



Stony Brook  
Medicine

# Parenteral Nutrition

## Standard Operating Procedures

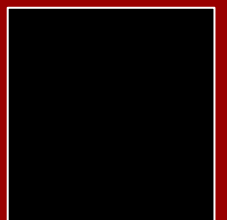
Stony Brook University Hospital  
Pharmacy Department

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## CONTENTS

<b>Purpose</b> .....	3
<b>Scope</b> .....	3
<b>Training and Competency</b> .....	3
<b>Responsibilities</b> .....	3
<b>Procedures</b> .....	4
Hospital Ordering Procedures .....	4
Day Shift Pharmacist Responsibilities .....	4
PN Order Entry Pharmacist .....	4
PN Checking Pharmacist .....	10
Day Shift Technician Responsibilities .....	11
Evening Shift Responsibilities .....	12
<b>Exceptions</b> .....	6
Broken Parenteral Nutrition Bag .....	13
Missed Delivery of Parenteral Nutrition .....	14
Downtime Procedures .....	14
<b>Reference Charts for PN Checking</b> .....	16
<b>SBUH Standard Formulas</b> .....	17
<b>Additional Resources</b> .....	18
<b>References</b> .....	18

## **PURPOSE**

The Parenteral Nutrition Pharmacy provides services to all inpatients requiring parenteral nutrition. The Pharmacy Department works closely with the Nutrition Department, Pediatric Gastroenterology service, and the Neonatal Intensive Care Unit to provide the optimal nutrition support to all patients in the hospital.

## **SCOPE**

For use by all pharmacists and technicians, working within the Stony Brook University Hospital. Especially for those individuals who are involved with the parenteral nutrition preparation process.

## **TRAINING AND COMPETENCY**

See attached documents for the Training and Competency Checklists for the following Staff Members who are part of the daily parenteral nutrition (PN) preparation process:

- PN Order Entry Pharmacist
- PN Checking Pharmacist
- IV Room Pharmacist
- Day Shift PN Technician
- Evening Shift IV Bench Pharmacist
- Evening Shift IV Room Pharmacist

## **RESPONSIBILITIES**

The Nutrition Support Pharmacist or Pharmacist Assigned to Parenteral Nutrition Order Entry is responsible for the daily Clinical Review of all parenteral nutrition orders for the hospital. This includes, but is not limited to, checking for appropriateness, safety, dosing accuracy, and calculation accuracy. The PN Order Entry pharmacist is then responsible for transcribing the order into CAPSlink in preparation for compounding by CAPS; and final verification of the order in PharmNet. The Nutrition Support Pharmacist is responsible for overseeing that all other steps of the PN process have been completed by the other team members.

The Pharmacist performing the second check is responsible for double checking all PN orders entered by the order entry pharmacist. This check includes, but is not limited to the accuracy and appropriateness of dosing, calculations, and transcription of the order between the two computer programs.

The Technician in the IV room is responsible for the preparation of the lipids and IV line sets for each PN formula for that day. The PN Pharmacist should provide the technician with a summary of how many PN orders there are that day. They are responsible for assembling all lipids and IV line sets for the evening shift so that they are prepared for when the PNs arrive later in the day.

The Pharmacist in the IV room is responsible for signing all lipid bags to confirm that they are on the right product and there is a sufficient volume to provide the full lipid dose to the patient. They are also responsible for overseeing that the IV Room technician has prepared all line sets for the evening shift.

The IV Bench Pharmacist on the evening shift is responsible for the receiving of the PN bags from the CAPS driver. They must sign off on the CAPS packaging sheet, and then compare the top sheet (sample label) of the Order Packet to the actual label on the bag to confirm that the bag verified during the day shift is the one that was delivered.

The Evening Shift Pharmacist in the IV Room is responsible for spiking the PN bags with their designated IV line sets that have been prepared by the day shift technician in the IV room.

## PROCEDURES

### Hospital Ordering Procedures

When the initiation of parenteral nutrition is being considered for a patient, there is a specific protocol that has to be followed depending upon the age and location of the patient.

- **Adult Patients**
  - All adult patients require a Nutrition Consult, which is placed by the patient's primary team. A dietician sees the patient and will determine (1) whether this patient is a candidate for PN, and (2) what formula they should receive.
    - Per hospital policy, all nutrition consults should be placed by 10:00. This assures that the dietician has a sufficient amount of time to see the patient and make recommendations before the 11:00 order deadline.
  - Once seen by nutrition, the primary team will place the orders for both PN and lipids based on the recommendations from Nutrition
    - Exception: patients in the Surgical Intensive Care Unit (18S) do not require a Nutrition Consult prior to initiating PN, since the surgeons who oversee PN are based in that unit
- **Pediatric Patients** - 11N, 11S1, & 11S2
  - All pediatric patients must be seen by the Pediatric Gastroenterology service. This service must be consulted if the primary team wants to initiate PN, and the Pediatric Gastroenterology service will manage all daily ordering and modifications of PN orders.
- **Neonatal Patients** – Neonatal Intensive Care Unit (NICU)
  - All patients in the NICU are eligible to receive PN without any consults. Orders are written by either a Nurse Practitioner or a NICU Fellow

Per hospital policy, all PN orders are due to the TPN Pharmacy by 11:00. The goal hang-time for orders is 21:00 the same day that the order is placed.

