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Nutrition Quality Control in the Prescription and Administration of Parenteral Nutrition Therapy for Hospitalized Patients

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Abstract

Background: Nutrition quality control in parenteral nutrition therapy (PNT) allows the identification of inadequate processes in parenteral nutrition (PN). The objective of this study was to assess the quality of PNT at a hospital with an established nutrition support team (NST). *Materials and Methods:* This observational, longitudinal, analytical, and prospective study examined 100 hospitalized PNT adult patients under the care of an NST for 21 days or until death/hospital discharge. The American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) 2007 guidelines for PNT prescription were followed. *Results:* PNT indications were not in accordance with the A.S.P.E.N. 2007 guidelines in 15 patients. Among the remaining 85 patients, 48 (56.5%) did not receive adequate PNT (≥80% of the total volume prescribed). Non-NST medical orders, progression to and from enteral nutrition, changes in the central venous catheter, unknown causes, and operational errors (eg, medical prescription loss, PN nondelivery, pharmacy delays, inadequate PN bag temperature) were associated with PNT inadequacy ($P < .005$). Compared with patients who died, the discharged patients received PN volumes ≥80% on most days ($P = .047$). The quality indicators for nutrition therapy related to estimated energy expenditure and protein requirements and glycemia levels reached the expected targets; however, the central venous catheter infection rate was higher than 6 per 1000 catheters/d and did not meet the expected targets. *Conclusion:* Despite an established NST, there was a moderate level of PNT inadequacy in indications, administration, and monitoring. It is important to establish periodic meetings among different health professionals who prescribe and deliver PNT to define responsibilities and protocols. (*Nutr Clin Pract*. 2015;30:406-413)

Keywords

vascular access devices; nutritional support; quality improvement; parenteral nutrition

Parenteral nutrition therapy (PNT) is a treatment in which nutrients are intravenously administered to patients who cannot be fed orally and/or fail to reach their energy and/or protein requirements via enteral nutrition therapy (ENT).[1,2]

PNT is beneficial in perioperative care and in cases of moderate to severe malnutrition (inability to feed through the digestive system), acute severe Crohn's disease, high-output gastrointestinal (GI) fistulas, severe short bowel syndrome, and critically ill patients with prolonged fasting[3–5] However, PNT can be costly and contribute to serious metabolic and infection-related complications when it is improperly administered or prescribed. PNT costs arise mainly from the costs of substrates, instruments, skilled professionals, nutrient formulations, administration, monitoring, and treatment.[6] PNT should be prescribed only to patients who would clearly benefit from treatment; however, identifying these patients is not easy.[7] Administering PNT to any critically ill patient with perioperative malnutrition or nutrient-depleting disorders may not be appropriate because of reported deaths associated with the treatment.[8,9] The relative ease of prescribing PNT contributes to its excessive use.[10]

For several years, nutrition therapy (NT) regulations have increased in order to reduce and/or prevent complication risks. In 1998, the Brazilian Health Surveillance Agency (ANVISA) published regulations regarding the use of NT in public hospitals, including the need to employ a nutrition support team (NST).[11] The NST is responsible for developing proper NT administration, with routine nutrition screening and assessments. Both PNT and ENT must be administered in a manner that contributes to the best clinical outcomes at reduced costs and with minimal complication risks. NT hospital protocols are useful tools for NST.[11] Quality

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Table 1. Parenteral Nutrition Therapy (PNT) Indications According to American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) 2007 Guidelines.[16]

PNT Indications According to A.S.P.E.N. 2007
Patient received oral feeding or enteral nutrition therapy (ENT) with <60% of nutrient requirements
Patient was under preoperative care (ie, malnourished with gastrointestinal obstructive disease) or postoperative care (complicated, with no ostomies or option of ENT)
Patient was under prolonged fasting (≥5 days)
Patient had a malfunctioning gastrointestinal tract (GIT) because of inflammatory bowel disease, mechanical bowel obstruction, enterocutaneous fistulas, mesenteric ischemia, prolonged paralytic ileus, malabsorption (short bowel syndrome), or enteral nutrition intolerance (even with postpyloric tube feeding)

indicators for nutrition therapy (QINTs) are useful for helping the NST evaluate the efficiency of NS.[11,12] It is crucial to identify the QINTs so that an effective action plan can be developed for improving the quality of healthcare.[12]

PNT is a highly complex treatment that has potential risks. The systematic use of hospital quality controls to optimize PNT and its costs/benefits is very important.[13] The mere existence of NST and PNT protocols does not ensure good PNT practices because certain factors outside the control of NST may interfere with the quality of NT.[14] The objective of this study was to assess the quality control of PNT at a hospital with an established NST.

