PARENTERAL NUTRITION - ADULT

This LOP is developed to guide clinical practice at the Royal Hospital for Women. Individual patient circumstances may mean that practice diverges from this LOP.

1. AIM

- To provide staff of the Royal Hospital for Women with information regarding the management of all aspects of Parenteral Nutrition (PN).
- To minimise potential catheter related, metabolic and infectious complications associated with PN.
- It is intended that the following information ensures our PN practices, with respect to patient selection, duration of treatment, monitoring of results and documentation are in keeping with the current evidence and best practice guidelines.

2. PATIENT

- Adult inpatients of the Royal Hospital for Women requiring PN.

3. STAFF

- Medical staff
- Clinical Nursing Staff
- Pharmacists
- Clinical Dietitian

4. EQUIPMENT

- Intravenous access device
- Intravenous giving set
- Administration reservoir (e.g. PN bag)
- Light-protective covering for PN bag
- Infusion delivery device

5. CLINICAL PRACTICE

5.1 INDICATIONS FOR PN

The basic indication for using PN is a requirement for nutrition when the gastrointestinal tract is not functional, cannot be accessed, or the patient cannot be adequately nourished by enteral means.

PN is not without risks (such as catheter insertion complications, infection, sepsis, fluid and electrolyte imbalances and metabolic complications) and financial cost; hence its use should be reserved to where clearly clinically indicated.

The use of PN should be considered in patients in whom the use of the intestine is not anticipated for >5 days. Short-term PN is appropriate in malnourished and/or severely catabolic patients unable to be adequately nourished enterally. In this patient group, the risks of complications of nutrition depletion are greater and PN should be started earlier.

PARENTERAL NUTRITION – ADULT cont'd

PN may be indicated, but is not limited to, the following situations:

- Where the gastrointestinal tract cannot be accessed e.g. intractable vomiting with inability to establish jejunal access
- Bowel obstruction or suspected gut ischaemia with failure of enteral feeding
- Gastrointestinal fistulae with inability to feed distally
- Malabsorptive states (e.g. short bowel syndrome before compensatory adaptation occurs, radiation enteritis, severe exacerbation of inflammatory bowel disease)
- Enteric anastomosis or imminent bowel resection

The duration of PN in most of the described categories depends on the return of normal gut function.

Where possible, combining PN with low-level enteral feeding maintains gut function and prevents bacterial overgrowth.

PN may not be appropriate where the prognosis is inconsistent with aggressive nutritional support.

COMMENCING PN

Team Management of Individual Patients
Care for patients requiring PN is enhanced by a multidisciplinary team approach that acknowledges the skills and training of the individuals and professions involved. Members of the multi-disciplinary team involved in the management of patients on PN include:

- Managing Medical Team
- Clinical Dietitian
- Pharmacist
- Clinical Nursing Staff

Managing Medical Team
As PN involves Intravenous (IV) access and administration of parenteral nutrients, it requires medical authorisation including sign-off of the PN order to ensure it is in keeping with the overall medical management of the patient. The medical team or anaesthetic registrar (if the patient is an inpatient in the acute care unit) are responsible for optimising fluid and electrolyte status on a daily basis. Medical staff will play a crucial role in the identification of patients who require PN, and monitoring of ongoing needs.

Clinical Dietitian
The Clinical Dietitian has responsibility for the nutrition assessment, development of nutrition prescription (in conjunction with the medical team) and nutrition monitoring of patients receiving PN. The nutritional assessment will include determination of nutrition requirements of the patient and risk of developing refeeding syndrome (see Appendix 1). They will also advise on alternative feeding routes and manage the transition of patients from parenteral to enteral and oral nutrition.

PARENTERAL NUTRITION – ADULT cont'd

Pharmacist
Supply of PN bags only.

