

# NUTRITION IN PEDIATRIC ONCOLOGY

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# OBJECTIVES

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- Malnutrition
- Pediatric nutritional assessment and screening
- Nutritional management and intervention
- Nutrition related side effects of chemotherapy
- Nutrition support routes

# WHAT IS CANCER?



“Cancer is an abnormal division and reproduction of cells that can spread throughout the body crowding our normal cells and tissues”

## PATHOPHYSIOLOGY AND CARE MANAGEMENT:

<ul style="list-style-type: none"><li>• different viruses</li><li>• excess energy (specially unsaturated fats)</li><li>• chemicals</li><li>• limited antioxidants and other nutrients</li><li>• radiation</li></ul>	Initiation Progression promotion	Malignant neoplasm (cancer cells)	proliferation of abnormal cells includes: increase mass of cells, interference with normal tissue function and possible metastases.
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**Medical management includes:** surgery, radiation, chemotherapy, immunotherapy and BMT.

**Nutritional management includes:** prevent or correct nutritional deficiencies, minimize weight loss, oral feeding, enteral tube feeding and parenteral feeding.

# COMMON TYPES OF CANCER IN CHILDREN

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- Leukemia.
- Brain and other central nervous system tumors.
- Neuroblastoma.
- Wilms tumor/ nephroblastoma
- Lymphoma (including both Hodgkin and non-Hodgkin)
- Rhabdomyosarcoma. (skeletal muscle sarcoma)
- Retinoblastoma.
- Bone cancer (including osteosarcoma and Ewing sarcoma)

## RISK FACTORS ASSOCIATED WITH CANCER:



Different cancers have different risk factors.

- overweight,
- Genetic factor, weakened immune system
- Inherited syndromes
- radiation exposure,
- parental exposures , **BUT**

*The causes of most pediatric cancers remain a mystery and cannot be prevented*

**Parents oftentimes will need a lot of reassurance at diagnosis and through the treatment process that they did nothing to cause their child's cancer.**