Materials and Methods

This was an observational, longitudinal, analytical, and prospective study that was approved by the Committee on Ethics and Research at the Hospital São Joaquim da Real e Benemérita Associação Portuguesa de Beneficência (BP) (476-09) and by the Ethics Commission for the Analysis of Research Projects of the Hospital das Clinicas da Faculdade de Medicina, University of São Paulo (142-10). In this study, 100 hospitalized patients were recruited; these patients (21–95 years of age) were PNT candidates between March 2009 and September 2010 and were hospitalized in intensive care units (ICUs) or wards at a large general hospital in the city of São Paulo, Brazil. Patients were enrolled if they met the following inclusion criteria: were followed by an NST staff member, were receiving central or peripheral PNT, and were >18 years of age. Informed written consent forms were signed. When the patient was unable to sign the consent form, a responsible relative signed it. The hospital NST (GANEP, Hospital Beneficência, São Paulo) has existed for 33 years and is composed of 4 physicians specializing in clinical nutrition, 4 medical residents, and 8 clinical nutrition dietitians. The average daily number of hospitalized patients receiving NT is 180, and 10% receive PNT. The NST team is usually consulted by medical written request. Patients are seen on a daily basis by a physician and a dietitian. Patients >60 years of age were classified as "elderly" because according to the World Health Organization (WHO), "elderly" people are those ≥60 years of age in developing countries.[15] Data were collected daily by investigators based on personal observation and the information available in each patient's medical records. When no written information was available, best efforts were made to obtain the data through interviews with a nurse and the medical staff. If no data were acquired, this information was considered "unknown causes."

Our study enrolled PNT patients who were on medical fasts or receiving ENT or oral feedings; patients in the latter 2 conditions were receiving supplementary PNT. We followed the 2007 American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) guidelines to assess whether PNT had been prescribed appropriately (see Table 1).[16] According to the A.S.P.E.N. guidelines, PNT should not be prescribed for patients who have an intact GI tract or have received ENT or oral feedings that met >60% of nutrient requirements, those with terminal cancers, or patients with hemodynamic instability (eg, altered blood pressure, cardiac arrest, cardiac arrhythmias, bleeding caused by central catheter loss, stroke, pulmonary congestion, respiratory failure, airway obstruction, hypercapnia, extubation, altered levels of consciousness, or hypo- or hyperglycemia).[16]

Primary and secondary diagnoses, duration of hospitalization, and anthropometric data, including current body weight (kg) and height (m), were obtained from patient medical records; alternatively, the ideal body weight[17] and estimated height[18] were computed. Patient outcome information was obtained from hospital medical records. The investigators collected data concerning PNT access (central or peripheral), primary diagnoses, daily PNT prescription, PN volume prescribed and received, daily causes of PNT nonreceipt, and final patient outcomes from patient medical records. In addition, mechanical and infectious complications related to central venous catheterization (CVC)[19,20] and capillary glucose levels (see Table 2) were obtained from patient medical records.

Energy requirements were estimated according to the Harris-Benedict equation (HB),[21] which was the standardized equation that the NST used as the time the study was conducted. The stress factor was corrected as follows: postoperative (1.1), cancer (1.1), fracture (1.2), and polytrauma (1.5).

Table 2. Parenteral Nutrition Therapy Mechanical and Infectious Complications Related to Central Venous Catheterization (CVC) Reported in Patients' Medical Records.