Clinical Nursing Staff
See section 5.4, below (Nursing Care of Patients on PN)

5.2.2 Assessment

Nutrition
Once referred to the dietitian, a nutrition assessment will be performed by the Clinical Dietitian for the hospital. Recommendations regarding the PN prescription will be discussed with the managing medical team and documented in the patient's health care record.
The dietitian is unavailable on weekends and therefore if PN is to be commenced, the managing medical team will initiate an After Hours Starting Regimen (see Appendix 2), which accounts for the possible risk of refeeding syndrome (see Section 5.2.3 – Starting PN).

IV Access
Due to the multitude of medication incompatibilities and the hypertonic nature of the PN solution, a multi-lumen central IV access is recommended. Thus, parenteral nutrition is to be infused via a stand-alone CVAD lumen into a central vein that will provide the required haemodilution to avoid phlebitis.
Queries regarding drug compatibility are to be referred to Pharmacy.
Refer to RHW Local Operating Procedure – Central Venous Catheter Access Device (CVAD) Management.

Baseline Investigations
The managing medical team is responsible for arranging biochemistry investigations. Prior to initiating PN, the following baseline biochemistry should be checked and fluid and electrolyte abnormalities managed appropriately. In those at risk of developing Refeeding Syndrome, particular care should be taken in managing suboptimal electrolyte levels (in particular phosphate, potassium and magnesium).

Refer to RHW Local Operating Procedure – Potassium – Administration of Oral and Intravenous Infusion
Refer to RHW Clinical Business Rule- Phosphate Intravenous Replacement

PARENTERAL NUTRITION – ADULT cont'd

Table 1. Baseline Investigations and Monitoring Guidelines

Test	Baseline	Critically ill	Stable Pt
EUC and CMP	Yes	Daily	3 x weekly
LFTs, Albumin	Yes	3 x weekly	Weekly
FBC	Yes	3 x weekly	Weekly
CRP	Yes	2-3 weekly until stable	Weekly
Triglycerides	Yes	Weekly	Monthly
INR, PT, aPTT	Yes	Daily/ 3 x weekly	Weekly
Iron studies	Yes	Monthly	Monthly
Manganese, Copper	If malnourished	Monthly	Monthly
Selenium, Zinc	Yes	Every 2 weeks	Monthly
25'OH Vitamin D		Monthly	Monthly
Vitamin A, E	If severely malnourished/ malabsorption		3 monthly
Vitamin B12, Folate	Yes	3 monthly	3 monthly
Weight	Yes	2 x weekly	2 x weekly
Fluid Balance	Yes	Daily	Daily
Capillary Glucose	QID (unless on insulin-then every 4 hours)	QID (unless on insulin-then every 4 hours)	QID (unless on insulin-then every 4 hours)
Temperature	QID	QID	QID
Pulse	QID	QID	QID
BP	QID	QID	QID

PARENTERAL NUTRITION – ADULT cont'd

5.2.3 Prescribing Parenteral Nutrition

What should be prescribed before PN commences?

Many patients requiring PN will have fluid and electrolyte imbalances, as well as a degree of protein/energy malnutrition. The managing medical team is responsible for optimising fluid and electrolyte status, and prescribing the following:

- Thiamine – 100mg IV, to be given 30 minutes prior to commencement of PN, then daily for 5 days. In cases of severe malnutrition/extreme risk of refeeding syndrome give 300mg IV daily for 10 days
- Vitamin K – 10mg IV weekly on Tuesdays (excluding patients on warfarin)
- Supplemental/correction scale of subcutaneous rapid acting insulin as per eMEDS/NSW Health Adult Subcutaneous Insulin Prescribing Chart. See Appendix 3- Blood Glucose Monitoring and Management in Patients Receiving Parenteral Nutrition.
- Additional Cernevit (IV multivitamin) and/or trace elements may be recommended by the Clinical Dietitian in severely malnourished patients receiving low-volumes of PN, until target rate is achieved.

