

Parenteral nutrition

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Overview

NCEPOD report 2010

Deciding when / when not to use PN

Venous access

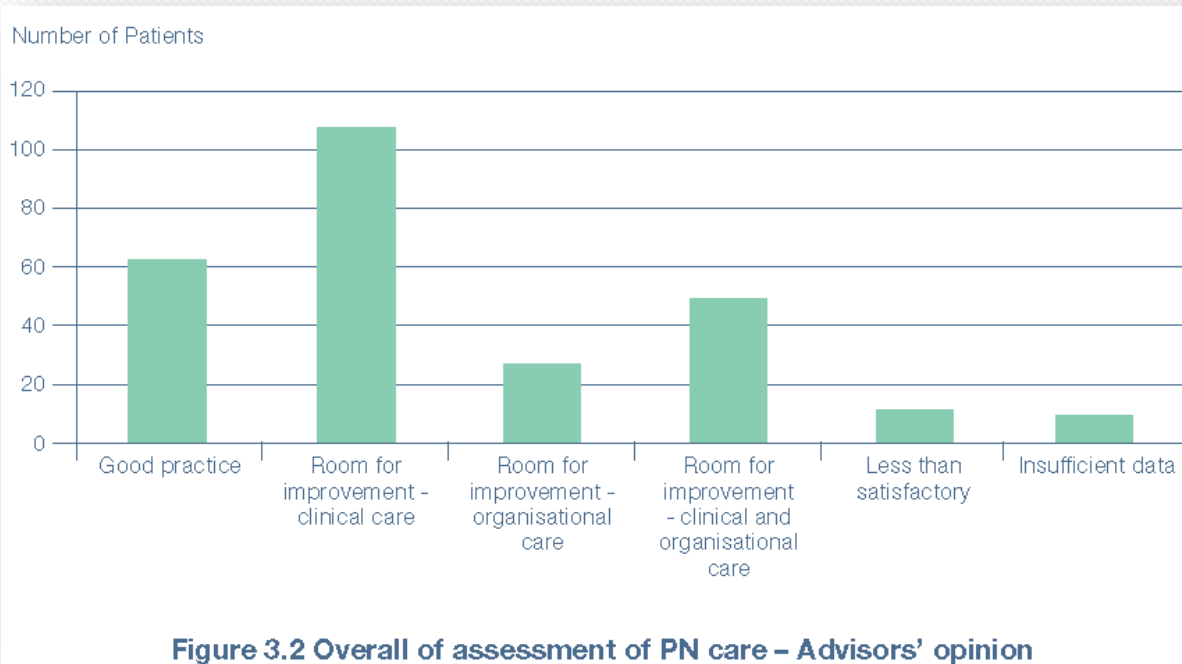
Parenteral nutrition formulation

Deciding how much to give

Type 1 IF

NCEPOD Report, 2010

- Adult in-patient PN (Jan 08-March 08)
- 1332 cases reviewed in England
- Majority: post-surgical complications (general ward)



