

# Parenteral Nutrition Practice in the United States: ASPEN Gap Analysis Findings

Parenteral nutrition (PN) is a high-alert medication with the potential for errors that result in patient harm. ASPEN has published guidance to support safe PN practices; however, the current implementation of this guidance remains unknown.<sup>1</sup> ASPEN conducted a cross-sectional survey of PN practices among US-based clinicians. The survey addressed multiple steps in the PN use process, with a total of 1,160 participants.<sup>2</sup> The purpose of this safety practice tool is to raise awareness of current practice gaps in prescribing, order reviewing, compounding/dispensing, administration, and monitoring of PN therapy. Clinicians should use these findings to evaluate current practices, identify areas of risk, and prioritize quality improvement initiatives aligned with ASPEN standards, recommendations, and safe practice guidance.

## General Findings

### Respondents' Demographics

- More than half were dietitians, followed by pharmacists, nurses, and physicians
- 47% of respondents were board certified in nutrition support
- 85% primarily practiced in hospitals
- 79% treated adult patients
- 33% treated pediatric patients
- 29% treated neonatal patients
- 43% had nutrition support teams at their institutions

### Respondents' PN Use

- 67% of organizations dispense up to 15 PN formulations per day
- 48% compound PN on site and 47% outsource at least some PN to an outside vendor
- Almost 22% report use of commercial multi-chamber bag PN (MCB-PN) with additives and/or MCB-PN without additives (15.9%)

## Prescribing

Respondents reported variable PN prescribing practices, which can lead to errors and patient harm. Standardized prescribing is critical to patient safety. The survey revealed an ongoing gap between published guidance and current practices for prescribing PN.<sup>1,2</sup>

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Practice Assessment Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Potential Improvement Actions                                                                                                                                                                       |
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| <b>PN Prescription</b> <ul style="list-style-type: none"> <li>• About 80% of PN prescriptions are ordered in the EHR</li> <li>• Only about 60% of electronic systems include clinical decision support (e.g., limit warnings, Ca/PO4 precipitation curves to minimize prescribing errors)</li> <li>• About 10% of organizations use an electronic PN prescription that is not part of the EHR</li> <li>• Nearly 10% of organizations continue to use handwritten paper orders for prescribing PN, which is an unsafe medication practice</li> <li>• 42% of organizations do not consider electrolytes inherent to amino acid products when prescribing electrolytes</li> </ul> <b>Trace Elements</b> <ul style="list-style-type: none"> <li>• About 2/3 use a standard volume of a multiple-trace element product and about 1/4 order patient-specific doses of individual trace elements</li> <li>• Almost 5% do not routinely add trace elements</li> </ul> <b>Non-nutrient Medications</b> <ul style="list-style-type: none"> <li>• Almost 2/3 allow the inclusion of non-nutrient medications within the PN prescription</li> </ul> <b>Dosing Formats for Macronutrients &amp; Electrolytes</b> <ul style="list-style-type: none"> <li>• Continued use of multiple formats and mixed formats within same PN prescription</li> </ul> | <ul style="list-style-type: none"> <li>• Are all PN orders entered electronically through the EHR?<sup>1</sup></li> <li>• Have handwritten PN orders been eliminated?<sup>1</sup></li> <li>• Does the EHR include PN-specific clinical decision support, alerts, dose limits, and Ca/PO4 precipitation curves?<sup>1</sup></li> <li>• Are electrolytes inherent to amino acid products accounted for during prescribing?</li> <li>• Are trace elements routinely prescribed and standardized?<sup>1</sup></li> <li>• Are non-nutrient medications restricted from inclusion in PN formulations unless clinically justified and compatible/stable?<sup>1</sup></li> <li>• Are macronutrients prescribed using ASPEN recommended units and dosing formats?<sup>1</sup></li> </ul> | <ul style="list-style-type: none"> <li>✓ Educate prescribers on recommended dosing nomenclature and units</li> <li>✓ Implement competency-based education for PN prescribers<sup>3</sup></li> </ul> |

Ca/PO4=calcium phosphate; EHR=electronic health record; ILE=intravenous lipid emulsion