### Day Shift Pharmacist Responsibilities

At least two pharmacists will be involved in the order entry and verification of all parenteral nutrition orders (PN) each day. The compounding of all parenteral nutrition orders is completed at an outside facility, CAPS (Central Admixture Pharmacy Services), based in Englewood, New Jersey. All PN orders must be submitted to CAPS via their web-based computer software program, CAPSlink.

#### PN Order Entry Pharmacist

- Checking Patient Profiles and Parenteral Nutrition (PN) Orders
  - When a PN order is received, the Pharmacist should first check the patient's profile in PowerChart. This check may include, but is not limited to:
    - Labs in "Results Flowsheet"
    - Diet Orders
    - Patient's clinical condition in "Progress Notes"
    - Medication List

- Current rate of PN administration in "I's & O's"
- Nutrition Consult Notes
- Type of IV Access (peripheral v. central line)
- **The PN order will print on the TPN printer as 2 sheets:** one for the PN itself and one for the lipids that will be infused concomitantly
  - For Adult patients, the orders should be cross-referenced with the most recent Nutrition consult note to make sure that the team is following Nutrition's recommendations
    - Formulas can be Standard or Special
      - The content of the Standard formulas **cannot** be modified
    - If a patient is on a standard formula and has an electrolyte abnormality, the team may be contacted by the PN Pharmacist to recommend switching over to a Special formula so that the electrolyte content can be modified to meet the patient's needs.
  - For Pediatric patients, all orders must be placed by the Pediatric Gastroenterology service. All formulas for Pediatric patients are individualized Special Formulas.
    - The top line of the order comments note the dosing of the macronutrients. These numbers should be cross-checked with the content ordered.
      - Dextrose (%), Protein (g/kg), Lipids (g/kg)
    - There will likely be a comment specifying how to balance the acetate and chloride (most often a 50/50 balance).
    - Each electrolyte ordered should be checked that their weight-based dose is within appropriate range (See **Reference Charts for PN Checking**)
  - For NICU patients, all orders are placed by either a NICU Nurse Practitioner or NICU Fellow. NICU formulas can be either Special or Standard.
    - There are 4 Standard Formulas used for the NICU, see **SBUH Standard Formulas** chart for full content of each formula.
      - NICU D5 Formula
      - NICU D10 Formula
      - NICU D12 Formula
      - NICU D15 Formula
    - Use the **NICU Standard TPN Calculator** Access file to determine the weight-based intake of each component of the PN formula
    - The top line of the Order Comments specify the dosing of the primary micronutrients and macronutrients for the formula
      - D10 (%) Na/K/Ca (mEq/kg) Amino Acids/Lipids (g/kg)
    - The order comments will also contain dosing instructions for the following parameters:
      - Acetate/Chloride balance (max, min, balance, specific %'s)
      - Calcium: Phosphorous ratio
        - Indicates mEq's of Ca to mmol's of Phos
        - The majority of formulas will default to a 2:1 ratio
          - Exception: very low birth weight neonates will likely have a goal of 1:1
        - The ratio can change based upon follow-up labs
    - If the patient weighs less than 1.5kg, L-Cysteine should be added to the bag by the PN Pharmacist
      - Dose = 40mg per 1g of Protein
      - L-Cysteine does not appear as a separate product in the PharmNet order. Therefore, the PN Pharmacist should add into the Order Comments specifying "L-Cysteine Added"
      - L-Cysteine is a conditionally essential amino acid in Neonates