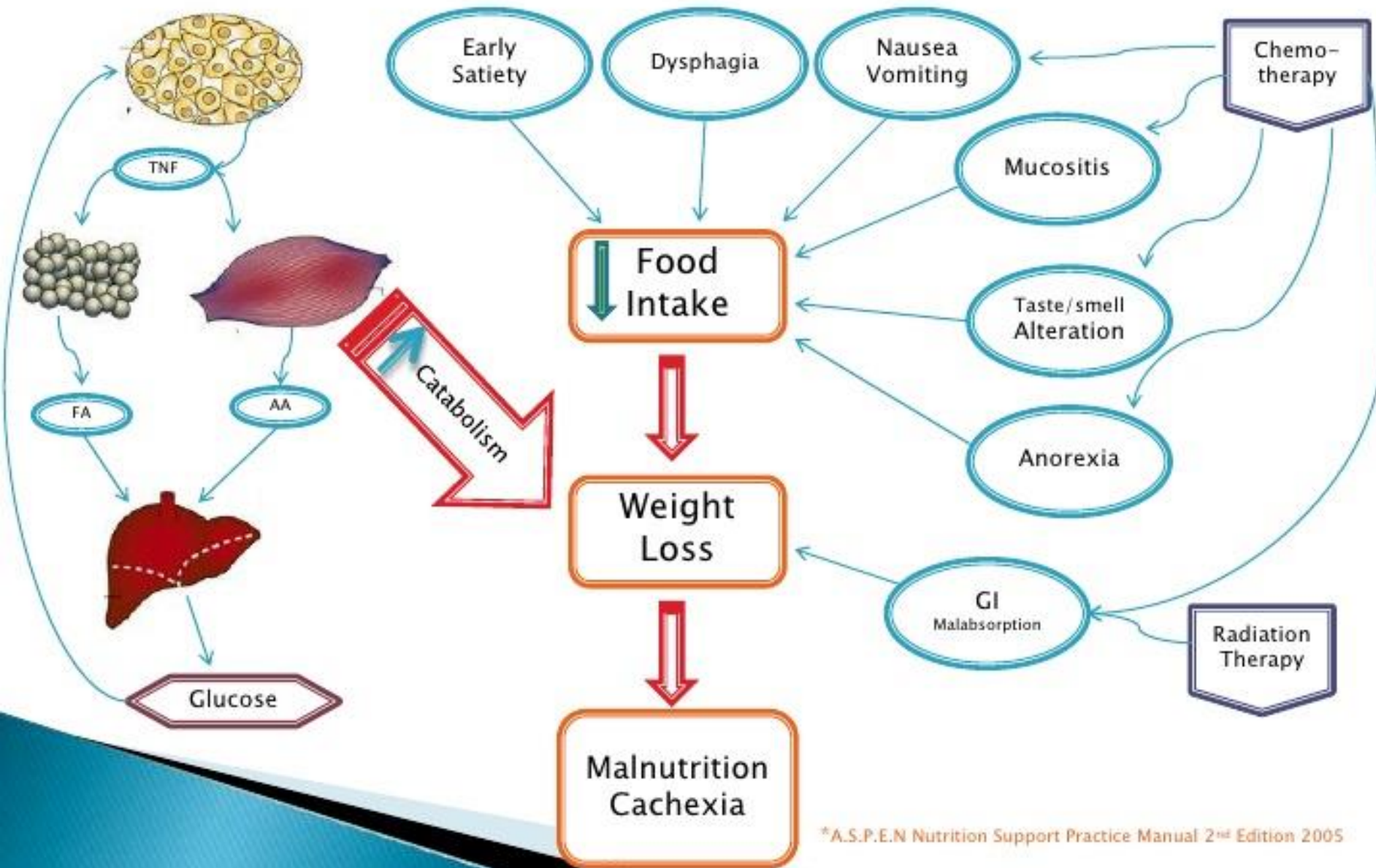
# RISK FACTORS ASSOCIATED WITH THE DEVELOPMENT OF MALNUTRITION

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- Irradiation to the GI tract
- Intense frequent course of chemotherapy ( < 3 weeks)
- Major abdominal surgery
- Advanced disease
- Lack of family or health care support system
- Alterations in taste, anorexia, mucositis, emesis, diarrhea
- Children are still growing
- High nutritional needs per kg of body weight and lower reserves
- Weight loss of even a small amount can be significant in proportion to their size. E.g a 1 kg wt. loss in a child weighing 10 kg is about 10% loss of body wt.

