaced [74].

Question 2.5

In which conditions related to access routes should enteral feeding be interrupted?

Recommendation 2.5

Enteral feeding should be interrupted in case of tube displacement, severe peristomal leakage or bleeding, and buried bumper syndrome.

—Strong consensus (100% agreement)

Comment 2.5

One of the most common access problems in enteral feeding is incorrect tube placement. Aspiration caused by incorrect tube placement is a critical, life-threatening situation requiring intervention [2,75]. The location of the tube should be verified prior initiating EN. In conscious patients, the onset of pain at or near the exit site of a percutaneous endoscopic gastrostomy (PEG) tube, gastric-jejunal tube, or J tube, and in unconscious patients, alterations in vital signs (including elevated blood pressure or heart rate), increased agitation, and restlessness have been reported as indicators that the tubes may have become dislodged [76]. Bleeding is one of the causes for ceasing nutrition [77]. Bleeding following gastrostomy placement is typically caused to peptic ulcer disease, traumatic erosion of the gastric wall induced by the internal button, or ulceration below the internal button. To reduce the risk of bleeding at the gastrostomy site, excessive traction on the tube and tension between the internal and external buttons should be avoided [78]. In cases of severe intra-abdominal or extra-abdominal bleeding, surgical removal of the tube is necessary to allow coagulation and interruption of nutrition [79,80]. Buried bumper syndrome is a complication caused by the external button tightly against the abdominal wall. Gradually, the internal button causes tension within the tract, leading to the deterioration of the stomach wall. This condition causes pain and obstruction of the tube. The feeding tube needs to be removed using an appropriate method, and a new access should be considered [81]. The most common management for a buried bumper syndrome is the surgical or endoscopic removal of the PEG tube. This causes a temporary interruption of the feeding [80,82]. If the buried bumper is detected, enteral feeding should be stopped, antibiotics should be started, and the tube should be removed even in asymptomatic patients [83]. Peristomal leakage usually occurs in the days following tube placement, but it can also be seen after the peristomal area has healed [33,84]. The probability of leakage occurs more often in patients with impaired wound healing due to factors such as insufficient nutritional support or diabetes. If the external button is too tight against the abdominal wall, it can reduce blood flow to the area, damage the stoma, and cause peristomal leakage [82]. Due to the absence of randomized controlled trials on peristomal leakage, the majority of the literature comprises case reports or expert opinions. If peristomal leakage is persistent (requiring frequent dressing changes), the tube can be removed and replaced with a new one, depending on confirmation that the tract is suitable [64,78].

Question 2.6

What is the appropriate method for the care of peristomal area in patients with gastrostomy/jejunostomy?

- Which dressing should be used?
- Which solution is recommended?
- How often the dressing should be changed?

a. Which dressing should be used?**Recommendation 2.6.a**

In patients with gastrostomy/jejunostomy, sterile dressings should be used until the tube exit site has healed (initial 5–7 d). The preferred dressing is sterile gauze. Glycerin hydrogel can serve as an alternative for the initial 5–7 d. Once the tube exit site has healed, the site can be left open.

—Consensus (86% agreement)

b. Which solution is recommended?**Recommendation 2.6.b**

In patients with gastrostomy/jejunostomy, saline or antiseptic solutions can be used until the tube exit site heals.

—Strong consensus (95% agreement)

c. How often the dressing should be changed?**Recommendation 2.6.c**

The dressing should be changed daily until the tube exit site heals (the first 5–7 d). After healing completely, the dressing can be changed once or twice a week.

—Strong consensus (93% agreement)

Comment 2.6

Healing of the tube exit site usually occurs within the first 5–7 d after tube placement, but it should be kept in mind that healing may be delayed in the presence of conditions that delay wound healing (such as malnutrition, frailty, chemotherapy, or immunosuppressive treatment with corticosteroids) [78]. It is important to take precautions to prevent infection in the peristomal area in the first week after tube placement. Daily observation should be made for signs of infection such as exudate, bleeding, pain, and erythema at the tube exit site. Y-shaped compresses, which do not release fibers, are positioned under the external button during dressing without causing tension, commonly used. Tight dressings should be avoided as they can cause skin maceration [85]. In the first week, a glycerin hydrogel can be used as an alternative. A randomized controlled study indicated that glycerin hydrogel dressings decreased infection rates compared to gauze and required five times less dressing changes [86]. Saline or antiseptic solutions can be used for peristomal area dressing until the tube exit site heals. After the tube exit site has healed, saline, low-pH soapy water, drinking water quality, or boiled lukewarm-cooled water can be used [33]. In a randomized, double-blind study comparing the effect of normal saline and antiseptic solution on the early peristomal infection rates in patients with a PEG tube, no significant difference was found in the rates of peristomal site infection. Normal saline can be the first choice for early peristomal care without signs of infection because it is non-irritating and non-allergenic, and cost-effective [87]. In a randomized controlled study comparing soapy water and saline in peristomal skin care for children, the saline group was found to have normal moisture levels compared to the soap group. It was also reported that the use of saline is a safer solution for PEG care because dryness and excessive moisture can create an environment for the increase of microorganisms on the skin [88]. The peristomal area should be monitored daily (for bleeding, pain, erythema, hardness, exudate, and infection) and aseptic wound care should be applied until the tube exit site heals, keeping the stoma area clean and dry [33].

Question 2.7

What is the appropriate management of complications related to gastrostomy/jejunostomy tubes?

- Peristomal leakage
- Buried bumper syndrome
- Hypergranulation tissue
- Peristomal infection
- Peristomal bleeding

a. Peristomal leakage**Recommendation 2.7.a**

In the management of peristomal leakage, the care of the peristomal area and the protecting of the skin is crucial. If peristomal leakage is persistent, tube replacement can be considered.

