APPROACH TO NUTRITIONAL SCREENING AND ASSESSMENT

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INTRODUCTION

Clinical nutrition is the discipline that deals with prevention, diagnosis and management of nutritional and metabolic changes related to disease .
There are large spectrum of diseases related to clinical nutrition.

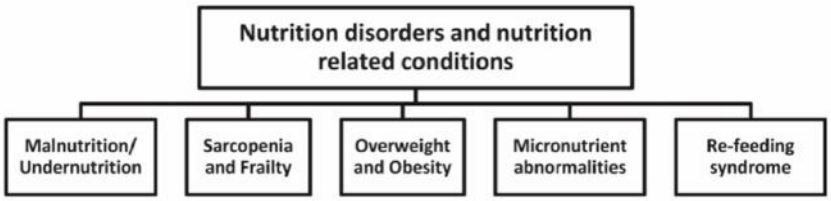


Fig. 1 Overview of nutrition disorders and nutrition related conditions

Malnutrition is 'a state resulting from lack of intake or uptake of nutrition that leads to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease' (1).
The prevalence of malnutrition (undernutrition) among hospitalized adult patients ranges from 30 to 50%. (2,3)
There are several categories of Malnutrition/under nutrition.

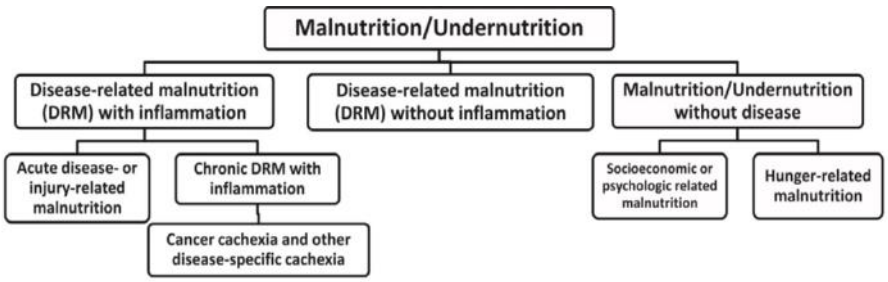


Fig. 2 Categories of Malnutrition.

Malnutrition/Undernutrition should be seen as an additional disease, as well as an important component of comorbidity.

Causes of malnutrition in hospitalized patients are-

- Underlying disease condition may directly impair the nutrition (E.g. esophageal stricture) and can induce metabolic and/or psychological disorders which increase the nutritional needs or decrease food intake.
- In addition, the long fasting periods before many examinations and interventions lead to further reduced food intake.

- Hospital undernutrition can also aggravated because of inappropriate meal services, inadequate quality and flexibility of the hospital catering

Consequences of Malnutrition are-

- A patient with poor nutritional status has an increase of complications, a longer length of hospital stay, higher mortality, higher costs and more re-admissions.
- Undernutrition also sometimes influences the efficacy or tolerance of several key treatments, such as antibiotic therapy, chemotherapy, radiotherapy or surgery.

To combat this there is a nutrition care process which includes following steps-

- Malnutrition risk screening
- Nutritional assessment
- Diagnostic procedure
- Nutritional care plan
- Nutritional care
  - ➢ Nutrition therapy
- Monitoring and evaluating the effects of nutritional care and therapy
- Documentation

Nutrition screening has been defined by the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) as 'a process to identify an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutrition assessment is indicated' (4).

Nutrition assessment has been defined by A.S.P.E.N. as 'a comprehensive approach to diagnosing nutrition problems that uses a combination of the following: medical, nutrition, and medication histories; physical examination; anthropometric measurements; and laboratory data' (4).

NUTRITIONAL SCREENING AND ASSESSMENT

All patients should have their nutritional status recorded by nutrition support clinician. Evaluation starts with a screening procedure and is followed by a detailed assessment in those patients screened and found to be at risk. Clinical skills, availability of resources and the clinical setting determine the specific methods to be used.

Screening should be performed within the first 24-48 h after the first contact and thereafter at regular intervals. Patients identified as at risk need to undergo nutritional assessment.