- Also lowers the pH of the formula, which improves calcium/phosphorous solubility
  - The dosing for each component of the TPN should be checked for accuracy and safety. Standard Doses of certain agents are listed below
    - Adult Formulas
      - Multivitamins: 10mL
      - MultiTrace-5: 5mL
        - Trace Element product contains zinc, copper, chromium, selenium, and manganese
    - Pediatric Formulas
      - Pediatric Multivitamins: 2mL/kg (max dose = 5mL)
      - MultiTrace-4 Pediatric: 0.2mL/kg (max dose = 3mL)
        - Trace Element product contains zinc, copper, chromium, and manganese
    - Neonate Formulas
      - Pediatric Multivitamins: 2mL/kg (max dose = 5mL)
      - Magnesium: 0.3mEq/kg
      - Trace Elements: please refer to **SBUH Trace Elements for Neonatal TPN Chart** for trace element dosing
        - All patients receive Zinc and Copper
          - Selenium and Chromium are reserved only for long-term patients, defined as longer than 3 weeks
            - Final determination of adding these products is made by the primary team
        - Dosing is differentiated by whether the patient is pre-term (<37 weeks postmenstrual age) or term (>37 weeks PMA)
        - For patients determined to have cholestasis (typically characterized by elevated bilirubin levels) by the primary team, the dose of copper will need to be reduced since it is metabolized in the liver.
          - Refer to the green cholestasis dosing column for copper on the Trace Element dosing chart.
    - Refer to **Reference Charts for PN Checking** for additional dosing recommendations for each patient age group
  - The PN Pharmacist is also responsible for calculation accuracy for orders that require the calculation of weight-based doses.
- Once the PN order has been determined as safe and appropriate, the PN Pharmacist is responsible for transcribing the order into CAPSlink, and then verifying the order in PharmNet.
  - The final verified order should be cross-checked with the sample label generated from CAPSlink to verify that no transcription errors have occurred.
    - This check includes both the ordered contents and the order comments section of the order.
  - These papers, along with the printout of the original order will be attached together to create the Order Packet.
- Using CAPSLink
  - Please refer to **CAPSLink Training Record** training checklist for full training requirements for TPN Pharmacist users of this program.
  - Weblink: <https://eastlink3.caps-oe.com/capslink/capslink-web/capslink101.html>
    - Login using User ID and Password
    - A super-user in the department (Nutrition Support Pharmacist or IV Room Supervisor) should have created a User ID and generated a temporary password for initial log-in. Once logged in, the program will prompt the creation of a new password, with the following restrictions:
      - At least 8 characters in length
      - At least 1 non-alphabetical character

- At least 1 capital letter
- Once logged in, the initial screen may give the option between "TPN/Custom RX" and "Drug Delivery"
  - Select "TPN/Custom RX" for individualized PN order entry
- The Home page of CAPSLink is the "Patient List," which lists all orders sent to CAPS within the past 24 hours.
- There are a number of options on the toolbar on the left-hand side of the screen:
  - **New Patient:** this option allows for the creation of a new patient profile.
  - **New Prescription:** this option allows the creation of a new order for an active patient who already has a profile created in CAPSLink.
  - **Other Reports:** allows the printing of various reports, such as the "Send to CAPS" report, error overrides, and total counts by type of formula (adult, pediatric, neonatal).
  - **User Management:** for administrators and super-users of the program. Allows the creation and management of user profiles.
- By double-clicking on any patient listed in the patient list, there will be an option between opening the "Patient View" or the "Prescription View"
  - See "Entering an Order in CAPSLink" below for further detail
- Entering an Order in CAPSLink
  - **Patient View:** contains all of the demographic information for the patient. This information should be reviewed daily when starting a new prescription.
    - Double click a patient from the Patient List and select "Patient View"
    - The following fields should be filled in on this page:
      - MRN
      - First name
      - Last name
      - Date of Birth
      - Gender
      - Area/Unit
      - Weight
      - Allergies
    - At the bottom of the patient view page, there is a list of all previous orders (if any). The most recent order will appear at the top of this list.
    - The prescription view can be entered by double clicking the order from this view, or by returning to the patient list and double clicking the patient and selecting "Prescription View"
  - **Prescription View:** contains the actual PN order entry content for today's PN prescription
    - There are two ways to access this page
      - Double click the patient from the Patient list and selecting "Prescription View"
      - Double click the most recent order from the bottom of the Patient View screen (see above on how to access this page)
    - Once open, the content windows will either be empty and white, or filled in and grey
      - The white fields show a new order, and is ready for order entry
      - The grey fields show yesterday's order. To generate a new modifiable template, select "Edit" on the top right of the screen.
        - The grey fields will retain their values and the fields will turn white, making the order editable and ready for order entry.
    - Transcribe all content values into the template (white fields) from the Cerner order sheet
    - Check the following safety parameters in the Order Summary, found on the left-side toolbar of the screen
      - **Osmolarity**
        - <900 mOsm/L can be given peripherally