Any critical biochemical abnormalities, particularly low levels of potassium, magnesium and phosphate, should be corrected in a planned manner either prior to commencement or simultaneously with the commencement of PN (See Appendix 1: Refeeding Syndrome).

As with all fluids for IV administration, PN needs to be prescribed by a medical officer on the Adult Fluid Chart.

Ordering PN from Pharmacy

To order PN, a member of the managing medical team or anaesthetic fellow must write the PN order on the Adult Fluid Order Form. This must then be sighted by pharmacy, who will supply the PN formulation to wards on request and this must be stored in the fridge. Due to the short expiry of the PN bags, they will not be stored on imprest. After hours and on weekends, please contact the on call pharmacist to arrange supply.

Starting PN

It is usual to commence PN in a graded manner. The Clinical Dietitian will recommend the starting rate and rate of progression. For patients at risk of refeeding syndrome, a slower commencement regimen may be required. The dietitian will advise if this is the case and recommend an appropriate starting regimen (See Appendix 1: Refeeding Syndrome).

On weekends (when dietitian unavailable) PN should be commenced at a maximum rate of 20mL/hr (providing 514 kcal over 24hours) and maintained at that rate until dietitian assessment can be conducted.

Thiamine 300mg IV must be given 30 minutes prior to commencement of PN and then daily until dietitian review. Contact the Pharmacist on call to arrange supply of PN (see Appendix 2: After Hours PN Starting Regimen).

PARENTERAL NUTRITION – ADULT cont'd

Composition of PN
The patient's nutritional requirements are based on the dietitian's assessment of the patient in consultation with the managing medical team.
The standard PN solution at RHW (PNS9) is an 'all-in-one' solution containing a mixture of glucose, amino acids, lipid, electrolytes, vitamins and trace elements (Baxter Olimel N9E: See appendix 4). This formulation is available only in 2000mL. A lower electrolyte formulation (PNS10EF) is also available with 48hours notice.

Fluids
The overall aim is to provide all nutritional requirements via the PN. However, if additional fluid is required, this should be prescribed and administered separately. The dietitian must be notified of any fluid restrictions.

Electrolytes
We do not have a sterile unit at RHW therefore TPN cannot be modified. The standard PN solution at RHW (PNS9) is an 'all-in-one' solution and contains electrolytes (see Appendix 4 for constituent of TPN).
Electrolytes are to be reviewed daily until stabilised on target rate of PN. It is the responsibility of the medical team to check the electrolyte content of the PN prior to prescribing additional electrolytes (see Appendix 4 for constituent of TPN).
Refer to RHW Local Operating Procedure – Potassium – Administration of Oral and Intravenous Infusion
Refer to RHW Local Operating Procedure – Phosphate Intravenous Replacement

Vitamins, Minerals and Trace Elements
The standard PN formulation includes vitamins and trace elements in amounts equal to the recommended daily requirement for stable patients on parenteral nutrition, except for Vitamin K, which is to be charted separately. This does not account for increased requirements related to baseline deficiency, illness or losses. Additional Zinc or Selenium, for example, may be required in patients with large gastrointestinal losses. Replacement will be determined by consideration of clinical condition and biochemistry screening results.

Micronutrient levels must be monitored in long-term PN patients to prevent overload or deficiencies (see Table 1).

5.3 MONITORING

5.3.1 Dietitian

All patients receiving PN will be reviewed daily, or as required/able (dietitian is not employed full time at the RHW), by the clinical dietitian for the RHW. Issues will be brought to the attention of the medical team and documented in the patient's health care record.

5.3.2 Medical Monitoring

It is the responsibility of the managing medical team to ensure that PN monitoring requirements are ordered and reviewed in accordance with Table 1, or more frequently if clinically indicated.

PARENTERAL NUTRITION – ADULT cont'd

The dietitian will advise on full micronutrient screening of long-term PN or "at-risk" patients.

Results should be monitored by the managing medical team, but will also be reviewed by the PN Team.

Note: The managing medical team retains overall responsibility for the patient.