Nutrition assessments may lead to certain recommendations for improving nutritional status of the patient. There is also provision of reassessment and monitoring methods as a part of overall nutrition care.

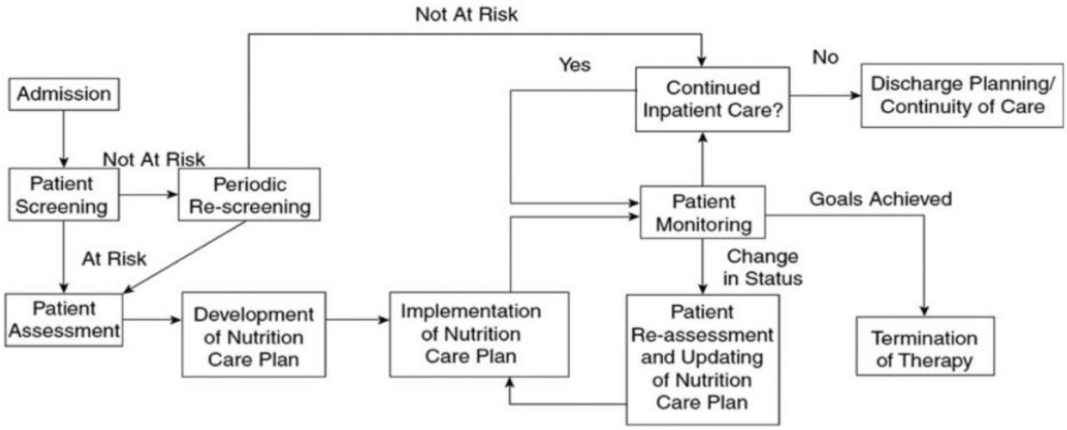


Fig 3. A.E.S.P.E.N recommend Nutrition care algorithm.

METHODS OF SCREENING

Screening should be a simple, rapid process and sensitive.
Several validated screening tools are available.

Instrument	Anthropometry and/or Diet-Related	Severity of Illness	Other (Physical, Psychological Variables or Symptoms)
Screening tools			
Birmingham Nutrition Risk Score	Weight loss, BMI, appetite, ability to eat	Stress factor, (severity of diagnosis)	
Malnutrition Screening Tool	Appetite, unintentional weight loss		
Malnutrition Universal Screening Tool	BMI, change in weight	Presence of acute disease	
Maastricht Index	Percentage ideal body weight	Albumin, prealbumin, lymphocyte count	
Nutrition Risk Classification	Weight loss, percentage ideal body weight, dietary intake		Gastrointestinal function
Nutritional Risk Index	Present and usual body weight	Albumin	
Nutritional Risk Screening 2002	Weight loss, BMI, food intake	Diagnosis (severity)	
Prognostic Inflammatory and Nutritional Index		Albumin, prealbumin, C-reactive protein, α1-acid glycoprotein	
Prognostic Nutritional Index	Triceps skin fold	Albumin, transferrin, skin sensitivity	
Simple Screening Tool	BMI, percentage weight loss	Albumin	
Short Nutrition Assessment Questionnaire	Recent weight history, appetite, use of oral supplement or tube feeding		

Fig 4. List of various validated Screening tools recommended by A.E.S.P.E.N

Screening tools recommended by European Society for Clinical Nutrition and Metabolism (ESPEN) are:

- Community: Malnutrition Universal Screening Tool (MUST)
- Hospital: Nutritional Risk Screening (NRS)
- Elderly: Mini Nutritional Assessment (MNA)

Community: Malnutrition Universal Screening Tool (MUST)

It has 3 components which are BMI, Weight loss and nutritional intake.

