NUTRITIONAL ASSESSMENT AND THERAPY

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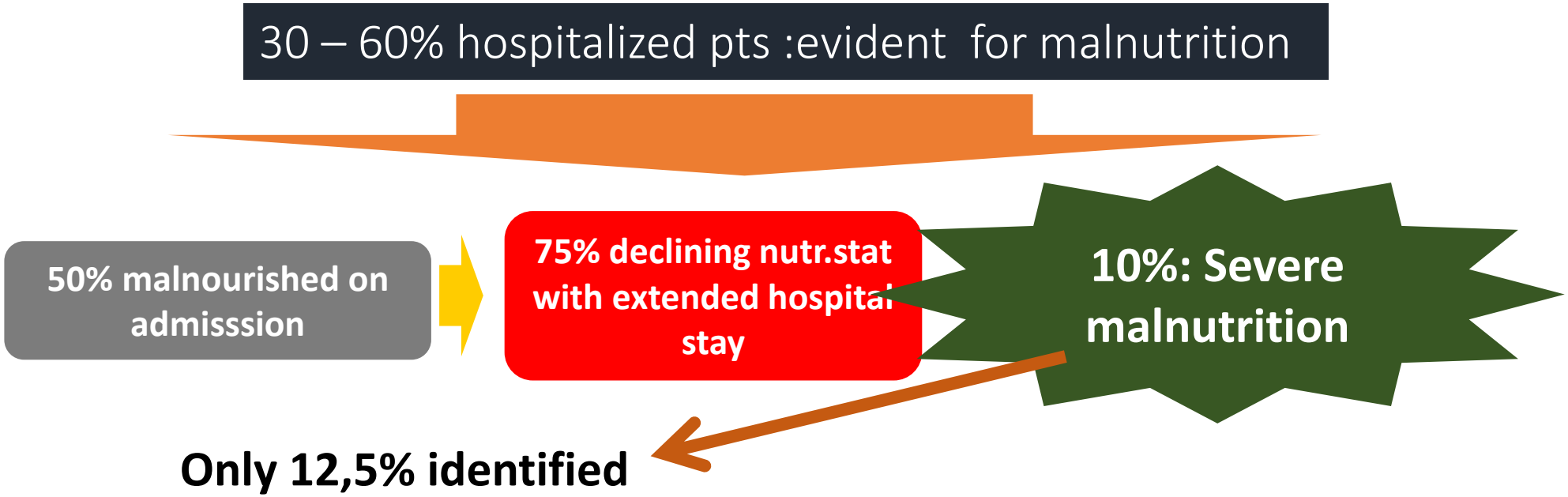
Updated 2023

Hospital malnutrition



The skeleton in the hospital closet

A problem of physician awareness

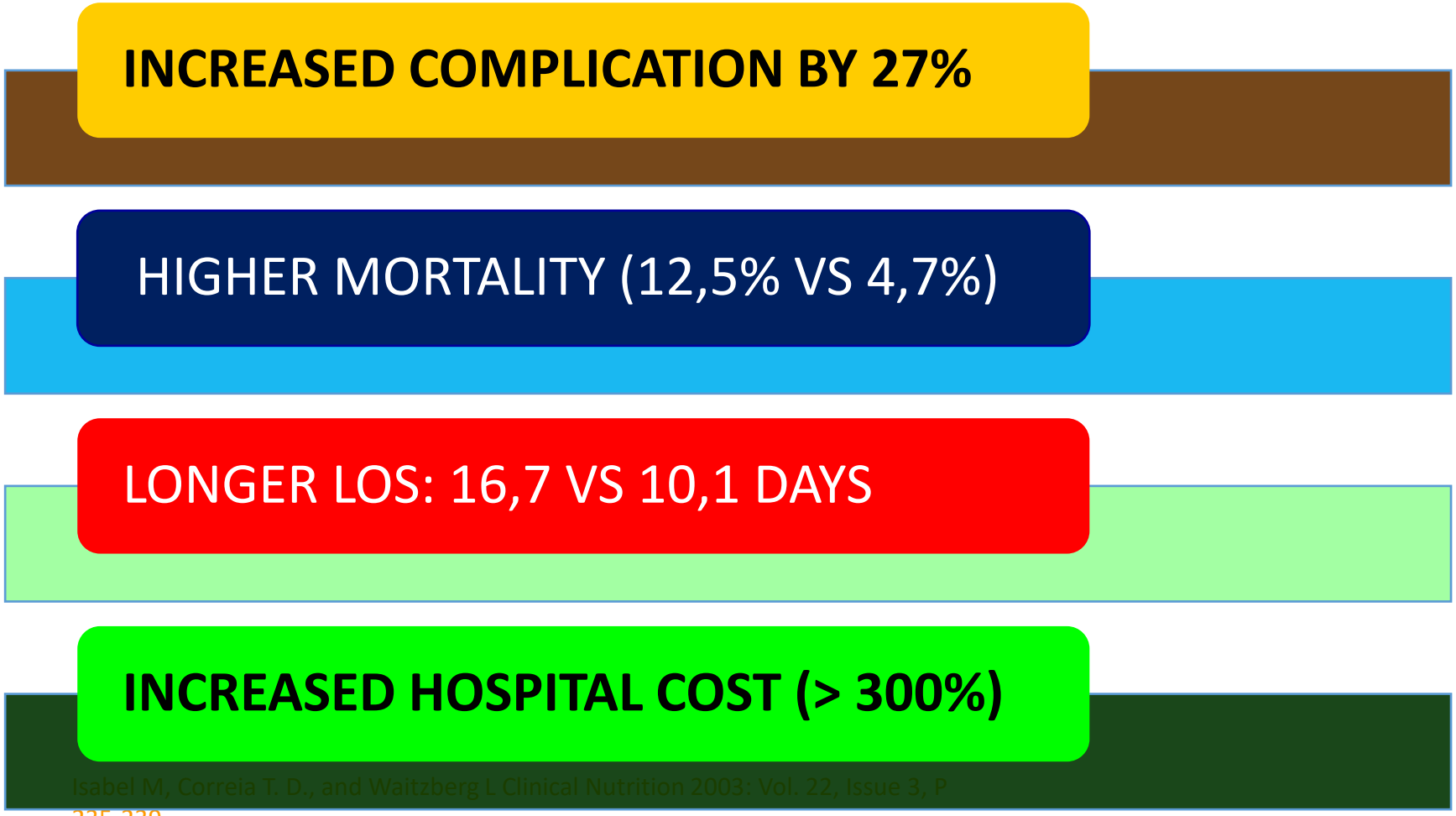
CLINICAL IMPLICATION

IMPAIRED IMUNE STATUS → ADVERSE OUTCOME: ON HEALTH AND RECOVERY

Increased morbidity and mortality

McWhirter J P and Pennington C R. Incidence and recognition of malnutrition in hospital *BMJ* 1994;308:945-948

The impact of malnutrition



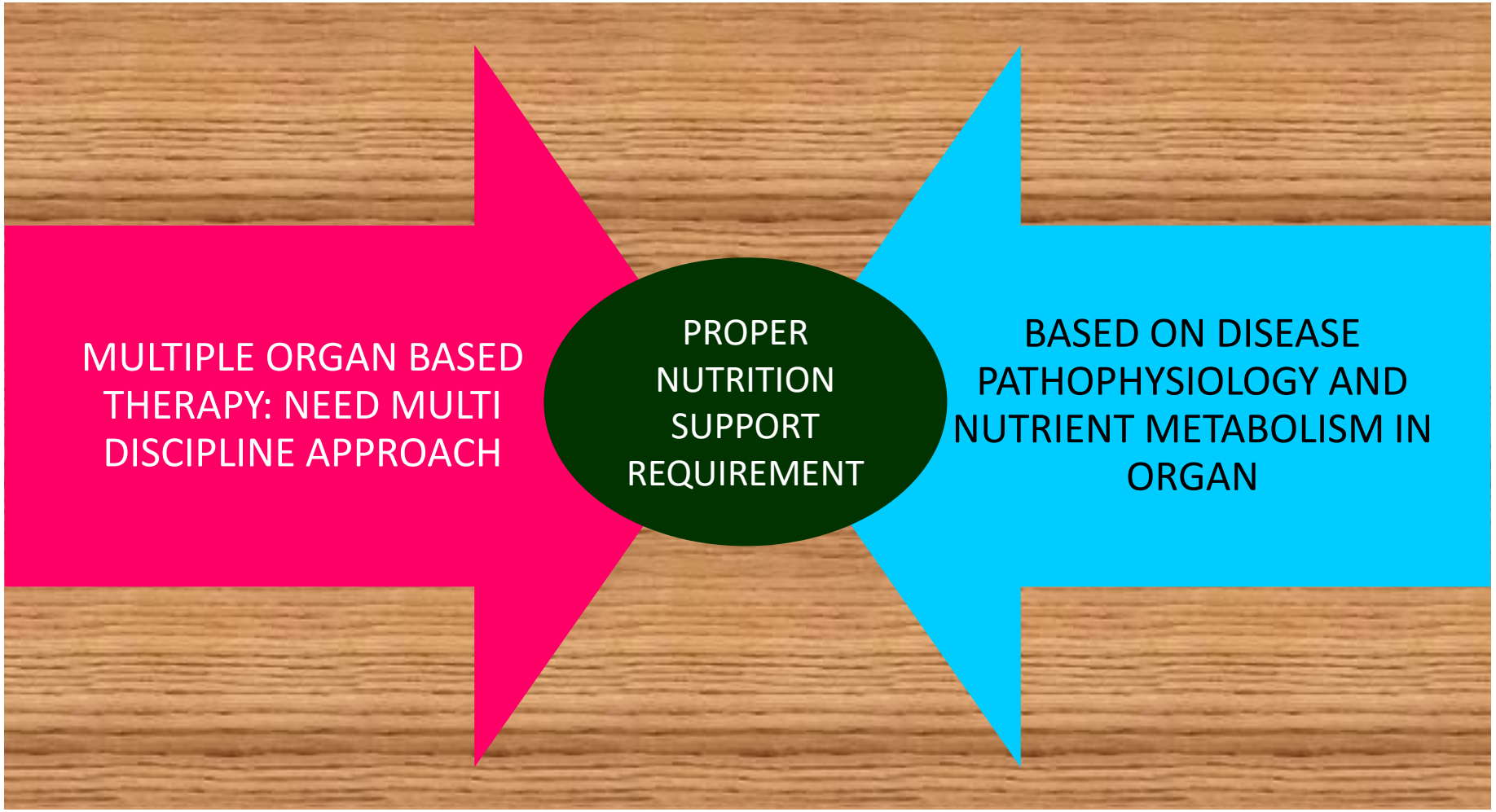
Isabel M, Correia T. D., and Waitzberg L Clinical Nutrition 2003: Vol. 22, Issue 3, P 235-239

Problem Identification

PHYSICIAN	NURSES	DIETITIAN
•LACK OF INTEREST ON NUTRITIONAL THERAPY; VERY SPECIALISTIC •MINIMAL NUTRITION TOPIC DURING MEDICAL SCHOOL •INSUFFICIENT TIME FOR NUTRITIONAL THERAPY	•UNAVAILABLE ESTABLISHED NUTRITION THERAPY PROGRAM • NURSE'S BELIEF OF NUTRITION IS NON NURSE RESPONSIBILITY	•LACK OF KNOWLEDGE ON PROPER DIET FOR NUTRITIONAL DEFICIENCIES THERAPY •POOR KNOWLEDGE ON PATHOPHYSIOLOGY OF DISEASE