5.4 NURSING CARE OF PATIENTS ON PN

The ward Nursing Staff will perform the following tasks for patients on PN:

Observations

- Weight at baseline and twice weekly thereafter, and recorded in Powerchart.
- Vital signs in accordance with frequency on SAGO chart.
- Accurate fluid balance chart and summary (to maintain accurate fluid balance and homeostasis).
- Capillary blood glucose monitoring (use opposite limb to site of infusion):
    - Baseline, then every six (6) hours.
    - Blood glucose monitoring may be reduced to daily once stable on target rate of PN (i.e. glucose between 4 – 8 mmol/L without requirement of insulin. (See Appendix 3.) following consultation with dietitian and managing medical team.
    - Return to QID when PN is being weaned.
- Bag change will be at 15:00 hrs each day unless otherwise required (should a bag change be required at an alternate time, the reason should be clearly documented and handed over). Bags must not hang for longer than 24 hours.

Collection and Storage of PN on Ward

PN is ordered via the fluid chart. Wards should fax their order to Pharmacy no later than Midday (26717) to facilitate a timely preparation of order, and pick up arrangements. Pharmacy will call the ward when the PN order is ready for collection (for administration at 1500hours).

Bags collected from Pharmacy for next-day administration (e.g. dispensed Friday for infusion Saturday), must be stored in a refrigerator (at between 2°C and 8°C) well away from any freezer compartment to prevent ice crystal formation in the PN.

Bags that have been refrigerated should be removed at least 1-2 hours before being infused, to allow the solution to reach room temperature.

Administration of PN

PN is to be infused via a dedicated lumen of the CVAD.

PN solutions must only be hung for a maximum of 24hours. The PN bag is to be changed every 24hours at 1500hrs each day regardless of the amount remaining in the previous bag, except where otherwise indicated by the PN Team. Infusion sets are to be changed each day at the same time as the bag change.

PARENTERAL NUTRITION – ADULT cont'd

For patients on rates greater than 84mL/hr (greater than 2000mL/day), bags and infusion sets are to be changed at the completion of each bag.

Bags connected to the patient should be protected from light (which breaks down some components of PN) using the coloured protective cover provided with each bag in accordance with manufacturer's instructions.

5.5 CESSATION OF PN

Cessation of PN is determined on a variety of factors and is a multi-disciplinary decision.

Patients will be started on an enteral or oral diet when thought appropriate by the managing Medical Team. The Clinical Dietitian will advise on weaning/ceasing PN in those patients who are able to tolerate and absorb adequate oral/enteral feeding. At this point, nursing staff or the patient should maintain accurate Food Record Charts, in addition to the existing fluid balance charts . Blood sugar level checks may be ceased with cessation of PN, unless the patient is on insulin.

Advising Dietitian

Dietitian should be consulted prior to cessation of TPN to discuss weaning procedures, and nutritional requirements in light of cessation.

Ceasing PN Suddenly or Unexpectedly, prior to establishing oral/enteral nutrition

Occasionally PN may need to be stopped for other reasons (e.g. acute operations, major metabolic disorders, line infections), despite the patient remaining NBM/nil enteral feeds.

One of the potential problems if PN is stopped suddenly or unexpectedly is rebound hypoglycaemia, which may be severe and dangerous.

To minimise this effect, the rate of PN must be reduced to half the current rate for at least 2 hours before ceasing. If PN needs to be stopped suddenly or unexpectedly, an infusion of 4 to 5% glucose should be initiated at approximately 1 mL/kg/hour for five (5) hours. Beyond this time, and in patients with large fluid losses or requirements, intravenous fluids should be administered as clinically indicated. (NB. When the patient is tolerating oral diet and fluids this is not necessary).

IV glucose 5% must be initiated when PN is stopped within 4 hours of administration of insulin if adequate oral/enteral intake has not been established.