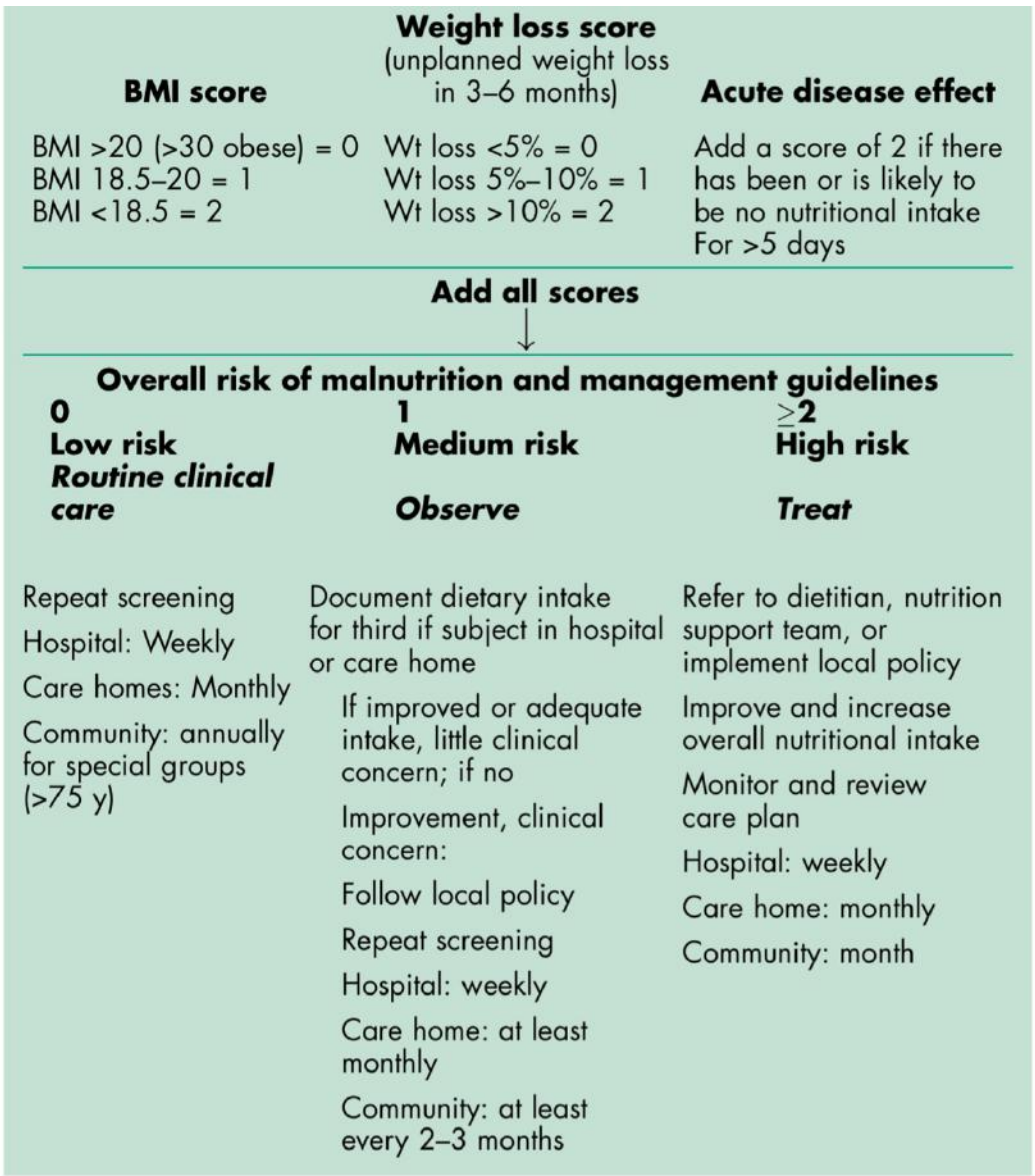


Fig 5. Malnutrition Universal Screening Tool (MUST)

Hospital: Nutritional Risk Screening (NRS):

It is a two step procedure

Nutritional Risk Screening (NRS 2002); Initial screening questions

Initial screening I		Yes	No
1	Is BMI <20.5?		
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 Step 2 is performed.
No: If the answer is 'No' to all questions, the patient is re-screened at weekly intervals. If the patient is (e.g.) scheduled for a major operation, a preventative nutritional care plan is considered to try to avoid the associated risk.