—Strong consensus (93% agreement)

Comment 2.7.a

In case of leakage after the gastrostomy tube is inserted, it is recommended to determine and treat the causes of peristomal leakage. Risk factors for peristomal leakage include increased gastric acid secretion, gastroparesis, increased intra-abdominal pressure, constipation, increased tension between the internal and external buttons, stoma diameter mismatch, medication side effects (e.g., anticholinergics), and buried bumper syndrome. Additionally, patient-related factors such as diabetes mellitus, immunosuppression, and malnutrition can affect healing [33]. If the tube is loosely or tightly secured, it should be repositioned so that there is a 0.5–1 cm gap between the skin and the tube. Proton pump inhibitors can be used to reduce stomach acid secretion. To minimize skin integrity impairment due to peristomal leakage, products containing zinc oxide or barrier creams can be used [33,85]. In the presence of local infection around the tube, regular peristomal care is performed, and topical antibiotics or antifungal agents may be used. If the leakage continues, the tube may need to be replaced [89,90]. However, replacing the PEG tube with a larger one should be avoided, as a larger tube can increase leakage by widening the stoma tract [90]. If the leakage persists despite these treatments, the tube should be removed, and the patient should be evaluated for a gastrostomy at a different site of the stomach after healing has occurred [33].

—Strong consensus (95% agreement)

b. Buried bumper syndrome

Recommendation 2.7.b

Buried bumper syndrome can be prevented by proper care. When buried bumper syndrome develops, the gastrostomy tube should be removed, and a new gastrostomy may be inserted in a different location.

—Strong consensus (95% agreement)

Comment 2.7.b

Since buried bumper syndrome is a serious complication, preventing this complication should be the goal. Resistance during infusion despite no obstruction, difficulty in tube movement, leakage from the tube exit site during flushing, abdominal pain, and a non-healing peristomal infection are among the symptoms of buried bumper syndrome [83]. The diagnosis of buried bumper syndrome is made by direct observation of the internal button through gastroscopy or by detecting the internal button's displacement toward the abdominal wall on abdominal computed tomography. The buried internal button can sometimes be palpated under the skin during an examination. To prevent buried bumper syndrome, care should be taken to ensure that no tension is created between the inner and outer buttons. The distance between the two buttons should not be too loose or too tight [33]. To prevent tension between the internal and external buttons of the tube and the tube from sticking to the mucosa, it is recommended that the external button be placed approximately 0.5–1 cm away from the abdominal wall, and that the tube be moved after the stoma tract begins to heal and gains a certain resistance (from day 7 onwards). It is recommended that the tube be rotated 180–360° daily on its axis and pushed and pulled vertically 1–2 cm once a week [91].

Although some guidelines suggest pushing and pulling the PEG tube vertically by 1–10 cm, there is no clear evidence on this topic, and 1–2 cm is generally considered sufficient [33,91,92]. Most of the tubes used in clinical practice have these buttons fixed; 1–2 cm is sufficient; otherwise, there is a risk of tube dislodgement [33,92].

To prevent buried bumper syndrome in children, the gastrostomy tube should be gently pushed into the stomach about 1 cm, then carefully withdrawn until resistance from the internal fixation piece is felt, and the tube should be rotated 180° around itself. It is recommended to start this practice approximately 7–10 d after the gastrostomy tube is inserted and to perform it at least once a week [93]. These movements should not be performed in gastrostomies and jejunostomies done by open surgery or percutaneous radiological intervention [2]. If buried bumper syndrome is not treated appropriately, it can lead to bleeding, perforation, and peritonitis. It can lead to serious intra-abdominal infections resulting in mortality [19,91]. The buried bumper should be removed endoscopically or surgically, and appropriate supportive treatment should be provided [94].

c. Hypergranulation tissue

Recommendation 2.7.c

For the prevention of hypergranulation tissue, keeping the skin clean and dry, avoiding friction, and ensuring tube fixation are recommended. If hypergranulation tissue develops, topical corticosteroid cream and silver nitrate (ensuring no touch with healthy skin) can be used.

—Strong consensus (93% agreement)

Comment 2.7.c

The formation of granulation tissue is a physiological process. Incorrect positioning of the external button can lead to friction and the formation of hypergranulation tissue on moist skin. Hypergranulation tissue is a vascular tissue that is easily bleeds and can sometimes be painful [85,95]. Topical corticosteroid creams can be used for 7–10 d [33]. Cauterization, performed by applying silver nitrate directly to hypergranulation tissue, is an effective method. During the process, healthy tissue must be protected. If there is an accompanying leakage or infection, it should be handled accordingly [33,85,95].

d. Peristomal infection

Recommendation 2.7.d

A single dose of prophylactic antibiotic is recommended to prevent peristomal infections. In case of peristomal infection, it is recommended to dress the wound with antiseptic solutions and keep the skin dry by increasing the frequency of dressing changes. Topical antimicrobial agents can be applied to the exit site. Systemic antibiotics are required in the presence of severe peristomal or systemic infections.

—Strong consensus (93% agreement)

Comment 2.7.d

Measurement tools can be used for the rapid diagnosis and management of peristomal infection [96]. Exudate and moist environments can create a breeding ground for infection [33,97]. It is recommended to use a single dose of prophylactic antibiotics before PEG placement. For this purpose, cephalosporins can be used [2,98]. The European Society for Pediatric Gastroenterology, Hepatology and Nutrition also recommends preprocedural antibiotic prophylaxis in children to prevent PEG site infection [99]. The first step in preventing peristomal infection is aseptic wound care and monitoring for symptoms of tissue loss, erythema, purulent/exudative/foul-smelling exudate, fever, and tenderness in the peristomal area [91]. Minor infections can be treated with frequent dressing changes and topical antiseptics [100,101]. Based on the culture results from the purulent exudate, appropriate antibiotics

can be given for the treatment of the infection. If the infection is treated with antibiotics, the tube may not need to be removed [102]. If the tissue integrity of the peristomal tract is compromised and the infection cannot be eliminated despite treatment, replacing the tube is recommended [2,103].

e. Peristomal bleeding

Recommendation 2.7.e

Peristomal bleeding typically results from injury to minor blood vessels during or following the procedure. Most bleeding cease spontaneously; however, in instances of prolonged or severe bleeding, endoscopic or surgical intervention may be required.