- Make sure the correct Route of Administration is selected in conjunction with the osmolarity
- **Ca:Phos Ratio**
  - A Ca:Phos ratio below 50 has a low probability of precipitating. The templates have been set to give the following overrides:
    - $\geq 45$  Warning – OK to give, make sure solubility curves look acceptable
    - $\geq 50$  Critical – do not give, formula must be adjusted
  - The stability of the solution should also be checked by using the CaPo<sub>4</sub> Curves (see below)
- **CaPo<sub>4</sub> Curves**
  - CAPSlink has documented solubility curves from Trissel's within their database, found on the left side-bar of the screen.
  - The current formula as written will be represented by a blue dot plot-point on the graph. Additionally, the program will automatically calculate the % amino acids and % dextrose, listed at the top of the graph.
    - The formula should be matched to the closest formula in the Trissel's database to determine the stability of the current formula.
  - For each solubility curve, the plot-point of the formula should fall to the lower left-hand side of the curve. This indicates that there is a low probability of precipitation from occurring.
    - If it is on the line or to the right of the curve, there is a high probability that the formula will precipitate, based on the content of the calcium and phosphorous.
  - Once all fields have been updated, the order can be saved or validated.
    - After saving the Order, the PN prescription in CAPSLink will read "Needs Verification" in blue. This keeps the order modifiable so that changes can be made at a later time.
- Validation of PN prescription
  - Once all updates have been made in today's prescription, select "Validate" on the top right of the Prescription View.
    - A pop-up window will appear with a prompt to enter the user's password.
    - This pop-up will also contain any warning/error messages that need an override. Address each warning by checking the box to the left of the error message to override before entering user password.
  - After validating the Order, the PN prescription in CAPSLink will read "Ready to Send" in yellow. Leave in this state at this time until double-checked by another pharmacist.
- Printing a CAPS Sample Label
  - Once validated, a sample label can be printed by selecting the printer icon either in the Prescription View, or from the primary patient list in CAPSLink. The sample label generates as a PDF in a separate window. Print a copy of this label.
  - This is an exact copy of what the bag label should be once it is submitted to CAPS for preparation.
- Verify the PN order in PharmNet by cross-checking the CAPS sample label with the original order.
  - One Cerner label should be printed for each order, one for the lipid order, and one for the PN formula.
    - These labels contain the barcode that should be scanned by nursing when administering the PN.



- Once verified, a Cerner verification page will print for both orders that will be used for assembling the Order Packet
- The Cerner labels should be initialed in the bottom left corner of both labels. Additionally, the CAPS sample label should be initialed in the top left corner of the paper.
  - **The 1<sup>st</sup> signature on the Cerner labels indicates the pharmacist who was responsible for the Order Entry of that parenteral nutrition order in both CAPSlink and PharmNet. This person is responsible for determining the appropriateness of dosing, safety of therapy given the patients' laboratory tests, accuracy of calculations, and precision of order transcription between programs.**
  - The PN Pharmacist should write out a signature area in the top right corner of the sample label with the following designations:
    - **Entered:** 1<sup>st</sup> Check RPh
    - **Verified:** 2<sup>nd</sup> Check RPh
    - **Label Check:** Evening IV Bench RPh
- Assemble the final Order Packet with the Cerner confirmation pages and CAPS Sample Label in the following order (listed from top to bottom).
  - Cerner labels (paper clipped)
  - CAPS Sample Label (paper clipped)
  - Cerner Pharmacist Verification – PN order (stapled)
  - Cerner Pharmacist Verification – Lipid order (stapled)
  - Cerner Original Order Confirmation– PN order (stapled)
  - Cerner Original Order Confirmation – Lipid order (stapled)
- The order packet should be given to the PN Checking Pharmacist for review.
  - See "**PN Checking Pharmacist**" Responsibilities below for detailed description of second check procedures
- Final Order Submission to CAPS
  - Once the TPN orders have been double-checked and signed by a second pharmacist, orders may be submitted to CAPS. There are two methods that this can be completed:
    - In Patient View, select the checkbox to the left of the prescription that you want to send and select the "Send to CAPS" option.
      - The prescription should turn green saying "Sent to CAPS", it will later turn orange saying "Received by CAPS" once they have downloaded the order into their system.
    - In Prescription View, and select the "Send to CAPS" button in the top right of the screen.
- Printing an Order Summary
  - In CAPSlink, select "Other Reports" on the left-side toolbar
    - Select from the Drop-down Menu "Release to CAPS Report"
    - At the top of the screen, select print, which will generate a PDF file of all orders sent to CAPS.
    - Print two copies of this file, one gets added to the TPN log binder, and the other stays with the order packets
  - The PN Pharmacist should handwrite the total number of each type of formula (Adult, Pediatric, NICU) at the top of the sheet for easy reference for the Day Shift Technician and evening shift.
  - This order summary should be kept together with the order packets.
- Send Order Packets with attached labels to the IV Room for further preparation by the IV Room Day Shift technician (see "**Day Shift Technician**" responsibilities below)
  - By the end of the day, the order packets should be sent back out to the IV Bench and stored in the TPN Order wall folder.
- If there are any orders for pre-made Clinimix E bags, they should be double-checked before the end of the day in the IV Room
  - The technician will have prepared manual additions for sodium chloride (20mL), multivitamins (10mL), and MultiTrace-5 (5mL) for addition by a pharmacist.

- The formula should be cross checked with the order packet to make sure no transcription errors have occurred.