Nutritional Risk Screening (NRS 2002); Final screening

Final screening II			
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 months 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 haemodialysis, diabetes, oncology
Moderate **Score 2**	Wt loss >5% in 2 months or BMI 18.5 - 20.5 + impaired general condition or Food intake 25-50% of normal requirement in preceding week	Moderate **Score 2**	Major abdominal surgery Stroke Severe pneumonia, hematological malignancy.
Severe **Score 3**	Wt loss >5% in 1 months (>15% in 3 months) or BMI <18.5 + impaired general condition or Food intake 0-25% of normal requirement 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 is (e.g.) scheduled for a major operation, a preventative nutritional care plan is considered to try to avoid the associated risk.

Fig. 6 Nutritional Risk Screening (NRS)

Elderly: Mini Nutritional Assessment (MNA)

Mini Nutritional Assessment (MNA); Screening

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 3 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 psychological 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 (subtotal max. 14 points)

12 points or greater **Normal - not at risk** **-> no need to complete assessment**

11 points or below **Possible malnutrition** **-> continue assessment**

Fig 7 Mini Nutritional Assessment (MNA)

There is another simple called Geriatric Nutrition Risk Index (GNRI) specifically designed to predict morbidity and mortality in hospitalized elderly patients. It uses two variables, serum albumin and weight loss..

$$GNRI = [1.489 \times \text{albumin } (g/L)] + [41.7 \times (\text{weight}/WLo)]$$

Fig. 8 Geriatric Nutrition Risk Index (GNRI) WLo: Weight loss

Depending upon the score it categorizes patients into four categories

Major Risk (GNRI < 82), Moderate Risk (GNRI 82-91), Low Risk (GNRI 92-98) and no risk (GNRI > 98) .

Nutric-Score for Risk Screening in the ICU

Nutric scoring system

Variables in Nutric score	Nutric scoring system Range	Nutric scoring system Points
Age	<50	0
	50-<75	1
	>75	2
APACHE II	<15	0
	15-20	1
	20-28	2
	>28	3
SOFA	<6	0
	6-<10	1
	>10	2
Co-morbidities	0-1	0
	2+	1
Days from hospital to ICU	0-<1	0
	1+	1
IL-6	0-<400	0
	400+	1

Fig. 9 Nutric-Score for Risk Screening

Nutrition Risk Index

The NRI was developed in 1991 for use in the evaluation of the efficacy of preoperative total parenteral nutrition in patients undergoing thoracic or abdominal surgery. The NRI relies on serum albumin measurements and differences in a patient's cur- rent and previous body weight.

$$NRI = 1.519 \times \text{serum albumin (g/L)} + 0.417 \times (\text{current weight/usual weight}) \times 100$$

No nutrition risk: NRI > 100
Borderline nutrition risk: NRI > 97.5
Mild nutrition risk: NRI 83.5–97.5
Severe nutrition risk: NRI < 83.5

Fig. 10 Nutrition Risk index.

Screening tools are validated by several studies. Kyle et al in his study in 2006 found that NRI,MUST, NRS 2002 has good ability to predict length of Hospital stay (5). Stratton et al and

Henderson et al found that MUST and Birmingham Nutrition Risk score has ability to predict outcome or mortality (6,7)

Methods for in Nutritional Assessment

A nutritional assessment should be done in those patients found to be at risk on screening, and when metabolic or functional problems prevent a standard plan being carried out.
Widely accepted tool for nutritional assessment is the Subjective Global assessment (SGA) and Mini Nutritional Assessment. ESPEN recommends SGA for assessment.
Nutritional assessment is more complex than screening and should include the following principles:

- History
- Clinical findings(Physical examination, Anthropometry, Body composition)
- Functional Assessment
- Laboratory Tests
- Assessment of Food intake and energy expenditure.