—Strong consensus (97% agreement)

Comment 2.7.e

Bleeding is a common early complication and manifests as leakage around the stoma. Some bleeding around the stoma stops with pressure. Surgical sutures may be necessary for ongoing bleeding. In case of severe bleeding from the mucosal surface, hematemesis and sometimes melena may occur [85,100,102,104]. In cases of bleeding from the mucosal surface, techniques such as endoscopic epinephrine injection or electrocoagulation can be used at the bleeding site [80,95]. In later stages, hypertrophic granulation tissue can also cause superficial bleeding [33,102] (see: 2.7.c). Careful monitoring is necessary in patients receiving anticoagulant/antiplatelet therapy or with coagulopathy [78,91,105]. Light bleeding in the form of a leakage may not pose an obstacle to feeding. However, in the presence of any bleeding, a detailed assessment should be conducted to determine whether feeding should continue.

Rarely, bleeding due to injury of intra-abdominal organs can occur during gastrostomy placement. Caution should be given in this situation for patients with a history of who abdominal surgery [106–108].

Question 2.8

What should be done in case of gastrostomy/jejunostomy tube dislodgement?

Recommendation 2.8

In case of dislodgement, tube can be reinserted cautiously. However, this procedure should be performed considering the time elapsed since the initial placement of the tube and expertise.

—Strong consensus (95% agreement)

Comment 2.8

Dislodgement of the gastrostomy/jejunostomy tube within the first 4 wk is an emergency. Patients and their relatives should be informed, in the event of tube dislodgement, they should present to the nearest healthcare facility without delay [33,85].

During this period, there is a risk of leakage into the abdomen because the stoma tract is not yet mature. This can also lead to peritonitis [109]. While the stoma tract is expected to mature in approximately 7–14 d, this maturation is not enough for the blind placement of the dislodged tube. Therefore, if the tube dislodges within 4 wk, a new tube can only be inserted with the aid of endoscopy [13]. If the tubes dislodge after the fourth week, it is considered that the tract has matured and gained sufficient strength, allowing for the placement of a new tube without the need for endoscopy or radiology. If possible, tubes of the same thickness should be selected. If the tube dislodges and there is no feeding tube available, a temporary Foley catheter can be used to protect the maturing stoma tract until a new suitable tube is found [33,64].

Question 2.9

What should be considered when administering medication via a feeding tube?

Recommendation 2.9

When administering medication through a tube, the pharmacokinetic and pharmacodynamic properties of the medication, its interaction with nutrients, the dosage form, the position of the tube's distal end, and any warnings regarding the active ingredient of the medication should be considered.

—Strong consensus (100% agreement)

Comment 2.9

Medication errors related to enteral access routes are mostly caused by the administration of medications that are not suitable for administration through a feeding tube, incorrect preparation of medications, and/or the use of inappropriate techniques for medication administration [110]. To prevent treatment failure, a pharmacist must be included in the nutritional support team. The pharmacist should be consulted regarding the suitability of dosage forms, methods of administering medication through the tube, and the prevention of interactions. If it is not possible to include a pharmacist into the team, institutions should develop a protocol on medication administration [111]. It is recommended to flush the tube with at least 15 mL of drinking-quality water before and after medication administration. For crushable solid dosage forms (immediate-release), it is recommended to crush them in a fine powder form, mix them with drinking-quality water, with at least 5 mL for children and 15–30 mL for adults. For liquid dosage forms, it is recommended to dilute them at a ratio of 1:1 or 1:1/2 depending on their viscosity. Hard gelatin capsules are opened, and the contents are mixed with at least 5 mL of drinking-quality water in children and 15–30 mL in adults. Soft gelatin capsules can be drawn into a syringe and administered. When multiple medications need to be administered, they should not be mixed together; each medication should be administered separately, and the tube should be flushed with at least 15 mL of drinking-quality water between medications. Medication should not be added directly to EN solutions [2,33,60,111–115].

Other principles to consider when administering medication through a feeding tube shown in below [2,33,60,110,112–116].

1. The position of the tube should be checked before administering medication. Postpyloric administration can alter the effectiveness and pharmacokinetics of certain medications.
2. In patients who need fluid restriction, it may be necessary to reduce the volume of fluid in which medications are mixed. Special care should be taken, especially in the pediatric age group.
3. Drinking-quality water, acidic fruit juice, or bicarbonate water can be used to prepare the different types of medication solution.
4. If the absorption of the medication is reduced by the EN solutions, feeding should be stopped at least 30 min before and after medication administration.
5. As little medication residue as possible should be left in the container where the medication is crushed/dissolved and prepared in order to prevent medication dose losses.
6. Depending on the properties of the medication's active ingredient (teratogenic, irritant, carcinogenic), protective equipment (such as gloves, masks, and glasses) should be used when necessary.

Section 3: Care of access routes in parenteral nutrition

Question 3.1

What is the proper approach for catheter care in patients receiving PN through a CVC?

- Which solution is recommended?
- Which dressing should be used?
- How often the dressing should be changed?

a. Which solution is recommended?

Recommendation 3.1.a

A 70% alcohol solution containing 0.5–2% chlorhexidine is the first choice for dressing CVCs. In the presence of any known contraindications to chlorhexidine solution, 10% povidone-iodine, or 70% alcohol can be used.

Additional recommendation for the pediatric age group:

Antisepsis at the catheter insertion site in pediatric patients should be performed with a 70% alcohol solution with 2% chlorhexidine. Chlorhexidine is contraindicated for infants under 2 mo due to potential adverse effects; only a 70% alcohol solution should be used.

—Strong consensus (97% agreement)

b. Which dressing should be used?

Recommendation 3.1.b

Sterile gauze, transparent semipermeable polyurethane dressings, and chlorhexidine gluconate-impregnated dressings can be used for dressing of CVCs.

—Strong consensus (97% agreement)

c. How often the dressing should be changed?

Recommendation 3.1.c

The frequency of dressing changes for CVCs depends on the selected dressing material. Gauze should be changed every 2 d, but transparent, semipermeable polyurethane dressings can be changed every 5–7 d. The dressing should be changed immediately if it gets wet, loose, or contaminated.