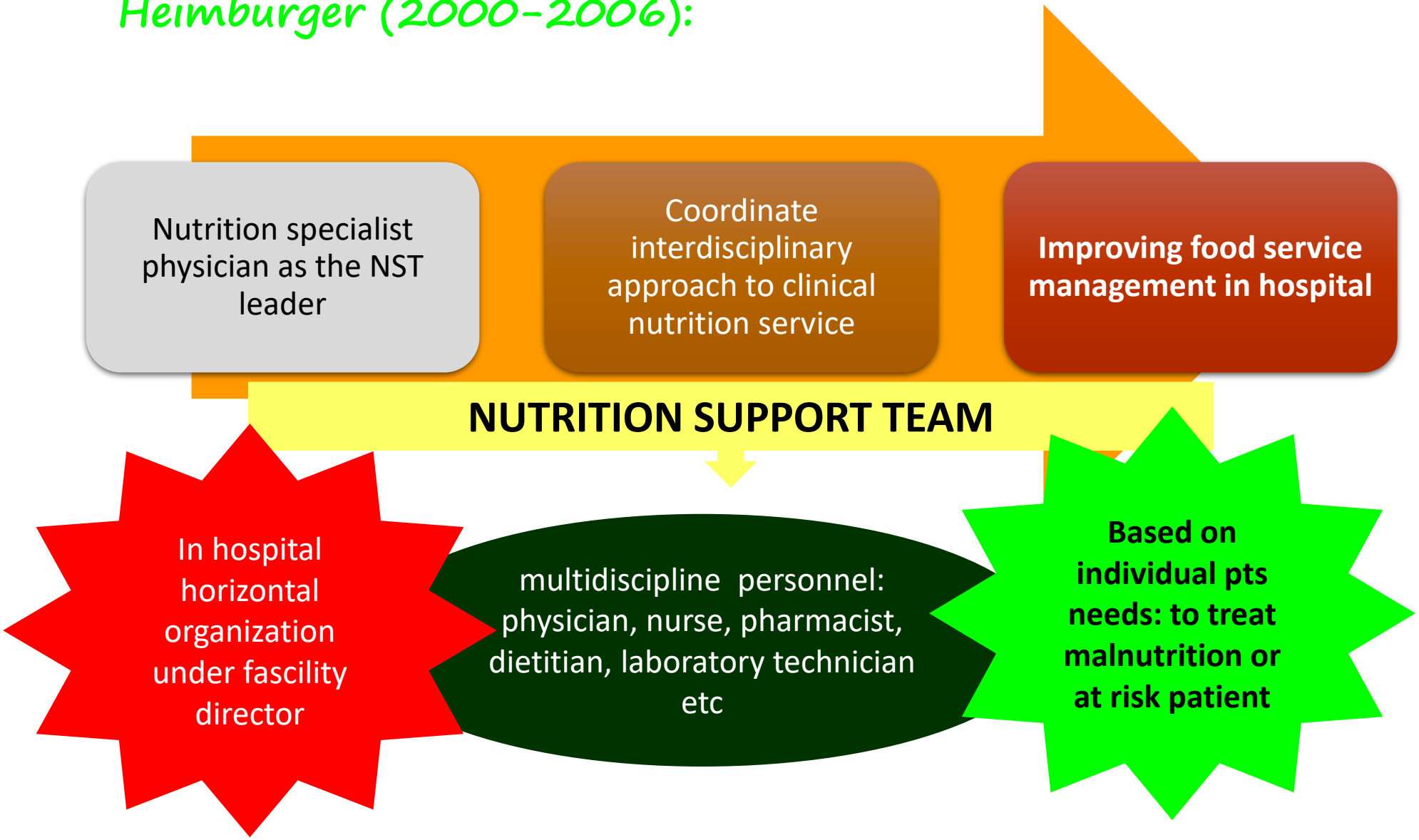
The 11th PENSA , 2006;

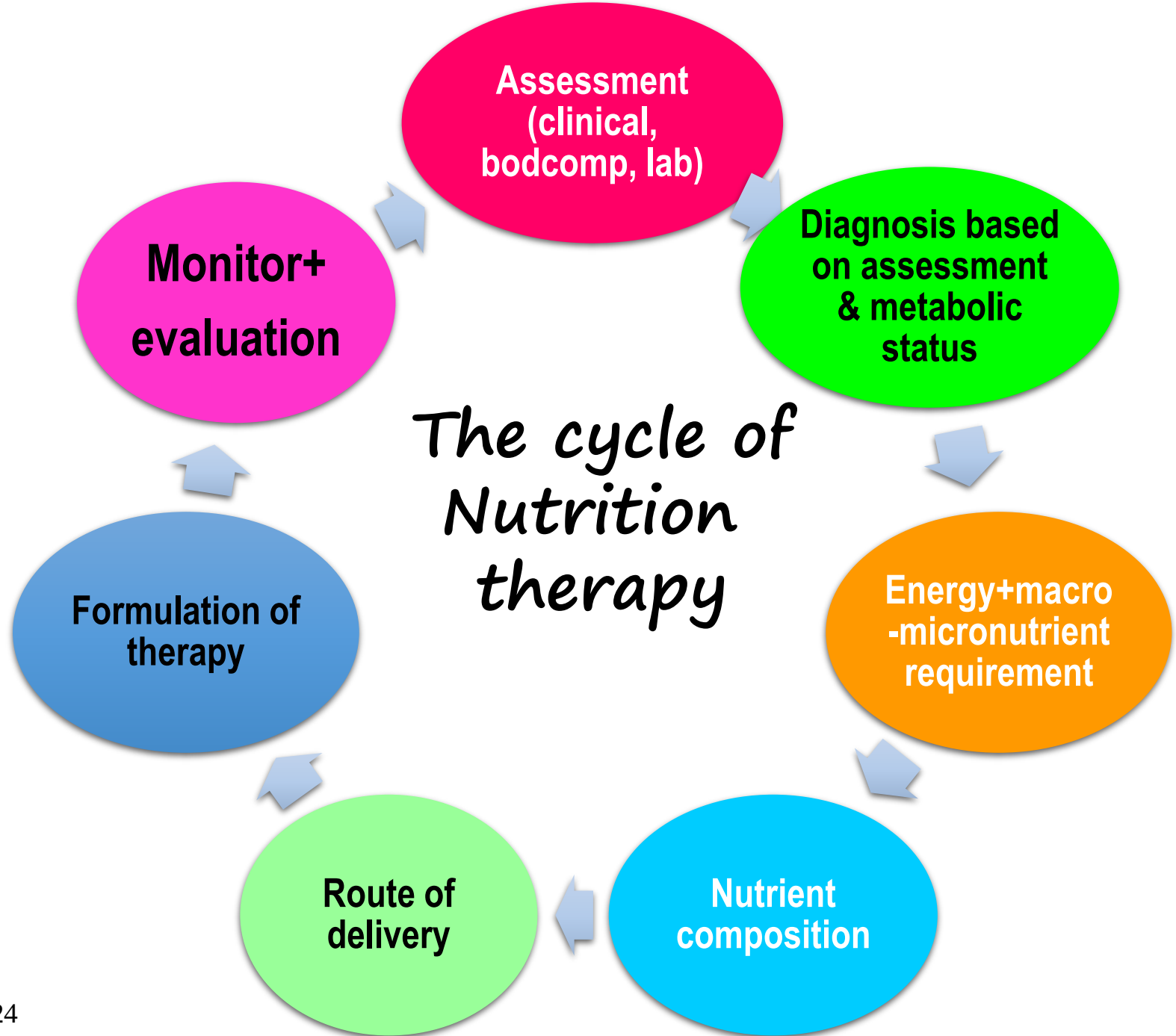
Characteristic of nutrition therapy



Evidenced based solutions

Heimburger (2000-2006):

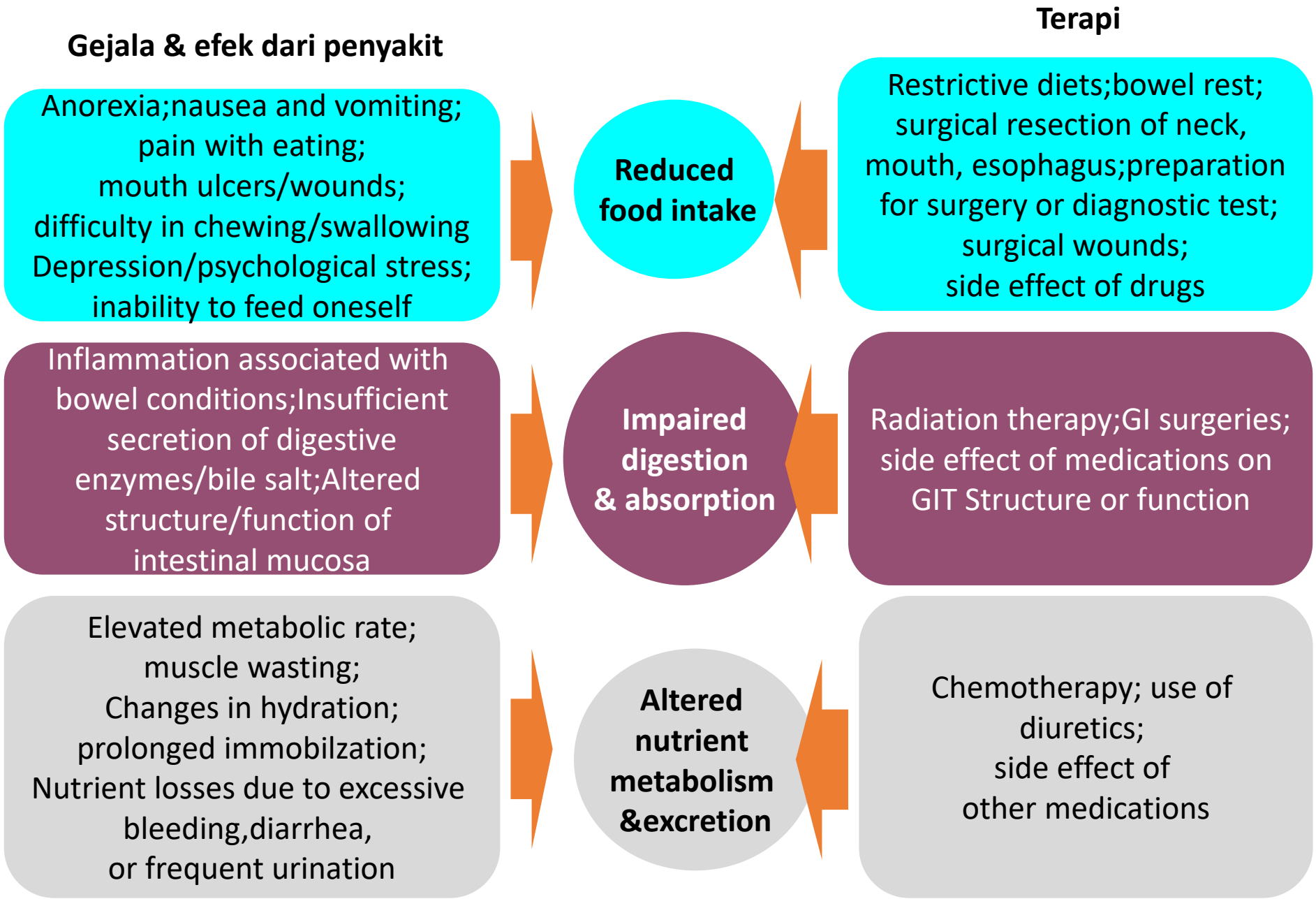



Assessment (clinical, bodcomp, lab)
Diagnosis based on assessment & metabolic status
Energy+macro -micronutrient requirement
Nutrient composition
Route of delivery
Formulation of therapy
Monitor+ evaluation
The cycle of Nutrition therapy

Pengaruh penyakit terhadap status gizi

Gejala dari suatu penyakit dan terapi yang diberikan dapat menyebabkan malnutrisi melalui ***menurunnya asupan makanan, gangguan pada proses digesti dan absorpsi atau berubahnya metabolisme zat gizi dan proses ekskresinya.***

Alur pengaruh penyakit terhadap status gizi



Tim perawatan gizi di rumah sakit

- Dokter
- Registered dietitians/dokter ahli gizi
- Registered dietetic technicians/D3 gizi
- Perawat
- Tenaga kesehatan lainnya

Skrining status gizi

- Suatu cara yang digunakan untuk menentukan apakah seorang pasien memiliki resiko mengalami malnutrisi selama perawatan

- Informasi yang digunakan mencakup:

  - Diagnosis
  - Medical record
  - Pemeriksaan fisik dan lab
  - Jawaban pasien atau pengasuh/penjaga pada kuesioner

subjective global assessment

✖Berguna untuk memprediksi status gizi dari pasien akut yang sedang dirawat

Element SGA:

- Riwayat medis dan diet
  - ✚Perubahan BB dalam 6 bln terakhir
  - ✚Perubahan asupan makanan dan lamanya perubahan
  - ✚Komposisi diet saat ini: suboptimal, rendah kalori, cair
  - ✚Gejala GI: mual, muntah, diare atau anoreksia
  - ✚Kemampuan fungsional
  - ✚Diagnosis medis sekarang
  - ✚Derajat stress metabolik: rendah, sedang, berat

Element SGA lanj...