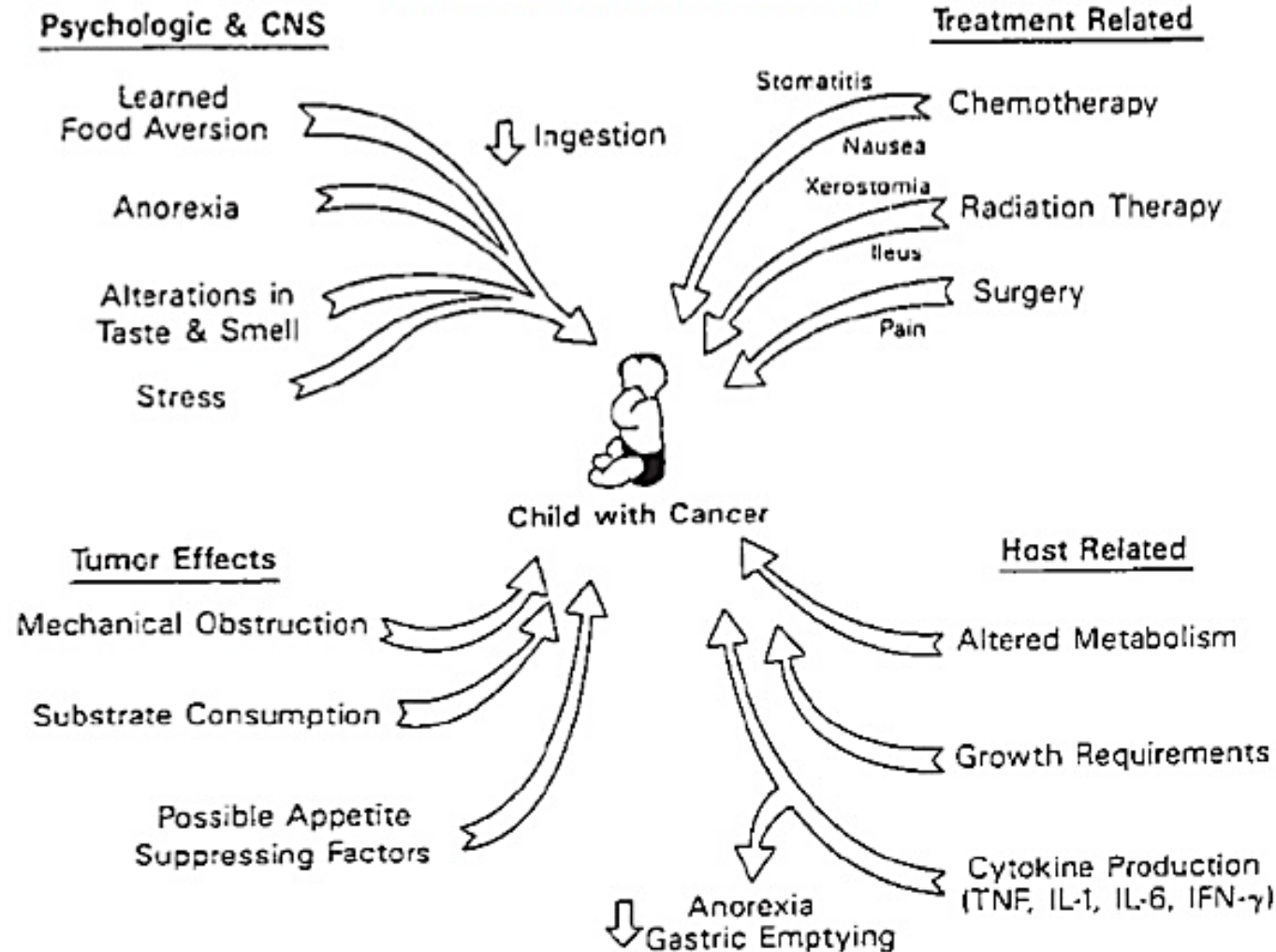
# Nutritional Alterations in Cancer\*







## ETIOLOGY OF CACHEXIA





# CANCER TYPES ASSOCIATED WITH MALNUTRITION FOR PEDIATRIC ONCOLOGY PATIENTS



## High risk factor for undernourishment

Solid tumors with advanced stages

Wilms tumor

Neuroblastoma stage 3 and 4

Rhabdomyosarcoma

Ewing sarcoma

Medulloblastoma

Multiple relapsed leukemia and lymphoma

Head and neck tumors

Post BMT (graft VS host disease)

## Moderate risk factor for undernourishment

Non metastatic solid tumors

Uncomplicated acute lymphoblastic leukemia

Advance disease in remission during maintenance treatment

## High risk factor for fat accumulation

Acute lymphoblastic leukemia receiving cranial irradiation

Craniopharyngeoma

Malignancies with large and prolonged doses of corticosteroids therapy or other drugs increasing body fat stores

Total body or abdominal or cranial irradiation



### **Entry Criteria for nutrition support during hospitalization**

- Total weight loss of  $> 5\%$  relative to pre-illness BW.
- Weight for height  $< 90\%$ .
- Decrease in current percentile for weight (or height) of two percentiles
- Adipose energy reserves as determined by triceps skinfold thickness  $< 5\text{th}$  percentile for age and gender.
- Voluntary food intake is  $< 70\%$  of estimated requirements for 5 days.
- Anticipated gut dysfunction due to treatment for more than 5 days.
- High nutritional risk patients based on tumor type and oncology treatment regimes.
- Bone marrow transplant as a treatment for any tumors.

# SHORT AND LONG TERM EFFECTS OF MALNUTRITION



SHORT TERM CONSEQUENCES	LONG TERM CONSEQUENCES
<ul style="list-style-type: none"><li>• Wasting of muscle and fat mass</li></ul>	<ul style="list-style-type: none"><li>• Growth impairment, reduced final height</li></ul>
<ul style="list-style-type: none"><li>• Decreased tolerance of chemotherapy</li></ul>	<ul style="list-style-type: none"><li>• Decreased long term survival in several tumors</li></ul>
<ul style="list-style-type: none"><li>• Treatment delays</li></ul>	
<ul style="list-style-type: none"><li>• Fatigue</li></ul>	<ul style="list-style-type: none"><li>• Impact on motor, cognitive and neuro development</li></ul>
<ul style="list-style-type: none"><li>• Biochemical disturbance</li><li>• (anemia and hypoalbuminemia)</li></ul>	<ul style="list-style-type: none"><li>• Risk for metabolic syndrome</li></ul>
<ul style="list-style-type: none"><li>• Delayed recovery of normal marrow function</li></ul>	<ul style="list-style-type: none"><li>• Risk for secondary cancers</li></ul>
<ul style="list-style-type: none"><li>• Drug dose alteration</li></ul>	<ul style="list-style-type: none"><li>• Risk for aging</li></ul>
<ul style="list-style-type: none"><li>• Decreased quality and productivity of life</li></ul>	<ul style="list-style-type: none"><li>• Increased mortality rate</li></ul>
<ul style="list-style-type: none"><li>• Greater level of psychological stress</li></ul>	<ul style="list-style-type: none"><li>• Retardation of skeletal maturation</li></ul>
<ul style="list-style-type: none"><li>• Higher susceptibility to infections</li></ul>	<ul style="list-style-type: none"><li>• Abnormal bone mineral density</li></ul>
	<ul style="list-style-type: none"><li>• Decreased quality of life</li></ul>