—Strong consensus (97% agreement)

Comment 3.1

The catheter insertion site should be assessed for cleanliness, dryness, and dressing integrity at 24 h after catheter insertion and at least once daily thereafter. Considering the patient's clinical condition, the catheter site should be closely monitored, and any signs of complications, such as fever, tenderness at the insertion site, bleeding, exudate, fluid accumulation, pain on palpation, and paresthesia, should be noted. Patients should be encouraged to express any discomfort they feel at the catheter site [117]. After performing hand hygiene during dressing changes, clean or sterile gloves can be worn. If other care practices are also being conducted for the patient at the same time, such as diaper changes, ostomy care, and oral care, catheter care should be performed first. Hand hygiene should be ensured after catheter care, and the care should be provided from a clean area to a dirty area [117].

For adult patients, it is recommended to use a 70% alcohol solution containing 0.5–2% chlorhexidine to clean the catheter insertion site, achieving antisepsis over an area approximately 20 cm in diameter. The skin should then be allowed to dry for 30 s [118,119]. If there are any known contraindications or sensitivities to alcoholic chlorhexidine solution, a mixture of 10% povidone-

iodine and 70% alcohol solution should be used. However, the solution needs to be left to dry for 1.5–2 min [119]. Due to antibiotic resistance and fungal infections, topical antibiotic treatment should not be applied to the exit site of the CVC [119].

The use of alcohol-based solutions containing chlorhexidine for skin antisepsis is not recommended for children under 2 mo of age because chlorhexidine was detected in the blood of premature and term infants, causing erythema and skin dryness at the catheter site. In this age group, antisepsis should only be achieved with a 70% alcohol solution [120,121].

The dressings for CVCs should be sterile, should protect the exit site from moisture, colonization, and infection, allow easy practical use, ensure patient comfort, secure the catheter, and be cost-effective. It is recommended to use sterile gauze or transparent, semipermeable polyurethane dressings, as well as chlorhexidine-impregnated dressings, for dressing the catheter site [122]. Sterile gauze can be used for its absorbent properties when the patient is sweating, or there is leakage at the exit site. Transparent polyurethane dressings may be preferred over sterile gauze dressings because they allow for continuous monitoring of the catheter insertion site and require fewer dressing changes. For dressing tunneled or implanted ports commonly used for long-term (approximately 6 mo) home PN, it is recommended to cover the exit site with a transparent dressing until it heals (approximately 3 wk). If the infection rate does not decrease despite adherence to basic preventive measures, including education and training on the prevention of catheter infections, and the source of the infection is an extraluminal route, the use of chlorhexidine gluconate-impregnated transparent dressings is recommended for reducing the infection [117]. In a Cochrane analysis of randomized controlled trials, chlorhexidine gluconate-impregnated dressings were reported to reduce the incidence of catheter-related bloodstream infection (CRBSI) compared to all other dressing methods [123]. The use of chlorhexidine-impregnated dressings is particularly recommended for children over 2 mo old with CVCs [121,123]. Possible reactions, such as dermatitis and redness, that may develop during the use of chlorhexidine-containing dressings should be monitored. They should not be used, especially in patients with a history of creating a reaction to chlorhexidine [117].

Although there are not enough high-quality studies to evaluate the relationship between CVC dressing change intervals and CLABSI, it is recommended that transparent, semipermeable polyurethane dressings be changed at least every 5–7 d, and gauze dressings be changed every 2 d [122,124]. The dates for catheter care and dressing changes should be noted. The dressing should be changed as soon as it becomes moist, loose, dirty, wet, or when the exit site needs to be assessed [125–127]. Unless necessary, dressing changes should be avoided as they can increase the risk of infection and cause the catheter to dislodge [125]. Dressings that are compromised, especially by contamination with oropharyngeal secretions or the regrowth of hair and beards, should be changed immediately [124]. Implementing CVC care bundles, created by various disciplines, is among the effective nursing care practices for patients and can help prevent infections [128].

Question 3.2

What is the proper approach for managing ports in patients receiving PN via an implanted port?

- Replacement of the implanted port needle
- Care of implanted port during PN

a. Replacement of the implanted port needle

Recommendation 3.2.a

Prior to the insertion of the port needle, 70% alcohol solution containing 0.5–2% chlorhexidine should be used for skin antiseptics. To prevent port damage, specially designed port needles (non-coring/Huber needles) should be used. These needles should be changed regularly, not exceeding 7 d.

—Strong consensus (95% agreement)

Comment 3.2.a

Before inserting the implantable port needle, the skin around the port is assessed for signs of local infection, such as swelling, redness, exudate, and tenderness [129]. The thickness of the subcutaneous tissue over the port is checked to be between 0.5 and 2 mm [117,130]. The site for inserting the implantable port needle is determined by palpating the port reservoir [131]. Access to the port can be easier when the port is visible and accessible. In situations where access to the port is difficult, positioning the patient to ensure the procedure is performed comfortably and safely is essential. In sensitive patients, topical local anesthetic agents can be applied before the procedure [129,132]. Protective equipment such as masks and gloves should be used when changing needles, and the procedure should be performed under completely aseptic conditions. Before inserting the port needle, unless contraindicated, the skin is wiped with 70% alcohol containing 0.5–2% chlorhexidine in a spiral motion from the inside out, centered on the port, and this should be done 3 times. Then, let it air-dry for at least 30 s [117,133–135]. It is important to ensure the area cleaned with the antiseptic solution is wider than the dressing area [118]. Although there is weak evidence, Lai et al. [136] reported in their systematic review, which included randomized controlled trials, that skin cleansing with chlorhexidine solution may reduce CRBSI rates compared to skin cleansing with povidone-iodine. Special port needles (non-coring/Huber needles) should be used to prevent damage to the silicone septum of the port. These needles are designed to avoid small particles (e.g., silicone or tissue fragments) from breaking off and entering the circulatory system when they penetrate to the skin or silicone membrane, and they also protect the port's septum, allowing for long-term use; however, they can cause injuries during needle removal [129,137]. New port needles were designed to improve the safety of healthcare workers. These needles allow for observation of the insertion site. Using a piston to eject the needle reduces the risk of injury [137,138]. Port needles can come in different lengths (16–32 mm) and gauges (19–22 gauge). The length and gauge of the selected needle may vary depending on the patient's weight, subcutaneous fat tissue, the type of treatment, or the reason for access [129]. It was essential to remove the air inside before attaching the needle. The needle is carefully inserted into the silicone part of the injection port at a 90° angle until a slight “click” is felt. After the needle is inserted, blood aspiration is performed, and the needle placement is confirmed [117,139]. When an implanted port is used for continuous infusions, there is insufficient evidence regarding the optimal needle replacement frequency [134]. When PN is administered through a port, the port access needle should be changed at least once a week [118]. When removing the port needle, maintain aseptic conditions [129]. The patient is instructed to take a deep breath and hold it. The needle is then checked to ensure it is not bent, and the port needle is inserted quickly and vertically. Pressure is applied to the area where the needle was removed to ensure hemostasis [137].