## Prescribing (continued)

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Practice Assessment Questions                                                                                                                                                                                                    | Potential Improvement Actions                                                                                                                                                                   |
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| <b>PN Orders for Adults</b> <ul style="list-style-type: none"> <li>Almost 50% of respondents reported using macronutrient dosing formats and units of measure not consistent with the published guidance format of amount per day</li> <li>Almost 70% prescribe electrolytes as the salt format</li> <li>About 20% prescribe electrolytes using a format other than the electrolyte salt and 12% were unsure</li> <li>About 30% continue the unsafe practice of prescribing phosphate as mEq of the cation instead of mmoles of phosphate and about 10% use a mix of both methods</li> </ul> <b>PN Orders for Pediatric and Neonatal Patients</b> <ul style="list-style-type: none"> <li>Almost 65% of organizations prescribe amino acids and ILE in the format of g or kcal/kg/day</li> <li>Only 12% of organizations prescribe dextrose in the format g or kcal/kg/day, while nearly half still use percent final concentration</li> <li>About 2/3 of organizations prescribe electrolytes as the salt and in the recommended units of mEq or mmol/kg/day</li> <li>For prescribing phosphate 51% use mmol with about 26% prescribing as mEq of the cation</li> </ul> | <ul style="list-style-type: none"> <li>Is phosphate consistently prescribed in mmol rather than mEq of the cation?<sup>1</sup></li> <li>Are electrolytes prescribed as salts rather than individual ions?<sup>1</sup></li> </ul> | <ul style="list-style-type: none"> <li>Educate prescribers on recommended dosing nomenclature and units</li> <li>Implement competency-based education for PN prescribers<sup>3</sup></li> </ul> |

Ca/PO4=calcium phosphate; EHR=electronic health record; ILE= lipid injectable emulsion

## PN Order Review\*

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Practice Assessment Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Potential Improvement Actions                                                                                                                                                                                                                                                                                                                                                 |
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| <b>PN Order Review</b> <ul style="list-style-type: none"> <li>25% do not have pharmacists dedicated to this critical step of PN order review</li> <li>Over 90% reported pharmacists perform both a clinical and a pharmaceutical review</li> <li>About 70% evaluate medication compatibility</li> <li>About 2/3 evaluate total nutrient admixture stability</li> </ul> <b>PN Order Clarification</b> <ul style="list-style-type: none"> <li>43% report &gt;10% of orders require clarification</li> <li>Over 50% reported an at least sometimes frequency for these causes requiring PN order clarification: <ul style="list-style-type: none"> <li>Micronutrient dosing</li> <li>Macronutrient dosing</li> <li>Unstable formula</li> <li>Incorrect rate</li> <li>Excessive osmolality for peripheral PN</li> <li>Missing information</li> <li>Insufficient volume</li> <li>Medication dosing</li> <li>PN component shortages</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Is every PN order reviewed by a pharmacist with PN competency?<sup>1</sup></li> <li>Is there time allocated for a pharmacist to dedicate to PN review?</li> <li>Are compatibility and stability assessments routinely performed?<sup>1</sup></li> <li>How frequently are PN orders clarified before preparation?</li> <li>What are the most common causes of PN order clarification?</li> <li>Are clarifications reported, evaluated, and trended?</li> </ul> | <ul style="list-style-type: none"> <li>Develop standardized PN verification checklists<sup>1</sup></li> <li>Track and trend ordering errors and clarification requests</li> <li>Implement competency-based education for pharmacists performing PN review<sup>1,4</sup></li> <li>Establish escalation pathways for instability, compatibility, and dosing concerns</li> </ul> |

\*Pharmacist only data

### References

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## Compounding and Dispensing\*

