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Guideline for the Management of Parenteral Nutrition (PN) in Adults

For use in:	Norfolk and Norwich University Hospital (NNUH)
By:	All Registered Nursing Staff and Medical Staff
For:	All adult patients
Division responsible for document:	Clinical Support NNUH
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Version Number	Date of Update	Change Description	Author
4	28/06/2025	Adjusted step-by-step guide to reflect current practice and added disconnection procedure. Author names added TPN and line infection added as key word Urokinase changed to Alteplase and relevant administration technique included Advice around dressings reworded Inclusion of TPN competency within broad recommendations NST pharmacist NMP removed Taurosept included within taurolidine segment Updated trust policy ID's in broad recommendations References updated Flow chart notes amended to reflect current practice	Ben Booth, Nicola Tonkes

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Quick reference guideline

The Nutrition Support Team (NST) within NNUH aims to provide a service by offering advice on nutritional management of patient care to primary clinicians. In general, this will be a patient requiring more complex form of artificial nutritional support.

- **Referral:**
  All adult patients considered for Parental Nutrition (PN) must be referred to the NST. This is under Services on ICE then Nutrition Support Team, please do not refer to Dietitians for adult TPN. All the referrals should be made on ICE before 09:00 am for the same day review. If a referral is made after 09:00 am but the same day review is required, then the Nutrition Nurse Specialist (NNS) on Helpline number 3159 or bleep 0554 should be notified.
  Any referral made on ICE should be preceded by a written referral in the patient's medical notes by the referring consultant's team. After patient assessment, the NST may feel PN is not appropriate for that patient. In this situation, alternative methods of feeding will be suggested along with appropriate healthcare professional follow-up.

  We discourage starting PN out of normal working hours (after 16:30 and over the weekend) unless this has been agreed earlier with the NST consultant. Moreover, starting PN less than 48 hours after surgery can be hazardous due to major metabolic instability (Weimann et al, 2017).

  If a referral is made after 12pm on a Friday (or a day before a bank holiday) then the ICE referral **must** be followed up with a discussion between the patient's Consultant and one of the Clinical Nutrition and Intestinal Failure consultants (available via Switch). They will then advise if PN is appropriate before the weekend and will liaise with the NST as to whether PN can be commenced.

- **Intravenous catheter:**
  Ideally PN should be administered via a dedicated single lumen central catheter (Loveday et al, 2014). If a multi-lumen catheter is used for the delivery of PN one port must be designated for the purpose of giving PN (Pittiruti et al, 2009). All lumens must be handled with the Surgical Aseptic Non-Touch Technique (ANTT). Other drug or fluid therapy must be given via a peripheral cannula whenever possible but if vascular access is problematic a second lumen can be used for IV therapy if surgical ANTT is used. Blood products must not be given via dual lumen Peripherally Inserted Central Catheters (PICC) at the same time as PN- if blood is needed stop PN and discard. Catheter dressing and correct connectors should be reviewed on every possible opportunity, at least once every 12 hours.

  PICC and Tunnelled lines are placed by the Interventional Radiology Unit (IRU) and Vascular Access Team – requests via ICE. Multi-lumen centrally placed lines are inserted via the Anaesthetic Dept. Bedside PICC line insertion does not usually require a chest X-ray if the vascular access team document the line is safe to be used.

- **PN prescription:**
  This will be based upon the patient's presenting clinical condition, weight, gastrointestinal losses and blood results (FBC, UandE's, LFT's, bone group and magnesium). The NST Nurse Specialists are non-medical prescribers. Prescriptions are done on the day for weekday prescriptions and on Fridays for weekend prescriptions. These are taken to Pharmacy by the Nutrition Nurse Specialists and will come up from Pharmacy with the PN. The On-Call pharmacists have access to a copy of the prescription.
- **PN procedures:**
  Procedures for PN monitoring (p5), connecting and disconnecting PN (p6-7), catheter management (p8) and suspected catheter sepsis algorithm (p9) are detailed within this guideline.