b. Care of implanted port during PN**Recommendation 3.2.b**

Transparent semipermeable or gauze dressings should be used for closure. The transparent semipermeable dressing should be changed every 5–7 d, and the gauze every 2 d. Port exit site should be cleansed with 70% alcohol solution containing 0.5–2% chlorhexidine. For pediatric patients 70% alcohol solution containing 2% chlorhexidine should be used. There is no clear evidence for port flushing solution, quantity, and frequency.

—Strong consensus (93% agreement)

Comment 3.2.b

The port area is examined daily for redness, exudate, tenderness, and swelling if a transparent dressing is used, or with each dressing change if gauze is used [129]. Aseptic techniques should be used with each access to the port [129]. Hand antisepsis and a no-touch technique with clean gloves, or hand antisepsis and sterile gloves, may be preferred for dressing the port exit site [131]. The catheter insertion site should be cleaned with a 70% alcohol solution containing 0.5–2% chlorhexidine, and in children, with a 70% alcohol solution containing 2% chlorhexidine [117,131,133].

Sterile, semipermeable, transparent dressings or gauze are used as a dressing cover [12,117,131]. The choice of dressing cover determines the frequency of dressing changes [140,141]. The dressing should be changed every 5–7 d if transparent dressing covers are used, every 2 d if sterile gauze is used, or when the dressing becomes moist, dirty, or the area needs to be examined. Dressings should be waterproof and protected during showering. The port exit area should not be brushed vigorously [12,122,134,142].

When using a port needle, the needle should not wobble or bend [129]. The port needle is stabilized by supporting it with sterile gauze at a 90° angle [129,134]. The gauze placed under the wings of the port needle to secure the port access needle is changed at least every 7 d [143]. Gauze should be changed as soon as possible when it becomes soiled. If the dressing at the puncture site is loose or soiled, it is recommended to change as quickly as possible [118,144]. The date of the port access needle change should be noted on the dressing material [129]. Topical antimicrobials should not be used in port site dressing unless recommended [145,146].

Flushing and locking implanted ports help prevent catheter obstruction [142,147–149]. There is no clear evidence for type, amount, and frequency of catheter/port flushing [150,151]. Studies have shown that fluids such as normal saline (21–23), low-concentration heparin [131,152], or normal saline followed by heparin [153–155] can be preferred as port flushing solutions. However, flushing and locking the access route are done according to the manufacturer's instructions. During flushing, a minimum flushing volume equal to twice the internal volume of the catheter system (e.g., catheter and accessory devices) is used [131]. Resistance is assessed using a 10 mL syringe to verify the catheter's functionality. Positive pressure techniques are used to minimize blood back-flow into the catheter lumen. Studies have shown that administering a 10 mL bolus in 1 mL increments with short pauses in between can be more effective in clearing debris such as fibrin and drug solution compared to continuous low-flow techniques [156,157]. Although manufacturers recommend flushing and locking the port every 4 wk to maintain catheter patency and prevent intraluminal clot formation, there is no clear evidence regarding the frequency of catheter flushing [154].

Question 3.3

What precautions should be taken to prevent catheter-related infections in patients receiving PN via CVC?

- a. How should be hand hygiene ensured?
- b. What precautions should be taken when using catheter sets and connection lines during the insertion and disconnection?
- c. How should be the catheter closed/locked?
- d. Can the catheter be used for practices other than PN? (Blood sampling, blood transfusion, central venous pressure measurement, medication administration, etc.)

a. How should be hand hygiene ensured?

Recommendation 3.3.a

Hand hygiene should be performed before and after all catheter-related procedures. Hands should be washed with soap and water or rubbed with alcohol-based hand antiseptics. Sterile gloves should be used prior to handling the ports.

—Strong consensus (100% agreement)

b. What precautions should be taken when using catheter sets and connection lines during the insertion and disconnection?

Recommendation 3.3.b

PN sets should be changed every 24 h under aseptic conditions without compromising their integrity. Aseptic technique procedures should be followed when using the sets and connection lines during insertion and disconnection.

—Strong consensus (97% agreement)

c. How should be the catheter closed/locked?

Recommendation 3.3.c

For catheter flushing and long-term closure/locking, 0.9% saline should be used. Volumes of 5–10 mL are frequently utilized in clinical practice. Furthermore, the manufacturer-recommended locking volume should be used for each catheter port.

Additional recommendation for the pediatric age group:

Although there is no clear evidence for pediatric age group, the flushing volume can be at least twice the volume of the catheter.

—Strong consensus (93% agreement)

d. Can the catheter be used for practices other than PN? (Blood sampling, blood transfusion, central venous pressure measurement, medication administration, etc.)

Recommendation 3.3.d

These practices should be avoided whenever possible, as these are significant risk factors for complications, including infections and thrombosis.