Complication	Diagnosis
Pneumothorax—presence of air in the pleural cavity[20]	Diagnosed with imaging studies
Hemothorax—presence of blood in the pleural cavity[20]	
Catheter occlusion—with hypotension, fibrin formation around the catheter, precipitated solution and failure to maintain catheter patency, and the need for increased pressure to maintain a continuous infusion rate[48]	Diagnosed with clinical examination and imaging
Deep vein thrombosis—mechanical trauma in the vein with hypotension, sepsis, and hypercoagulopathy; pain and swelling in the arms or legs[20]	Diagnosed with imaging studies
Gas embolism—occurs when the central venous catheter is opened and air enters the venous system[49]	Diagnosed with imaging studies
Venous catheter embolization—occurs when the catheter pulls back through the needle used for insertion[49]	Diagnosed with imaging studies
Inappropriate CVC location—results from vascular abnormalities or professional inexperience	Diagnosed with imaging studies
Phlebitis—occurs with peripheral administration of hypertonic solution with osmolarity = 900 mOsmol/kg; redness, swelling, and pain at the puncture site[49]	Diagnosed with physical examination
Positive peripheral vein blood culture	Obtained with microorganism culture
Positive central vein blood culture	Obtained with microorganism culture
Positive catheter tip culture	Obtained with microorganism culture
Infection related to CVC	Presence of local signs of infection (redness or puss) in patients without a concomitant diagnosis of primary bloodstream infections[50]
Sepsis related to CVC	Diagnosed with a body temperature >38°C or <36°C, a heart rate >90 bpm, and/or leukocyte concentration >12,000/mm³ or <4000/mm³ and/or hyperventilation with RR >20 bpm and $PaCO_2$ <32 mm Hg[20]
Bacteremia related to CVC	Diagnosed with 15–30 min of shivering, general malaise, and the presence of microorganisms at <10 colony-forming units/mL[20]
Hypoglycemia or hyperglycemia	Diagnosed with capillary glucose levels, with abnormal glucose levels of ≤80 or ≥180 mg/dL[25]

Activity level was corrected as follows: bedridden (1.2), bedridden and mobile (1.25), and ambulating (1.3).[22]

Our study considered the following factors for PNT-related operational errors: loss of PN medical prescription, delay in PN solution delivery, and delivery of PN solution at low temperatures. Brazilian regulation has determined that the ideal temperature for storing and transporting PN solution is between 2°C and 8°C.[23] The nurses considered the PN solution to be at a "low temperature" when it was within this range and waited to administer PN until the bag reached ambient temperature. Nutrition support (NS) progression refers to the increase or decrease (withdrawal) of daily PN solution volume levels. PNT was considered improperly administered when patients received <80% of the PN solution prescribed in the medical chart. This information was collected daily. PNT was considered administered early when the PN solution was administered before the 48-hour initial NST consultation. The adequacy of PNT was considered starting on the second day of PN administration. The PN solution was administered primarily via CVC in an exclusive lumen.

This study applied 3 of the QINTs established by the Clinical Nutrition Task Force of ILSI Brazil.[24] The indicators were frequency of measuring or estimating energy/protein requirements in hospitalized patients, frequency of CVC infection in patients receiving PNT, and frequency of abnormal glucose in patients receiving PNT.

The first QINT (frequency of measuring or estimating energy/protein requirements in hospitalized patients) was measured at the end of the study. It was defined as the total number of patients receiving PNT with the estimated energy and protein requirements divided by the total number of patients receiving PNT multiplied by 100. The second QINT (frequency of CVC infection in PNT patients) was determined at the end of the study as the number of CVC-associated infections in patients receiving PNT divided by the total number of

Table 3. Descriptive Analysis of the 100 Patients Receiving PNT.

Variable	n
Male	55
Female	45
ICU admission	46
Ward admission	54
Surgical treatment	58
Clinical treatment	42
CVC	92
PVC	8
PNT only	42
PNT + ENT	24
PNT + oral diet	34

CVC, central venous catheter; ENT, enteral nutrition therapy; ICU, intensive care unit; PNT, parenteral nutrition therapy; PVC, peripheral venous catheter.

CVC days in patients receiving PNT multiplied by 1000. The third QINT (frequency of abnormal glucose in PNT patients) was determined by the number of patients receiving PNT with hyper- or hypoglycemia divided by the total number of patients receiving PNT multiplied by 100.[24] Patients with 1 episode of a glucose level ≤80 mg/dL or ≥180 mg/dL were considered to have abnormal glucose level.[25]

The investigators monitored patients for 21 days, recording clinical outcomes, PNT administration, changes to ENT or oral feeding, hospital discharge, and death. On average, PNT at our institution is used for 12.7 ± 5.9 days. To capture all of the PNT days, we expanded our period observation to 21 days.