# CASE STUDY Part 1



F.A is a 13 yrs. old male child with diagnosis of Ewing's sarcoma was admitted in oncology ward to receive his 2nd cycle of chemotherapy . Initially he was adequately eating orally but now after 2<sup>nd</sup> dose of chemo he is experiencing poor oral intake due to nausea and vomiting with grade 1 mucositis . Has h/o 2 kg wt. loss after 1<sup>st</sup> cycle of chemo. His current height is 148 cm and wt. is 37 kg. And since admitting in hospital he experienced further 1 kg wt. loss due to poor oral intake. What will be his nutritional plan?

## Nutritional Assessment

**1. Plot ht and wt on growth chart and interpret?**

**Ans:** ht Less than 25<sup>th</sup> centile, wt less than 10<sup>th</sup> and BMI: > 10<sup>th</sup> centile

**2. Is the wt loss is significant?**

**And:** yes

# ASSESSMENT OF NUTRITION FOCUSED FINDINGS

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*physical findings* includes:

Overall appearance, Body language, Cardiovascular-pulmonary, Extremities, muscles and bones, Head and eyes, Vital signs, Digestive system (mouth to rectum), Nerves and cognition, skin.

*Anthropometrics* includes:

Height/length, Weight, Weight change, Body mass index, Growth pattern indices/percentile ranks, Body compartment estimates.

## Categories of Nutritional Status for the Pediatric Oncology Patient

### Identify appropriate category

Age >2 years: choose either

Body mass index percentile (BMI) OR

Estimated desired weight (EDW; formerly Ideal Body Weight, or IBW)

(for height or length percentile)

Age <2 years: choose either

WT/LT (Weight for Length - percentile) OR

EDW (for height or length percentile)

Underweight	Normal	Risk of overweight	Overweight
Weight loss/gain may or may not be present			
BMI			
<5th percentile	5th-85th percentile	>85th-95th percentile	>95th percentile
WT/LT			
<10th percentile	10th-90th percentile	>90th percentile	
EDW			
Severe: <70%	>90%-110%	>110%-120%	>120%
Moderate: >70-80%			
Mild: >80%-90%			

Measure		
<b>Daily:</b> <ul style="list-style-type: none"> <li>Weight</li> </ul>	<b>Weekly</b> <ul style="list-style-type: none"> <li>Height</li> <li>MUAC</li> <li>Triceps, biceps, sub-scapular skinfold measurements</li> </ul>	<b>Calculate</b> <i>On each assessment:</i> <ul style="list-style-type: none"> <li>% EWA</li> <li>% EWH</li> <li>% EHA</li> </ul>



### Comments:

- ☐ Weight is inaccurate when child has oedema, large tumour masses and organs extensively infiltrated with tumour, effusions or organ congestion, excess fluid administration.
- ☐ Redo weight post surgical resection of solid tumours
- ☐ Skinfold measurements are inaccurate if the patient has oedema

# What nutritional lab parameters should we have to consider?



LABS: BUN, Cr, Na, k+, GI profile, inflammatory profile, protein profile, LFTs, CBC.