—Strong consensus (95% agreement)

Comment 3.3

Catheter-related infections include both local and systemic infections. Local infections include exit site, tunnel infections, while systemic infections include CRBSI. Catheter infections are associated with increased mortality, morbidity, hospital stay, and costs [158]. It has been shown that implementing care bundles specifically designed to prevent catheter infections reduces the incidence of infections from 6.4 to 2.5 per 1000 catheter days [159]. The care bundle includes hand hygiene, the appropriateness of the catheter dressing, performing the dressing with a 2% chlorhexidine and alcohol-containing solution, disinfecting the catheter lumen tips (hubs), and questioning the necessity of the CVC [119]. Poor hand hygiene is a significant risk factor in the transmission of infections and contributes to the spread of antibiotic-resistant

organisms in hospitals [160]. The catheter lumen tip, the set tip, and the syringe tip are critical points for skin infection surrounding the catheter exit site. It is essential to prevent contact and contamination in these areas. Hand hygiene should be ensured before and after all catheter-related interventions, such as catheter palpation, dressing changes, PN administration, and medication administration. The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommend alcohol-based hand sanitizers containing 60% to 95% alcohol as the most suitable method for hand disinfection [161]. Suppose there is visible dirt or contamination with organic matter and spore-forming microorganisms on the hands. In that case, hands should be washed with soap and water, dried with a disposable paper towel. To ensure effective hand hygiene, an antiseptic solution should be used, but the hands must first be cleaned of dirt and organic matter. The antiseptic solution should be applied to the entire surface of the hands and rubbed vigorously until it evaporates and the hands are dry. Hand hygiene must be maintained before and after using gloves. During hygiene, jewelry should be removed, nails should be clean and short, and any cuts or scrapes on the hands should be covered with a waterproof dressing [162].

When attaching and detaching the PN bag to the catheter, sterile conditions must be maintained and aseptic techniques followed in the use of the sets and connection lines. Maintenance practices should be provided by experienced individuals [163]. Every attempt to access the catheter lumen tips and connectors carries the risk of infection. Therefore, before each use, the catheter lumen tips and connectors should be mechanically cleaned by rubbing with at least 5 s of 70% alcohol or a 2% chlorhexidine and alcohol-containing antiseptic solution [125,164]. In a meta-analysis study, the use of antiseptic barrier caps that continuously passively disinfect the catheter lumen tips was found to be effective in reducing contamination and catheter infections [165]. During the patient's bath, the catheter and connection ends should be covered with a waterproof sheet, and the bath should be in the form of a shower [117]. The following steps can be followed during bag replacement.

1. Hand hygiene is ensured,
2. A non-sterile drape is placed over the patient's chest,
3. An infusion set is attached to the bag, the air is removed from the set, and it is hung.
4. The hands are cleaned again with antiseptic solution,
5. The lumen end of the catheter is wiped with disinfectant and sterile gauze,
6. Sterile gloves are worn,
7. The catheter cap is opened and cleaned by rubbing with disinfectant and sterile gauze,
8. A PN application set is connected to the end of the catheter,
9. The connection points are covered and sealed with sterile gauze.

Flushing and locking the catheter is quite essential to prevent catheter blockage. The purpose of a catheter lock is to avoid colonization, biofilm formation, and clotting when the catheter is not in use, and to maintain catheter patency. When using CVCs intermittently, it is recommended to flush with 0.9% normal saline before and after each infusion, particularly when there are clinical indications such as signs of obstruction in continuous infusions, to prevent catheter obstruction and maintain patency. CVCs should be flushed using the turbulent method and positive pressure technique. To effectively flush the catheter, it is recommended to administer 10 mL of normal saline in 1 mL increments with short pauses each time (turbulent/pulsatile/push/pause technique), clamp the catheter during the final part of the flush, and leave

0.5–1 mL of normal saline in the syringe (positive pressure technique) to prevent catheter blockage. This ensures the removal of residues, such as fibrin and medication solution, and prevents the backflow of blood into the catheter [156,166].

Although there is no clear evidence, it has been reported that in both adults and children, the flushing volume can be at least twice the catheter volume. In clinical practice, volumes of 5–10 mL are commonly used [119,156]. Furthermore, the manufacturer-recommended locking volume should be used for each catheter port. In multi-lumen catheters, all lumens should be flushed using a new syringe for each lumen [167,168].

The positive pressure technique can be used during flushing and locking to prevent blood from flowing back into the catheter lumen. This technique, also known as the push-pause, pulsatile, or turbulent technique, is used to remove debris from the catheter by injecting saline into it.

After flushing with every 1 mL of fluid from the syringe, a brief pause (approximately 1 s) is taken, and the catheter is flushed by injecting 1 mL volumes of normal saline into the lumen, followed by clamping and locking the catheter while administering the final 0.5 mL of fluid [156]. The fibrin sheath surrounding the catheter lumen also increases the risk of infection because it promotes catheter colonization [125]. A recent Cochrane review indicates that there is no significant difference in superiority between heparin and saline in terms of both infection risk and prevention of catheter blockage, and uncertainty remains on this issue due to low-conclusive evidence [169].

Additionally, the use of heparinized flushing solutions increases costs and can lead to heparin-induced thrombocytopenia [168]. Considering the lower risk of biofilm formation in the catheter lumen, it is recommended to use 0.9% saline solution for catheter flushing and locking due to its safe profile and low cost [170].

Frequent manipulation should be avoided in PN therapy. Catheters should not be used unless for PN practices. When blood needs to be drawn from the lumen used for PN, trained healthcare professionals should draw it. The catheter should be flushed with 5–10 mL of normal saline in children and adults before and after blood collection. To prevent contamination and blockage, the blood sample should not be re-infused through the catheter after it is taken [118,119].

Question 3.4

What is the proper approach for managing venous access in patients receiving peripheral PN?

- How to choose venous access route?
- Which types of catheters should be used?
- How often should the catheters be changed?

a. How to choose venous access route?

Recommendation 3.4.a

Peripheral veins in the forearm can be preferentially used for peripheral PN. Venous access should be selected from the distal to the proximal side of the upper extremity.

—Strong consensus (100% agreement)

b. Which types of catheters should be used?

Recommendation 3.4.b

Soft, flexible, and small-bore catheters preferentially made of polyurethane should be used.

—Strong consensus (97% agreement)

c. How often should the catheters be changed?

Recommendation 3.4.c

If there are no signs of phlebitis (redness, tenderness, swelling) at catheter site or extravasation, catheters can remain up to 4 d.

—Consensus (81% agreement)

Comment 3.4

It is stated that the insertion of a venous catheter along a joint can increase endothelial damage by causing the cannula to move within the vein during flexion and extension [171]. However, placing the peripheral venous catheter in the antecubital fossa and forearm veins instead of the back of the hand reduces the risk of phlebitis by 30–50% [172]. Its use is not recommended for lower extremities due to complications such as pulmonary embolism and thrombophlebitis, and tissue damage and necrosis risk in patients diagnosed with diabetes mellitus [166,173].