Key Finding – Quality of Care

Number of Patients

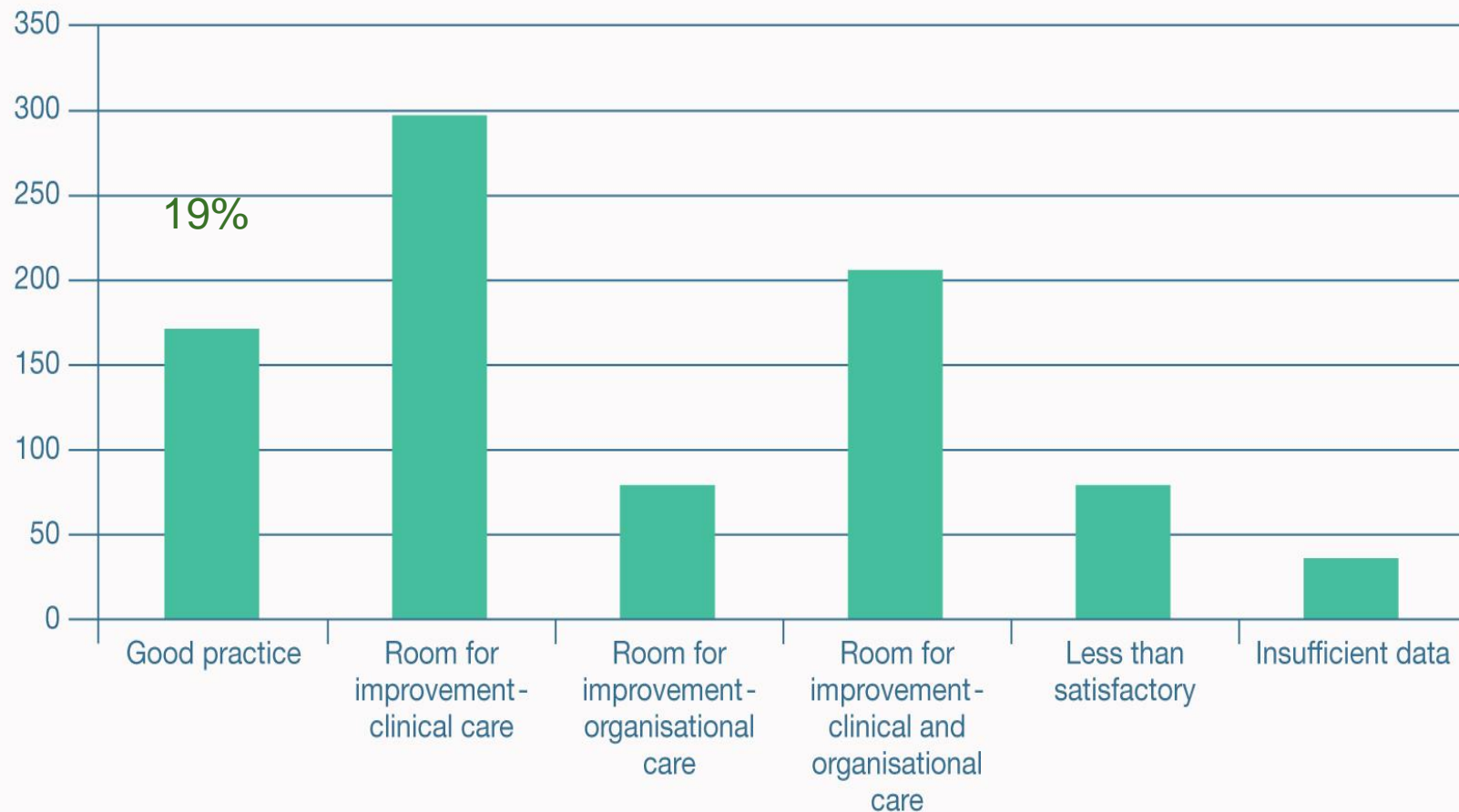


Figure 2.2 Overall of assessment of PN care – Advisors' opinion

Good practice: A standard that you would accept from yourself, your trainee and your institution .

Other Key Findings

- 33% inadequate consideration to enteral feeding
- 29% inappropriate indication in 29%.
- Delays
 - 16% unreasonable delay in recognition of need for IVN
 - 9% unreasonable delay starting IVN
- 54% deficiencies in assessment and monitoring
- 40% metabolic complications (49% avoidable)
- 75% additional IV fluids

Key Finding - Assessment

Table 2.15 Advisors' opinion on whether the patient received an adequate biochemical and nutritional assessment prior to the commencement of PN

Adequate assessment given	Number of patients	%
Yes	339	45.9
No	399	54.1
Subtotal	738	
Unknown/insufficient data	139	
Total	877	

Step 1 BMI score

+

Step 2 Weight loss score

+

Step 3 Acute disease effect score

BMI kg/m ²	Score
>20(>30 Obese)	= 0
18.5-20	= 1
<18.5	= 2

Unplanned weight loss in past 3-6 months	
%	Score
<5	= 0
5-10	= 1
>10	= 2

If patient is acutely ill and there has been or is likely to be no nutritional intake for >5 days
Score 2

If unable to obtain height and weight, see reverse for alternative measurements and use of subjective criteria

Step 4

Overall risk of malnutrition

Add Scores together to calculate overall risk of malnutrition
Score 0 Low Risk Score 1 Medium Risk Score 2 or more High Risk

Step 5

Management guidelines

0 Low Risk
Routine clinical care

- Repeat screening
Hospital – weekly
Care Homes – monthly
Community – annually for special groups e.g. those >75 yrs

1 Medium Risk
Observe

- Document dietary intake for 3 days if subject in hospital or care home
- If improved or adequate intake – little clinical concern; if no improvement – clinical concern - follow local policy
- Repeat screening
Hospital – weekly
Care Home – at least monthly
Community – at least every 2-3 months

2 or more High Risk
Treat*

- Refer to dietician, Nutritional Support Team or implement local policy
- Improve and increase overall nutritional intake
- Monitor and review care plan
Hospital – weekly
Care Home – monthly
Community – monthly
- * Unless detrimental or no benefit is expected from nutritional support e.g. imminent death.

All risk categories:

- Treat underlying condition and provide help and advice on food choices, eating and drinking when necessary.
- Record malnutrition risk category.
- Record need for special diets and follow local policy.

Obesity:

- Record presence of obesity. For those with underlying conditions, these are generally controlled before the treatment of obesity.

“MUST” Malnutrition Universal Screening Tool

Re-assess subjects identified at risk as they move through care settings
See The ‘MUST’ Explanatory Booklet for further details and The ‘MUST’ Report for supporting evidence.