## Patient/client history:

Personal History

Medical history

Family History/ Social History

Diet History

Biochemistry	
<p><i>Monitor the following</i></p> <ul style="list-style-type: none"> <li>• Urea, creatinine, sodium, potassium during chemotherapy</li> <li>• Glucose if receiving corticosteroids</li> <li>• FBC: Haemoglobin, platelets, WCC, Neutrophils</li> <li>• Liver function tests when receiving TPN ( refer to PN protocol)</li> </ul>	<p><i>Comments</i></p> <ul style="list-style-type: none"> <li>• Limit the use of sugar in isolation if patient presents with glycosuria</li> <li>• Monitor potassium, phosphate, urea and creatinine during tumorlysis syndrome.</li> </ul>
Clinical	
<ul style="list-style-type: none"> <li>• Determine from <b>Medical History</b> : <ul style="list-style-type: none"> <li>➢ Type and stage of tumour,</li> <li>➢ Intensity of planned treatment,</li> <li>➢ Presence or absence of remission</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Determine from <b>Diet History</b>: <ul style="list-style-type: none"> <li>➢ Appetite and recall of actual food intake</li> <li>➢ Acquired food aversions and food intolerances</li> <li>➢ Use of nutritional supplements</li> <li>➢ Treatment and related complications</li> <li>➢ Recent weight changes</li> <li>➢ Treatment schedules and other medication affecting GIT</li> <li>➢ Developmental status</li> <li>➢ Family and social history</li> </ul> </li> </ul>



## CURRENT LABS



BUN: 18 mmol/l

Cr: 0.5 mmol/l

Mg: 2.1

TB: 0.2

K<sup>+</sup> : 3.8 mmol/l

Na: 133 mmol/l

Phos: 4.3

DB: 0.1

Hb: 10.9

Wbc: 3.5

Plt: 88

SGPT: 26

## CURRENT MEDICATIONS

Ondasetrone

Fluoxetine

Doxorubicin

enoxaprine

Ranitidine

sodium Bicarb

Dimenhydrinate

co- trimoxazole

Aprepitant

natural tears

Magic mouthwash

**Is there any drug nutrient interaction?**

ANS: no

# CALCULATION OF NUTRITIONAL NEEDS



## Energy Needs

< 1 year: 120-150kcal/kg

> 1 year: Schofield x 1.5-1.8 combined activity and stress factor

OR

Use catch-up growth formula: Total calories= (BMR × SF)

## Protein Needs

- Birth to 6 months: 3 g protein/kg/d
- 6 months to 12 months: 2.5 to 3 g protein/kg/d
- 1 to 13 years: 1.5 to 2 g protein/kg/d
- 13 to 18 years: 1.5 g protein/kg/d

## Fat Needs

- < 2 year : 30-50% NPE
- > 2 year : 30% of NPE

## Fluid Needs

- Less than 10 kg
  - 100 mL/kg/24h
- 11 kg to 20 kg
  - 1,000 mL + 50 mL/kg for each kg over 10 kg
- 21 kg to 40 kg
  - 1,500 mL + 20 mL/kg for each kg over 20 kg
- More than 40 kg
  - 1,500 mL/m<sup>2</sup>/24 hours

Adjustments are needed for the following conditions:

Fever, Stress, Diarrhea, Acute weight loss, Loss from ostomies /drains should be replaced daily.

## COMMENTS:

- Decrease energy requirements post surgical resection and during maintenance chemotherapy .
- Restrict protein to RDA during tumour lysis syndrome
- Supplement glutamine at 0.57g/kg, before and during selected intensive chemotherapy regimes ,to decrease duration of mucositis , Dissolve glutamine powder in at least 100mls cold clear liquid and administer as a swish and swallow solution
- Restrict fat to 2g/kg if patient is neutropenic or if INR is prolonged
- Fluid restriction may be indicated during cardiac failure or tumour lysis syndrome

# NUTRITIONAL PLAN/ DIETARY REGIMEN



REQUIRED KCAL:  $1270 \times 1.8 = 2286$  kcals

REQUIRED PROTEIN: 55.5 gms

FLUID: 1840 ml

## **PLAN:**

Energy dense Small and frequent meals

Ensure adequate liquids

Oral nutritional supplement

## **Mucositis:**

Serve bland soft/pureed foods,

Moisten foods with butter, gravies or sauces, Avoid spicy/salty foods,

Soothe mouth/esophagus with cold, non-irritating foods.

## **Nausea and Vomiting:**

Do not feed in rooms that are filled with odors of cooking or uncover food trays in front of patients

Encourage sipping liquids throughout the day

Avoid high-fat foods

Limit acidic juices/foods

Give breads: toast, crackers

Encourage small, frequent feedings

Counseled parents and asked them to be in follow up at clinic. Contact provided  
(But pt's family didn't maintained follow up)