Definitions

Total Parenteral Nutrition (TPN)- Provision of intravenous nutrition via a central venous catheter. This meets all of the patients' fluid and nutrition requirements, the patient is otherwise Nil by Mouth.

Parenteral Nutrition (PN)- Provision of intravenous nutrition via a central venous catheter. This may not meet all of the patients' fluid and nutrition requirements and is often given as a supplement alongside oral fluids and nutrition.

For definitions relating to central venous catheters please see Trust Protocol for the Insertion and Care of Intravenous Access Devices in Adult Patients age 16 years and over Trustdocs Id: 16619

Objective

To promote safe and effective delivery and management of PN, minimising the risks associated with this therapy.

Rationale

As well as being a potentially life-saving treatment PN is an expensive and potentially dangerous therapy. Bloodstream infections associated with the insertion and maintenance of central venous catheters (CVCs) increase the mortality and morbidity of patients receiving PN (Lal et al, 2019).

These guidelines have been formulated on existing evidence (see reference section) for the safe delivery of PN and to minimise the risk of line sepsis, subsequent septicaemia and metabolic complications. Reductions in catheter-related sepsis rates from 18-35% to 0-4% respectively were reported after introduction of an NST. This reduction can be seen within the NNUHT in consecutive annual audits since 1995.

Broad recommendations

All staff who undertake care of patients receiving PN must adhere to Trust policies and guidelines and comply with their own professional body.

These guidelines are to be used in conjunction with other existing NNUHT guidelines:

- ANTT guidance for peripheral and central Intravenous Therapy (8273). Trustdocs Id: 8273
- 5 moments for hand hygiene-Central Venous Catheter Trustdocs Id: 13574
- Competence for the safe and effective provision of Parenteral Nutrition (ID 17826) Trustdocs Id: 17826
- Trust Protocol for the Insertion and Care of Intravenous Access Devices in Adult Patients age 16 years and over Trustdocs Id: 16619
- Sepsis Screening tool/ Sepsis Six Trustdocs Id: 13148

Patient Monitoring During PN

Glucose:

- Check finger prick glucose before initially commencing PN and 1 hour after commencement.
- Monitor blood glucose levels 6 hourly in the first 48 hours of PN. If normal, thereafter, use daily urinalysis. In patient's known to have diabetes monitoring may be more frequent.
- Daily blood glucose levels if sugar detected in urine.
- If blood glucose >11mmol/L then the use of an intravenous insulin infusion to maintain euglycaemia may be required.
- If glycaemic control is suboptimal or the patient is known to have diabetes or is on steroids or is needing insulin regularly then referral to Diabetic Inpatient Specialist Nurses is recommended.
- In surgical ITU patients, tight euglycaemic control is recommended.

Weight:

- Commencement of PN, then twice a week for duration of PN.
- Consider daily weights if unable to accurately measure fluid balance.

Temperature:

- 6 hourly.

Fluid balance:

- Accurate daily measurement of any gastrointestinal output is essential (nasogastric drainage, fistula output, vomit, diarrhoea) and inputs (such as medications, IV fluid and oral intake if any).

Blood Tests:

- FBC, UandE's, LFT's, CRP, Bone group, Magnesium, Bicarbonate and Chloride – initially daily. These tests are available to request as 'TPN bloods' on ICE, under profiles. NST will advise when to reduce frequency of blood tests

  Failure to complete daily blood tests may result in PN not being prescribed.
- Urinary electrolytes- at discretion of NST.
- Trace elements – at discretion of NST.

Connecting PN infusion

Equipment list:

- PN prescription.
- PN bag.
- Administration Set, with filter and compatible with IV pump.
- Non-sterile gloves
- Dressing pack with sterile gloves.
- Two Sani-cloth CHG 2% wipe (2% chlorhexidine and 70% isopropyl alcohol).
- 10mLs sodium chloride 0.9% pre-filled syringe.
- Silver Trolley- cleaned with Clinell wipe before use and all equipment placed on bottom of trolley.