HISTORY
History should be taken to assess

Weight loss;
Appetite;
Diet history
Medical and drug history;
Gastrointestinal symptoms; (diarrhea, constipation, nausea, vomiting);
Fever;
Symptoms of psychiatric illness (e.g. depression, anorexia nervosa).
Drug intake (e.g. Methotrexate and phenytoin cause folate deficiency)

CLINICAL FINDINGS

I. PHYSICAL EXAMINATION

Main objective of a physical examination is to detect signs of nutrient deficiencies or toxicities, and tolerance of current nutritional support using the traditional methods of inspection, palpation, percussion, and auscultation.
The physical examination should include:
Assessment of muscle mass and subcutaneous fat stores;
Inspection and palpation for water retention (edema and ascites);
Inspection and evaluation for signs and symptoms of vitamin and mineral deficits, such as dermatitis, glossitis, cheilosis, neuromuscular irritability, and coarse, easily pluckable hair.

II. Body Mass Index (BMI)

The BMI does not reliably indicate the distribution between lean mass and adipose tissue as there is no linear relationship between BMI and body compartments. Individuals with a low BMI may have an increased fat free mass; on the other hand, individuals with a high BMI may have a disproportionately low fat free mass.

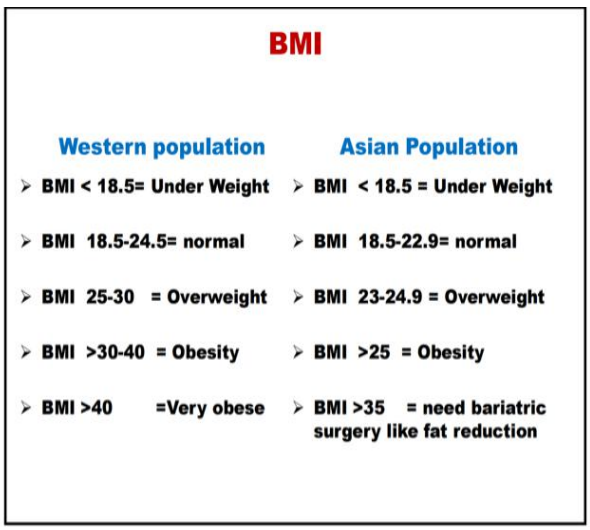


Fig. 11 BMI table

III. Bedside Anthropometric Measurements

Mid-arm Circumference (MAC)
MAC is measured using a tape at the mid point between the acromion and olecranon processes

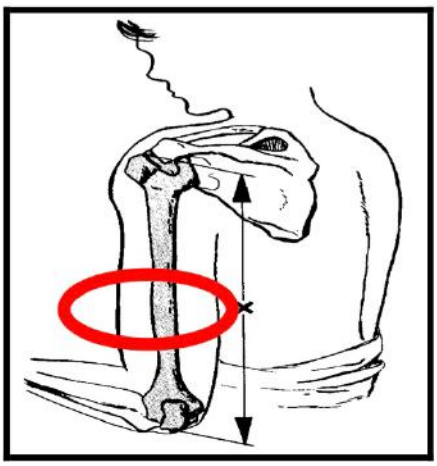


Fig. 12 measurement of mid arm circumference

Triceps Skinfold Thickness (TSF)

Fig. 13 measurement of Triceps Skinfold Thickness (TSF)

Creatinine Height Index (CHI)

Creatine is metabolized to creatinine at a stable rate and reflects the amount of muscle. It is different in man and women depending upon the muscle mass and correlates with lean body mass and body weight.

CHI(%) = measured 24hr urinary creatinine x 100/normal 24hr urinary creatinine

A deficit of 5–15% may be classed as mild, 15–30% moderate and > 30% as severe depletion.

Renal insufficiency, meat consumption, physical activity, fever, infections and trauma influence urine creatinine excretion.

IV. New Tools for Measuring Body Composition

Hydrodensiometry:

Hydrodensitometry, or underwater weighing, has been regarded as a gold standard for body composition analysis in the past. This laboratory technique is based on Archimedes' principle, which states that the volume of an object sub- merged in water is equal to the volume of water the object displaces.

To perform hydrodensitometry the subject is first placed in a temperature- regulated tank or pool and submerged. After complete exhalation, the subject is weighed underwater on a suspended chair or frame for approximately 10 to 15 seconds. Archimedes' principle is applied by comparing the mass of the subject in air with the mass of the subject in water.