### **PN Checking Pharmacist**

- The PN Checking Pharmacist is responsible for double-checking all PN orders after they have been entered and verified by the PN Order Entry Pharmacist. There are 3 primary checks that this pharmacist is responsible for
  - Dosing Accuracy
    - The dosing for each component of the TPN should be checked for accuracy and safety. Standard Doses of Certain Agents are listed below
      - Adult Formulas
        - Multivitamins: 10mL
        - MultiTrace-5: 5mL
      - Pediatric Formulas
        - Pediatric Multivitamins: 2mL/kg (max dose = 5mL)
        - MultiTrace-4 Pediatric: 0.2mL/kg (max dose = 3mL)
      - Neonate Formulas
        - Pediatric Multivitamins: 2mL/kg (max dose = 5mL)
        - Magnesium: 0.3mEq/kg
        - Trace Elements: please refer to **SBUH Trace Elements for Neonatal TPN Chart** for trace element dosing
          - All patients receive Zinc and Copper
          - Selenium and Chromium are reserved only for long-term patients, defined as longer than 3 weeks
            - Final determination of adding these products is made by the primary team
          - Dosing is differentiated by whether the patient is pre-term (<37 weeks postmenstrual age) or term (>37 weeks PMA)
      - Refer to **Reference Charts for PN Checking** for additional dosing recommendations for each patient age group.
        - The checking pharmacist should make sure that each dose is within normal limits, and if not they should discuss the reasoning behind any out-of-range doses with the PN Order Entry Pharmacist.
    - Calculation Accuracy
      - The checking pharmacist should check to make sure that all calculations have been completed appropriately for each PN order.
    - Transcription Accuracy
      - Using the order packet, the Checking Pharmacist should check the original order with the final verified order, and then compare with the sample label from CAPSlink to assure that no transcription errors have occurred.
  - Any errors or discrepancies noted should be addressed with the TPN Order Entry Pharmacist so that the orders can be updated.
  - Once the order has been fully checked with no errors or discrepancies, the PN Checking Pharmacist should sign as the second signature on all PharmNet labels and the front page of the Order Packet (the CAPSlink sample label) next to the spot that says "Verified:".
    - **The 2<sup>nd</sup> signature on the Cerner labels represents the pharmacist who conducted the second clinical check of the PN orders. This person ensures that all doses ordered are in an appropriate range, all mathematical calculations have been completed accurately, and that no transcription errors have occurred.**
  - All double-signed order packets should be returned to the PN Order Entry Pharmacist for final submission to CAPS.

## IV Room Pharmacist

- Responsible for checking any Clinimix E (Adult Standard PN) bags that have been prepared by the day shift technician.
  - These bags will also be checked by the PN Pharmacist before the end of the day.
- All lipid bags will be labelled and prepared by the day shift technician. The IV Room Pharmacist is responsible for checking and signing these bags as the third check.
  - **The 3<sup>rd</sup> signature on the lipid bag label ensures that the label is on the correct product, and provides a sufficient quantity for the dose ordered.**
- The IV Room Pharmacist should make sure that all IV lines have been appropriately prepared by the Day Shift Technician, and assure that the order packets have been sent out to the IV bench before the end of the day shift.

## Day Shift Technician Responsibilities

The Day Shift Technician is responsible for assembling all lipids and IV line sets for each PN order received each day. Their goal is to set up everything possible for the evening shift so that they are prepared for when the PNs arrive later in the day. The following steps should be followed by the IV Room Technician designated to PN processing for that day.

- Clinimix E bags will be prepared and assembled with adult IV sets
  - Manual additions will be prepared for these formulas so the pharmacist can later add these in when it is time to check them. These additions are listed on the back label of the order packet, and include:
    - Sodium chloride 4mEq/mL = 20mL
    - Adult Multivitamins = 10mL (note, vial 1 = 5mL & vial 2 = 5mL)
    - MultiTrace-5 = 5mL
- Lipids for all PN orders will be labelled and stored on the IV room counter so that they can be signed by the day shift IV Room Pharmacist. They will later be paired with their respective PNs upon delivery during the evening shift.
  - Lipid bags should be labelled and dated to Use By the following day at 21:00
    - If the bag volume does not match the quantity ordered, place an orange "Note dose strength" sticker on the bag
  - There are 3 commercially available sizes of lipid bags that should be used.
    - 100mL
    - 250mL
    - 500mL
    - The total volume should be rounded up to the next largest bag volume in order to accommodate the dose.
      - If the dose volume does not match the total volume of the bag, please place a "Note Dose" sticker on the bag label.
  - For Adult & Pediatric lipid bags, use a rubber band to tie a 1.2 micron filter to each lipid bag
    - All Pediatric (11N and 11S) bags should also have a #2260 low-sorbing tubing set tied to the lipid bag in addition to the 1.2 micron filter
  - For Neonate bags, place a 1.2 micron filter and a #2260 low-sorbing tubing set for each lipid bag into a clear plastic bag to hang on the IV pole.
    - Lipid bags should also be placed into this plastic bag once triple-checked by the IV Room Pharmacist
- The PN Order Entry Pharmacist will send back an Order Summary sheet with a total count of Adult, Pediatric, and NICU orders. The technician will prepare the exact number of IV sets for that day's PNs.