Peripheral PN should be limited to 14 d because it is a significant risk factor for the development of phlebitis [166,174]. The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines recommend using a CVC if PN therapy is anticipated for longer than 7–10 d [174]. For newborns and children, it is recommended to use peripherally inserted central catheters or tunneled CVCs for long-term PN during hospitalization [121].

In peripheral PN, catheter selection should be made considering the material of the catheter. One of the factors contributing to the development of thrombophlebitis in patients receiving peripheral PN is the type of catheter material used. Catheters should be flexible to avoid mechanical trauma and venous irritation [171]. Polyurethane and silicone catheters have a lower thrombogenic potential compared to polyvinyl catheters due to their more flexible properties, which causes less trauma to the vessel wall [175]. It is recommended that the catheter diameter be $\leq 1/3$ of the vein diameter [176]. A total of 20–22-gauge polyurethane catheters facilitate flow and reduce the risk of clotting [176]. In the study by May et al. [177], severe phlebitis and thrombotic occlusion occurred in 12 out of 24 catheters in the patient group where a 23-G silicone cannula was inserted into the forearm vein, and peripheral PN solution was administered for 24 h. The flexible and soft structure of catheters can reduce vascular damage during arm movements. Additionally, large-bore vessels can help dilute infusion fluids, relieving pressure on the vein and reducing the risk of phlebitis, extravasation, and infiltration [177].

There is no clear evidence to support the routine replacement of peripheral catheters more frequently than every 72–96 h in adult patients to reduce the risk of thrombophlebitis and infection. Peripheral catheters in adults should only be changed when clinically indicated. Peripheral catheter insertion site should observe every shift [117,178,179]. On the other hand, the incidence of phlebitis is highest in catheters that remain in place for longer than 96 h [172]. In Webster et al.'s [178] Cochrane systematic review, they recommend removing and replacing catheters only if signs of inflammation, infiltration, or obstruction are present. However, this recommendation applies only to patients with catheters for peripheral PN.

Question 3.5

What is the proper approach for managing medication administration in patients receiving PN?

- What precautions should be taken to ensure the stability of the nutrition solution and prevent drug-nutrient incompatibility?
- Which procedures should be implemented to avoid contamination during PN?

a. What precautions should be taken to ensure the stability of the nutrition solution and prevent drug-nutrient incompatibility?

Recommendation 3.5.a

Medications should not be added directly to the PN solution and should be infused through a separate catheter.

—Strong consensus (93% agreement)

Comment 3.5.a

PN solutions are sterile solutions containing over 50 components. The mixture has a more sensitive stability than the components alone, and is simultaneously at risk of incompatibility. Stability refers to the maintenance of the chemical integrity of each active ingredient or the physical integrity of the dosage form/system over time in a specific environment. Compatibility, on the other hand, refers to the ability of two or more ingredients to coexist physically and chemically without issues over time after being combined. Therefore, incompatibility is the interaction between two or more components (active ingredients, excipients, and/or materials [e.g., packaging, containers, infusion sets]) over time in a specific environment. While stability issues can be observed physically (e.g., crystallization, absorption, emulsion breakdown) or chemically (e.g., hydrolysis, oxidation), signs of incompatibility can include a change in color, pH, osmolality, or viscosity, gas formation, or the appearance of a precipitate (visible or invisible) that alters the mixture [180].

Stability and incompatibility issues can often be prevented with safe preparation and application techniques. After filling, the PN solution should be stored at 2–8°C and protected from light until the application stage [181]. The implementation phase is the responsibility of the nurse, and PN solutions should be visually inspected for any defects or leaks affecting bag integrity, visible particles, discoloration, or emulsion issues (e.g., oiling out, phase separation, clumping, or creaming) [181]. For visual inspection, a biological microscope with a camera, if available, and dynamic light scattering analysis for oil droplets can be used under laboratory conditions in a pharmacy setting [182]. It must then be confirmed that the label and prompt content are the same. If filters are to be used, ensure they do not contain “Di (2-ethylhexyl) phthalate (DEHP).” In-line filters can be used to reduce the risk of particulate matter reaching the patient; however, if used, they should be changed daily, just like the sets. Since most precipitates are not visible to the naked eye, it should be considered that using a 1.2 µm in-line filter placed as close as possible to the bottom or hub of any Y-catheter in the application set during PN application may be beneficial for capturing particles [181].

For newborn and infant two-in-one PN solutions, a 0.22-micron filter is recommended. For intravenous lipid emulsion, a 1.2-micron filter is recommended. A 1.2-micron filter can be used for all-in-one mixtures [183].

The PN solution to be applied should not be shaken quickly (oxygen entry may occur) and should not be applied or stored in direct sunlight [181]. Especially electrolytes, trace elements, and vitamins are quite crucial for stability. The order and amounts of additions should be carefully examined [10].

In addition to being soluble, compatible, and stable in the PN solution without altering its stability or compatibility, the medication must also be therapeutically effective. Since there are very few medications that meet these conditions, adding medication to the PN solution is generally not recommended. When administering an intravenous medication, a different access route should be used than the catheter used for PN administration, if available [180]. In cases where there is only one catheter for the medication and PN

solution, incompatibility should be assessed. If incompatibility is detected, it may be possible to administer the PN solution intermittently and administer the medicines during these gaps. If there is incompatibility, another alternative option is to pause the PN solution infusion. Before and after administering the medication, the catheter and any filters are flushed with 0.9% normal saline. If the medication is not compatible with 0.9% saline, 5% dextrose is used for flushing. When PN is interrupted, the patient should be monitored for the risk of hypoglycemia [181]. It is recommended to consult a pharmacist regarding the simultaneous administration of medication with PN solutions.

b. Which measures should be implemented to avoid contamination during PN?

Recommendation 3.5.b

All centers should have structured protocols to avoid microbial and chemical contamination, and any intervention should be done under aseptic technique.