Procedure (At patient bedside):

1. Take sealed PN bag out of light protective cover and check integrity of bag.
2. Remove PN from sealed bag.
3. Check PN against prescription in accordance with the Trust's Medicines Policy.
4. Cover checked PN with light protective bag and hang on drip pole.
5. Wash hands, complying to Trust policy for hand hygiene. Apply non-sterile gloves.
6. Open dressing pack onto clean trolley top and prepare sterile field.
7. Open Sani-cloths, 0.9% sodium chloride flush and administration set onto sterile field.
8. Stop infusion pump, clamp giving set and remove giving set from pump *(disregard this point if hanging PN for the first time or PN is not infusing over 24hours)*
9. Remove gloves and sanitise hands.
10. Put on sterile gloves.
11. Using Sani-cloth clean infusion port of PN bag. Allow to dry.

12. Clamp giving set. Insert giving set into infusion port of PN bag.
13. Slowly release clamp to allow the line to prime over approx. 5 minutes. Ensure arrow on in-line filter is pointing up when infusion reaches this point. Place end of giving set on sterile field whilst priming.
14. Open out sterile towel and leave on sterile field.
15. Using second Sani-cloth to hold Bionector™, disconnect the giving set and allow giving set to drop. Continue to clean the central venous catheter thoroughly with the wipe, starting at the Bionector™ and working up. Still holding central venous catheter place sterile towel under the catheter.
16. Allow central venous catheter to drop onto the sterile towel and allow to dry for 30 seconds before accessing. Discard wipe.
17. Flush line with 10mLs 0.9% sodium chloride using push pause technique.
18. When administration set is primed, connect to designated Bionector™ on central venous catheter.
19. Set pump for new infusion, open administration set clamp, set pump to run.
20. Complete appropriate documentation to comply with professional/legal requirements.
21. Dispose of equipment as per hospital policy.

Disconnection -If patient is not on 24-hour infusions or PN needs to be stopped.

Equipment list:

- Dressing Pack
- Sani-cloth 2% CHG wipe
- Gloves (1x pair sterile and 1x pair non-sterile)
- 0.9% Sodium Chloride 10ml flush (pre-filled syringe)
- Curos™ cap
- Silver Trolley-cleaned with Clinell wipe and equipment placed on the bottom

Procedure

1) Stop infusion, clamp giving set, remove from pump and clamp line (if clamp present)
2) Wash hands
3) Put on non-sterile gloves
4) Open dressing pack onto trolley and prepare sterile field
5) Open equipment (sterile gloves, Sani-cloths and flush) and drop onto sterile field
6) Remove gloves and sanitise hands

7) Put on sterile gloves

8) Open out sterile towel and leave on sterile field

9) Using Sani-cloth to hold Bionector ™, twist off giving set and allow to drop. Continue to clean the central venous catheter thoroughly with the wipe, starting at the Bionector™ and working up. Still holding central venous catheter place sterile towel under the catheter.

10) Flush line with 0.9% Sodium Chloride pre-filled syringe, using push-pause technique. For lines other than Power-PICC™ close clamp online whilst administering final 'push' of flush to maintain positive pressure in line.

11) Attach Curos™ cap to Bionector ™

12) Remove gloves and wash hands

13) Dispose of equipment according to hospital policy

The needle free device e.g., Bionector™, should be changed weekly or after the manufacturer recommended number of accesses if sooner.

The PN infusion must NOT be disconnected and reconnected once the infusion has commenced. If for any reason the PN is disconnected, the bag and giving set MUST be discarded. Please contact the Nutrition Support Team if, for any reason, you have had to stop and discard the PN infusion. Use IV crystalloids to maintain fluid balance and give IV electrolytes as indicated by bloods, until new PN can be supplied.

If PN is discontinued due to potential defective product then this should be retained for the NST pharmacist.

Catheter patency:

- Central Venous Catheters must be flushed before and after each PN infusion

Flush with 10mL 0.9% sodium chloride pre-filled syringe, using the push-pause and positive pressure technique, see below (Cawley et al, 2018). It is not necessary to use heparin to lock the line if the catheter is not in use for 24 hours or more (Pittiruti et al, 2009). Surgical ANTT must be used for **ANY** access to any lumen of a central venous catheter which is being used for PN.