- IV sets must be assembled in the IV room and used within 6 hours of preparation, this should be one of the last tasks of the day.
- There are two types of IV sets, as follows:

<b>Adult/Pediatric IV Sets "Adult"</b>	<b>Neonatal IV Sets "05NN"</b>
Low-Sorbing tubing (#2260)	Low-Sorbing tubing (#2260)
0.2 micron filter	0.2 micron filter
	Stopcock

- Once assembled, IV sets should be placed into separate bags in the IV hood for later use. These bags should be labelled as either "Adult + 11N/S" or "05NN"
- Day Shift technicians will continue to maintain inventory of PN compounding supplies, including Clinimix E bags, IV line sets, lipids, Vanilla TPNs, and anything else as designated by the IV Room Supervisor
- Vanilla TPNs are stored in the refrigerator by the IV Bench, the Day Shift Technician is responsible for checking the expiration dates of the Vanilla TPNs and ordering new supplies of both formulas. There are two Vanilla TPN formulas:
  - Dextrose 10% with 3.5% Trophamine and Calcium
    - Par level = 16 bags
  - Dextrose 5% with 3% Trophamine and Calcium
    - Par level = 12 bags

## Evening Shift Responsibilities

- CAPS will deliver PNs directly to the pharmacy each night. Upon arrival all PNs will need to be cross-checked with the CAPS packaging slip and the TPN Order Summary sheet.
  - The TPN Order Summary sheet will be found in the folder that contains the order packets and labels for that evening; located on the wall over the IV bench. Ensure that the correct number of orders were delivered.
    - The packaging slip must be signed and timed. The driver will leave the white copy behind, which should be left in the TPN wall folder.
  - CAPS should be contacted directly if there is a bag missing from the order. They have a pharmacist on call after 6pm who can help to resolve such issues.
    - CAPS Englewood Office Phone: 1 - (800) 698-6759
- The IV Bench pharmacist will compare the sample label from the order packet to the actual label on the bag to ensure that a bag has been received for each patient.
  - Once verified, the pharmacist will sign the pre-signed Cerner label as a 3<sup>rd</sup> signature, and then place the Cerner label onto its corresponding PN bag.
    - **The 3<sup>rd</sup> signature on the PN Cerner label represents the accurate placement of the Cerner label onto its corresponding PN bag from CAPS. This person has no clinical responsibilities for checking the PN bag contents.**
- The top sheet of the order packet is the sample label, the next sheet following the sample label represents the final verified product currently in the PharmNet system. This can be used as a reference in case there are any discrepancies between the labels.
  - Any discrepancies between the bag label and the order packet must be clarified with the day TPN Pharmacist and/or the evening/on-call Supervisor.
- Once the bags have been checked, they need to be brought into the IV room so that the IV Room Pharmacist can spike the PN bags with IV sets that have been prepared by the day shift technician.
  - Refer to "Day Shift Technician Responsibilities" for the description of each type of IV set in case a new set needs to be prepared.

- Only PN bags have to be pre-spiked. Lipid bags are sent up to the floors with a 1.2 micron filter, and are spiked on the floor by nursing with a low-sorbing (#2260) tubing set.
- Once PN bags have been labeled, checked, and spiked; they can be delivered to the floors for an anticipated 9pm (21:00) hang time house-wide.
  - Exception: NICU orders will be spiked and hung on an IV pole and covered with a yellow gown. NICU staff will pick this up from pharmacy at around 8:30pm (20:30).

## EXCEPTIONS

### Broken Parenteral Nutrition Bag

In the event that a parenteral nutrition (PN) bag is broken upon delivery from CAPS or is broken during processing in the pharmacy or on the unit, the following actions are to be taken:

- The prescriber should be contacted and made aware of the situation, it should be made clear that the patient will be unable to receive their PN until the next day.
- For adult patients, a Clinimix E bag may be offered as a substitute for that day.
  - Bags are named based on the amino acid and dextrose content, these should be matched up as closely to the original formula as possible.
    - Example: Clinimix E 5/15 = 5% amino acids (100g) and 15% dextrose
  - Downtime labels will need to be filled out based on the ordered content of each macronutrient and electrolyte, based on the order in PharmNet. These labels will need to be attached to each bag in addition to the Cerner label with the administration barcode.
    - Downtime labels can be found in the cabinet above the TPN Desk
  - The Nutrition Support Pharmacist may be contacted for further guidance for ordering Clinimix bags. Otherwise, offer dextrose 10% with electrolytes as an alternative.
- For neonatal patients, a Vanilla PN can be offered as an alternative, even though they have a limited amount of macronutrients
  - Bags only contain dextrose, amino acids, and calcium
  - There are two Vanilla TPN formulas available (Also see **SBUH Standard Formulas** for more content details):
    - Dextrose 10% with 3.5% Trophamine and Calcium
    - Dextrose 5% with 3% Trophamine and Calcium
- For all other patients, the preferred alternative is a Dextrose 10% continuous infusion, prescribers may choose to add electrolytes (Sodium chloride & Potassium chloride) to this bag as well based on the patient's needs
  - Standard adult PNs typically have the sodium equivalent of 0.45% NS, but can go up as high as 0.9% NS
  - Please note max of 60 mEq/L of potassium in continuous infusions as per hospital policy
  - Note: do NOT add any phosphorus-containing electrolytes to these infusions, especially in the presence of calcium because of the increased risk of precipitation.
  - To verify the osmolarity of the ordered formula, please use the following reference calculator: [http://www.globalrph.com/osmocalc\\_valid.htm](http://www.globalrph.com/osmocalc_valid.htm)