Key Finding - Assessment

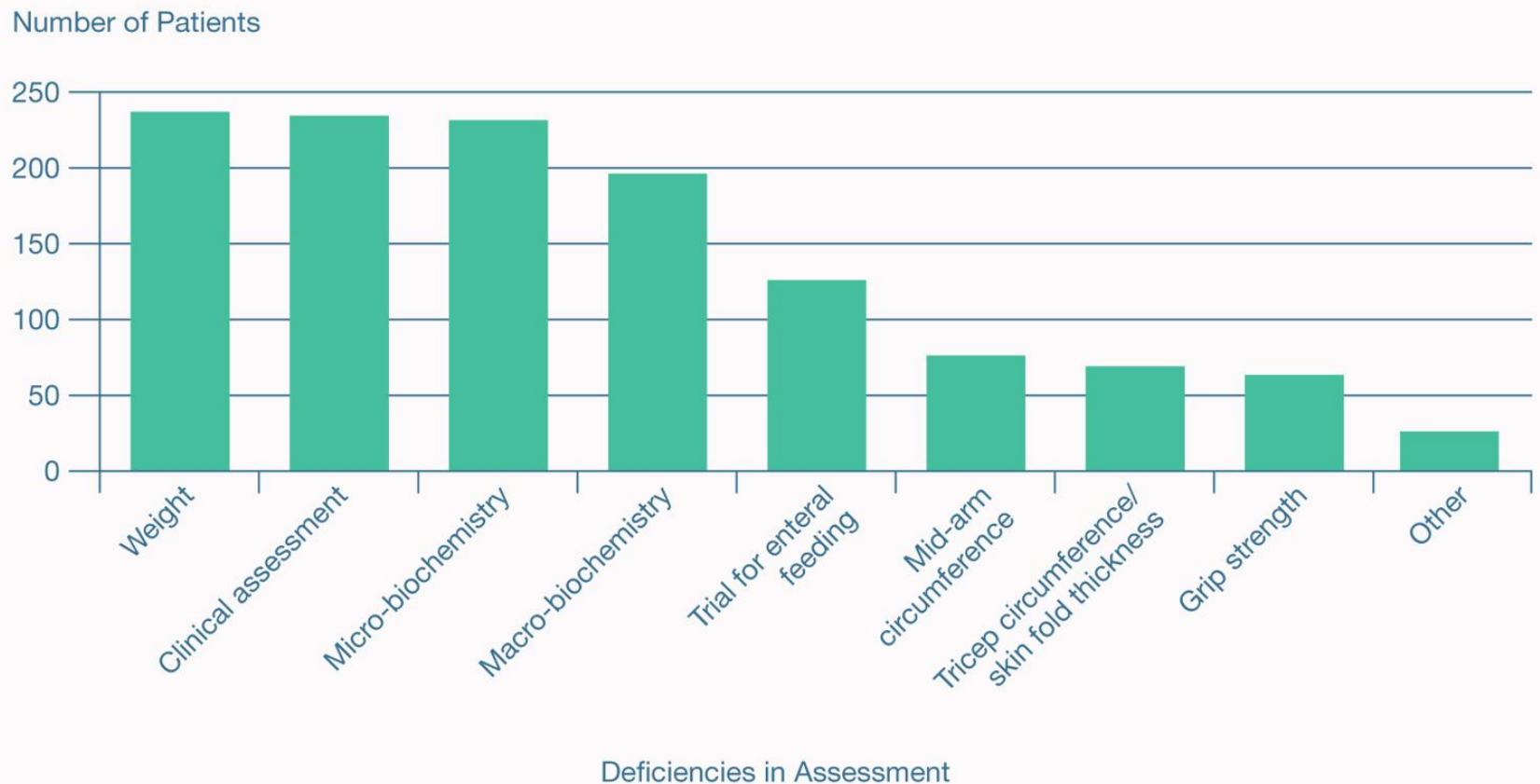


Figure 2.6 Deficiencies in biochemical and nutritional assessment (answers may be multiple)

Key Finding – Indication for PN

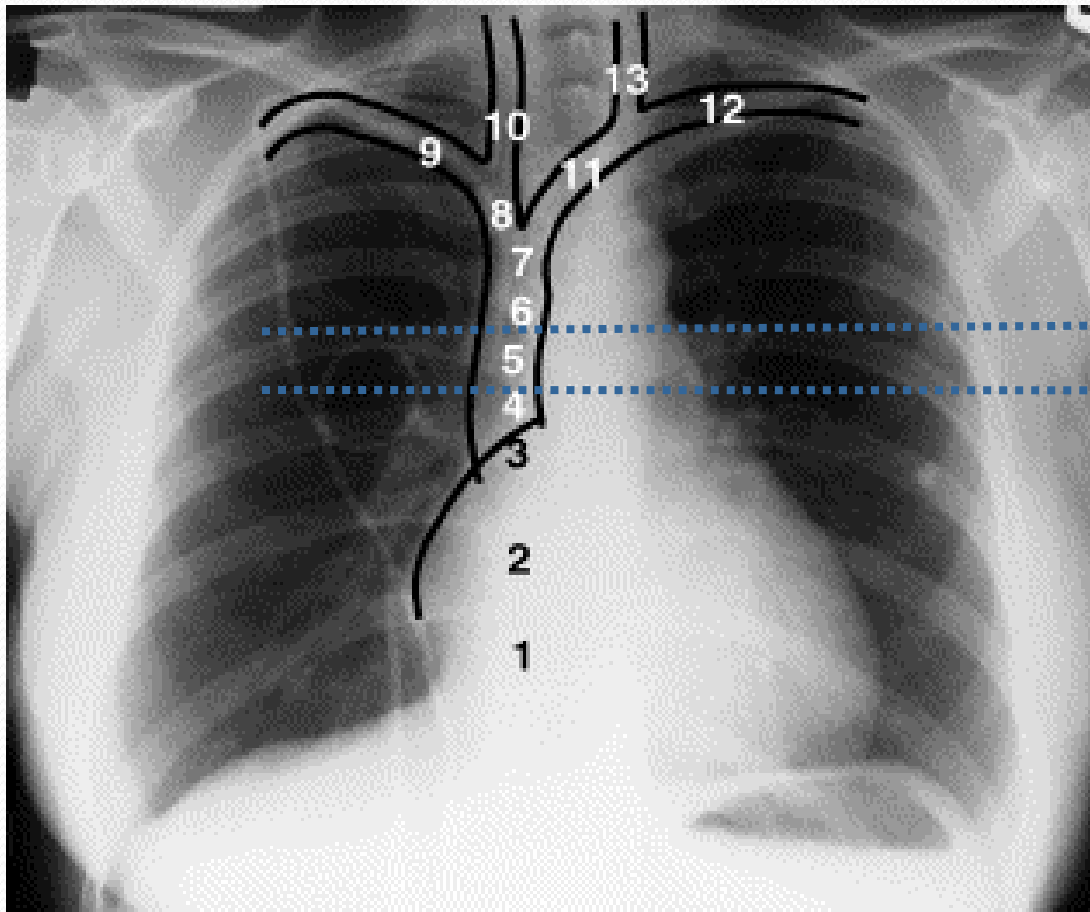
Documented indication for PN	Number of patients
Post-operative ileus	195
Post-surgical complications	124
Obstruction	119
Non functioning gut	109
Failure of enteral nutrition	109
Perforated/leaking gut	91
Other	86
No indication documented	73
Fistulae	48
No access for enteral nutrition	45
Cancer	30
Dysphagia	25
Malabsorption	23
Short bowel	22
Dysmotility	22
Infection	20
Crohn's disease	15
Pre-operative nutrition	14
Radiation enteritis	6
Chemotherapy	6
Radiation damage	5
Graft-Versus-Host disease	4
Volvulus	1