Statistical Analyses

The data were analyzed with SPSS (SPSS, Inc, an IBM Company, Chicago, IL) software. The data were subjected to univariate analyses, Fisher exact test to assess the association between variables, and Mann-Whitney test to verify the adequacy of prescribed and administered PN volumes. The Kruskal-Wallis test was used to assess the association between disease groups and patient outcomes.

The Fisher exact test was used to assess the association between death outcome and PNT inadequacy, early and late PNT start, and sepsis associated with CVC infection to determine the causes of PNT inadequacy. Statistical significance was set to $P < .05$.

Results

Of 100 patients receiving PNT, roughly half were male, elderly, and under surgical treatment (Table 3).

The patients' primary and secondary diagnoses are shown in Table 4. The median hospitalization length was 32.5 days (5–195 days). The median hospital stay was 37 days (5–156 days) for surgical patients and 23 days (8–195 days) for medical patients.

Of 100 patients, 92 received PNT via CVC and 8 received PNT via peripheral vein catheter (PVC).

The medical reasons for prescribing PNT and the reasons for interrupting PNT are described in Table 4. Of the 100 patients included in the study, 65 were discharged and 35 died.

Nonadherence to PNT was observed in 15 patients, as described in Table 5. The most common inappropriate reason for prescribing PNT was the patients' ability to receive oral feeding or ENT. All of the subsequent statistical analyses for quality control were performed on the 85 patients who met the A.S.P.E.N. 2007[16] guidelines for PNT prescriptions. The total number of PNT administration days was 1061.

The most frequent causes of discrepancy between the PN volume prescribed and the PN volume administered included operational errors, unknown causes, NS progression, medical orders (non-NST), CVC exchange, and CVC removal. There were no reports of mechanical complications for either CVC or PVC (Table 6).

Regarding infectious complications associated with CVC, 14 patients (16.5%) had positive catheter tip cultures, 8 patients (9.4%) had positive peripheral vein blood cultures, and 2 patients (2.4%) had positive central vein blood cultures. Among the 85 patients with PNT, 14 (16.5%) had sepsis, of which 8 (9.4%) cases were CVC related. There were no significant associations between patients with positive blood cultures or positive catheter tip cultures and death ($P > .05$).

The patients who were discharged from the hospital spent the most days receiving PN solution volumes ≥80% of those prescribed, whereas the patients who died received >80% of the prescribed PN volume but for shorter periods of time ($P < .05$; Table 7). Of the 85 patients receiving PNT, only 37 received PN properly. There was no statistically significant association between ICU or ward status and appropriate volume receipt ($P = .84$).

There were no statistically significant associations between the different diseases and death outcome. PNT was given early in 82% of the patients. However, there was no significant association between early or late PNT administration and death ($P > .05$).

Two PNT quality indicators (frequency of measuring or estimating energy/protein requirements in hospitalized patients and frequency of abnormal glucose in patients receiving PNT) met the targets, but one indicator (frequency of CVC related to sepsis) was higher than the expected rate (Table 8).[26]

Discussion

The objective of our study was to investigate PNT quality and practice in a large hospital with an established NST. PNT is a complex therapy; when it is prescribed without medical reasons, PNT provides no benefits and increases the risks of health complications and hospital costs. A study conducted in the United States reported that 32% of PNT noncompliance contributed to hospital costs of US$138,000 after 552 days.[27] In this study,

Table 4. Diseases, Secondary Diagnoses, PNT Indications According to A.S.P.E.N. Guidelines 2007,[16] and Reasons for Interrupting PNT in 100 Patients.

Characteristic	n
Disease	
GI tract disease	49
Cancer	36
Aortic aneurysm	7
Heart disease	6
Complicated childbirth	1
Polytrauma	1
Secondary diagnosis[a]	
Hypertension	26
Unspecified diabetes mellitus	15
Chronic renal failure	10
Obesity	7
Dyslipidemia	7
PNT indication	
Malfunctioning GIT	57
Prolonged fasting	15
Diarrhea	7
ENT or insufficient oral feedings	5
Lack of EN access	1
Noncompliance with A.S.P.E.N. 2007 guidelines	15
Reasons for interrupting PNT	
Oral feeding progression	26
End of protocol	21
Progression to ENT	19
Death before the end of the study	13
Hospital discharge before the end of the study	3
Removal of venous catheter	3

A.S.P.E.N., American Society for Parenteral and Enteral Nutrition; EN, enteral nutrition; ENT, enteral nutrition therapy; GI, gastrointestinal; GIT, gastrointestinal tract; PNT, parenteral nutrition therapy.
[a]Patients may have no, 1, or more than 1 secondary diagnosis.