- Pemeriksaan fisik
  - ✚Hilangnya lemak subkutan: di trisep atau dada
  - ✚Muscle wasting: di quadriceps atau deltoid
  - ✚Edema pergelangan kaki
  - ✚Edema sacral
  - ✚Ascites

Tingkatan SGA

- ✖Gizi baik bila ada penambahan BB, kehilangan lemak atau otot ringan, perbaikan gejala
- ✖Malnutrisi sedang bila > 5% kehilangan BB (bukan dari perubahan hidrasi), menurunnya asupan makanan, wasting ringan
- ✖Malnutrisi berat bila kehilangan BB > 10% (bukan dari perubahan hidrasi), wasting berat, edema

SKRINING:
SIMPLE, MUDAH, DAN AKURAT!

Have you lost weight recently without trying?		
No	0	
Unsure	2	
If yes, how much weight (kg) have you lost?		
1-5	1	
6-10	2	
11-15	3	
16-20	4	
Unsure	2	
Have you been eating poorly because of decreased appetite?		
No	0	
Yes	1	
	Total	..

Score of 2 or more = patient at risk of malnutrition

Figure 1 Malnutrition Screening Tool.[33]

Did you lose weight unintentionally?	
• More than 6 kg in the last 6 months	3
• More than 3 kg in the last month	2
Did you experience a decreased appetite over the last month?	1
Did you use supplemental drinks or tube feeding over the last month?	1

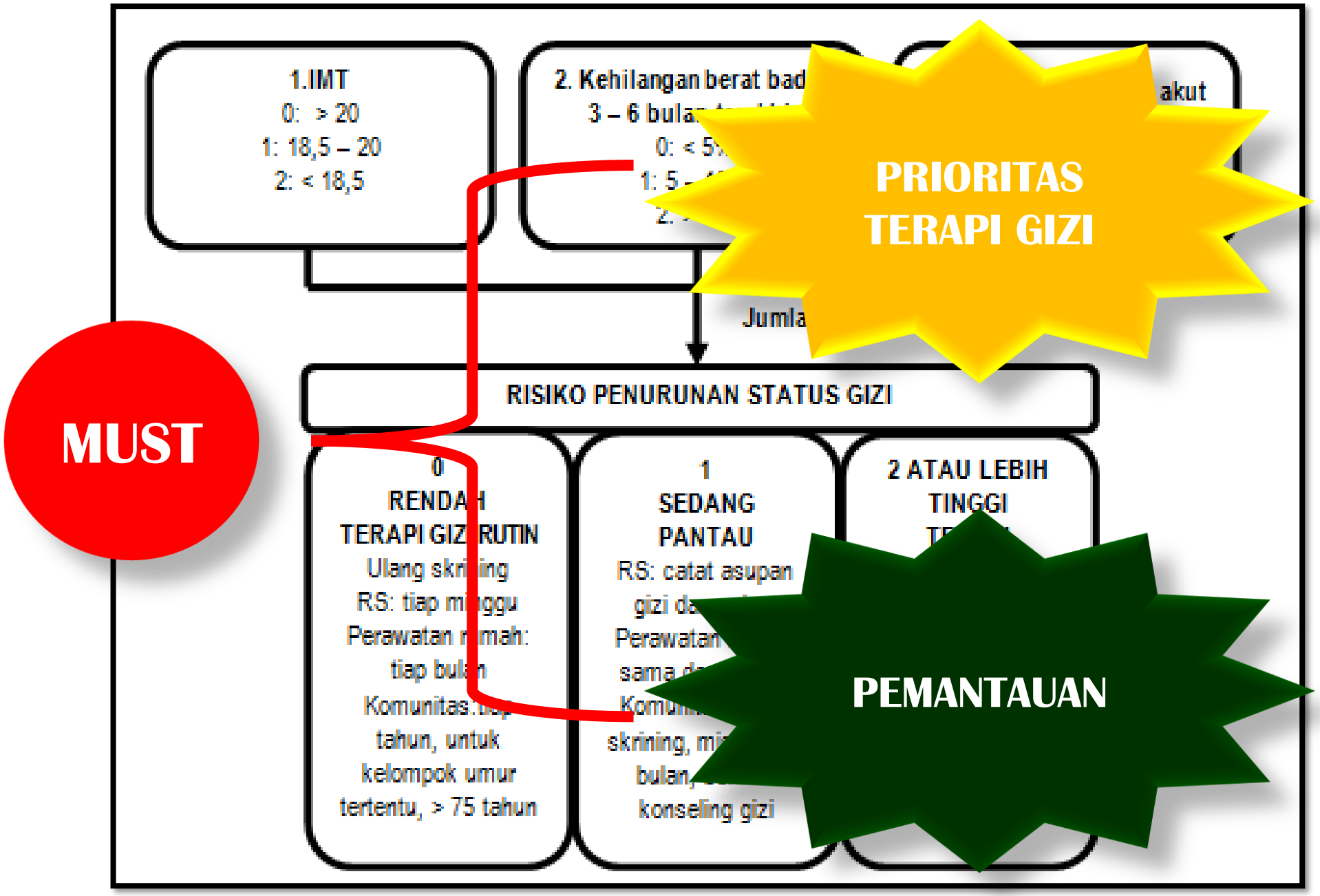
0 or 1 point	well nourished
2 points	moderately malnourished
3 points or more	severely malnourished

Figure 2 Short Nutritional Assessment Questionnaire.[32]

MST

SNAQ

High applicability and clinically relevant sensitivity and specificity


1.IMT
0: > 20
1: 18,5 – 20
2: < 18,5
2. Kehilangan berat bad
3 – 6 bula
0: < 5
1: 5 –
2:
akut
Jumla
RISIKO PENURUNAN STATUS GIZI
0
RENDAH
TERAPI GIZ RUTIN
Ulang skri ing
RS: tiap mi ggu
Perawatan r mah:
tiap bula
Komunitas:
tahun, untuk
kelompok umur
tertentu, > 75 tahun
1
SEDANG
PANTAU
RS: catat asupan
gizi da
Perawatan
sama d
Komu
skrining, mi
bulan,
konseling gizi
2 ATAU LEBIH
TINGGI
T
MUST
PRIORITAS
TERAPI GIZI
PEMANTAUAN

Nutritional Risk Screening (NRS 2002)

Table 1 Initial screening			
1	Is BMI < 20.5?	Yes	No
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill ? (e.g. in intensive therapy)		
Yes: If the answer is 'Yes' to any question, the screening in Table 2 is performed. No: If the answer is 'No' to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.			

Table 2 Final screening			
Impaired nutritional status		**Severity of disease (↑ Increase in requirements)**	
Absent **Score 0**	Normal nutritional status	Absent **Score 0**	Normal nutritional requirements
Mild Score 1	Wt loss >5% in 3 mths or Food intake below 50-75% of normal requirement in preceding week	**Mild Score 1**	Hip fracture*. Chronic patients, in particular with acute complications: cirrhosis*, COPD*. *Chronic hemodialysis, diabetes, oncology*
Moderate Score 2	Wt loss >5% in 2 mths or BMI 18.5–20.5 + Impaired general condition or Food intake 25-60% of normal requirement in preceding week	**Moderate Score 2**	Major abdominal surgery* Stroke* *Severe pneumonia, hematologic malignancy*
Severe Score 3	Wt loss >5% in 1 mth (> 15% in 3 mths) or BMI <18.5 + Impaired general condition or Food intake 0-25% of normal requirement in preceding week in preceding week.	**Severe Score 3**	Head injury* Bone marrow transplantation* *Intensive care patients (APACHE> 10).*
Score:	+	**Score:**	**=Total score**
Age	If ≥70 years: add 1 to total score above	**=age-adjusted total score**	
Score ≥3: the patient is nutritionally at-risk and a nutritional care plan is initiated Score <3: weekly re-screening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.			

NRS-2002 is based on an incorporation of available randomized clinical trials.

*Indicates that a trial directly supports the categorization of patients with that diagnosis. Diagnoses shown in *italics* are based on the prototypes given below.

Nutritional risk is defined by the present **nutritional status** and risk of impairment of present status, due to **increased requirements** caused by stress metabolism of the clinical condition.

A nutritional care plan is indicated in all patients who are

(1) severely undernourished (score = 3), or (2) severely ill (score = 3), or (3) moderately undernourished + mildly ill (score 2 + 1), or (4) mildly undernourished + moderately ill (score 1 + 2).

Prototypes for severity of disease

Score = 1: a patient with chronic disease, admitted to hospital due to complications. The patient is weak but out of bed regularly. Protein requirement is increased, but can be covered by oral diet or supplements in most cases.

Score = 2: a patient confined to bed due to illness, e.g. following major abdominal surgery. Protein requirement is substantially increased, but can be covered, although artificial feeding is required in many cases.

Score = 3: a patient in intensive care with assisted ventilation etc. Protein requirement is increased and cannot be covered even by artificial feeding. Protein breakdown and nitrogen loss can be significantly attenuated.

Initial Screening in Mini Nutritional Assessment (MNA®) for the elderly

A	**Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?** 0 = severe loss of appetite 1 = moderate loss of appetite 2 = no loss of appetite	
B	**Weight loss during last months?** 0 = weight loss greater than 3 kg 1 = does not know 2 = weight loss between 1 and 3 kg 3 = no weight loss	
C	**Mobility?** 0 = bed or chair bound 1 = able to get out of bed/chair but does not go out 2 = goes out	
D	**Has suffered physical stress or acute disease in the past 3 months?** 0 = yes 2 = no	
E	**Neuropsychological problems?** 0 = severe dementia or depression 1 = mild dementia 2 = no psychological problems	
F	**Body Mass Index (BMI) [weight in kg]/[height in m]2** 0 = BMI less than 19 1 = BMI 19 to less than 21 2 = BMI 21 to less than 23 3 = BMI 23 or greater	
Screening score (total max. 14 points)		
12 11	points or greater points or below	Normal—not at risk → no need to complement assessment Possible malnutrition → continue assessment

Form SGA

MEDICAL HISTORY

	SGA Rating		
	A	B	C
1. **Weight Change** Clothing Size _____ No Change _____ Change Overall loss in past month: _____ _____ 6 months _____ 1 year			
% Loss of usual weight _____ < 5% _____ 5-10% _____ > 10%			
Change in past 2 weeks _____ Increase (*gain*) _____ No change (*stabilization*) _____ Decrease (*continued loss*)			
2. **Dietary Intake** Reduction _____ Unintentional _____ Intentional Overall Change _____ No Change _____ Change Increase or Decrease			
Duration _____ Weeks _____ Months			
Diet Change _____ Suboptimal solids (i.e., 75%, 50%, 25% intake) _____ Full liquid diet _____ Hypocaloric fluids _____ NPO (*starvation*)			
3. **Gastrointestinal Symptoms** (*persisting daily for > 2 weeks)* _____ None _____ Diarrhea _____ Dysphagia/Odynaphagia _____ Nausea _____ Vomiting _____ Anorexia			
4. **Functional Impairment** Overall impairment _____ None _____ Mild _____ Severe			
Duration _____ Days _____ Weeks _____ Months			
Type _____ Ambulatory (Walking or Wheelchair) Bedridden			