- Note: PN formulas may be given peripherally as long as the osmolarity is below 900 mOsm/L; otherwise a central line is required
- The Supervisor On-Call should only be contacted in the event of a prescriber who is resistant to ordering an alternative option to PN

## Missed Delivery of Parenteral Nutrition

In the event that a delivery is not going to arrive as scheduled, a representative from CAPS will communicate this information with SBUH pharmacy staff as soon as they are aware of this information. Any delays should be communicated with the units with a projected time of arrival.

If a daily delivery is going to be missed entirely, the SBUH pharmacy staff will need to compound parenteral nutrition (PN) formulas in-house. In order to do this, the following actions will need to be taken:

- The Supervisor on-call will be contacted and made aware of the situation.
- The Nutrition Support Pharmacist will be contacted to come in to help with compounding and PN checking.
- All floors with PN patients will be contacted and made aware of the situation, with a warning that PN delivery to the floors may be delayed.
- For all Adult Formulas:
  - Assess if any formulas are close enough to be substituted for a Clinimix bag. If so, contact the on-call prescriber and ask them to enter a new order.
- The Nutrition Support Pharmacist will calculate and verify the volumes of each component of the PN formula to be added, using the formula from CAPSlink as a reference. PNs will then be compounded with the use of the Pinnacle pump.
- Downtime labels will need to be filled out based on the ordered content of each macronutrient and electrolyte, based on the order in PharmNet. These labels will need to be attached to each bag in addition to the Cerner label with the administration barcode.
  - Downtime labels can be found in the cabinet above the TPN Desk
  - The file for downtime labels can be found in the TPN Folder on the Pharmacy Share Drive
  - In case of re-ordering new labels, the ordering information is as follows:
    - Staples Label Product #479876
    - Staples® Inkjet/Laser Shipping Labels, 6 Labels Per Sheet, White, 3 1/3"H x 4"W, 600 Labels/Bx
- PNs will be double-checked by a second pharmacist and then delivered to the floors.

## Downtime Procedures

### **Stony Brook University Hospital Downtime**

- Downtime order sheets will need to be distributed to each prescriber who is looking to order TPN for that day.
  - The downtime order sheet can be found in the TPN folder on the Pharmacy Share Drive. Additional copies may be found in the cabinet above the TPN desk.
- These order sheets will be entered into PharmNet once the system is back up and operating. They should still be verified by the PN Order Entry Pharmacist and the PN Checking Pharmacist.
- If internet is available, enter the orders into CAPSlink as usual (see TPN Pharmacist

responsibilities above)

- If internet is not available, fax each hand-written order sheet to CAPS (see CAPS downtime for further instruction)
- CAPS Fax number: (201) 541-0088
- **Cerner labelling and administration downtime procedures**

### **CAPS Downtime**

- All TPN orders should be verified by the TPN Pharmacist and double-checked by the PN Checking Pharmacist for dosing accuracy and that there are no transcription errors.
  - Verification and double-check will occur without a sample label
  - In the case of a change in acetate/chloride balance in NICU and Pediatric orders, an order comment will be added by the TPN Pharmacist stating "acetate value subject to change based on ordered balance"
- The top sheet of the order packet should be faxed directly to CAPS, so that they can enter the order in manually in their system
  - CAPS Fax number: (201) 541-0088
  - The top sheet of the order packet reflects the final verified order, as noted by the TPN Pharmacist's name at the bottom of the page
- Once all orders have been faxed over to CAPS, the TPN Pharmacist should call CAPS (800-698-6759) and speak with one of their pharmacists to confirm that all of the orders have been sent to them.
  - Provide CAPS with a total number of each type of order (Adult, Pediatric, and Neonatal) that was submitted for that day for final confirmation.

## REFERENCE CHARTS FOR PN CHECKING

### Adult Patients: Nutrient Requirements

PN Component	Critically Ill Patients	Stable Patients
Protein	1.5-2 g/kg/day	0.8-1 g/kg/day
Carbohydrate	≤4 mg/kg/min	≤7 mg/kg/min
Lipids	≤1 g/kg/day	1 g/kg/day
Total Energy	25-30 kCal/kg/day	20-30 kCal/kg/day
Fluid	Minimum needed to deliver adequate macronutrients	30-40 mL/kg/day

### Adult Patients: Electrolyte Requirements

Electrolyte	Standard Daily Requirement
Calcium	10-15 mEq
Magnesium	8-20 mEq
Phosphorus	20-40 mmol
Sodium	1-2 mEq/kg
Potassium	1-2 mEq/kg
Acetate	As needed to maintain acid-base balance
Chloride	As needed to maintain acid-base balance