Key Findings: central venous devices

- 33% lack of documentation about insertion
- 55% position of catheter tip not documented
- 26% catheter complications
- 54% complications avoidable
- 12% complications managed inappropriately
- 58% catheter or metabolic complication

Tip Position

The risk of thrombosis is significantly increased with proximal SVC tip position



Catheter tip	Thrombosis %	
Proximal	42	
Intermediate	5	
Distal	3	

Cadman et al (2004)

CVC Complications

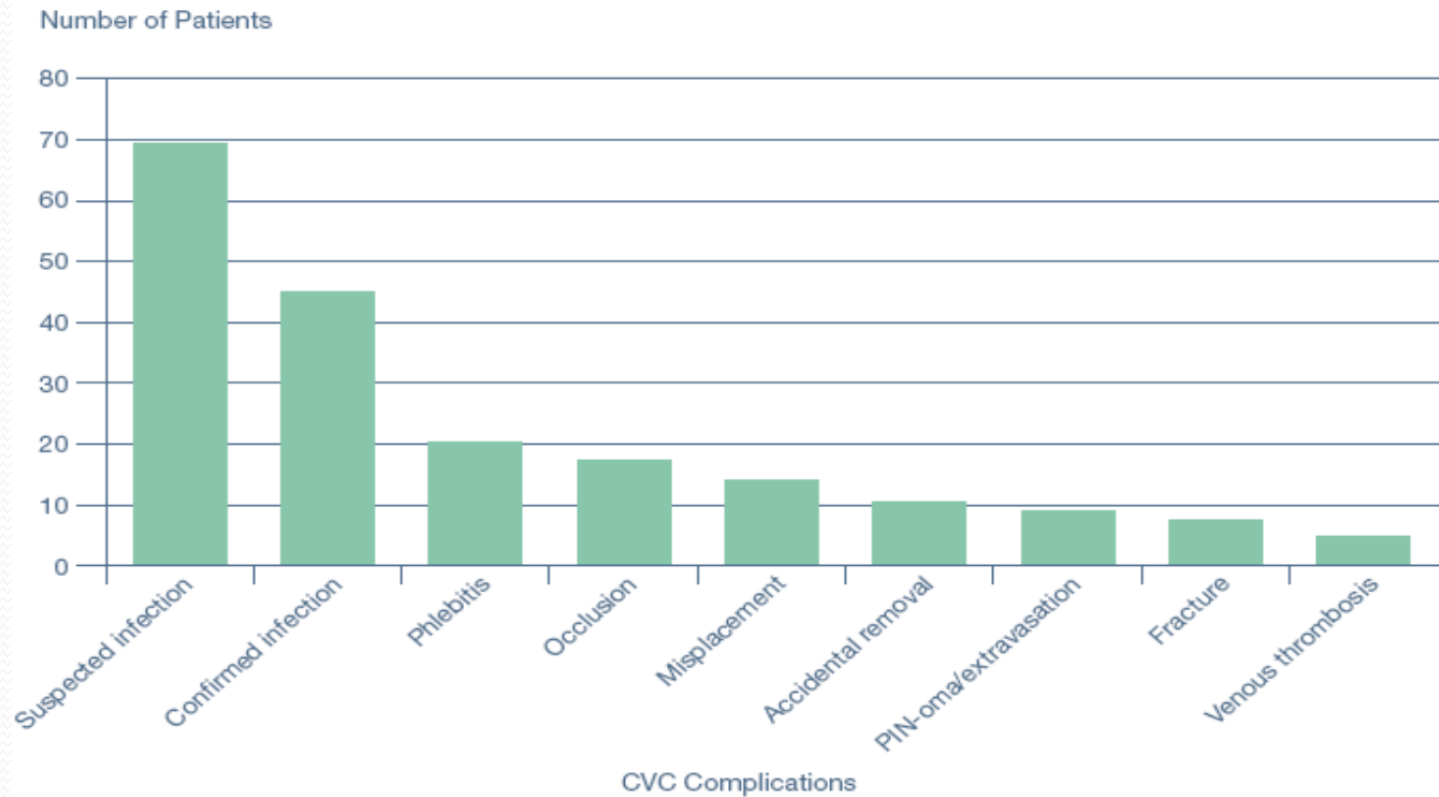


Figure 4.1 Type of CVC complication (answers may be multiple)

- 26% had CVC related complications
- 54% complications were deemed to be avoidable.
- 12% of complications were managed inappropriately.
- Lack of awareness and surveillance surrounding complications.

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Indications for PN

With severe intestinal failure

- If it is harmful to feed through the gut (bowel/anastomotic leak/fistula)
- When enteral feeding has failed

As therapy

- Specific treatment eg Crohn's disease (rarely)

Common indications for PN

Bowel obstruction

Prolonged ileus

Enterocutaneous fistula

especially if output >500 ml/24 hrs

Jejunal perforation/fistula

Short bowel

<100cm & no colon

<50cm & a colon

Graft verses host disease

Deteriorating nutritional state on EN

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Clinical factors influencing parenteral feeding

- Duration of intestinal failure
- Aetiology
- Co-morbidity
- Prognosis
- Available venous access

Few days: ride it! (unless severe malnutrition)
1-2 weeks: peripheral PN / via PICC
2-6 weeks: Central PN
>8 weeks: Long term CPN