PHYSICAL EXAMINATION

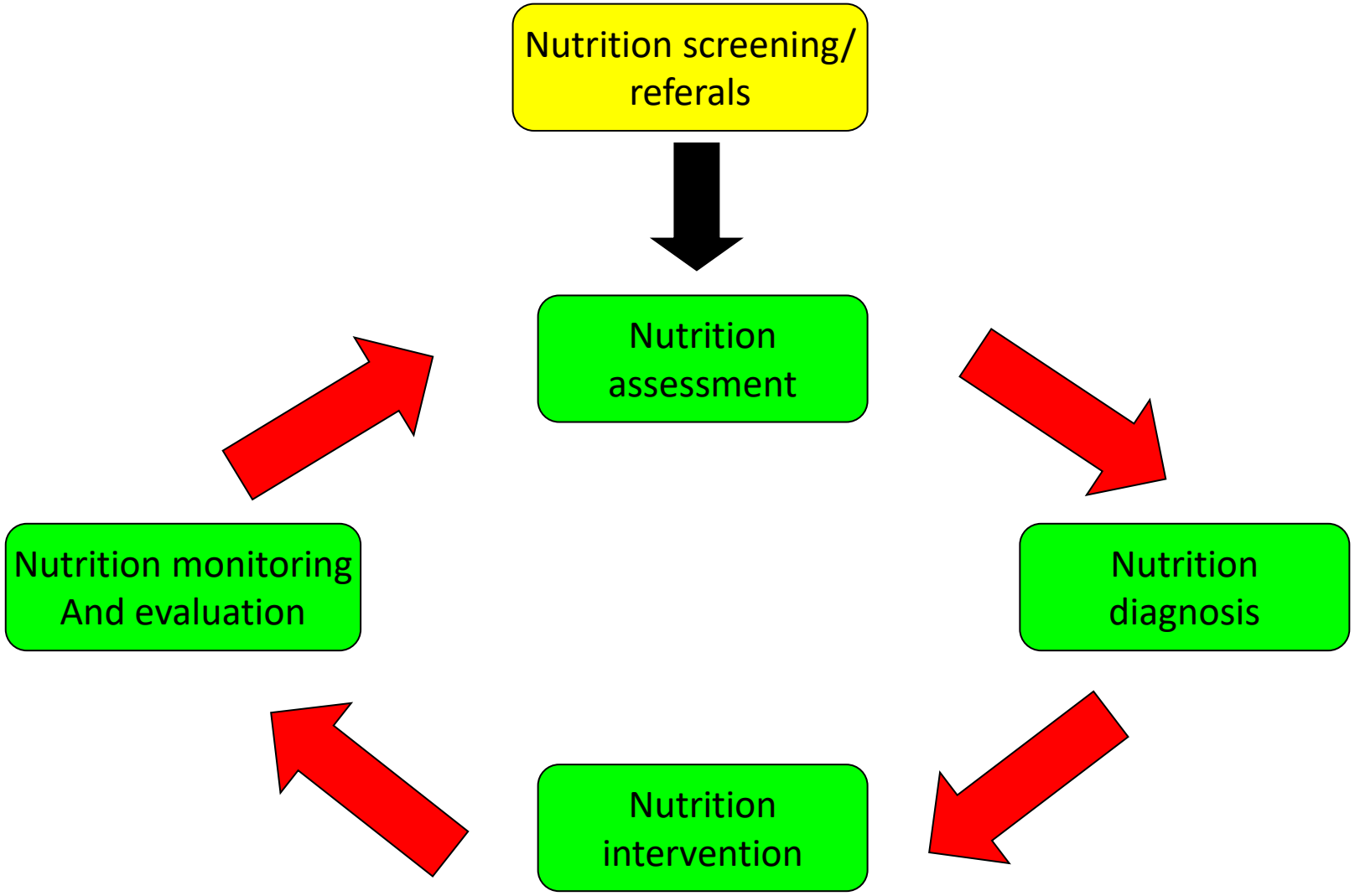
	SGA Rating		
	Well (A)	Mild/Mod (B)	Severe (C)
5. **Muscle Wasting** _____ Bicep _____ Tricep _____ Quadricep _____ Deltoid _____ Temple			
6. **Subcutaneous Fat Loss** _____ Tricep _____ Chest _____ Eyes _____ Perioral _____ Interosseous _____ Palmar			
7. **Edema** _____ Hands _____ Sacral _____ Lower extremity			

(A) Well Nourished ____ (B) Mild/Moderate Undernutrition ____ (C) Severe Undernutrition ____

Kriteria untuk mengidentifikasi resiko malnutrisi

- Usia,diagnosis medis, beratnya penyakit
- TB,BB,IMT,perubahan BB saat ini
- Hasil lab yang menunjukkan buruknya status kesehatan
- Masalah atau gejala yang menyebabkan kesulitan makan
- Alergi makanan/intoleransi/batasan thd makanan tertentu yang ketat
- Anemia, tissue wasting, luka akibat tekanan
- Riwayat diabetes, penyakit ginjal, atau penyakit kronis lainnya
- Penggunaan obat-obatan yang dapat memperburuk status gizi
- Depresi atau isolasi sosial

Proses perawatan gizi



Nutrition assessment

Memberikan informasi yang dibutuhkan untuk mengidentifikasi masalah dan merencanakan rencana perawatan gizi; follow up assessment untuk menentukan apakah rencana perawatan telah efektif.

Jenis informasi yang dikumpulkan dalam nutrition assessment

- Historical information
  - Riwayat medis
  - Riwayat sosial
  - Riwayat diet
- Data asupan makanan
- Data antropometri
- Analisis biokimia
- Pemeriksaan fisik

Historical information

Riwayat medis	Riwayat sosial	Riwayat diet
Keluhan saat ini Riwayat penyakit terdahulu Riwayat penyakit keluarga Riwayat operasi Riwayat pengobatan Alergi Penggunaan suplement diet/herbal	Status sosioekonomi Identitas budaya/etnis Tingkat pendidikan Keadaan lingkungan tempat tinggal Rokok/narkoba Peralatan masak Lokasi tempat tinggal dan pasar	Kebiasaan makan Pantangan BB biasanya alergi./intoleransi makanan Konsumsi alkohol Kemampuan mengunyah/menelan Bantuan untuk makan

Masalah medis yang seringkali berhubungan dengan malnutrition

- AIDS
- Penyakit hati akibat konsumsi alkohol
- Anorexia nervosa
- Pneumonia aspirasi
- Bulimia
- Luka bakar
- Kanker dan terapinya
- Penyakit celiac
- Dehidrasi
- Diabetes yang baru didiagnosis/tidak terkontrol
- Gestasional diabetes
- Trauma kepala
- Hipoglikemia
- Penyakit radang usus
- Fraktur rahang
- Trauma multipel
- Penyakit hati, ensefalopati hepatik
- Hipertensi kehamilan
- Penyakit ginjal stadium akhir
- Ulkus kulit
- Kesulitan menelan
- Muntah yang berlebihan

Data asupan makanan

Metode pengumpulan data

- 24-hour recall
- Food frequency questionnaire
- Food record
- Observasi langsung

Data antropometri

- Data yang dikumpulkan:
  - TB
  - BB
  - TLK (tebal lipatan kulit)
  - LLA (lingkar lengan atas)
- Penilaian status gizi:
  - IMT (indeks massa tubuh)
  - BBI → indeks brocca { (TB – 100) – 10%(TB – 100)}

Analisis biokimia (lab)

- Disesuaikan dengan diagnosis penyakit yang diderita → utamanya utuk melihat status protein dan energi, vitamin dan mineral, keseimbangan cairan dan elektrolit, serta fungsi organ.

- Kebanyakan test berdasarkan analisa darah dan urin yang mengandung protein, nutrient dan metabolit yang menggambarkan status gizi dan kesehatan

Beberapa indikator penting dalam penilaian status gizi

- Plasma protein

  untuk menilai status protein → PEM / penyakit hepar
- Albumin

  plasma protein terbanyak dalam tubuh dan paling sering dinilai selama sakit
- Transferin

  bermanfaat untuk transport besi → PEM dan status zat besi dalam darah
- Prealbumin dan Retinol-Binding Protein

  menurun selama PEM dan berespons cepat bila ada perbaikan intake protein.

Pemeriksaan fisik: beberapa gejala klinis yang berhubungan dengan defisiensi nutrient

sistem	normal	Gejala malnutrisi
rambut	Berkilau, kuat	Kusam, kering, rontok, rambut tembaga
mata	Cerah, bening, berespon cepat dengan cahaya, konjungtiva merah muda	Pucat, ada bercak putih, kering, rabun senja, kemerahan pada susut mata
bibir	Licin, mulus, lembab	Kering, pecah-pecah, luka pada sudut bibir
Mulut dan gusi	Lidah kemerahan tidak bengkak, dapat merasa dgn baik, tdk karies gigi, gusi tdk berdarah dan bengkak	Lidah magenta yang mulus, menurunnya kemampuan merasa, bengkak
kulit	Mulus, kencang, berwarna baik	Luka sulit sembuh, kering, kasar, kurang lemak bawah kulit, perdarahan bawah kulit
kuku	Mulus, kencang, pink	Bergerigi, kuku sendok, oucat
lainnya	-	Dementia, neuropati perifer, gondok

Diagnosis gizi

- Setiap masalah gizi ditulis dalam diagnosis terpisah mencakup masalah gizi spesifik, etiologi, gejala dan tanda.

- Contoh diagnosis gizi:

  kehilangan BB (*problem*) yang berhubungan dengan kurangnya asupan kalori (*etiologi*) yang ditunjukkan dengan kehilangan BB 5 kg dalam beberapa bulan (*gejala dan tanda*)

- Diagnosis gizi dapat berubah sesuai dengan perjalanan penyakit

Intervensi gizi

- Intervensi dapat berupa perubahan diet, pendidikan gizi atau perubahan pengobatan.

- Bergantung pada kebiasaan makan pasien, gaya hidup dan faktor personal lainnya.

Terapi diet

- Bergantung pada diagnosis gizi yang dibuat

- Contoh:
  - Diet tinggi kalori tinggi protein → PEM
  - Diet rendah garam → hipertensi, udem
  - Diet rendah lemak → dislipidemia, penyakit hati
  - Diet rendah purin → Gout, penyakit ginjal
  - Diet rendah kalori → DM, obesitas

Modifikasi diet (1)

Jenis diet	Definisi	Indikasi
Cair		
Cair jernih	Makanan cair jernih dengan suhu ruang yang kandungan residunya minimal serta tembus pandang bila diletakkan dalam wadah bening	Sebelum/sesudah operasi, mual muntah, tahap awal pada penderita perdarahan usus. Contoh: air kaldu, air jeruk, teh manis
Cair penuh	Makanan bentuk cair atau semicair dengan kandungan serat minimal yang tidak tembus pandang	Perpindahan dari cair jerih. Contoh: makanan mengandung susu, makanan blender, formula komersial (entrasol)
Cair kental	Konsistensi kental/semipadat pada suhu kamar, tdk perlu dikunyah	Pasien yang tidak mampu mengunyah dan menelan, mencegah aspirasi. Contoh: sup krim jagung, kentang pure, milk shake

Modifikasi diet (2)

Jenis diet	Definisi	Indikasi
Saring	Makanan semipadat dengan tekstur lebih halus dari makanan lunak (biasanya diblender) sehingga mudah ditelan dan dicerna	Setelah operasi tertentu, infeksi akut, infeksi saluran cerna, kesulitan mengunyah, perpindahan dari makanan cair kental → makanan lunak
Lunak	Makanan yang bertektur lebih mudah dikunyah, ditelan, dan dicerna dibandingkan makanan biasa. Zat gizi cukup asalkan pasien dapat makan dalam jumlah cukup	Pasien sesudah operasi tertentu, pasien dengan kenaikan suhu tidak terlalu tinggi, pasien dengan kesulitan mengunyah dan menelan, perpindahan dari makanan saring ke makanan biasa
Biasa	Makanan dengan tekstur yang sama dengan makanan sehari-hari sesuai pola menu seimbang dan AKG	Pasien tanpa diet khusus

Alternative feeding routes

- Pemberian makanan selalu mengutamakan jalur fisiologis, yaitu via oral. Bila tidak memungkinkan barulah memikirkan jalur alternatif lain

- Tube feeding: formula lengkap gizi yang diberikan melalui pipa yang dipasang langsung ke lambung/usus (nasogastric tube = NGT). Dipilih bila GIT berfungsi.