The Push-Pause and Positive Pressure Flushing Technique

Action:	Rationale:
Flush using pulsating push-pause motion	**Allows turbulent flow to remove any medication or blood residue from inside catheter**
Keep pressure on the plunger of syringe until the catheter is clamped or syringe disconnected	**Maintains positive pressure within the catheter preventing back flow of blood into the catheter tip**
Do not use smaller than a 10mL syringe (check with individual manufacturers)	**Smaller syringes can exceed 25 psi pressure which can cause venous damage and catheter rupture**

Peripherally Inserted Central Catheters (PICC):

The management of these catheters is the same as for a centrally placed line, plus the following specific points:

- To prevent line occlusion do not allow PN bag to completely run dry and respond quickly to occluded pump alarms (Hill et al, 2013).
- If a PN infusion is to be stopped for any reason, clamp the catheter first and then switch volumetric pump off to provide positive pressure within the catheter.
- Flush catheter with 10mL 0.9% sodium chloride pre-filled syringe between PN changes using the push-pause method.
- Occasionally these catheters occlude due to the external part kinking. Look for this if the pump keeps reading ‘occlusion’. Redress if this is the case.

Observe patient for signs of central venous catheter related complications such as: peripheral vein thrombosis or mechanical phlebitis. If these or other complications occur, please refer to Trust Protocol for the Insertion and Care of Intravenous Access Devices in Adult Patients age 16 years and over Trustdocs Id: 16619 which lists complications and how to manage them.

Catheter Related Sepsis Protocol (suspected and documented infection)

Symptoms: chills, flu-like symptoms (especially with the IV nutrition)

Signs: fever >38°C, rigors

1. Stop PN
2. Follow sepsis 6 guidance
3. Central and peripheral blood cultures
4. Blood tests (incl. FBC, CRP)
5. Screen for other causes of infection (incl. CXR, MSU)

No shock
(Await culture results)

Mild shock
Relative hypotension and tachycardia

Septic shock (Fever, hypotension, tachycardia requiring inotropes or ITU)

Empirical antibiotic lock in CVC see notes 1-3

Blood culture negative

Blood Culture Positive

Any other orgar
from CVC cultu

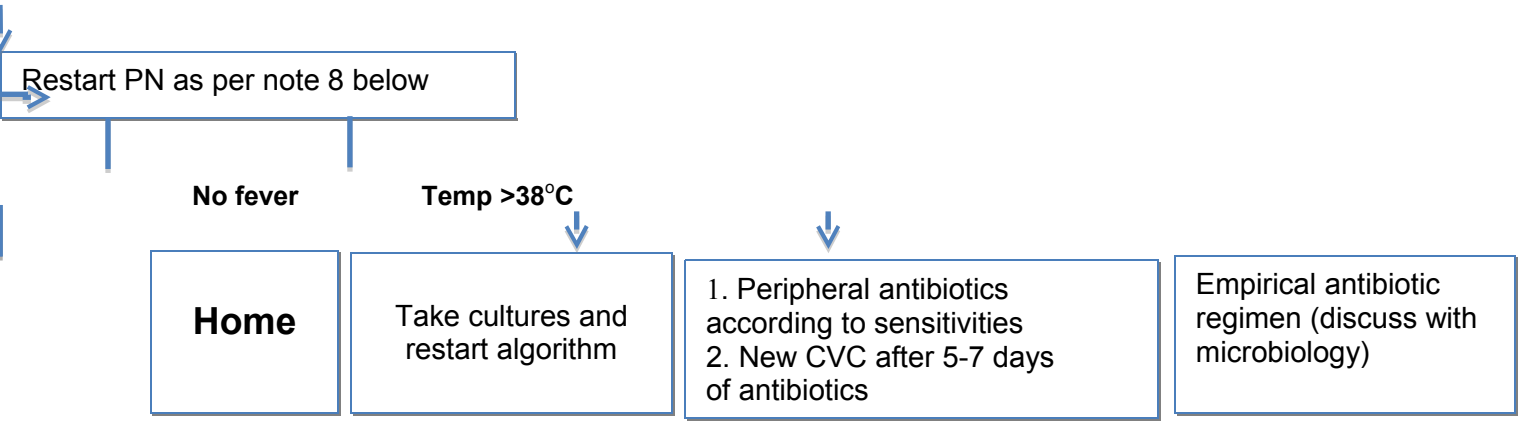
Candida/Staph Aureus Pseudomonas or repeated similar organism from CVC. See note 6 below