Sepsis
Renal failure
Liver failure
Cardiac failure

Post-op ileus
Bowel injury
Bowel obstruction
- Mechanical, failure of peristalsis
GI fistulae
Short bowel syndrome
Motility disorders

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Parenteral Nutrition: Access

- Central
 - Dedicated single lumen CVC (ideal)
 - Triple lumen catheter (dedicate 1 lumen)
 - Peripherally inserted central catheter (PICC)
 - If long term IVN then a tunneled, cuffed CVC (Hickman type)
- Peripheral
 - Short term
 - Low osmolarity regimen required

Venous access: catheter choice

Depends on anticipated length of support

< 2 weeks: PPN

- Pink venflon, changed every 2-3 days
- PICC line, (long lines)

> 2 weeks: CPN

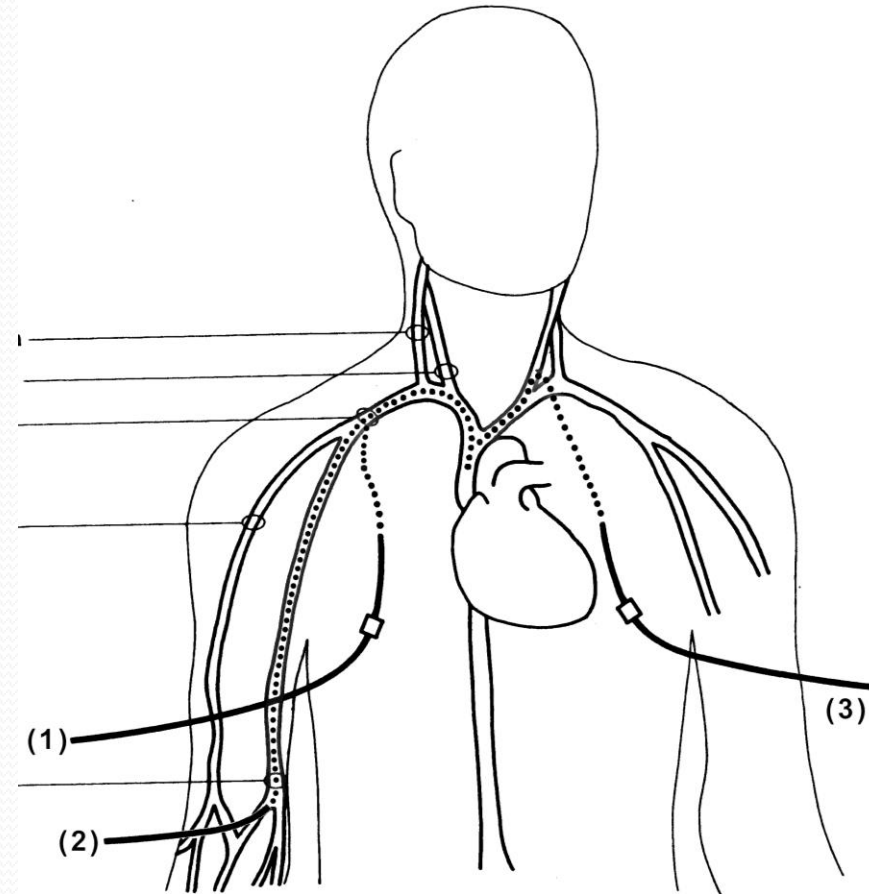
- Tunnelled single lumen catheter
- Dedicated multi-lumen catheter (ITU)

'Long term': HPN

- Silastic catheter (Hickman, Portacath, Dacron)

Central Venous Access Sites

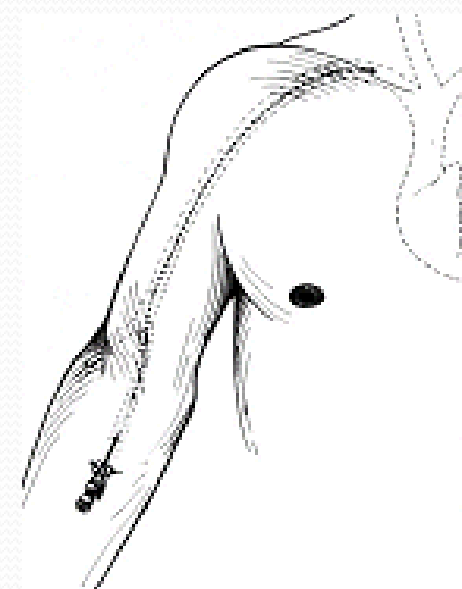
- SVC
 - Subclavian vein
 - Internal jugular vein
 - Cephalic vein
 - Basilic vein
- IVC
 - Femoral vein
 - Long saphenous vein