Whole Body Counting and Nuclear Activation:

Shielded whole-body counters can measure the radiographic decay of various, naturally occurring minerals and substances, such as ^{40}K. The ^{40}K count can be used to determine total body potassium. Total body potassium can then be used to calculate body cell mass and fat-free mass. Whole-body counting and nuclear activation is considered a gold standard for determining body composition.

Duel Energy X ray Absorptiometry:

Originally designed for the determination of bone density and mass, it was subsequently found to be effective for quantifying fat and muscle mass of the human body.

CT and MRI:
CT and MRI are imaging modalities capable of measuring body composition including muscle mass and visceral tissue.

Near Infrared Interactance:
originally designed by the agriculture industry to assess the composition of grains and seeds, is used today by nutritionists to provide estimates of body fat in patients and athletes. This is based on the principles of light absorption and reflection.

FUNCTIONAL ASSESSMENT

Muscle strength
To assess Muscle strength hand grip strength, knee extension or hip flexion strength or peak expiratory flow are typically used.
Impaired hand grip strength has been shown to be a good predictor of increased postoperative complications, increased length of hospitalization, higher re-hospitalization rates and decreased physical status (8). It is also recommended to use in sarcopenia screening.

Fig. 14 Hand grip dynamometer to assess hand grip.

Cognitive Function
mood, concentration, memory assesses by MMSE.

Immune Function
Total lymphocyte counts (TLC) and delayed hypersensitivity reactivity (DHR) have been used in the past to detect malnutrition-related immunosuppression.
For the moment, the routine measurement of immune function is not recommended

LABORATORY INVESTIGATION

General Laboratory parameters-
Full Hematological screen
Liver parameters
Electrolytes, urea and creatinine
vitamins and minerals

Measurement of Inflammation-
Albumin, transthyretin [TTR] formerly prealbumin, transferrin.

ASSESSMENT OF FOOD INTAKE AND ENERGY EXPENDITURE
Food intake-
can be measured using either 3 or 7 day food diaries kept by the patient, or by food intake charts kept by nursing staff and used by the dietician to calculate energy and protein intake.

Nitrogen Balance-
A patient's daily nitrogen balance is a measure of their daily intake of nitrogen minus their daily excretion of nitrogen.
Daily nitrogen balance can be calculated as follows:
Collect 24-hour urinary urea nitrogen and obtain total grams of nitrogen
Add 4 g of nitrogen for insensible losses (stool and skin)
24-hour urinary urea nitrogen + 4 g = daily nitrogen needs to maintain a stable nitrogen balance.
A positive nitrogen balance is essential for wound healing and recovery from illness.

Colorimetry and Nutrition-
Colorimetry is a very essential tool in nutrition science. Direct colorimetry is based on the principle of measurement of total heat loss from body to assess metabolism.
Indirect method mostly used to use now a days and measures total energy production.
REE (Resting energy expenditure) calculated in indirect colorimetry based on O2 consumption and CO2 production.