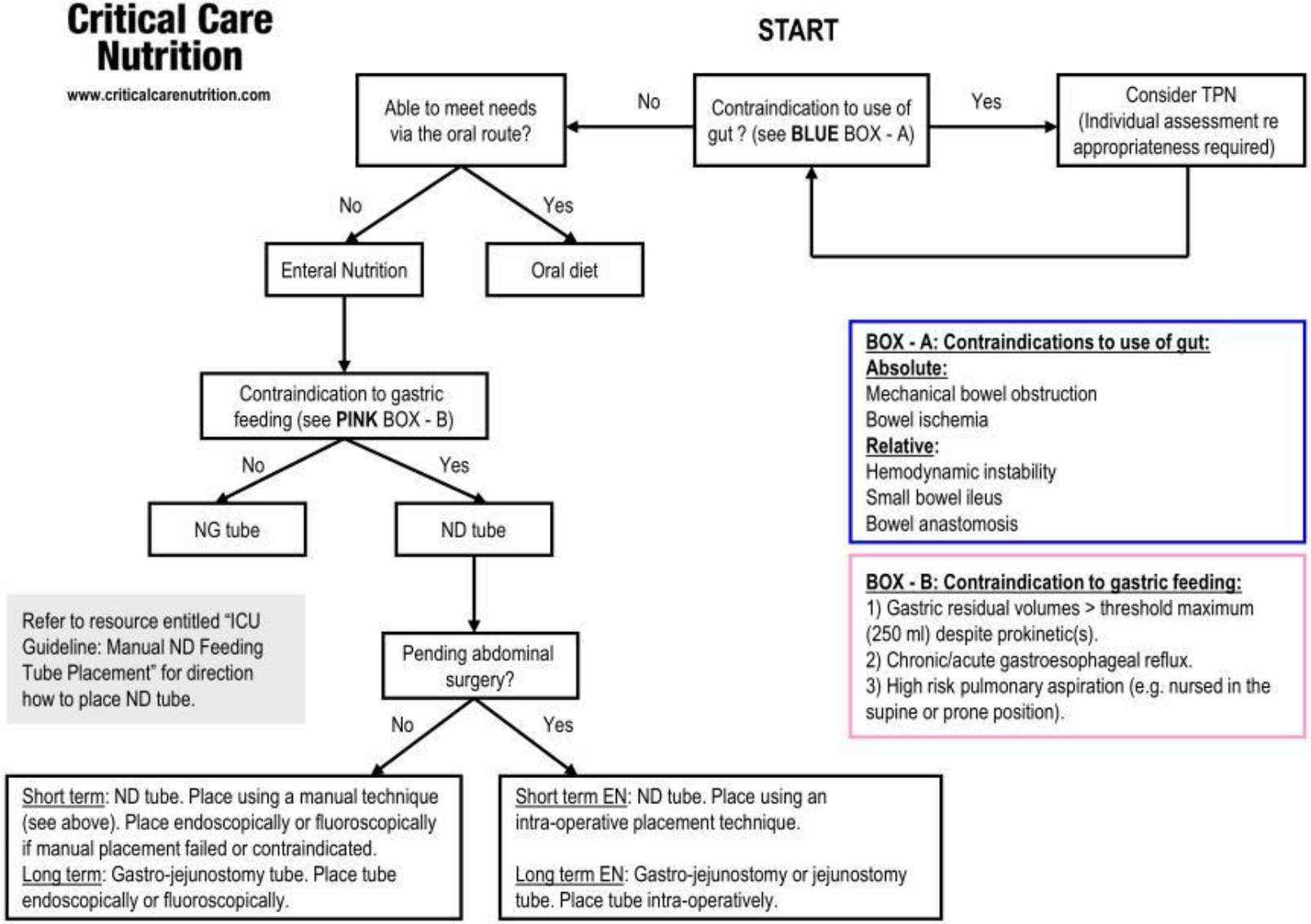
- Intravenous feeding: beberapa kondisi yang melarang pasien menerima NGT untuk mendapat zat gizi. Bila pasien malnutrisi dan GIT tak dapat digunakan dalam waktu yang lama.

BAGAIMANA MEMUTUSKAN JALUR NUTRISI YANG AKAN DIGUNAKAN?

Critical Care Nutrition

www.criticalcarenutrition.com

ICU GUIDELINE: ROUTES OF NUTRITION SUPPORT



BOX - A: Contraindications to use of gut:

Absolute:
Mechanical bowel obstruction
Bowel ischemia

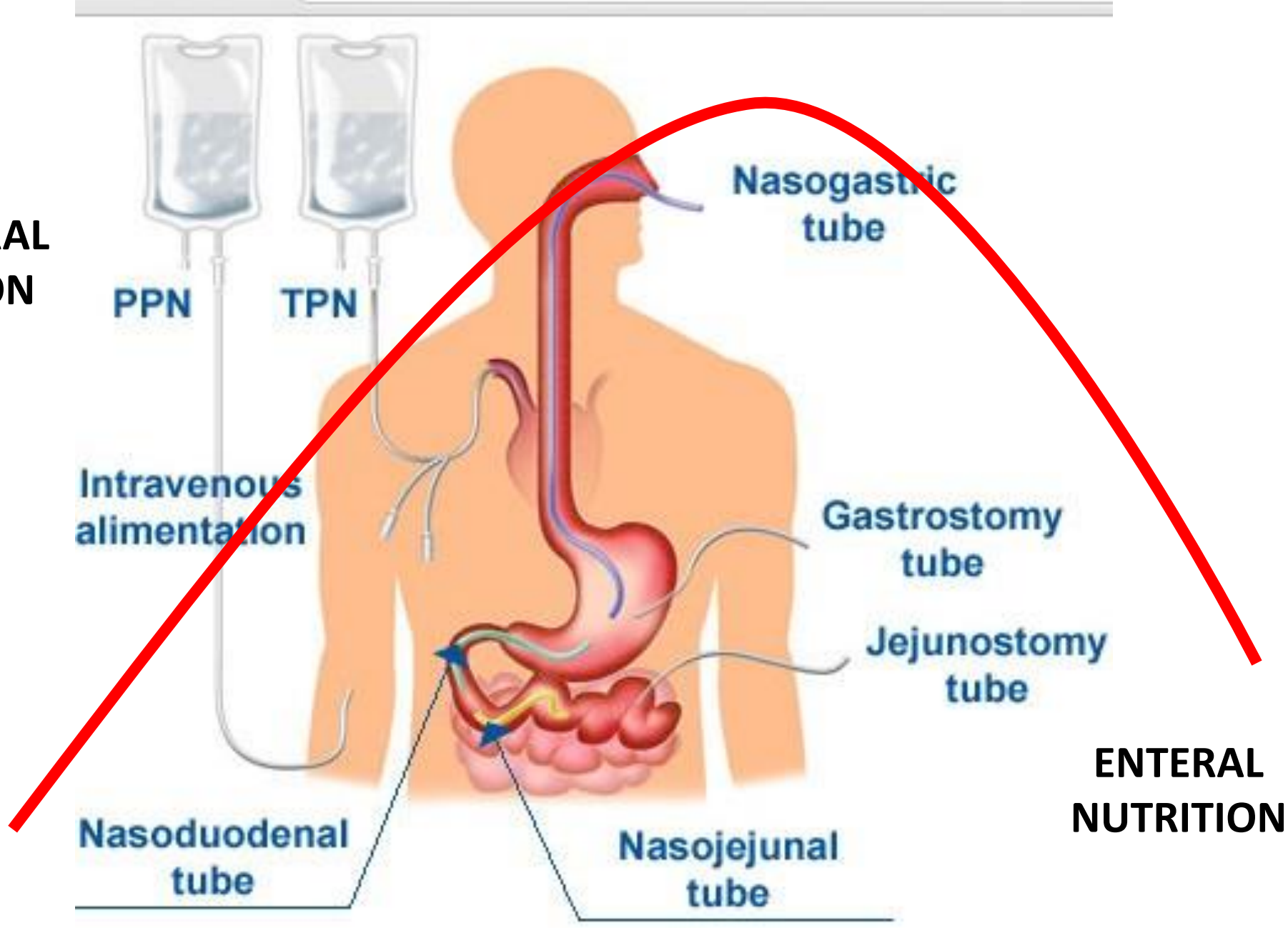
Relative:
Hemodynamic instability
Small bowel ileus
Bowel anastomosis

BOX - B: Contraindication to gastric feeding:

1) Gastric residual volumes > threshold maximum (250 ml) despite prokinetic(s).
2) Chronic/acute gastroesophageal reflux.
3) High risk pulmonary aspiration (e.g. nursed in the supine or prone position).

Developed by: J. Greenwood, RD. Critical Care Program – Vancouver Coastal Health Authority (Update 7/4/2010). Used with permission.

PARENTERAL NUTRITION



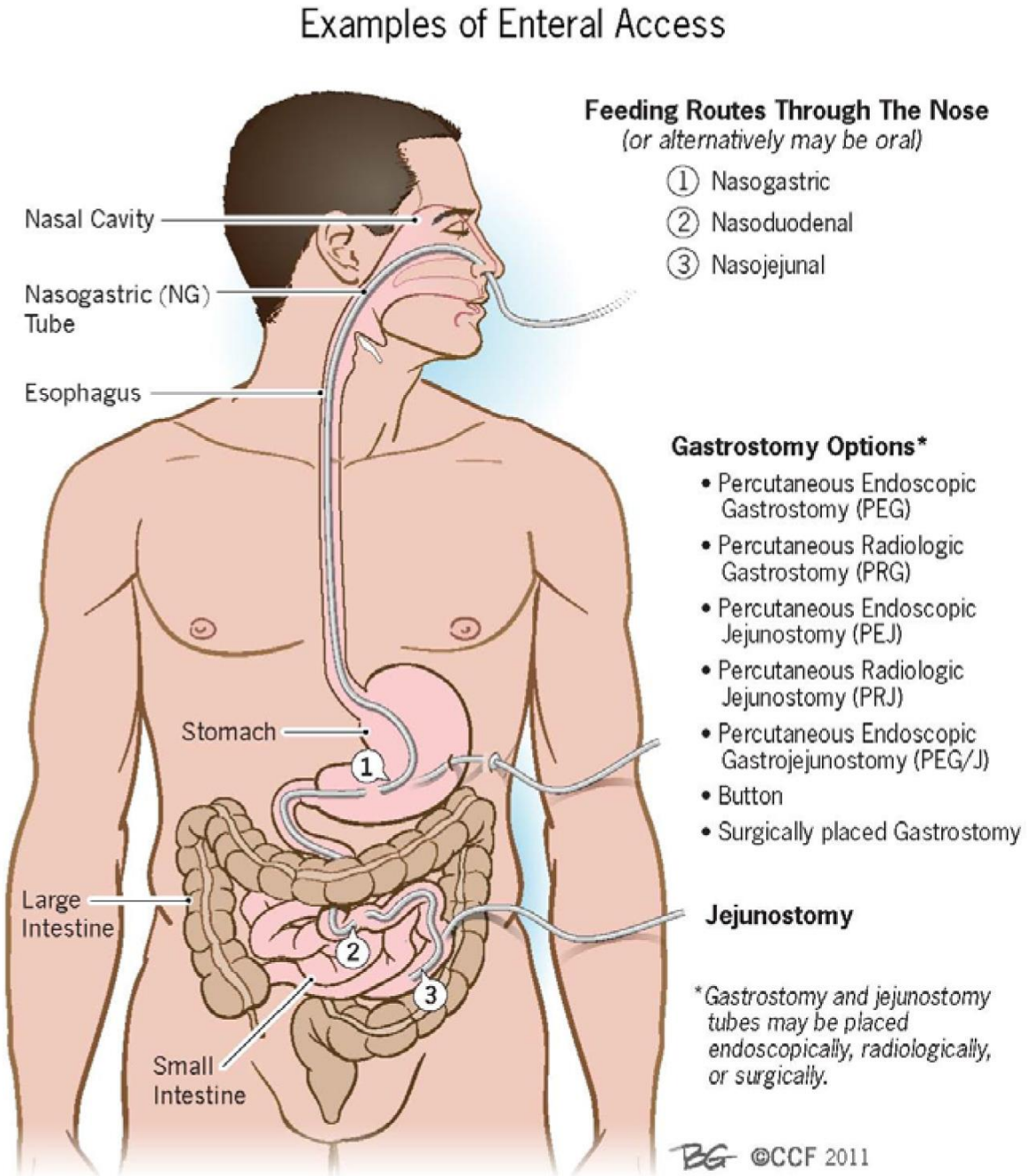
ENTERAL NUTRITION

ENTERAL FEEDING

HAL-HAL YANG DIPERTIMBANGKAN DALAM TERAPI GIZI ENTERAL

- KEMAMPU-TERAPAN
- LOKASI TUBE
- SELEKSI FORMULA
- KEBUTUHAN ZAT GIZI/MEDIS
- KECEPATAN PEMBERIAN
- TOLERANSI

LOKASI TUBE


Examples of Enteral Access
Feeding Routes Through The Nose
(or alternatively may be oral)
1 Nasogastric
2 Nasoduodenal
3 Nasojejunal
Nasal Cavity
Nasogastric (NG) Tube
Esophagus
Stomach
Large Intestine
Small Intestine
Gastrostomy Options*
• Percutaneous Endoscopic Gastrostomy (PEG)
• Percutaneous Radiologic Gastrostomy (PRG)
• Percutaneous Endoscopic Jejunostomy (PEJ)
• Percutaneous Radiologic Jejunostomy (PRJ)
• Percutaneous Endoscopic Gastrojejunostomy (PEG/J)
• Button
• Surgically placed Gastrostomy
Jejunostomy
*Gastrostomy and jejunostomy tubes may be placed endoscopically, radiologically, or surgically.
BG ©CCF 2011

Comparing enteral feeding tubes

This table lists types of enteral feeding tubes along with their features.