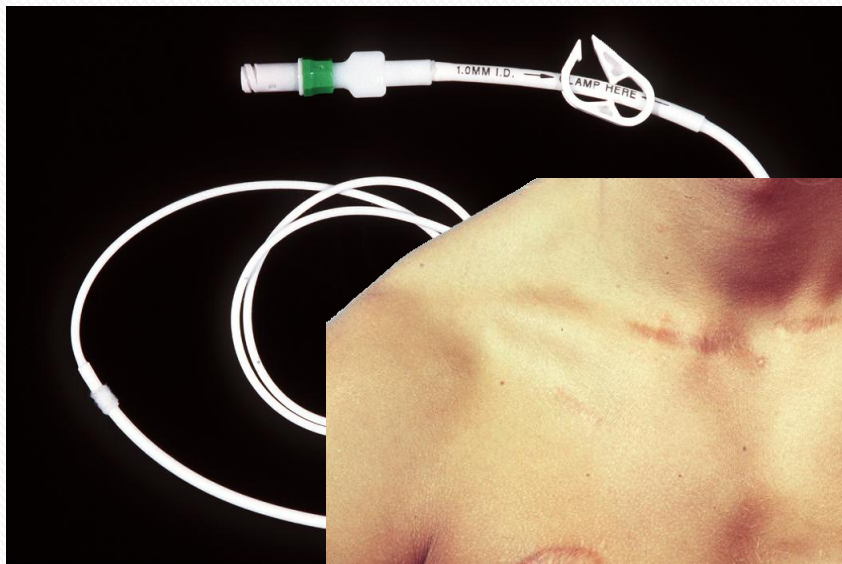
PICC

Peripherally inserted central catheters

- Access via basilic vein (preferably)
- Catheter tip in superior vena cava
- Can use for 1 – 52 weeks
- Relatively easy to place
- IVN regimen as for CPN
- Complications
 - Failed venous access
 - Malposition
 - Mechanical thrombophlebitis
 - Catheter blockage – rare, minimal infection rate



Long Term Central Venous Catheters



C

Portacath



Central Venous Catheters

Complications

Early

- Pneumothorax
- Arterial puncture
- Haemothorax
- Anaesthetic complications
- Malposition

Late

- Thrombosis
- Sepsis
- Blockage
- Fracture or puncture
- Cuff exposure
- Inadvertent removal

Peripheral Parenteral Nutrition

- Peripheral - not greater than about 14 days
- Thrombophlebitis can be a major problem
- Advantages
 - Less risk of central vein thrombosis
 - Less risk of infection
 - Cost
- Formulation of feed
 - Osmolarity as low as possible
 - Low nitrogen, glucose & potassium conc
 - Lipid
 - Isotonic
 - Protects veins



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PN Formulation

- Fluid
- Electrolytes
- Calories
 - Glucose
 - Lipid emulsions
- Amino acids
- Vitamins
- Trace elements



Key rates/amounts

- Protein
 - Requirement 0.17-0.45 g N₂/kg (=1-3 g Protein/kg)
 - Balance with 24-32 non-N₂ calories for every 1g of protein
- Carbohydrate
 - Requirement: 145-160 g/day
 - Rate: GOR: 5.7 g/kg/day (4 mg/kg/min)
- Lipid
 - Requirement: ?
 - Rate: 0.1-0.15 g/kg/h

PN Regimens

- All-in-one
 - Carbohydrate, amino acid and lipid emulsion
 - Convenient
 - Stable for ~7 days

- Two-in-one
 - Glucose and amino acids
 - Cheaper
 - More stable
 - Reduce incidence of blocked CVC



Parenteral Nutrition Solution



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Deciding how much to give

Nutritional requirements

- Macronutrients
 - anabolic substrate: protein
 - energy substrate: carbohydrate & lipid
- Micronutrients
 - minerals
 - trace elements (essential inorganic micronutrients)
 - vitamins (essential organic micronutrients)

Macronutrient requirements

	Health (g/kg/day)	Disease (g/kg/day)
Protein	1.5-1.7	1.5-2.0
CHO	4.0-5.0	4.0-5.0
Lipid	1.0-1.5	1.0-1.5*

* lower (0.8-1.0) in critical illness

Energy expenditure

- 3 components
 - Resting energy expenditure
 - Metabolic requirements of exercise/illness
 - Thermic effects of food
 - 5-10% for carbohydrate
 - 0-3% for fat
 - 20-30% for protein

Resting energy expenditure

- Measurement
 - direct or indirect calorimetry
 - doubly labeled water method
- Calculation
 - Harris Benedict equation
 - Schofield equation



Schofield estimation of EE

	REE	
Age	Male	Female
15-18	$17.6W + 656$	$13.3W + 690$
18-30	$15W + 690$	$14.8W + 485$
30-60	$11.4W + 870$	$8.1W + 842$
>60	$11.7W + 585$	$9W + 656$

W = weight (kg)

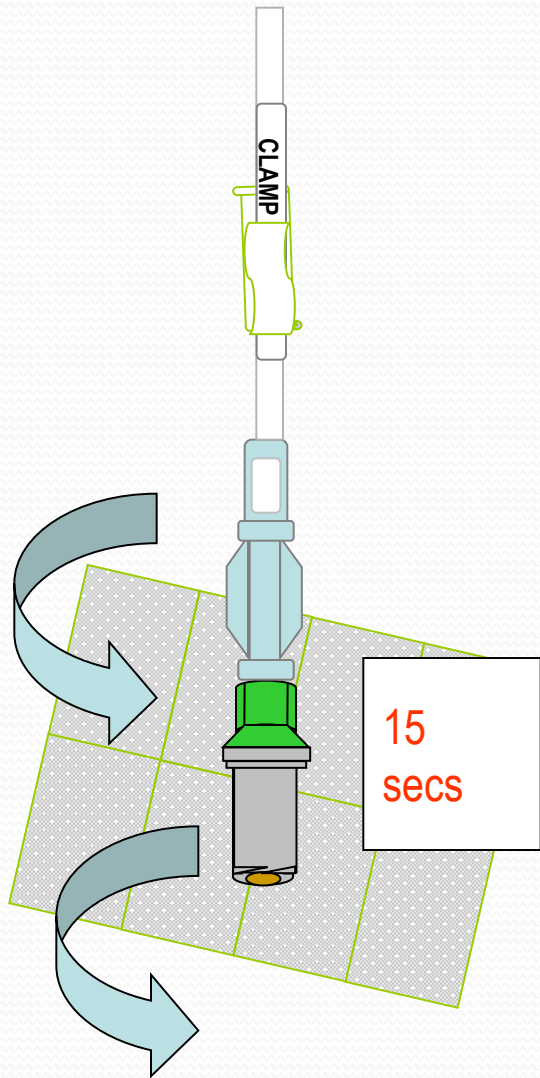
Make adjustments to calculate energy requirements