Patients on long-acting insulin – HIGH risk of hypoglycaemia

Care must be taken with patients on long-acting insulin regimens to ensure optimal glycaemic control and avoid hypoglycaemia when weaning/ceasing PN. Endocrine must be consulted in these cases. See Appendix 4.

Advising Pharmacy

Pharmacy must be advised immediately if PN is to be ceased via phone (26716). The same should also be documented clearly in eMeds.

PARENTERAL NUTRITION – ADULT cont'd

Line Removal
Refer to RHW Local Operating Procedure - Central Venous Catheter Access Device (CVAD) Management.
After cessation of PN, the dietitian may maintain contact with the patient in order to audit clinical outcome and performance.

6. DOCUMENTATION

- Adult Fluid Order Chart
- Patient Health Care Record

7. EDUCATIONAL NOTES

ABBREVIATIONS/DEFINITIONS:

CVAD – Central Venous Access Devices include any catheter that is placed so that the distal tip sits in a major or central vein. This is usually the Superior Vena Cava (SVC) although the Inferior Vena Cava may also be used, as is the case for femoral catheters. Catheters that belong to this group include short term central venous catheters (CVC) and peripherally inserted central catheters (PICC) as well as longer term tunnelled catheters (e.g. Hickman Catheter), and implanted venous ports (e.g. Port-a-Cath or PAS-Port).

Medical Team – This term is used throughout this document to refer to the medical team responsible for the patient.

Medical Officer- MO

PICC – Peripherally Inserted Central Catheters (see CVAD)

PN – Parenteral Nutrition (PN) refers to the provision of nutrients intravenously, thus bypassing the gastrointestinal tract.

Rebound hypoglycaemia – Due to the high glucose and amino acid load in PN, pancreatic hormones (especially insulin) are produced in moderate-to-high quantities. If the nutrient load is suddenly stopped, the hormones are still produced and active for some time. This can produce a hypoglycaemic state.

Refeeding Syndrome – Refeeding syndrome is the term used to describe the adverse metabolic effects and clinical complications that can arise when a starved or seriously malnourished individual commences refeeding (see Appendix 1).

8. RELATED POLICIES / PROCEDURES / CLINICAL PRACTICE LOP

- RHW Local Operating Procedure - Central Venous Access Device (CVAD) Management
- RHW Local Operating Procedure – Potassium – Administration of Oral and Intravenous Infusion
- RHW Local Operating Procedure - Phosphate Intravenous Replacement
- Sepsis Management in the Gynecological or Oncological Patient

PARENTERAL NUTRITION – ADULT cont'd

9. RISK RATING

- Extreme Risk

10. NATIONAL STANDARD

1. Governance for Safety and Quality in Health Service Organisations
3. Preventing and Controlling Healthcare Associated Infections
11. Provision of Care