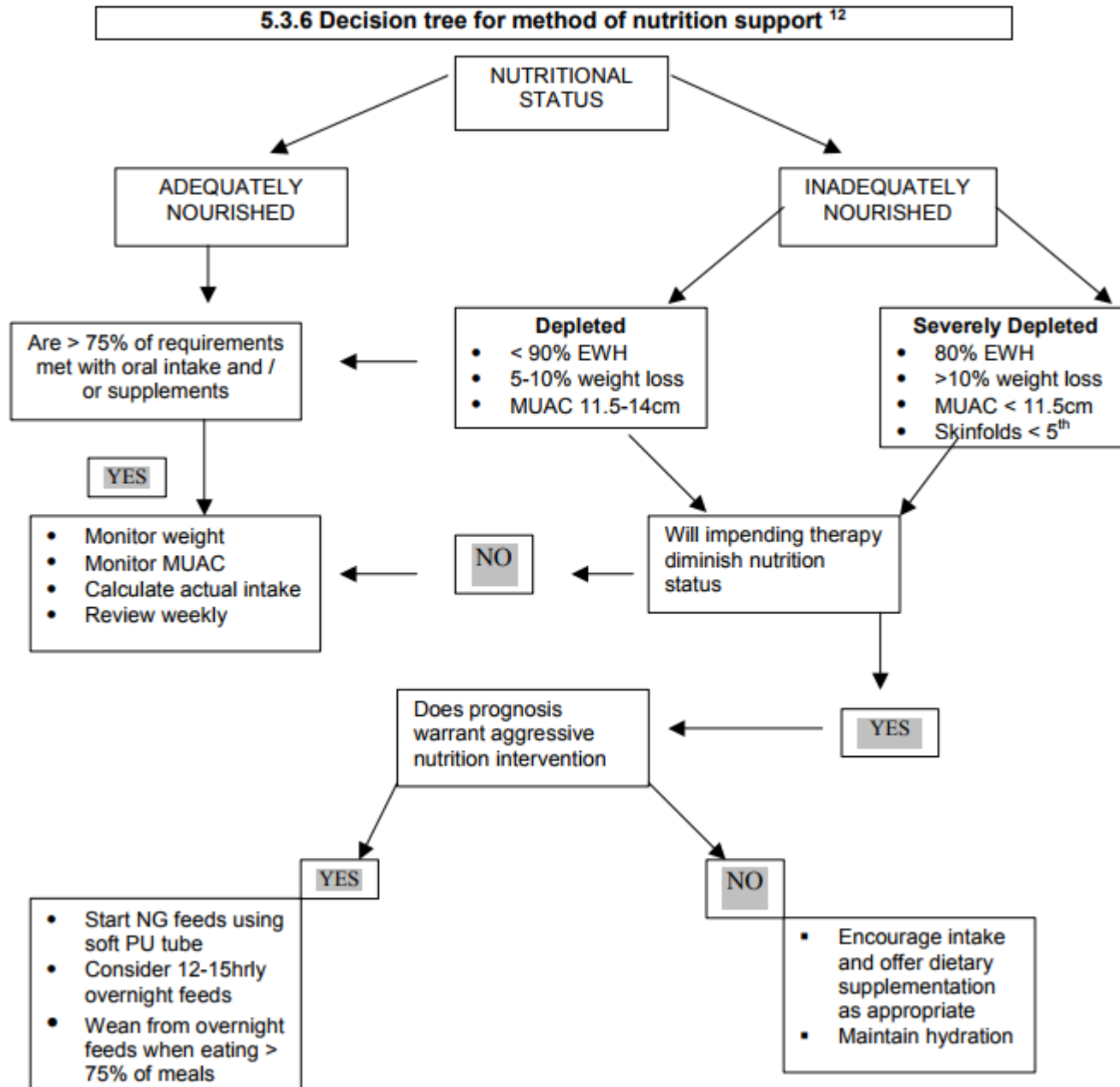
# NUTRITION SUPPORT ROUTES



NUTRITIONAL STRATEGIES	INDICATION
Oral feeding	<ul style="list-style-type: none"><li>• patients with low nutritional risk,</li><li>• less advanced disease or</li><li>• Disease in remission on maintenance chemotherapy.</li></ul>
<b>Entry criteria for the administration of enteral feeding</b>	<ul style="list-style-type: none"><li>• <b>Present state of malnutrition at diagnosis that failed to or is not expected to improve within 1 week.</b></li><li>• <b>No improvement in nutritional status with food based supplements or supplementary drinks alone.</b></li><li>• <b>Weight loss after diagnosis &gt; 5% from the weight at diagnosis.</b></li><li>• <b>Voluntary food intake is &lt; 70% of estimated requirements for 5 days with no improvement after prescription of dietary supplementary drinks</b></li><li>• <b>Anticipated gut dysfunction due to treatment for more than 5 days.</b></li></ul>