Table 5. Causes of Noncompliance With PNT Indications According to A.S.P.E.N. 2007[16] Guidelines in 15 Patients.

Cause	n
Met >60% of the estimated energy requirements via oral feeding on the second day of PNT	4
Received central PN ≤3 days because of ENT use	4
Had no other possibilities for clinical therapies	3
Started oral feeding on the third day of PNT with removal of PN on the fourth day regardless of energy intake	1
Initiated ENT on the third day after PNT with suspension of PNT	1
Had postpartum uterine lesions but was eating normally	1
Initiated oral feeding on the first day with removal of PN on the third day	1

A.S.P.E.N., American Society for Parenteral and Enteral Nutrition; ENT, enteral nutrition therapy; PN, parenteral nutrition; PNT, parenteral nutrition therapy.

PNT noncompliance occurred mainly in the form of very early prescription of PNT for patients who were fasting or receiving ENT. Controversy persists about the best time for ENT patients to begin PNT. Canadian and U.S. guidelines recommend waiting 1 week before prescribing PNT.[28,29] In comparison, the European Society for Clinical Nutrition and Metabolism (ESPEN) 2009 guidelines[30] indicate that PNT should be initiated after 3 days of following inadequate dietary intakes.[31] In a study conducted in Switzerland, PNT was prescribed according to A.S.P.E.N. guidelines in all but 7% of the patients, who could receive oral feedings or ENT; however, according to the authors, only 31.5% of the patients received an adequate energy supply.[13]

In the present study, operational errors were the most common reason for inadequate PNT volume delivery. Such errors were attributed to delayed delivery of the PN solution by the outsourced pharmacy, PN prescription loss by the clerk, late PN solution request by the physician, and inadequate temperature for PNT bag administration. Unknown causes were the second leading cause of inadequate PNT administration. The investigators did not follow the patients for 24 hours, and all indications of improper receipt of PNT were collected from medical records and interviews with nurses and doctors. When such information was not available, the PN inadequacy was attributed to unknown causes.

The third cause of PNT inadequacy was associated with PNT progression (volume increase/decrease or PNT withdrawal). Changes in the infusion rate contributed to delayed PN drips. Delivering an adequate PN volume within the scheduled time requires the use of specialized infusion pumps and nurses' control. Infusion pumps must undergo periodic maintenance and calibrations to guarantee their efficacy.[32]

The fourth most common cause of PNT inadequacy was the order of PN suspension or temporary interruptions by non-NST medical professionals. Brazilians bylaws allow non-NST physicians to make changes in PN only after NST consultations. However, in our hospital, this was not always observed, suggesting that either nonspecialist medical professionals are not fully aware of the importance of PNT or the communication process among the medical staff is not adequate. In a German hospital with an established NST, 25% of patients receiving PNT did not receive adequate energy levels because PNT was prescribed by nonspecialized physicians.[33] In a complex setting such as the ICU, intensive care physicians may not consider nutrition an integral part of patient treatment and may underestimate patients' energy and protein requirements. Improved communication among NST physicians and continuing nutrition education/training of non-NS health professionals are of outmost importance.[34,35]

Heyland et al[36] reported that an alternative way to reduce inconsistencies between prescribed and received ENT amounts is to deliver the total volume of EN formula over a full 24-hour

Table 6. Reasons for Improper PN Volume in 85 Patients, Considering All Events Manifested Over 1061 Days of PNT.

Cause	No. of Days	%	Odds Ratio	95% CI	*P* Value[a]
Operational errors (eg, medical prescription loss, pharmacy delay/no PN delivery, inadequate temperature of PN solution)	388	36.5	74.2	10.2–540.3	<.0001
Unknown causes (infusion delay unjustified in medical records)	173	16.0	51.3	24.9–105.7	<.0001
NS progression (NS progression or withdrawal)	164	15.5	47.0	22.8–96.9	<.0001
Medical order (non-NST)	24	2.2	36.6	4.9–271.9	<.001
CVC exchange	17	1.6	4.2	1.6–10.8	.0019

CI, confidence interval; CVC, central venous catheter; NS, nutrition support; NST, nutrition support team; PN, parenteral nutrition.
[a]Fisher test.