If recurre
note 4 below

line and send tip
culture- see
e 5 below

TARGETED ANTIBIOTIC REGIMEN (7 DAYS)
According to antibiotic sensitivities. Via CVC, leaving the antibiotic in catheter (no flush between doses and stop PN) Duration 7 days.
Give peripheral fluids/electrolytes according to PN requirements (Volume, Na, K and Mg).

If very limited venous access see note 7 below


Restart PN as per note 8 below
No fever
Temp >38°C
Home
Take cultures and restart algorithm
1. Peripheral antibiotics according to sensitivities
2. New CVC after 5-7 days of antibiotics
Empirical antibiotic regimen (discuss with microbiology)

1. **How to line lock:**
   The antibiotic should be drawn up and given using surgical ANTT. Once the infusion or bolus is completed, the central venous catheter should NOT be flushed afterwards. This keeps the antibiotic within the lumen of the central venous catheter. The line can then be flushed before the next dose of antibiotic.

2. For multi lumen CVC's evenly split the antibiotic dose between each lumen and make prescribing rationale clear on EPMA. Discuss with Senior Pharmacists if unsure.

3. Vancomycin is an appropriate first choice antibiotic until blood culture sensitivities are reported for suspected central venous catheter related blood stream infections, as advised by the Joint Formulary Committee (2022) and supported by Lal et al (2019). It is also recommended to add a broad-spectrum antipseudomonal beta-lactam if Gram-negative sepsis is suspected, particularly if the patient is immunocompromised (Joint Formulary Committee, 2022).

4. **If recurrent infection (another infection within 3 months with any organism):**
   1st recurrent infection: Alteplase, with a targeted antibiotic course to prevent catheter removal (Refer to the table below for administration advice and check against current Medusa advice).

   2nd recurrent infection: remove CVC, send tip for culture and give peripheral antibiotics according to sensitivities. Consider TauroLock™ via new central venous catheter for maintenance after treatment for this infection has finished.

5. **Sending a CVC tip for culture:**
   Using sterile scissors cut end 5cm of line and without touching the tip, put in a white top specimen pot. Please make it clear on the request form that a CVC infection is suspected or known.

6. **Candidal infections:**
   Remove the CVC. Contact microbiology for advice on antifungal treatment then change antifungal treatment based on species and antifungal sensitivity results. Give 2 weeks of IV antifungal treatment before CVC replacement. Request an Echocardiogram (ECHO) and urgent ophthalmology review and computerised tomography scan (CT) head if any neurological signs.

7. **Patients with very limited venous access (patients with a CVC in their only remaining central vein, direct Inferior vena cava (IVC) or atrial CVC):**
   Salvage treatment for a CVC infection may be considered. Please discuss with the Nutrition Team before removing line, even if advised by Microbiology.

8. Re-culture all lumens of the CVC line prior to restarting PN after appropriate course of antibiotics has finished. Do not delay restarting PN whilst awaiting these culture results UNLESS instructed to wait by the NST.

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Drug (Reference)	Indication	Dose	Mode of instillation
Alteplase	**Suspected fibrin deposits/ Difficult to flush line but can instill 2mls of fluid**	2mg/2ml	1. Using Surgical ANTT: Reconstitute 2mg vial with 2.2ml water for injection. Draw up 2ml into 10ml luer lock syringe. Inject 2mL into lumen via bionector using a push-pause motion 2. Monitor catheter closely for signs of "ballooning" or traumatic fracture. 3.Leave insitu for 30 minutes 4. Attempt aspiration, if able to aspirate easily then flush catheter with 10mLs 0.9% sodium chloride. If unable to aspirate leave for further 90 minutes and retry. 5. Repeat once if initial dose not successful. 6. If still unable to flush/ aspirate consider new line, discuss with NST. *Advice taken from NNUH access to Medusa IV administration Guide* https://medusa.wales.nhs.uk/IVGuideDisplayNewFormat.asp