NUTRITIONAL STRATEGIES	INDICATION
Entry criteria for parenteral Nutrition	<p>Unable to meet dietary requirements via enteral route Severe GI intolerance due to :</p> <ul style="list-style-type: none"><li>• Mucositis</li><li>• GVHD of the GIT</li><li>• Typhilitis</li><li>• Severe vomiting and diarrhea</li><li>• Severe pancreatitis</li><li>• Paralytic ileus</li></ul>



# FACTORS THAT AFFECT APPETITE

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- Endocrine abnormalities
- Intermediary metabolites
- Secondary infections
- Medications
- Neurological and physiological conditions



## CASE STUDY Part 2



patient underwent limb salvage surgery after 2<sup>nd</sup> cycle of chemo. Now admitted again in hospital with c/o fever after 4th chemo cycle, currently he is experiencing constipation, altered taste, nausea and loss of appetite, with further reduction of 5 kg wt. in last 2 months.

**Current wt** is 32 kg < 5<sup>th</sup> centile

### **Dietary recall:**

He was taking only bread slice with jam, 1/2 bowl of soup, jelly, only 2- 3 tbsp. of daal with rice in a whole day.

### **Current labs:**

BUN: 15 mmol/l	Cr: 0.3 mmol/l	Mg: 2.0	TB: 0.2
K <sup>+</sup> : 3.8 mmol/l	Na: 130 mmol/l	Phos: 4.3	DB: 0.1
Hb: 9.2	Wbc: 1.2	Plt: 34	SGPT: 26

## What will be the next regimen?

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Insert Ng tube and start feeding the patient. Along with encouraging for oral intake. Start with trophic rate of continuous feed and progress to bolus as per tolerance

Recalculate required kcals and proteins, use kcal and protein boosters to reduce the quantity but to increase the quality of feed.



### ***Changes in Taste:***

- Enhance food flavors and taste
- Try tart or spicy foods
- Provide aromatic foods
- Give fluids with meals to help wash away tastes
- do not give excessively sweet food
- Avoid metallic silverware



### ***Constipation:***

- adequate fluids,
- Consider hot/warm food to help stimulate the bowel,
- Promote high-fiber intakes,
- Use fruit nectars or prune,
- Consider stool softeners or laxatives.

### ***Loss of Appetite/Early Satiety:***

- Small, frequent meals and snacks,
- High-energy drinks between meals,
- Favorite foods between treatments to help prevent aversion,
- Appetite stimulant, which may be helpful to improve intakes; use after all other options have failed