Table 7. Percentage of Days With Adequate Parenteral Nutrition Therapy Volume for 85 Patients.

Clinical Outcome	Days, Mean (SD), %	*P* Value[a]
Hospital discharge	59.9 (18.8)	.047
Death	49.7 (20.6)	

[a]Mann-Whitney test.

period instead of prescribing per hour. Therefore, delays in or interruptions of EN administration (eg, for imaging tests or other procedures) could be compensated during the remaining hours of the day. However, simply applying the PEPuP protocol to PNT may be insufficient or undesirable because the rapid supply of large volumes of PN solution, which is usually hyperosmolar and contains high glucose levels, may not be tolerated by critically ill patients.

The results of our study revealed that patients who spent the most NT days receiving ≥80% of the prescribed PN volume were those most likely to be discharged from the hospital. PNT aims to prevent nutrition deficiencies, maintain lean body mass, prevent complications, and improve clinical outcomes.[37] Reduced nutrient levels in associations with increased energy requirements are significant causes of hospital malnutrition.[38–40] PNT can reduce morbidity in surgical patients with severe malnutrition and may reduce mortality in critically ill patients.[41,42] However, we cannot disregard the possibility that this significant association could have arisen because the less severe patients received more PNT and were discharged. This is a limitation of our study because we were not able to measure severity scores in our patients.

The serious consequences of CVC contamination in PNT, including local infections, septic thrombophlebitis, endocarditis, and other infections,[43] tend to obscure the benefits of PNT. In the United States, 8% of catheterized patients annually develop sepsis. The rates of septicemia associated with uncuffed catheters range from 4%–14%.[26] The National Nosocomial Infections Surveillance (NNIS) from the Centers for Disease Control and Prevention (CDC) reported an average rate of CVC infection in ICUs ranging from 2.9–5.9 per 1000 catheters/d,[43] which shows that our rates are not in accordance with these guidelines. Action plans to decrease this dangerous complication are under way.

The PNT patients' blood glucose levels were within the established guidelines,[24] showing that our patients had good glycemic control.

Conclusion

The limitations of our study include that the researchers did not personally follow all of the patients for 24 hours, 7 days a week. We had to partially rely on information written in medical records by physicians and nurses. Unfortunately, sometimes this information was lacking, and despite our best effort to complete the missing data, we were unable to do so in all cases.

Another limitation is related to the total amount of energy and protein intake that each patient received. We did not compute oral intake, oral supplements, or ENT, which could have jeopardized the interpretation of results. However, except for the cases that did not conform to PNT indications, most of the patients' energy and protein were provided via PNT.

Nutrition quality control helps to identify specific issues related to NS processes.[44] The results of our this study revealed that PNT quality was moderately inadequate based on PNT indication and PN delivery volume. We observed that for 15% of the patients, the PNT indication was not in accordance with A.S.P.E.N. 2007 guidelines. Moreover, for the remaining patients receiving PNT, there were inadequacies in the volume administered. The main cause for improper PN volume was operational errors. It is possible that these errors were related to miscommunications among healthcare professionals regarding the best practice in NT.[45–47] Therefore, it is important to establish periodic meetings among different health professionals who prescribe and deliver PNT to define responsibilities and protocols. Even with the presence of a well-organized NST consisting of specialized doctors and dietitians, we observed a need for additional information and periodic training in NS. With a well-targeted NST, there could be greater chances that PNT will be delivered in accordance with established guidelines.

Table 8. Quality Indicators in Parenteral Nutrition Therapy.[24]

Quality Indicator	Results, %	Goal, %
Frequency of measuring or estimating energy/protein requirements in hospitalized patients	100	≥80
Frequency of CVC-related sepsis in PNT patients	9.4	8[26]
Frequency percentage of abnormal glucose in patients receiving PNT	ICU Hyperglycemia: 18.8 Hypoglycemia: 2.3 Wards Hyperglycemia: 25.8 Hypoglycemia: 5.8	Hyperglycemia Noncritical patients: <30 Critical patients: <70 Hypoglycemia Critical patients: <7

CVC, central venous catheter; ICU, intensive care unit; PNT, parenteral nutrition therapy.

The NST must have open communication and discuss clinical cases with medical teams to optimize efficacy and efficiency of PNT prescription.

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