Tube type	Features
	PREPYLORIC
Nasogastric tube	• Can be placed at bedside by qualified nurse • With weighted tube (Dobhoff), fluoroscopic or radiologic confirmation of placement required before stylet removal • For short-term use (4-6 weeks); longer use poses risk of nasal mucosal damage or sinusitis
Gastrostomy tube	• Inserted surgically • Terminates in stomach • Poses risk of implantation in stomach wall • Allows administration of crushed medications
Percutaneous endoscopic gastrostomy tube	• Inserted endoscopically • Minimally invasive • Allows administration of crushed medications

	Postpyloric
Nasojejunal tube	• Terminates in jejunum • Commonly placed in radiology lab under fluoroscopic guidance; can be placed at bedside with radiographic confirmation • For short-term use (4-6 weeks); poses risk of nasal mucosal damage or sinusitis with longer use
Gastric-jejunal tube	• Terminates in small intestine • Can be used in patients requiring both stomach drainage and intestinal feeding at same time • Poses risk of jejunal extension becoming clogged from inappropriate medication administration or from attempt to rotate tube (as with G tube), causing it to curl back into stomach or protrude out through skin
Percutaneous endoscopic jejunal tube	• Terminates in small intestine • Preferred for patients who need single tube for feeding into small bowel • Required for gastrectomy or esophagectomy patients with gastric pull-up

HAL-HAL YANG DIPERHATIKAN DALAM SELEKSI FORMULA

- STATUS GI
- KARAKTERISTIK FORMULA
- RASIO MAKRONUTRIEN
- KEMAMPUAN DIGESTI+ ABSORBSI
- KEBUTUHAN METABOLIK KHUSUS
- ADANYA KEBUTUHAN ELEKTROLIT/RESTRIKSI CAIRAN
- COST EFFECTIVENES

Selection of Enteral Formula

TYPES OF FORMULA	
Standard Formulas	•For people who can digest and absorb nutrients. •They contain intact protiens or protein Isolates. Carbohydrate sources are modified starch, Glucose polymer etc.
Elemental Formulas	•For patients with compromised digestive and absorptive functions. •Contain protein s or CHO that have been broken partially or fully broken down into fragments for easy digestion. •The formulas are low in fat and may contain MCT.
Specialized formulas	•Also called disease specific formulas are designed to meet the specific nutrient needs of patients with particular Illness.
Modular Formulas	Created from individual macronutrient preparations for patients who require specific nutrient combinations to treat their illness.

Table 1. Summary of Characteristics of Enteral Formulations and Recommendations for Use.

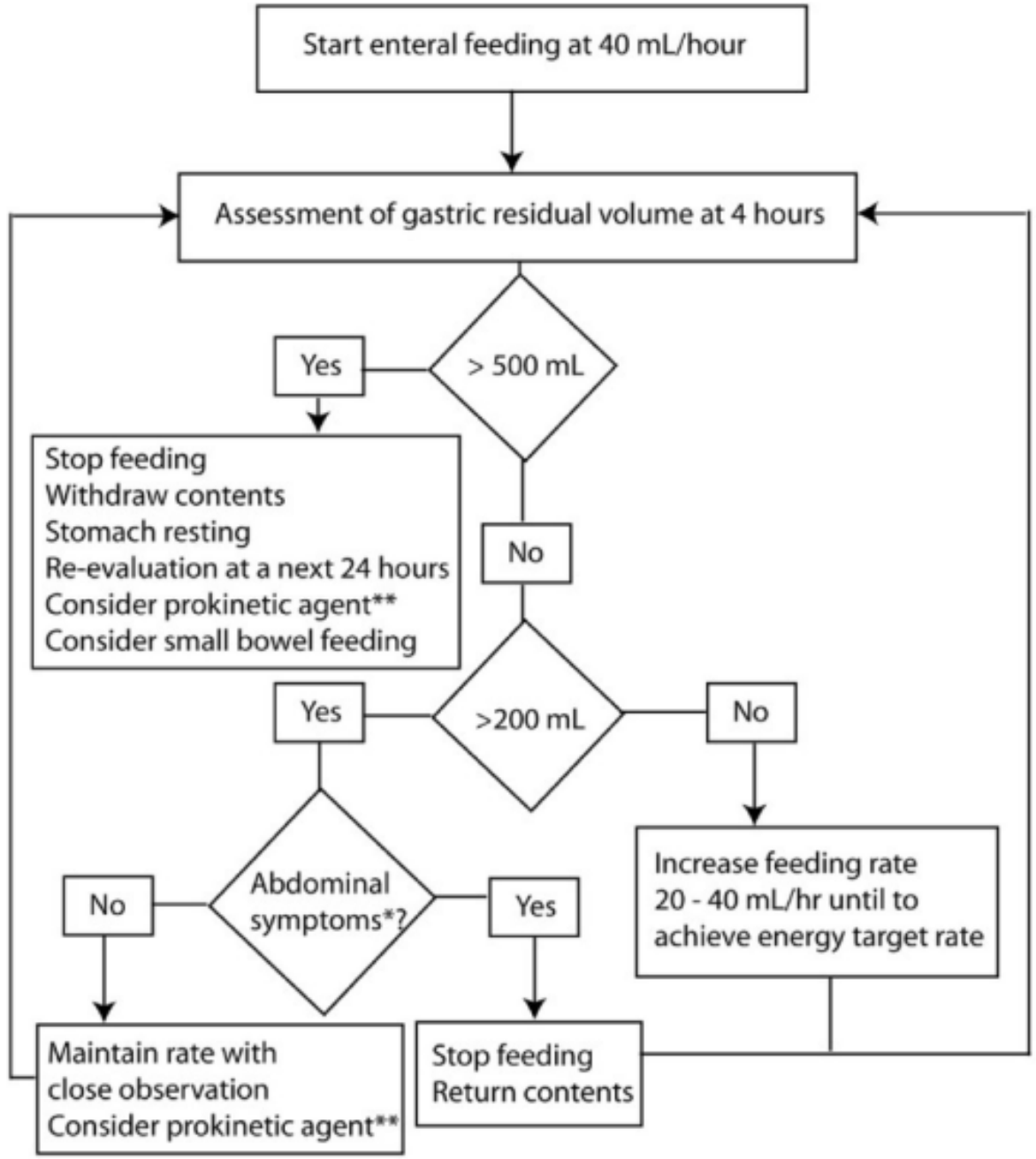
Formula Type	Summary of Characteristics	Recommendations for Use
Polymeric	• Contain macronutrients as nonhydrolyzed protein, fat, and carbohydrate • Range in concentration from 1–2 kcal/mL • 1–1.5 liters usually meets RDA for vitamins and minerals • May be disease specific and/or contain pre- and probiotics	• Intended for use among patients without severe malabsorptive disorders
Fiber containing[5–16]	• Fiber content intended to improve the health of the GI tracts regulating frequency and/or consistency of stool by maintaining healthy GI flora • Fiber content is typically well below total daily fiber recommendations • May contain prebiotics in the form of fructooligosaccharides, oligofructose, or inulin • May also contain probiotics	• Recommended for use among patients with diarrhea and/or to promote/maintain gut microbiota
Whole food/blenderized[17]	• Blenderized whole foods designed to allow patients to receive qualities of food not found in standard enteral formulas, such as phytochemicals	• Only considered for use in medically stable patients with a healed feeding tube site and no signs of infection • Best suited for patients with safe food practices and tube maintenance techniques • Should be provided as bolus feeds to maintain safe food practices (hang time ≤2 hours) • RD should be involved in development of feeding composition to ensure adequate nutrient delivery

Diabetes/glucose intolerance[18–25]	• Intended to reduce hyperglycemia with macronutrient composition of 40% carbohydrate, 40% fat, and 20% protein • Fat and soluble fiber content may slow gastric emptying and prevent elevated blood glucose	• Use of DM-specific enteral formulas is not currently supported by strong research; instead, efforts should be made to prevent overfeeding
Renal[9,26–32]	• Fluid restricted	• Standard enteral formula should be the first line for patients with renal insufficiency
	• Contain lower amounts of electrolytes, specifically potassium and phosphorous to prevent excessive delivery to patients with renal insufficiency	• If significant electrolyte abnormalities exist or develop, a renal formula should be considered until electrolytes stabilize
	• Protein content varies	• Standard, high-protein formulas without fluid restriction should be used among critically ill patients receiving dialysis; if electrolyte abnormalities exist without dialysis, renal formulas should be considered
Hepatic[9,33–39]	• Contain lower protein content with higher percentage of branched-chain amino acids, lower aromatic amino acids to prevent hepatic encephalopathy	• Standard EN formula should be administered as first line among patients with hepatic encephalopathy
	• Low protein content may result in inadequate protein delivery	• Reserve only for use among encephalopathic patients in whom standard therapy with luminal acting antibiotics and lactulose does not improve encephalopathy
	• Fluid and sodium restricted to attenuate effects of ascites	
Bariatric[9,40–49]	• Contain approximately 37% kcal from protein in efforts to maintain positive nitrogen balance, modest carbohydrate content for glucose control, and EPA/DHA in efforts to modulate inflammatory response	• Intended for patients with BMI >30 kg/m^2

Table 1. (continued)

Formula Type	Summary of Characteristics	Recommendations for Use
		• Goal enteral delivery should not exceed 60%–70% of target energy requirements, but provide adequate protein
Elemental/semi-elemental[52–55]	• Macronutrients are hydrolyzed to maximize absorption	• Intended for use among patients with malabsorptive disorders; not intended for routine use
Pulmonary/fish oil[56–73]	• In efforts to reduce carbon dioxide production, these formulas are contain >50% total calories from fat, with lower carbohydrate (<30%) and similar protein content (16%–18%)	• Efforts to prevent excessive EN delivery should be employed to reduce complications associated with overfeeding
	• Typically also contain ω-3 fatty acids derived from fish oil to increase delivery of anti-inflammatory properties of EPA/DHA	• Pulmonary formulas should be used with caution among septic, critically ill patients
Immunonutrition/ immune modulating[66–67,70–71,73–88]	• Contain pharmacologically active substances, such as arginine, glutamine, ω-3 fatty acids, γ-linolenic acid, nucleotides, and/or antioxidants in efforts to modulate immune function	• Administration of immune-modulating substances as components of EN are potentially beneficial when used for patients undergoing elective surgery; however, research is not sufficient to recommend immune-modulating formulas for routine use among critically ill patients

BMI, body mass index; DHA, docosahexaenoic acid; DM, diabetes mellitus; EN, enteral nutrition; EPA, eicosapentaenoic acid; GI, gastrointestinal; RD, registered dietitian; RDA, recommended dietary allowances.