- mobility (+20-40%)
- dynamic action of food (+10%)
- temperature (+10% for every degree rise in temperature)
- clinical condition (+10-30%)

Conclusion

- The choice of which type of fluids or PN is made depending on the clinical situation of the patient
- Need to tailor the fluid or PN bag to the patients requirements and losses.
- May need to tailor the micronutrients to the patient
- For patients on long term PN, use a 'liver friendly' formulation from the start
- Careful monitoring of the patient will allow you to make changes to the formulation appropriately as the clinical situation changes

Catheter Manipulations



- **Aseptic Technique by competent staff using protocol.**
- **Hubs should be cleaned for at least 15 secs using 2% Chlorhexidine and alcohol before and after access.**
- **Minimal manipulations.**

Day of week PN commenced

Table 2.4 Day of the week on which PN was commenced

Day PN was commenced	Number of patients	%
Monday	124	14.7
Tuesday	112	13.2
Wednesday	132	15.6
Thursday	141	16.7
Friday	198	23.4
Saturday	86	10.2
Sunday	53	6.3
Subtotal	846	
Unknown	31	
Total	877	

- 84% PN started during weekday
- 79% of cases time PN started was appropriate
- Never an emergency in adults

Monitoring

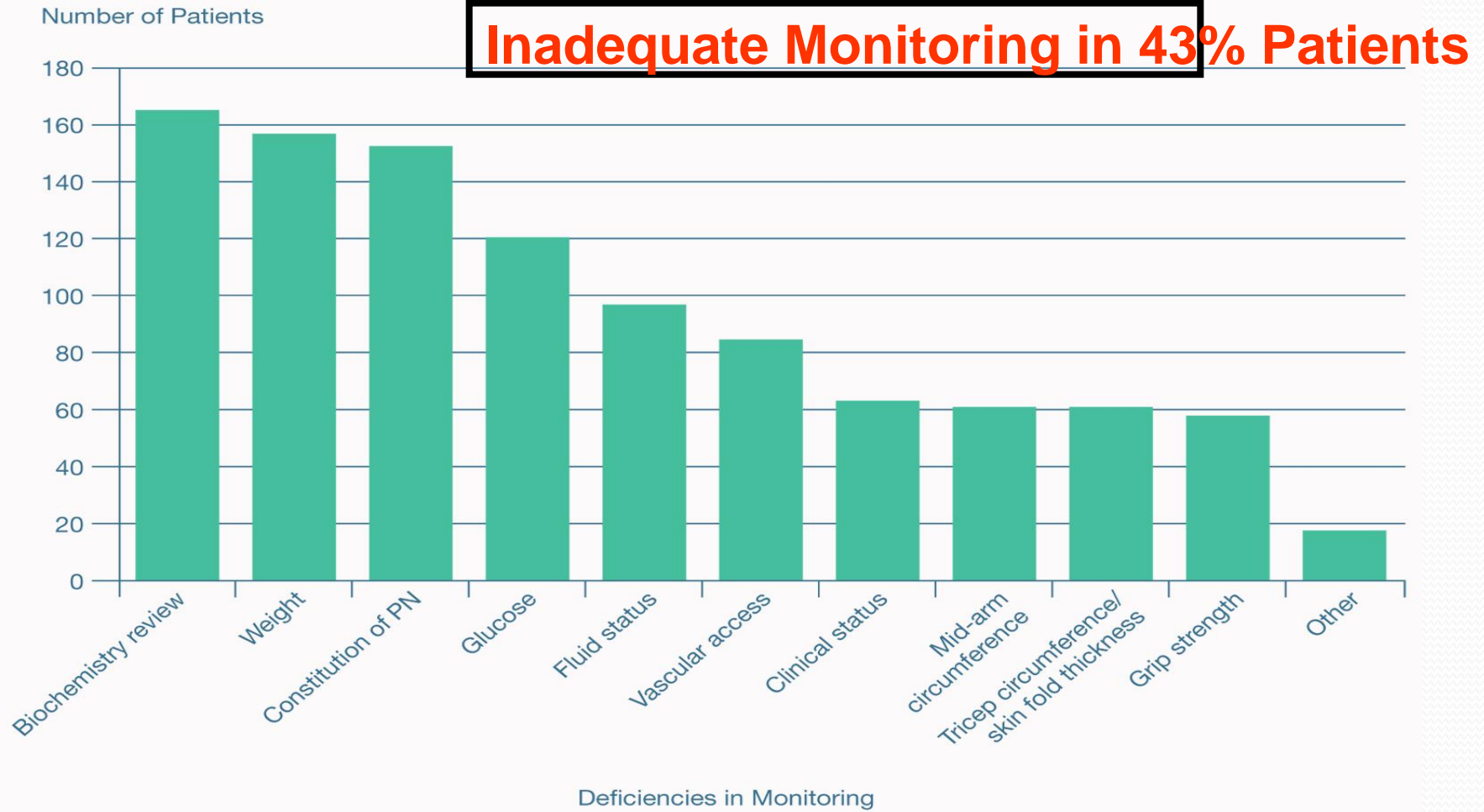
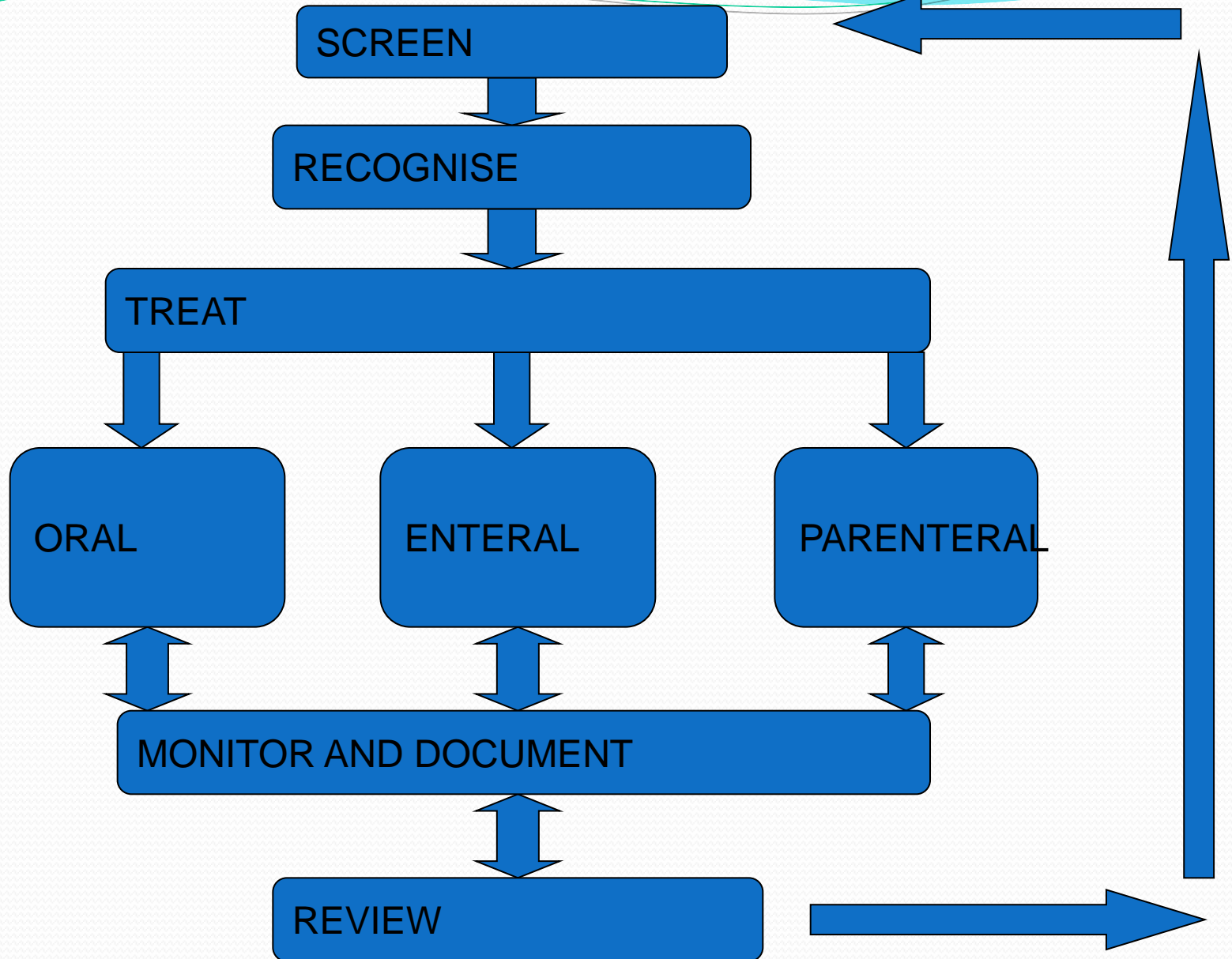