Recurrent CVC infections (recurrent CRS)

Prophylaxis of recurrent central venous catheter infection

There are reports of the use of antimicrobial agents e.g. TauroLock™ (taurolidine and citrate) in the successful prevention of CVC infections in patients with recurrent CRBSI:

Taurolidine lock: Only TauroLock™ (taurolidine and citrate) is currently available at NNUH. In addition to having a broad-spectrum bactericidal activity, it prevents or reduces the adherence of bacterial cells to the epithelium by altering the bacterial cell wall structures and by destroying the fimbriae and flagellae. Anti-adherence is achieved when either the bacterial or epithelial cell is exposed to taurolidine (chemically derived from the aminosulphonic acid taurine, the drug is metabolised to water and carbon dioxide). Its bactericidal mechanism of action is attributed to reactive methylene iminium ions, the conversion to which occurs in an aqueous medium. Bacteria and fungi cell wall constituents are then methylolated and killing is affected. Resistance for a vast array of microbes as well as superinfection with the use of taurolidine have never been reported.

Taurolidine Solutions

These are used to aim to prevent CRBSI's in patients receiving PN, it is most commonly used in patients receiving PN at home. It is to be used with a catheter-based vascular access device. It is to be instilled in the device lumens between treatments in order to make the internal flow passages resistant to clot formation and hostile to bacterial and fungal growth. The product is sterile filter processed and supplied as a clear, sterile, non- pyrogenic solution. Each single-use ampoule contains 5ml although can also come in pre-filled syringes.

TauroLock™

TauroLock™ contains anticoagulant and antimicrobial substances in the form of taurolidine and citrate. The pH is adjusted with citric acid and/or sodium hydroxide. Taurolidine has proven antimicrobial effectiveness against both gram-positive and gram-negative bacteria and fungi (Gabriel, 2020). It is an antiseptic solution so does not lead to the development of antibiotic resistance (Gudiol et al, 2018). The solution must be withdrawn prior to initiating the next treatment.

Taurosept ®

Taurosept® is currently the strongest concentration of taurolidine (2%) available in the UK and does not contain citrate. As it does not contain citrate it does not need to be withdrawn prior to initiating the next treatment. Evidence suggests it may be more effective at inhibiting microbial growth than Taurolock ™ (Olthof et al, 2015). This is not currently available at NNUH.

Indications for Taurolidine:

TauroLock™ can be used in patients who have had any of the below:

- ≥2 infections over a 2-year period.
- ≥2 fungal central venous catheter infections.
- 1 fungal infection on a background of repeated bacterial infections.
- 1 bacterial infection that has caused endocarditis, osteomyelitis or discitis.
- Recurrent CVC infections with problematic venous access (for inpatients this may include short term parenteral nutrition).

Clinical audit standards:

Annual audit to be undertaken by the NST to incorporate:

- All PN patients referred to NST.
- Target CRBSI rate of <1/1000 PN catheter days.
- Designated PN catheter.
- All intravenous catheter tips of suspected CRBSI to be sent to microbiology.
- CRBSI in relation to patient location within hospital
- IF type
- Identification of micro-organism in positive CRBSI patients.

Summary of development and consultation process undertaken before registration and dissemination:

The authors listed above updated this guideline on behalf of the Nutrition Support Team who has agreed the final content. During guideline development, the previous version was circulated for comment to those listed in the 'supported by' section and to Dr Ngozi Elumogo, Director of Infection Prevention and Control. The previous version has been endorsed by the Clinical Guidelines Assessment Panel.

Distribution list/ dissemination method

Trust Intranet

References/ source documents

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Source documents

Trust Protocol for the Insertion and Care of Intravenous Access Devices in Adult Patients age 16 years and over Trustdocs Id: 16619

ANTT guidance for peripheral and central Intravenous Therapy (8273). Trustdocs Id: 8273

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