8. REFERENCES

- Prince of Wales Hospital Clinical Business Rule: Parenteral Nutrition Guidelines.
- Agency for Clinical Innovation (2010). Parenteral Nutrition Pocketbook. ACI, Chatswood.
- National Institute for Health and Clinical Excellence (2006). Clinical Guideline 32 Nutrition Support in Adults: oral nutrition support, enteral tube feeding and parenteral nutrition. London.
- Lidder PG, Flanagan D, Fleming S, Wheatley T, Rahamin J, Lewis SJ (2010). Enteral trickle feeding reduces abnormal intestinal permeability in patients receiving parenteral nutrition. *Proceedings of the Nutrition Society, 69* (OCE2): E169.
- Dietitians Association of Australia Nutrition Support Interest Group (2015). *Parenteral Nutrition Manual for Adults in Healthcare Facilities*. DAA, Canberra.
- Osland EJ, Ali A, Nguyen T, Davis M, Gillanders L (2016). Australasian society for parenteral and enteral nutrition (AuSPEN) adult vitamin guidelines for parenteral nutrition. Asia Pacific Journal of Clinical Nutrition 25: 636-650.
- Consensus statement POWH Parenteral Nutrition Forum. 2016
- Osland EJ, Ali A, Isenring E, Ball P, Davis M, Gillanders L (2014). Australasian Society for parenteral and enteral nutrition guidelines for supplementation of trace elements during parenteral nutrition. *Asia Pacific Journal of Clinical Nutrition, 23*:545-554.
- Wagman LD, Miller KB, Thomas RB, Newsome HH, Weir GC. The effect of acute discontinuation of total parenteral nutrition. Annals of Surgery 1986; 204:524-529.
- Australian Diabetes Society Guidelines for Routine Glucose Control in Hospital; 2012. [Cited 2014 March 31]. Available from: https://www.diabetessociety.com.au/documents/ADSGuidelinesforRoutineGlucoseControlinHospitalFinal2012_000.pdf
- Gosmanov AR, Umpierrez GE. Management of hyperglycemia during enteral and parenteral therapy. Curr Diab Rep. 2013; 13:155-166.
- Pos, DD. Important Notice, Re change to 3.5 litre dual chamber bag to Baxa 3.0 litre bag. Baxter Healthcare Pty Ltd. 2014, 31st July 2014.

REVISION & APPROVAL HISTORY

Reviewed and endorsed Gynaecology Services Division Management Committee 23/8/18
Approved Quality & Patient Safety Committee 17/7/14
Reviewed and endorsed Therapeutic & Drug Utilisation Committee 10/6/14
Appoved Quality & Patient Safety Committee 18/8/11
Reviewed Therapeutic & Drug Utilisation Committee 16/8/11
Approved Quality Council 15/12/03

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APPENDIX 1: Refeeding Syndrome

What is Refeeding Syndrome?

Refeeding syndrome is the term used to describe the adverse metabolic effects and clinical complications that may arise when a starved or seriously malnourished individual commences refeeding by any route. When the malnourished patient is fed carbohydrate, anabolism leads to intracellular influx of anabolic ions in response to insulin. The resulting electrolyte shifts can lead to dangerously low plasma levels of these ions.

Signs of refeeding syndrome include:

- Severe hypophosphataemia, hypokalaemia or hypomagnesaemia;
- Vitamin deficiencies (most notably, thiamin depletion);
- Glucose intolerance;
- Fluid balance disturbances.

Who is at risk?

"Some" risk of refeeding syndrome	Any patient who has had very little nutrition intake for >5 days is at some risk of re-feeding problems.
High risk of refeeding syndrome	**Patient has one or more of the following:** • BMI <16kg/m^2 • Unintentional weight loss of >15% within the previous 3-6 months • Very little or no nutrient intake for >10 days • Low levels of potassium, phosphate or magnesium prior to any feeding **Or patient has two or more of the following lesser criteria:** • BMI <18.5kg/m^2 • Unintentional weight loss >10% within the previous 3-6 months • Very little or no nutrient intake for >5 days • A history of alcohol abuse or some drugs including insulin, chemotherapy, antacids or diuretics.
Extreme risk of refeeding syndrome	**Use extra caution in patients with:** • BMI <14kg/m^2 **Or** • Negligible intake for more than 15 days

Precautions to be taken

1. Identify at-risk patients.

All patients should be assessed for risk of refeeding syndrome by a Dietitian. If a dietitian assessment is not possible (for example, on weekends), then a risk of refeeding syndrome should be assumed and the following precautions taken.

2. Treat electrolyte abnormalities.

Electrolyte levels (in particular phosphate, potassium and magnesium) must be assessed at baseline and any abnormalities corrected.

3. Provide vitamin supplementation.

Thiamine (300mg IV) must be given daily for 10 days. An IV multivitamin (Cernevit, 1 ampoule) and trace elements (1 syringe) must also be provided daily for 5 days or until the target-rate of PN is achieved.