### **Goals for nutritional repletion:**

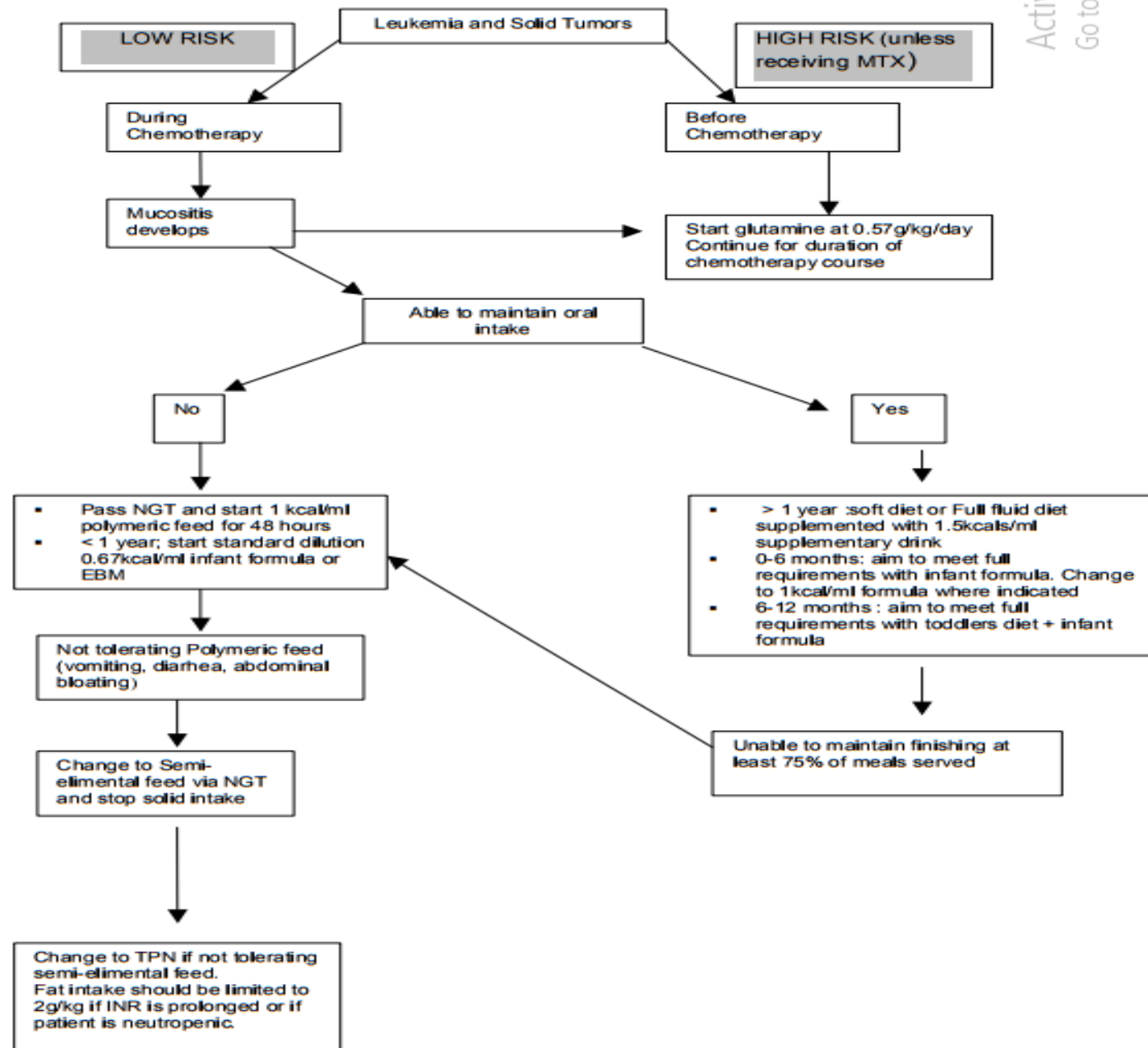
90% Weight for age or 90% weight for height

Arm fat area > 5th percentile

Subscapular skinfold > 10th percentile

MUAC > 14.5cm

### 6.3 Algorithm for Glutamine supplementation and Nutritional Support in Oncology and Hematology



Activate Wi  
Go to PC setting



# RECOMMENDED FOODS



FOOD GROUPS	RECOMMENDED
<b>Beverages</b>	Bottled water Well water that has been boiled for 15 to 20 minutes; must be stored in a refrigerator and used within 48 hours Freshly made ice from acceptable water source Hot beverages heated to at least 175°F Tea made with boiling water
<b>Bread and Cereal Products</b>	All breads and cereals <ul style="list-style-type: none"> <li>• Freshly prepared rice or pasta</li> </ul>
<b>Meats and Other Protein Foods</b>	Any well-cooked, canned, or prepackaged heat-treated meat, fish, or poultry <ul style="list-style-type: none"> <li>• Roasted or cooked nuts</li> <li>• All eggs must be cooked well done (no runny yolks).</li> </ul> Avoid raw or rare meat and fish and uncooked or undercooked eggs. Cook meat until it's well-done.
<b>Dairy Products</b>	Pasteurized milk or yogurt <ul style="list-style-type: none"> <li>• Cheeses made from pasteurized milk</li> <li>• Prepackaged or freshly homemade pasteurized ice cream, frozen yogurt, or sherbet</li> <li>• Commercially made nutritional products, supplements, and baby formulas</li> </ul>
<b>Fruit</b>	All well-washed fresh fruits(peeled) except for berries and fruits that cannot be peeled off <ul style="list-style-type: none"> <li>• All cooked or canned fruits</li> <li>• Pasteurized juice</li> </ul>
<b>Vegetables</b>	All well-washed fresh vegetables (peeled) eat immediately after cutting <ul style="list-style-type: none"> <li>• All cooked or canned vegetables</li> </ul>
<b>Fats and Spices</b>	Oils, butter, cream cheese, margarine <ul style="list-style-type: none"> <li>• Cooked spices prepared/cooked in foods</li> <li>• Salt</li> </ul>







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I wish cancer  
got cancer and  
died.



**Thank  
You!!!**