*Abdominal symptoms including abdominal tenderness, distention, nausea, vomiting, or abdominal discomfort
**Prokinetic agent was prohibited during the study period

Monitoring of enteral nutrition

Feed administration	*daily*
Fluid balance	*daily*
Laboratory tests	
Na, K, Glucose	*initially daily*
P, Ca, Urea, Creatinine, ALT, Blood count	*initially twice/week*
Nutritional status	*weekly/every 2nd week*
Weight, albumin, Bioimpedance analysis	
Functional status	*weekly*
Hand grip strength	

Clinical Enteral Feeding Complications

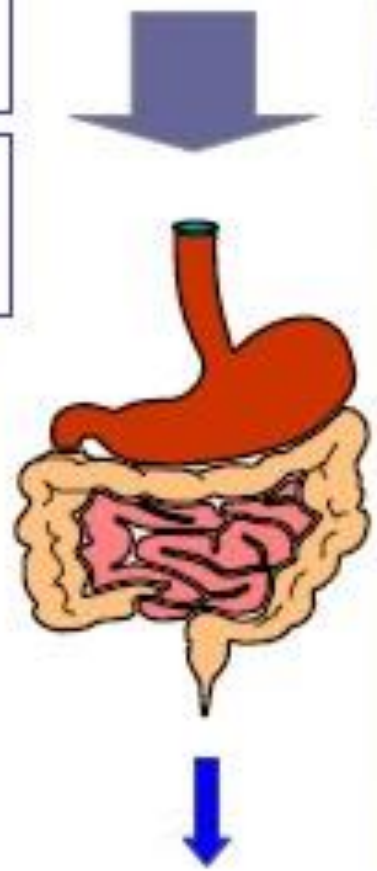
Gastrointestinal
Diarrhea, nausea, vomiting, bloating, abdominal distension

Technical
tube and/or stoma placement and maintenance

Metabolic
fluid, glucose and electrolyte imbalance

Infective
gastroenteritis, septicemia

Psychological
oral aversion, altered body self-image



Formula selection & feeding techniques (modes)

Delivery site & delivery route
stomach vs intestine
tubes
gastro/jejunostomies

Functional & Morphologic state (Disease)
Requirements
Digestion
Absorption
Specific metabolic demands

PARENTERAL NUTRITION

CLINICAL INDICATION OF PARENTERAL NUTRITION: WHENEVER ORAL/ENTERAL ROUTE IS NOT POSSIBLE

Table 1. Examples of clinical conditions requiring PN [4,7,8].

Condition	Mechanism/Indication for PN	Example
Short bowel Intestinal fistula Extensive intestinal mucosal disease	Reduction of absorption capacity Loss of nutrients	Short bowel syndrome, ischemic bowel, complications of colorectal or bariatric surgery, high-output stoma, high-output intestinal fistula Radiation or chemotherapy-related enteritis, mucositis, autoimmune enteropathy, gut graft-versus-host disease
Mechanical bowel obstruction	Blockage of intestinal lumen Recurrent vomiting	Malignant bowel obstruction, intestinal adhesions, stenosis or strictures, inflammatory disease, peritoneal carcinomatosis
Motility disorders	Failure to tolerate adequate oral or enteral intake Recurrent vomiting	Functional gastrointestinal disorders, ileus, scleroderma, acute pancreatitis, post-operatively, gastrointestinal failure associated with critical illness, pseudo-obstruction, adhesive disease
Bowel rest needed	Need to restrict oral or enteral intake	Ischemic bowel, perioperative status, acute pancreatitis, chylous fistula
Other	Failure of oral or enteral nutrition	Unable to achieve or maintain secure oral or enteral access

Parenteral Nutrition

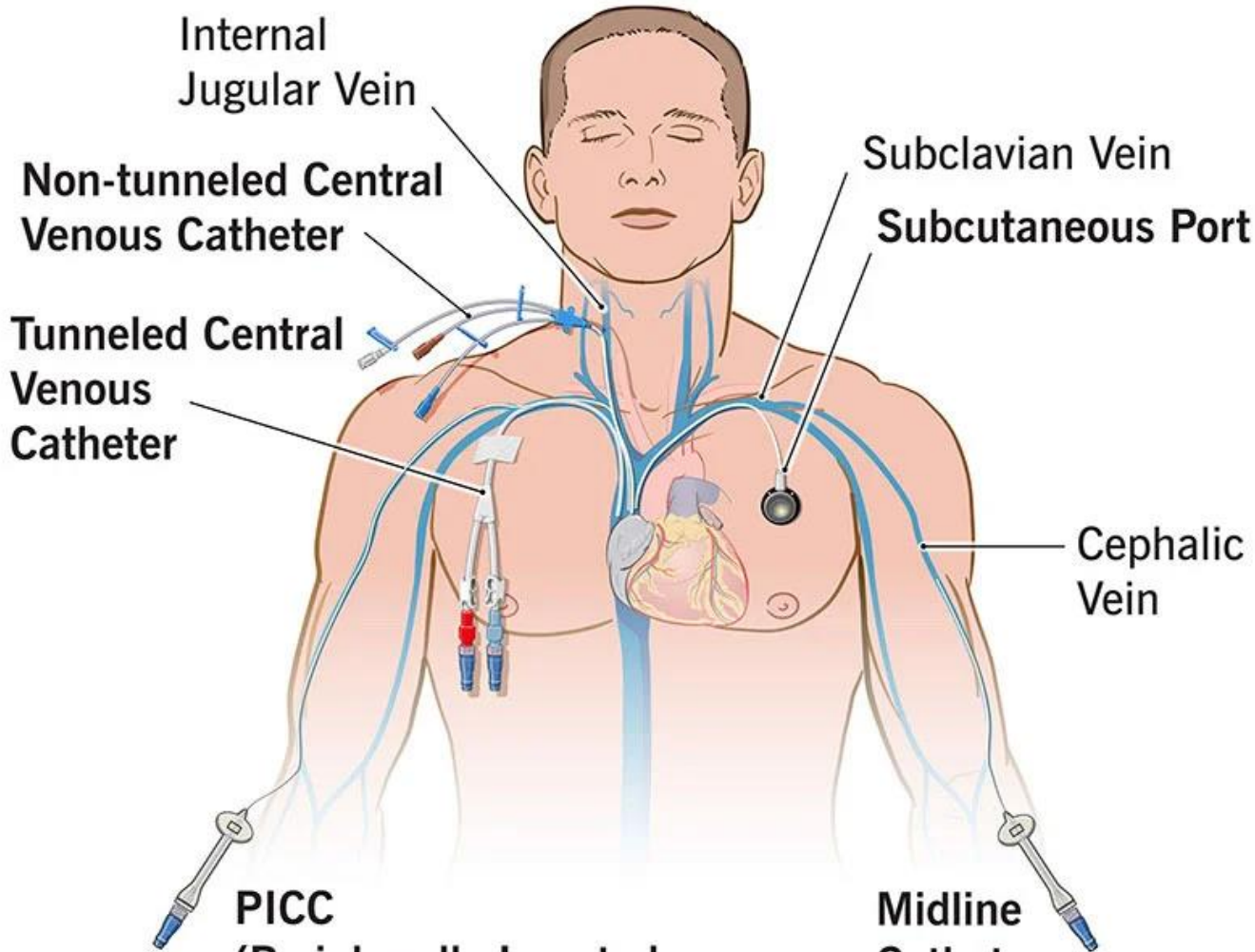


Table 2. Types of VAD used for PN administration [3,8,24,26].

Type of VAD	Placement	Limitations	Advantages
Short peripheral catheter	Percutaneous peripheral insertion.	Infusion < 600 mOsm/L, high risk of phlebitis.	Easy to place, cost, lower infection risk.
Midline	Percutaneous peripheral insertion.	Not appropriate for infusions > 900 mOsm/L (needs central access).	Lasting 2–4 weeks.
PICC	Percutaneous placement via a peripheral vein (basilic, cephalic or brachial vein).	Self-care difficult, uncomfortable for long periods, placement needs trained personnel.	Low risk of placement complications. Used in acute and home care settings. Easy to remove. Lasting weeks to months.
Nontunneled central VAD	Subclavian, jugular or femoral vein.	Operating room or hospital setting for placement.	Long-term usage, easy self-care.
Tunneled central VAD	Subclavian or jugular (Hickman, Broviac, Hohn types).	Hospital setting, small procedure for removal.	Lower risk of infection, position on chest facilitates self-care; lasting months to years (home PN).
Implanted ports	Subclavian or jugular.	Hospital setting, surgical procedure for removal, needle access required.	Associated with lower risk of infection.

Types of parenteral nutrition

Central	Peripheral
• Amino acids (> 5%) • Dextrose (> 20%) • Lipids • Includes vitamins, minerals, and trace elements • Carrier of pharmaconutrients like glutamine or omega-3-fatty acids • Osmolality (> 700 mOsm/kg H_2O) • Volume restriction	• Total kcal limited by concentration and ratio to volume being administered (usually delivers between 1000 to 1500 kcal/day) • The current formulations can now deliver the daily requirements of macro and micronutrients • Osmolality < 700 mOsm/kg • No volume restriction

TABLE 1. MACRONUTRIENTS

Disease/Clinical Condition	Protein/Amino Acids (g/kg/d)	Total Energy (kcal/kg/d)	PN	Component	Fluid (mL/kg/d)
			Dextrose (mg/kg/min)	ILE* (g/kg/d)	
Stable	0.8-1.5	20-30	4-5	1	30-40
Critically ill, trauma, sepsis	1.2-2.5	20-30	<4	<1	Minimal to provide adequate macronutrients
Different Amino Acid Requirements than Above	**Protein Amino Acids (g/kg/d)**	**Total Energy (kcal/kg/d)**			
Traumatic brain injury	1.5-2.5				
Burns	1.5-2				
Open abdomen	Additional 15-30 g/L exudate				
Acute kidney injury	0.8-2.0				
Continuous renal replacement therapy	Additional 0.2 g/kg/d not to exceed 2.5 g/kg/d)				
Chronic kidney failure with maintenance hemodialysis	1.2				
Hepatic failure	1.2-2 (based on "dry" weight and tolerance)				
Obese	2-2.5 (based on IBW)	22-25 (based on IBW)			

IBW = ideal body weight

**Soybean oil-based emulsion. For indications and dosing of other lipid injectable emulsions (ILE), see manufacturer's product literature.*

TABLE 2. ELECTROLYTE AND MINERAL

Nutrient	Standard Daily Requirement	Factors That Increase Needs
Calcium*	10-15 mEq	High protein intake
Magnesium	8-20 mEq	GI losses, medications, refeeding
Phosphorus*	20-40 mmol	High dextrose intake, refeeding
Sodium	1-2 mEq/kg*	Diarrhea, vomiting, NG suction, GI losses
Potassium	1-2 mEq/kg*	Diarrhea, vomiting, NG suction, GI losses, medications, refeeding
Acetate	As needed to maintain acid-base balance	Renal insufficiency, metabolic acidosis, GI losses of bicarbonate
Chloride	As needed to maintain acid-base balance	Metabolic alkalosis, volume depletion

**Use caution in prescribing calcium and phosphorus related to compatibility.*

GI = Gastrointestinal

TABLE 3. DAILY REQUIREMENTS FOR ADULT PARENTERAL VITAMINS*

Vitamin	Standard Daily Requirement
Thiamin (B_1)	6 mg
Riboflavin (B_2)	3.6 mg
Niacin (B_3)	40 mg
Folic acid	600 mcg
Pantothenic acid	15 mg
Pyridoxine (B_6)	6 mg
Cyanocobalamin (B_{12})	5 mcg
Biotin	60 mcg
Ascorbic acid	200 mg
Vitamin A	990 mcg
Vitamin D	5 mcg
Vitamin E	10 mg
Vitamin K	150 mcg

** Prescribe full daily dose unless patient able to ingest and/or absorb orally/enterally. Full dose of most multivitamin products available in the US provides the above requirements.*

TABLE 4. DAILY REQUIREMENTS FOR ADULT PARENTERAL TRACE ELEMENTS*

Trace Element	Standard Daily Requirement
Chromium	<1 mg
Copper	0.3-0.5 mg
Manganese	55 mcg
Selenium	60-100 mcg
Zinc	3-5 mg

** Prescribe full daily dose unless patient able to ingest or absorb orally/enterally.*

Note: These requirements are different than the multi-trace element products currently available in the US.