### Pediatric Patients: Energy Requirements

Age	Total Daily Energy Requirement (kcal/kg/day)
Preterm Neonate	90-120
< 6 months	85-105
6-12 months	80-100
1-7 years	75-90
7-12 years	50-75
12-18 years	30-50

### Pediatric Patients: Protein Requirements

Age	Total Daily Protein Requirement (g/kg/day)
Preterm Neonate	3-4
Infants	2-3
Children >10kg or Age 1-10 years	1-2
Adolescents Age 11-17 years	0.8-1.5

### Pediatric Patients: Lipid Requirements

Age	Total Daily Lipid Requirement
Preterm Neonate	3 g/kg/day
Infants & Children	2-3 g/kg/day
Adolescents	2 g/kg/day

### Pediatric Patients: Carbohydrate Requirements



Calculate initial dextrose infusion rates to match approximate endogenous glucose production rates

- Approximately 6-8 mg/kg/min

Rates should be increased gradually each day until nutritional requirements are met

- Maximum rate of 12-14 mg/kg/min

### Pediatric Patients: Electrolyte Requirements

Nutrient	Preterm Neonates	Infants/Children	Adolescents & Children > 50 kg
Sodium	2-5 mEq/kg	2-5 mEq/kg	1-2 mEq/kg
Potassium	2-4 mEq/kg	2-4 mEq/kg	1-2 mEq/kg
Calcium	2-4 mEq/kg	0.5-4 mEq/kg	10-20 mEq/day
Phosphorus	1-2 mmol/kg	0.5-2 mmol/kg	10-40 mmol/day
Magnesium	0.3-0.5 mEq/kg	0.3-0.5 mEq/kg	10-30 mEq/day
Acetate	As needed to maintain acid-base balance	As needed to maintain acid-base balance	As needed to maintain acid-base balance
Chloride	As needed to maintain acid-base balance	As needed to maintain acid-base balance	As needed to maintain acid-base balance

### Pediatric Patients: Trace Element Requirements

Trace Element	Preterm Dose	Term Dose*
Zinc	400 mcg/kg	250 mcg/kg
Copper	29 mcg/kg	20 mcg/kg
Selenium	2 mcg/kg	2 mcg/kg
Chromium	0.1 mcg/kg	0.2 mcg/kg

\*Term = postmenstrual age over 37 weeks

## SBUH STANDARD FORMULAS

### Adult Standard Formulas

	Adult Standard PPN 4.25/5	Adult Standard TPN 4.25/10	Adult Standard TPN 5/15	Adult Standard TPN 5/20
Total Volume	2000mL	2000mL	2000mL	2000mL
Protein	85g	85g	100g	100g
Dextrose	5%	10%	15%	20%
Na	150	150	150	150
K	60	60	60	60
Mg	10	10	10	10
Ca	9	9	9	9
Acetate	140	140	160	160
Cl	142.23	142.23	137.33	137.33
Phos	10	10	10	10
MVI	10ml	10ml	10ml	10ml
MTE-5	5ml	5ml	5ml	5ml

### Neonatal Standard Formulas

	NICU D5 Formula	NICU D10 Formula	NICU D12 Formula	NICU D15 Formula
Total Volume	500mL	500mL	500mL	500mL
Protein	10g	14g	10g	14g
Dextrose	5%	10%	12%	15%
Na	7	9	7	14
K	7	7	7	7
Mg	1	1	1	1
Ca	7	10	7	10
Acetate	10.76	13.58	9.7	13.58
Cl	8.21	8.52	9.27	13.52
Phos	3	5	3	5
MVI	5mL	5mL	5mL	5mL
Heparin	0.5 units/mL	0.5 units/mL	0.5 units/mL	0.5 units/mL
Zinc	750mcg	750mcg	750mcg	750mcg
Copper	60mcg	60mcg	60mcg	60mcg
Osmolarity	506 mOsm/L	843 mOsm/L	859 mOsm/L	1115 mOsm/L

### Vanilla Standard Formulas

Vanilla 5% Dextrose Formula	Per 250mL	Per 100mL
Trophamine	7.5g	3g
Dextrose	12.5g	5g
Calcium gluconate	3.75mEq	1.5mEq

Vanilla 10% Dextrose Formula	Per 250mL	Per 100mL
Trophamine	8.75g	3.5g
Dextrose	25g	10g
Calcium gluconate	3.75mEq	1.5mEq

### Additional Resources

- SBUH Trace Elements for Neonatal TPN – dosing chart
- CAPSLink Training Record – training checklist
- Downtime Order Forms
- Downtime Bag Labels
- NICU Standard TPN Calculator – Microsoft Access File
- Vanilla Compounding Formulas
- Sample Order Sheets

### References

1. Ayers P, Guenter P, Holcombe B, and Plogsted S. *A.S.P.E.N. Parenteral Nutrition Handbook*. 2nd ed. Silver Spring, MD: American Society for Parenteral and Enteral Nutrition, 2014. Print.