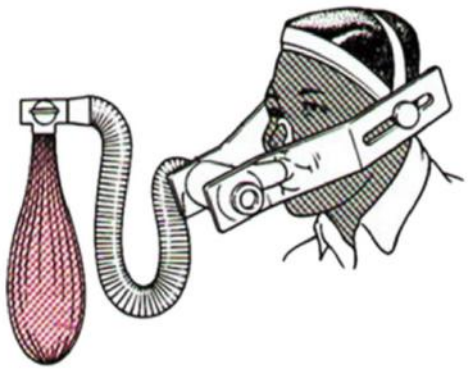
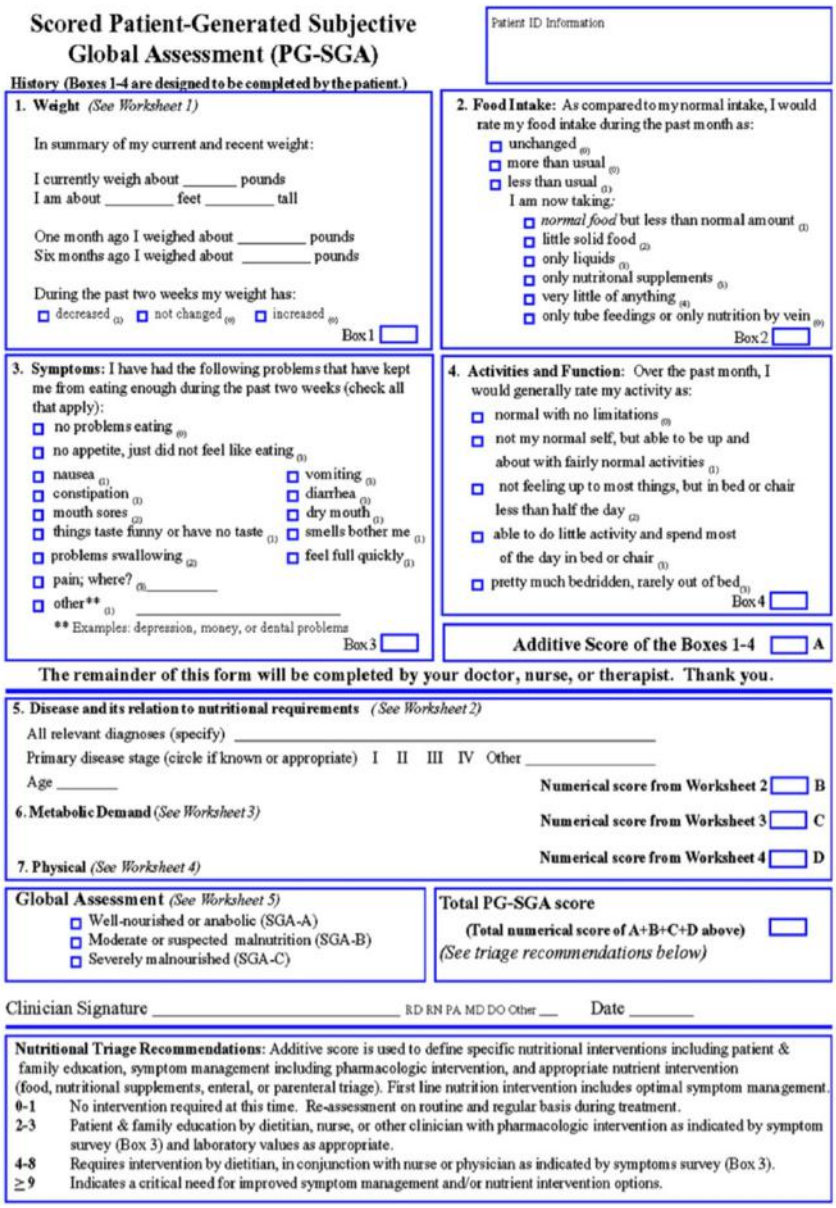


Fig 15 Indirect Colorimetry

Widely used tools for Nutritional Assessment are-

Subjective Global Assessment(SGA)



Scored Patient-Generated Subjective Global Assessment (PG-SGA)

Patient ID Information

History (Boxes 1-4 are designed to be completed by the patient.)

1. Weight *(See Worksheet 1)*

In summary of my current and recent weight:

I currently weigh about _____ pounds
I am about _____ feet _____ tall

One month ago I weighed about _____ pounds
Six months ago I weighed about _____ pounds

During the past two weeks my weight has:
☐ decreased (1) ☐ not changed (0) ☐ increased (0)

Box 1 ☐

2. Food Intake: As compared to my normal intake, I would rate my food intake during the past month as:
☐ unchanged (0)
☐ more than usual (0)
☐ less than usual (1)
I am now taking:
☐ *normal food* but less than normal amount (1)
☐ little solid food (2)
☐ only liquids (3)
☐ only nutritonal supplements (3)
☐ very little of anything (4)
☐ only tube feedings or only nutrition by vein (0)