TABLE 5. DOSING FOR INITIATION AND ADVANCEMENT OF PN MACRONUTRIENTS

	Initiation		Advance By		Goals	
Infants (<1 y)	**Preterm**	**Term**	**Preterm**	**Term**	**Preterm**	**Term**
Protein (g/kg/d)*	1-3 (3–4 max)	2.5–3	—	—	3–4	2.5–3
Dextrose (mg/kg/min)	6–8	6–8	1–2	1–2	10–14 (max 14–18)	10–14 (max 14–18)
ILE (g/kg/d)**	0.5–1	0.5–1	0.5–1	0.5–1	3 (max 0.15 g/kg/h)	2.5–3 (max 0.15 g/kg/h)
Children (1–10 y)						
Protein (g/kg/d)	1.5–2.5		—		1.5–2.5	
Dextrose (mg/kg/min)	3–6		1–2		8–10	
ILE (g/kg/d)**	1–2		0.5–1		2–2.5	
Adolescents						
Protein (g/kg/d)	0.8–2		—		0.8–2	
Dextrose (mg/kg/min)	2.5–3		1–2		5–6	
ILE (g/kg/d)**	1		1		1–2	

**Protein does not need to be titrated; protein needs are increased with critical illness.*

*** ILE dosing based on soybean oil-based emulsion. See manufacturer's product information for dosing of other ILE products.*

ILE= Lipid injectable emulsion

GIR = glucose infusion rate; GIR calculation (mg/kg/m) = [dextrose (g/d) x 1000] / [24 (h/d) x 60 (m/hr) x weight (kg)]

TABLE 6. PN ELECTROLYTE AND MINERAL DAILY DOSING*

	Preterm Neonates	Infants/Children	Adolescents & Children Greater than 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
Phosphorus	1-2 mmol/kg	0.5-2 mmol/kg	10-40 mmol
Magnesium	0.3-0.5 mEq/kg	0.3-0.5 mEq/kg	10-30 mEq
Acetate	As needed to maintain acid base-balance		
Chloride	As needed to maintain acid base-balance		

**Use caution in prescribing calcium and phosphorus related to compatibility.*

TABLE 7. PN DAILY MULTIPLE VITAMIN PRODUCT DOSING

Manufacturer Recommendations†		NAG-AMA Recommendations◊	
Weight (kg)	**Dose (mL)**	**Weight (kg)**	**Dose (mL)**
Less than 1	1.5	Less than 2.5	2 mL/kg
1 to less than 3	3.25	Greater than or equal to 2.5	5 mL
Greater than 3	5		

† Infuvite Pediatric (Baxter) and M.V.I. Pediatric (Hospira)

◊ Nutrition Advisory Group-American Medical Association

TABLE 8. PN TRACE ELEMENT DAILY DOSING*

Trace Element	Preterm Neonates	Term Neonates 3-10 kg	Children 10-40 kg	Adolescents Greater than 40 kg
Zinc	400 mcg/kg	250 mcg/kg	50 mcg/kg (max 5000 mcg/d)	2-5 mg
Copper	20 mcg/kg	20 mcg/kg	20 mcg/kg (max 500 mcg/d)	200-500 mcg
Manganese	1 mcg/kg	1 mcg/kg	1 mcg/kg (max 55 mcg/d)	40-100 mcg
Chromium	0.05-0.3 mcg/kg	0.2 mcg/kg	0.2 mcg/kg (max 5 mcg/d)	5-15 mcg
Selenium	2 mcg/kg	2 mcg/kg	2 mcg/kg (max 100 mcg/d)	40-60 mcg

**Note: These requirements are different than the multi-trace element products currently available in the US.*

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Corkins MR, ed. *The A.S.P.E.N. Pediatric Nutrition Support Core Curriculum, 2nd Ed.* Silver Spring, MD: ASPEN; 2015.

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Mueller CM, ed. *The ASPEN Adult Nutrition Support Core Curriculum, 3rd Ed.* Silver Spring, MD: ASPEN; 2017.

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IV Fluid Comparison

Type	Solution	Uses	Special Considerations
Isotonic	Dextrose 5% in water (D5W)	• Fluid loss • Dehydration • Hypernatremia	• Use cautiously in renal and cardiac patients • Can cause fluid overload
Isotonic	0.9% sodium chloride (normal saline) NaCl	• Shock • Hypernatremia • Blood transfusions • Resuscitation • Fluid challenges • DKA	• Can lead to overload • Use with caution in patients with heart failure or edema
Isotonic	Lactated Ringer's (LR)	• Dehydration • Burns • Lower GI Fluid loss • Acute blood loss • Hypovolemia due to third spacing	• Contains potassium, don't use with renal failure patients • Don't use with liver disease, can't metabolize lactate
Hypotonic	0.45% sodium chloride (½ normal saline)	• Water replacement • DKA • Gastric fluid loss from NG or vomiting	• Use with caution • May cause cardiovascular collapse or increased intracranial pressure • Don't use with liver disease, trauma, or burns
Hypertonic	Dextrose 5% in ½ normal saline	• Later in DKA treatment	• Use only when blood sugar falls below 250 mg/dL
Hypertonic	Dextrose 5% in normal saline	• Temporary treatment for shock if plasma expanders aren't available • Addison's crisis	• Don't use in cardiac or renal patients
Hypertonic	Dextrose 10% in water	• Water replacement • Conditions where some nutrition with glucose is required	• Monitor blood sugar levels

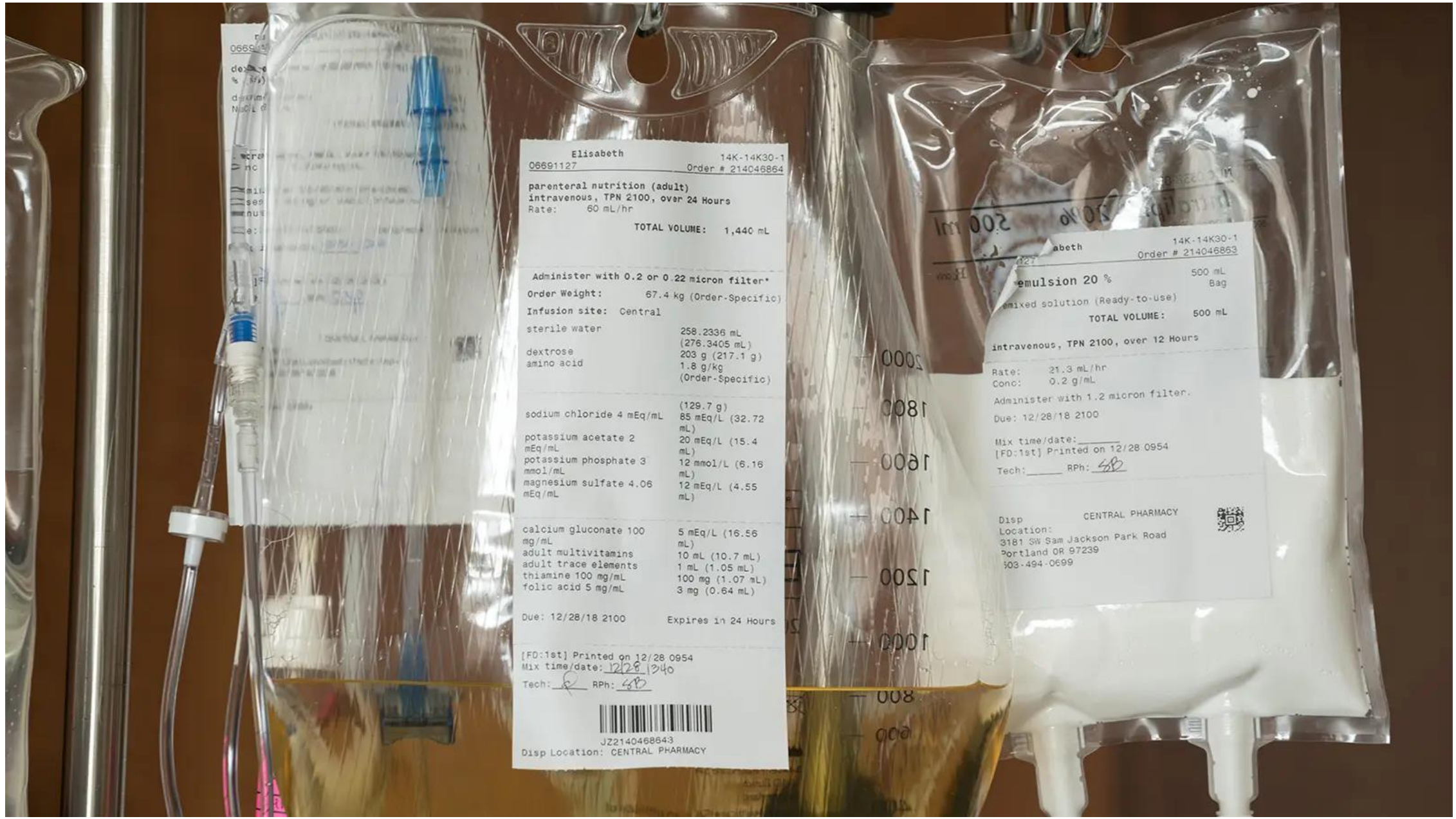
Elisabeth
06691127
14K-14K30-1
Order # 214046864
parenteral nutrition (adult)
intravenous, TPN 2100, over 24 Hours
Rate: 60 mL/hr
TOTAL VOLUME: 1,440 mL
Administer with 0.2 or 0.22 micron filter*
Order Weight: 67.4 kg (Order-Specific)
Infusion site: Central
sterile water 258.2336 mL (276.3405 mL)
dextrose 203 g (217.1 g)
amino acid 1.8 g/kg (Order-Specific)
(129.7 g)
sodium chloride 4 mEq/mL 85 mEq/L (32.72 mL)
potassium acetate 2 mEq/mL 20 mEq/L (15.4 mL)
potassium phosphate 3 mmol/mL 12 mmol/L (6.16 mL)
magnesium sulfate 4.06 mEq/mL 12 mEq/L (4.55 mL)
calcium gluconate 100 mg/mL 5 mEq/L (16.56 mL)
adult multivitamins 10 mL (10.7 mL)
adult trace elements 1 mL (1.05 mL)
thiamine 100 mg/mL 100 mg (1.07 mL)
folic acid 5 mg/mL 3 mg (0.64 mL)
Due: 12/28/18 2100
Expires in 24 Hours
[FD:1st] Printed on 12/28 0954
Mix time/date: 12/28 1340
Tech: RPh:
JZ2140468643
Disp Location: CENTRAL PHARMACY
14K-14K30-1
Order # 214046863
emulsion 20 %
500 mL Bag
mixed solution (Ready-to-use)
TOTAL VOLUME: 500 mL
intravenous, TPN 2100, over 12 Hours
Rate: 21.3 mL/hr
Conc: 0.2 g/mL
Administer with 1.2 micron filter.
Due: 12/28/18 2100
Mix time/date:
[FD:1st] Printed on 12/28 0954
Tech: RPh:
Disp Location: CENTRAL PHARMACY
3181 SW Sam Jackson Park Road
Portland OR 97239
503-494-0699

Table 5

Recommendations for Monitoring PN in Hospitalized Patients

Monitoring parameter	Initial frequency	Frequency when more stable
Body weight	Daily	Every other day
Inputs and outputs	Daily	Daily
Vital signs	3–4 times daily	1–2 times daily
Serum electrolytes	Daily	2–3 times weekly
Blood urea nitrogen, creatinine	Daily	2–3 times weekly
Blood glucose	1–4 times daily	Daily
Triglycerides	Daily	Weekly
Liver function tests	2 times weekly	Weekly
International normalized ratio	Weekly	Weekly
Complete blood count	Weekly	Weekly
Albumin, prealbumin	Weekly	Weekly
Nitrogen balance	Weekly	Weekly