—Consensus (90% agreement)

Comment 3.5.b

Contamination of PN solution components can be addressed in two ways: contamination from the naturally occurring components present in the solution, and microbial contamination that occurs during the solution preparation/administration steps. Microbial contamination that occurs during the steps of preparing/applying the PN solution is more dangerous than natural contamination. PN solutions are sterile solutions containing all their components. Ready-to-use or filled PN solution should be approached in the same way. Aseptic conditions must be maintained during the opening of the barrier between the chambers of ready-to-use products [184]. Additionally, in both cases, good aseptic conditions, control of particles in the air, and laminar flow cleanroom conditions, meaning good manufacturing practice standards, should be considered for trace elements, vitamins, and other electrolytes that will be added to the solution later [185]. The area where operations related to PN solutions will be performed is referred to as a “clean room.” This room is designed according to aseptic conditions. The cleanroom must meet the ISO 5/Class 100 (workbench) and pre-preparation room ISO 8/Class 100 000 standards, as well as the ISO 7/Class 10 000 standards for the filling room/pass-box. These standards encompass particle sizes in the environment, as well as control over heat and humidity. Here’s what needs to be done in this room:

- In the entrance room, designated personnel perform hand hygiene according to aseptic handwashing procedures.
- Then, before entering the clean room, they put on personal protective clothing and equipment (aprons, shoe covers, caps, and masks) appropriate to aseptic working conditions and complete all necessary preparations in the prepreparation room.
- All materials entering the clean room (such as glass, metal, and PVC bags) are surface-cleaned before being admitted.
- Designated personnel perform filling operations or opening chambers between ready-to-use products and adding vitamins/trace elements.
- They deliver finished products through a protected window opening into the entrance room.

Naturally, contamination in components is reported chiefly as aluminum (Al) contamination [186]. It can easily cause toxicity in patients without a protective gastrointestinal barrier and with kidney dysfunction. In patients receiving long-term PN treatment or

with impaired kidney function, up to 40% of the total Al entering the body from the infusion of PN solutions contaminated with Al can accumulate in the body [186]. In systemic aluminum toxicity, various problems can arise, including pulmonary, cardiovascular, neurological, pancreatic, and hepatorenal diseases. Calcium, phosphate, potassium, multivitamins, and trace elements are components naturally contaminated with Al. The US Food and Drug Administration recommends that the acceptable aluminum concentration in large-volume intravenous products be less than 25 µg/L [187]. To stay on the safe side, it is recommended that the Al dose be between 2 and 5 µg/kg body weight/d [186]. In a study, the aluminum content of ready-to-use and refill products was compared, and it was reported that ready-to-use products had less contamination [188].

Section 4: Patient/caregiver education

Question 4.1

What are the essentials of education for patients/caregivers for home nutrition therapy?

Recommendation 4.1

Every patient/caregiver should receive education before discharge. Discharge education should include the following topics:

- Aseptic techniques
- Maintaining nutrition therapy
- Care of access routes
- Medication administration
- Preventing and recognizing potential complications
- Contact information of healthcare facilities/professionals in case of need
- Strong consensus (100% agreement)

Comment 4.1

Discharge education for patients who will receive EN/PN therapy at home should be standardized and coordinated by an interdisciplinary nutrition team (physician, nurse, dietitian, pharmacist). The goal of discharge education is to enable patients and/or caregivers to achieve self-efficacy in performing nutritional practices, avoid nutrition-related problems, and diminish readmission rates [189]. A patient-centered care approach should be adopted in education, enabling patients and/or caregivers to understand, apply, and gain self-efficacy in the necessary procedures to continue treatment safely. The patient and/or caregiver must be able to understand and follow the procedures required for the safe administration of treatment [190]. A primary caregiver should be identified for patients who are unable to perform self-care or require assistance with their care, and home environment conditions should be considered during training [189,191].

Patients should be evaluated regularly postdischarge to assess the indications, efficacy, and potential risks of treatment. Nutrition teams need to communicate with and inform patients and caregivers. Based on the patient's/caregiver's needs, updates in the education are provided every few days. Training should be completed 2–7 d before the patient's discharge [189,191]. Qualified healthcare professionals should provide education.

The content of discharge education for patients undergoing home clinical nutrition therapy can be summarized as follows: [2,33,95,118,184,189,192].

–Aseptic practice techniques;

Ensuring hand hygiene, wearing sterile gloves when necessary, preparing enteral or PN products, preventing contamination of infusion set connections, changing sets, storage conditions,

organizing the patient's room, and preparing the environment for the products.

–Organizing and maintaining nutrition;

Determining the amount and method of administration (intermittent, continuous) of the nutrition product, preparing the nutrition product, using a pump when necessary, the hanging time of the products, situations requiring interruption of feeding, restarting feeding and increasing the dose, daily fluid intake, and training on the use of the flow regulator if necessary.

–Access route care;

Catheter care and dressing for patients receiving PN therapy, care and dressing of the peristomal area for patients receiving EN, and ensuring the protection and safety of access routes during patient care.

–Medication administration;

Making necessary arrangements by the pharmacist on the team regarding the correct preparation and administration of the patient's medications.

–Preventing and recognizing potential complications;

The importance of proper positioning, feeding rate, and feeding method, care of access route, medication administration, and signs of infectious, mechanical, and metabolic complications.

–Medical personnel to contact after discharge;

Medical personnel available for contact 24 h a day for situations necessitating communication with healthcare professionals.

The literature reports that standardized discharge education minimizes postdischarge problems and improves the quality of life for caregivers [193].

Home nutrition education guidelines and checklists should be used, and it is beneficial to support education with written materials, online videos, simulation training, and live conferences conducted by patient support groups [118,184,192].

Conclusion

This consensus report offers a practical and standardized reference for healthcare professionals involved in clinical nutritional therapy. Through an interdisciplinary and evidence-based approach, it is intended to improve safety, standardize care practices, and support the effective implementation of nutritional care in routine clinical practice.

Declaration of generative AI and AI-assisted technologies in the writing process

Artificial intelligence (AI)-assisted translation was used during the preparation of this manuscript. The AI tool was used solely for language translation and linguistic editing. All scientific content, interpretations, and the final version of the manuscript were reviewed and approved by the authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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