Box 2 ☐

3. Symptoms: I have had the following problems that have kept me from eating enough during the past two weeks (check all that apply):
☐ no problems eating (0)
☐ no appetite, just did not feel like eating (1)
☐ nausea (1)
☐ constipation (1)
☐ mouth sores (2)
☐ things taste funny or have no taste (1)
☐ problems swallowing (2)
☐ pain; where? (0)_____
☐ other** (1) _____
☐ vomiting (3)
☐ diarrhea (3)
☐ dry mouth (1)
☐ smells bother me (1)
☐ feel full quickly (1)
** Examples: depression, money, or dental problems

Box 3 ☐

4. Activities and Function: Over the past month, I would generally rate my activity as:
☐ normal with no limitations (0)
☐ not my normal self, but able to be up and about with fairly normal activities (1)
☐ not feeling up to most things, but in bed or chair less than half the day (2)
☐ able to do little activity and spend most of the day in bed or chair (3)
☐ pretty much bedridden, rarely out of bed (3)

Box 4 ☐

Additive Score of the Boxes 1-4 ☐ **A**

The remainder of this form will be completed by your doctor, nurse, or therapist. Thank you.

5. Disease and its relation to nutritional requirements *(See Worksheet 2)*

All relevant diagnoses (specify) _____

Primary disease stage (circle if known or appropriate) I II III IV Other _____

Age _____

Numerical score from Worksheet 2 ☐ **B**

6. Metabolic Demand *(See Worksheet 3)*

Numerical score from Worksheet 3 ☐ **C**

7. Physical *(See Worksheet 4)*

Numerical score from Worksheet 4 ☐ **D**

Global Assessment *(See Worksheet 5)*
☐ Well-nourished or anabolic (SGA-A)
☐ Moderate or suspected malnutrition (SGA-B)
☐ Severely malnourished (SGA-C)

Total PG-SGA score
(Total numerical score of A+B+C+D above) ☐
(See triage recommendations below)

Clinician Signature _____ RD RN PA MD DO Other ___ Date _____

Nutritional Triage Recommendations: Additive score is used to define specific nutritional interventions including patient & family education, symptom management including pharmacologic intervention, and appropriate nutrient intervention (food, nutritional supplements, enteral, or parenteral triage). First line nutrition intervention includes optimal symptom management.

0-1	No intervention required at this time. Re-assessment on routine and regular basis during treatment.
2-3	Patient & family education by dietitian, nurse, or other clinician with pharmacologic intervention as indicated by symptom survey (Box 3) and laboratory values as appropriate.
4-8	Requires intervention by dietitian, in conjunction with nurse or physician as indicated by symptoms survey (Box 3).
≥ 9	Indicates a critical need for improved symptom management and/or nutrient intervention options.

Fig. 16 Subjective Global Assessment scale.

Mini Nutritional Assessment Short Form (MNA- SF) also used for nutritional assessment in older population

Mini Nutritional Assessment Short Form (MNA-SF)

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 3 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 psychological distress 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
F1. BMI

0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater
IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2. DO NOT ANSWER QUESTION F2 IS QUESTION F1 IS ALREADY COMPLETED
F2. Calf circumference
0 = CC less than 31cm
1 = CC 31cm or greater

Screening score (max 14 points)

12 - 14 points: **normal nutritional status**
8 - 11 points: **at risk of malnutrition**
0 - 7 points: **malnourished**

According to Kyle et al and Wakahara et al SGA score has ability to predict length of Hospital stay (5,9). Atalay et all in their study demonstrated ability of SGA ability to predict mortality (10).

SUMMARY

All Hospitalized patients should have their nutritional status recorded at admission to . Nutritional screening is done by a rapid and simple tool for evaluation of patients at risk of undernutrition.
ESPEN recommends MUST for the community people, the NRS-2002 for the hospital patients and the MNA for the elderly population for screening.
Nutritional assessment is a more detailed approach and has to be done in those patients screened at risk of undernutrition.
A complete nutritional assessment consists of a combination of subjective and objective parameters. Patient history, physical examination and body composition, disease status, functional assessment and laboratory tests are used.
The main goal is to identify patients at risk and to start adequate nutritional intervention in all patients at risk.

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