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Practice Assessment Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Potential Improvement Actions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| <b>PN Compounding and Dispensing</b> <ul style="list-style-type: none"> <li>79% use an ACD</li> <li>50% have an automated interface between the EHR and ACD</li> <li>37% use error-prone manual entry to enter PN order information into the ACD</li> <li>Assigned BUD varies between organizations and PN admixture systems</li> <li>Up to 20% of respondents were “unsure” of the BUD assigned to various PN admixtures</li> <li>96% affix a label to the PN formulation listing each component and respective dosage</li> <li>50% do not refrigerate and light protect the PN between compounding and the start of infusion, which increases the risk of incompatibility and instability within the assigned BUD</li> </ul> | <ul style="list-style-type: none"> <li>Are PN admixtures prepared using an ACD?</li> <li>Does an electronic interface exist between the EHR and ACD?<sup>1</sup></li> <li>Is manual transcription prohibited?<sup>1</sup></li> <li>Are BUDs consistent with current standards?<sup>1</sup></li> <li>Are staff knowledgeable about assigning BUD?<sup>1</sup></li> <li>Do labels include all ingredients and dosages?<sup>1</sup></li> <li>Are PN admixtures refrigerated and protected from light between compounding and administration?<sup>1,5</sup></li> </ul> | <ul style="list-style-type: none"> <li>Eliminate manual transcription<sup>1</sup></li> <li>Validate electronic interfaces between systems<sup>1</sup></li> <li>Standardize storage and handling procedures<sup>1</sup></li> <li>Conduct routine staff training on BUD and stability considerations.</li> <li>Adhere to USP &lt;797&gt; guidance for assigning BUDs to PN admixtures<sup>1</sup></li> <li>Implement competency-based education for pharmacists performing PN compounding<sup>4</sup></li> </ul> |

\*Pharmacist only data. ACD = automated compounding device; BUD = beyond use dating; EHR = electronic health record; USP = United States Pharmacopeia

## Administration

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Practice Assessment Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Potential Improvement Actions                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <b>PN Administration</b> <ul style="list-style-type: none"> <li>75% use amino acids/dextrose (2-in-1) solutions with separate ILE administration</li> <li>48% use total nutrient admixtures (3-in-1)</li> <li>The most common maximum hang time for both 2-in-1 and 3-in-1 PN admixtures is 24 hours</li> <li>The maximum hang time for ILE administered separately from the PN varied: <ul style="list-style-type: none"> <li>53% reported 12 hours</li> <li>34% reported 24 hours</li> <li>10% unsure of organization's practice</li> </ul> </li> <li>93% use barcode scanning for PN</li> <li>78% use smart pump technologies</li> <li>About 1/4 allow the administration of a PN admixture coming from home or an outside facility, which should be avoided because of the inability to verify preparation and storage conditions</li> </ul> <b>Use of Filters for PN Administration</b> <ul style="list-style-type: none"> <li>Use of various filter sizes for 2-in-1 solutions <ul style="list-style-type: none"> <li>1/3 use a 0.22 micron filter</li> <li>1/3 use a 1.2 micron filter</li> <li>1/3 unsure of organization's practice</li> </ul> </li> <li>Use of filters for separate ILE administration <ul style="list-style-type: none"> <li>61% use a 1.2 micron filter</li> <li>2% do not use a filter</li> <li>35% unsure of organization's practice</li> </ul> </li> <li>Use of filters for 3-in-1 admixtures <ul style="list-style-type: none"> <li>72% use a 1.2 micron filter</li> <li>28% unsure of organization's practice</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Are 1.2 micron filters used when administering all PN admixtures?<sup>1,6</sup></li> <li>Do clinicians understand that 1.2 micron filters are required for 2-in-1, 3-in-1, and separate ILE infusions?<sup>1,6</sup></li> <li>Are maximum hang times consistent with current recommendations?<sup>1</sup></li> <li>Are barcode medication administration systems consistently used?<sup>1</sup></li> <li>Are smart pump technologies used?<sup>1</sup></li> <li>Does the organization prohibit administration of PN admixtures prepared outside its control?<sup>1</sup></li> <li>Are nurses routinely educated on PN administration safety requirements?</li> </ul> | <ul style="list-style-type: none"> <li>Standardize filter selection and administration procedures<sup>1,6</sup></li> <li>Review separate ILE infusion practices and hang times<sup>1</sup></li> <li>Expand nursing education regarding PN administration</li> <li>Restrict use of patient-supplied PN admixtures<sup>1</sup></li> <li>Implement competency-based education for nurses administering PN<sup>7</sup></li> </ul> |