4. Deliver energy and fluids slowly.

PN should be commenced at no more than half the goal rate and increased gradually. The dietitian will provide recommendations on starting rates and progression for patients at risk of refeeding syndrome. *After hours* (dietitian unavailable) PNS9 2000ml solution should be commenced at a maximum of 20mL/hr and maintained at that rate until a dietitian assessment can be conducted.

5. Monitor the patient.

Fluid balance should be carefully documented so as to avoid fluid overload. Biochemistry should be monitored intensively during the first week of feeding and any abnormalities corrected (specifically phosphate, potassium and magnesium). Refer to Table 1. Baseline Investigations and Monitoring Guidelines.

APPENDIX 2: After Hours PN Starting Regimen

After hours and weekends (when Dietitian unavailable):

1. Contact Pharmacist on call for Sterile via switchboard re: accessing PN solution. PN must be ordered via fluid chart (see section 5.4 for details).

2. PNS9 2000ml solution should be commenced at a maximum rate of 20mL/hr and maintained at that rate until a Dietitian assessment can be conducted.

3. Prescription: Thiamine (300mg IV 30mins prior to commencing PN and then daily), Cernevit (1 ampoule IV daily) and trace elements (1 syringe IV daily).

4. Prescribe sliding scale insulin regimen (see Appendix 3).

5. Monitor potassium, phosphate and magnesium levels for refeeding syndrome (supplement if low) daily. Refer to Table 1. Baseline Investigations and Monitoring Guidelines.

APPENDIX 3: Blood Glucose Monitoring and Management in Patients Receiving Parenteral Nutrition

3.1 Blood Glucose Monitoring during PN

- All patients starting PN: BGL check prior to commencement of PN and every 6 hours (QID) until goal rate of PN achieved, then daily if BGL<8mmol/L.
- Patients on insulin: BGL monitoring every 4 hours
- Patients where there is an abrupt interruption to PN: every 2 hours for 12 hours for those NBM on insulin. Patients not on insulin: a single BGL 1hr post PN cessation is sufficient12
- For most patients the target BGL range is 5-10mmol/L, pregnancy is an exception.

3.2 Insulin Regimens

- IV insulin may be preferred with haemodynamically unstable or critically ill patients with hyperglycaemia on PN. Discuss with Endocrine.
- Supplemental/correction scale of subcutaneous rapid acting insulin should not be used alone to optimize glucose control in patients receiving PN.
- RHW dietitian can be consulted regarding rates of glucose administered in PN.

3.2.1 Patients with known Diabetes Mellitus on PN

- Commence 1 unit of insulin per 10g glucose provided in two (2) divided doses as per dosing chart below (See Table 2-Levemir dosing for patients with known Diabetes Mellitus on PN)
- Prescribe as Levemir (Determir) subcutaneous every 12 hours at 1800 and 0600 hours plus supplemental/correction scale of subcutaneous rapid acting insulin every four (4) hours) as per eMEDS/NSW Health Adult Subcutaneous Insulin Prescribing Chart.
- Reduce insulin dose by 20% if BGLs are under 5mmol/L.

Example: Pt commencing PNS9 at 30mL/hr providing 110g glucose/1000ml PN = 79g glucose/day. Prescribe Levemir 4 units every 12hours at 1800 and 0600 hours plus supplemental/correction scale of subcutaneous rapid acting insulin every four (4) hours as per eMEDs/NSW Health Adult Subcutaneous Insulin Prescribing Chart.

- For patients with Type 1 Diabetes Mellitus, on a basal bolus insulin regimen or subcutaneous insulin pump, seek immediate advice from Endocrine Team.