Figure 2.7 Deficiencies in monitoring (answers may be multiple)

Care Pathway for Nutrition Support



Multi-chamber bags

Developed in response to NHS demands to:

- Reduce PN compounding time
- Reduce pressure on capacity limits
- Access to products with pre-defined stability limits for additions

Why needed?

- Reduction in the investment of aseptic units resulting in rationalisation of products that can be produced

Type of Parenteral Nutrition

Multi-chamber bags

- Licensed
- Good stability already tested
- Ready to use
- Room temperature storage
- Are not nutritionally complete

Compounded bags

- Unlicensed
- Stability needs to be assessed
- Need to be compounded
- Need refrigeration
- Are nutritionally complete

MCB and IF

- Do not make the patient fit the bag
- Macronutrient content must fulfil patient's requirements
- Electrolytes must be added to replace losses
- Are not useful in the extremes of volume



Parenteral nutrition



1665 Christopher Wren

- intravenous infusions of wine, ale and opiates in a dog
- used a goose quill and a pig bladder
- noted similar effects as seen in humans after oral ingestion

Parenteral nutrition

1873 Dr EM Hodder

3 patients with cholera: IV fresh (still warm) cows milk (2 survived)

1896 First infusion of peripheral IV glucose

1937 First casein hydrolysate infusion

1961 First non-toxic fat emulsion infused

1968 Central venous catheters

Allowed infusion of hypertonic solutions in patients with intestinal failure

Amino Acids in PN

- Protein hydrolysates have been superseded by synthetic crystalline L-amino acid solutions
- Some non essential amino acids are not included in standard preparations
 - ?Some may be conditionally essential
 - Glutamine (burns, bone marrow transplant, critical illness)

Carbohydrate in TPN

- Glucose
 - Requirement = 145-160 g/day
 - Essential nutrient for:
 - CNS tissue
 - Red blood cells
 - Renal cortex
 - Metabolic fate depends on the insulin/glucagon ratio (feed/fast cycle)
 - CO₂ formed from its metabolism

Lipids in TPN

10 or 20% emulsion

- Soybean, safflower oil
- Olive oil
- Fish oil
- MCT/LCT
- Mixed

Effects

- Nutritional (energy)
- Influences phospholipid composition of cell membranes
 - enzyme & transport-receptor functions
- Formation of prostaglandins & leukotrienes
- Immune status
- Haemodynamic effect