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## Monitoring, including PN-related Errors and Shortages

| Survey Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Practice Assessment Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Potential Improvement Actions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| <p><b>PN Monitoring, including PN-related Errors &amp; Shortages</b></p> <ul style="list-style-type: none"> <li>Almost 1/4 do not have an ongoing clinical effectiveness or quality improvement process; 28% were unsure if a process exists in their organization</li> <li>Oversight of the PN process primarily falls on pharmacy services and nutrition and dietetic services. Oversight by medical staff and nutrition support teams has declined.</li> </ul> <p><b>Impact of PN-related Drug Shortages</b></p> <ul style="list-style-type: none"> <li>48% reported valuable time consumed developing contingencies</li> <li>35% were unable to meet patients' macronutrient needs</li> <li>31% were unable to meet patients' micronutrient needs</li> <li>25% were unable to meet patients' fluid needs</li> <li>11% reported shortages directly impacted patient outcomes</li> <li>6% reported shortages contributed to PN-related errors</li> <li>30% reported shortages had no significant impact on their organization</li> </ul> <p><b>Medication Errors Involving PN</b></p> <ul style="list-style-type: none"> <li>70% indicated medication errors involving PN are evaluated at their organization; 4% reported errors are not evaluated; roughly 1/4 were unsure</li> <li>Frequency and type of PN errors (one or more errors/month) <ul style="list-style-type: none"> <li>35% associated with prescribing, transcribing or verification</li> <li>17% associated with compounding</li> <li>37% associated with administration</li> </ul> </li> <li>Over 50% were unsure of the monthly frequency of PN-related errors for all steps of the PN process</li> <li>Errors involving specific components <ul style="list-style-type: none"> <li>41% electrolytes</li> <li>36% ILEs</li> <li>28% dextrose</li> <li>25% trace elements</li> <li>22% amino acids</li> <li>22% vitamins</li> </ul> </li> <li>Over 40% were unsure of the frequency of errors associated with any specific PN component</li> <li>About 1/3 of respondents have cared for a patient affected by a PN-related error in the last 12 months, 39% had not and 27% unsure.</li> <li>Most errors (68%) reached the patient but did not cause harm; 15% caused temporary harm; 4% caused permanent harm</li> </ul> | <ul style="list-style-type: none"> <li>Do you have an active PN quality improvement process with defined metrics and regular review?<sup>1</sup></li> <li>Are PN-related medication errors and near misses consistently reported, evaluated, and trended?</li> <li>Can you identify where PN errors occur most frequently (prescribing, compounding, or administration)?</li> <li>Do you routinely monitor errors involving PN components?<sup>1</sup></li> <li>Do you have a formal plan to manage PN-related drug shortages and assess their impact on patient care and safety?<sup>1</sup></li> </ul> | <ul style="list-style-type: none"> <li>Implement a formal PN quality and safety program with routine review of key performance indicators<sup>1</sup></li> <li>Establish interprofessional oversight involving pharmacy, nutrition, nursing, and medical staff</li> <li>Track and trend PN-related errors by process step and component to identify recurring risks and improvement opportunities</li> <li>Share error findings and lessons learned with clinicians and incorporate them into ongoing education and process improvement efforts</li> <li>Develop standardized drug shortage contingency plans, par levels, and regularly evaluate their effectiveness in maintaining safe and adequate nutrition support<sup>1</sup></li> </ul> |

## Critical Safety Gaps

- Prescribing practices that lack standardization and do not align with guidance
- Inadequate storage practices between compounding and administration required to maintain compatibility and stability
- Lack of adherence to specific filter type guidance
- Lack of adherence to the maximum hang time of separate ILE infusions
- Limited PN oversight; minimal quality improvement activities; inadequate evaluation of PN-related errors
- Pervasive unawareness of key institutional PN practices (e.g., ordering processes, BUDs, filter use, error evaluation procedures, and quality improvement efforts) likely from fragmented care and limited communication among siloed clinicians