Table 2: Levemir dosing for patients with known Diabetes Mellitus on PN

PNS-9 Parenteral Nutrition Solution infusion rate	Amount of glucose provided based on a 24 hour infusion	Dose* of Levermir insulin for patients **with known** Diabetes Mellitus on PN
15-18mL/hr	40-47grams	2 units b.d.
19-26mL/hr	50-69grams	3 units b.d.
27-34mL/hr	71-90grams	4 units b.d
35-41mL/hr	92-108grams	5 units b.d.
42-49mL/hr	111-129grams	6 units b.d.
50-56mL/hr	132-148grams	7 units b.d.
57-64mL/hr	150-169grams	8 units b.d.
56-71mL/hr	172-187grams	9 units b.d.
72ml/hr or higher	190grams or higher	10 units b.d.

*Consider dose reduction if patients body weight is under 45kg or eGFR less than 30mL/min/1.73m2

3.2.2 Patients with no known Diabetes Mellitus on PN with one or more BGL ≥10mmol/L

- Commence 1 unit of insulin per 20g glucose provided in two (2) divided doses as per dosing chart below (See Table 3: Levemir dosing for patients with no known Diabetes Mellitus on PN).
- Prescribe as Levemir (Determir) subcutaneous every 12 hours at 1800 and 0600 hours, plus supplemental/correction scale of subcutaneous rapid acting insulin every four (4) hours) as per eMEDs/NSW Health Adult Subcutaneous Insulin Prescribing Chart.
- Reduce insulin dose by 20% if BSLs are under 5mmol/L.

Example: Pt on PN at 50mL/hr of PNS9 providing 110g glucose/1000ml PN = 130g glucose/day. Chart Levemir 3 units every 12 hours at 1800 and 0600 hours plus supplemental/correction scale of subcutaneous rapid acting insulin every four (4) hours) as per eMEDS/NSW Health Adult Subcutaneous Insulin Prescribing Chart.

Table 3: Levemir dosing for patients with no known Diabetes Mellitus on PN

PNS-9 Parenteral Nutrition Solution infusion rate	Amount of glucose provided based on a 24 hour infusion	Dose* of Levermir insulin for patients with **no known** Diabetes Mellitus on PN with one or more BGL ≥10mmol/L
15-22mL/hr	40-48grams	1 unit b.d.
23-37mL/hr	61-98grams	2 units b.d.
38-53mL/hr	100-140grams	3 units b.d.
54-68mL/hr	143-180grams	4 units b.d
69mL/hr or higher	182grams or higher	5 units b.d.

*Consider dose reduction if patients body weight is under 45kg or eGFR less than 30mL/min/1.73m2

3.2.3 Adjustment to insulin

- Change in rate of PN, BGL results and need for supplemental/correction scale of subcutaneous rapid acting insulin should guide daily adjustment of Levemir. Increase total Levemir dose by 2/3 of the units of Novorapid given on the correction scale in the last 24 hours.
- If BGL < 5mmol/L, reduce Levemir dose, e.g. by 10-20% before next dose is due.
- Consider use of protophane twice daily as a cost-effective option for patients with ongoing Levemir requirements over 50 units per day.

3.2.4 Sudden Cessation of PN

- Hypoglycaemia may occur, especially in patients on Levemir. Commence IV glucose 10% at 0.5mL/kg/hr or 5% at 1mL/kg/hr to prevent hypoglycaemia.

3.2.5 Ongoing insulin requirement after PN is ceased

For patients transitioning to oral intake who are still requiring Levemir, seek Endocrine consult regarding transition to home diabetes regimen.

Appendix 4: Formulation of PNS-9 2L= Olimel N9E (with electrolytes)

Prescription Details		**PNS-9 2L**
Amino Acid	g	113.9
Glucose	g	220
Lipid (ClinOleic)	g	80
Nitrogen	g	18
Sodium	mmol	71.5
Potassium	mmol	60
Magnesium	mmol	8
Calcium	mmol	7
Chloride	mmol	90
Phosphate (including lipid)	mmol	30
Phosphate (excluding lipid)	mmol	24
Acetate	mmol	107
Ascorbate	mg	300
Trace Elements	mL	10
Cernevit	mL	5
Total Volume	mL	2016
Osmolarity	mosmol/L	1310