GUIDELINE ON MALNUTRITION

RECOGNISING, DIAGNOSING AND TREATING MALNUTRITION IN ADULTS

Authors:
Hinke Kruizenga PhD RD [1,2,3], Sandra Beijer PhD RD [1,4], Getty Huisman-de Waal PhD RN [1,5], Cora Jonkers-Schuitema Bsc RD [1,6], Mariël Klos Bsc RN [1,7], Wineke Remijnse-Meester Bsc RD [1,8], Abel Thijs PhD MD [1,9], Michael Tieland PhD [10], Ben Witteman PhD MD [1,11]

[1] Dutch Malnutrition Steering Group, [2] dietitian-researcher at VU University medical center, Amsterdam, [3] Editor-in-chief NTVD, Dutch Association of Dietitians, Houten, [4] dietitian-researcher at IKNL, Utrecht [5] nurse-researcher at IQ healthcare, Radboudumc, Nijmegen, [6] dietitian at Amsterdam Medical Center, Amsterdam, [7] nutrition nurse specialist for Gelre Hospitals, Apeldoorn [8] policy advisor to Dutch Association of Dietitians, Houten, [9] internist at VU University medical centre Amsterdam, [10] senior researcher at Amsterdam University of Applied Sciences, lecturer in weight management, [11] Professor of Nutrition and intestinal health in transmural care and Gastroenterologist, Gelderse Vallei Hospital, Ede

August 2017

Translation: Alison Fisher (afisher@xs4all.nl)

Dutch Malnutrition Steering Group

TABLE OF CONTENTS

List of abbreviations

RDA	Recommended Daily Allowance
BIA	Bio-electric impedance analysis
BMI	Body Mass Index
DEXA	Dual Energy X-ray Absorptiometry
ESPEN	European Society for Clinical Nutrition and Metabolism
LASA	Longitudinal Aging Study Amsterdam
LESA	Landelijke Eerstelijns SamenwerkingsAfspraak; National Primary Care Collaboration Agreement
LPZ	Landelijke Prevalentiemeting Zorgproblemen; National Prevalence Measurement of Care Problems
MNA	Mini Nutritional Assessment
MUST	Malnutrition Universal Screening Tool
NAP	Nutritional Assessment Platform
PG-SGA	Patient-Generated Subjective Global Assessment
IC	Intensive Care
REE	Resting Energy Expenditure
SNAP	Short Nutritional Assessment Procedure
SNAQ	Short Nutritional Assessment Questionnaire for hospitals
SNAQ RC	Short Nutritional Assessment Questionnaire for residential care
SNAQ 65+	Short Nutritional Assessment Questionnaire for elderly people living at home
TPN	Total Parenteral Nutrition
FMI	Fat Mass Index
FFM Index	Fat-free mass index

INTRODUCTION

Aim of guideline

The aim of this malnutrition guideline is a timely, optimal and uniform recognition and treatment of malnutrition related to disease and ageing.

Contents

The first chapter of the guideline covers definitions, risk indicators, different types of malnutrition, and the causes, consequences and prevalence of malnutrition. The second chapter contains information about recognising and diagnosing it, while the third chapter explores treatment, evaluation and monitoring. In the fourth chapter, transmural, multidisciplinary collaboration is discussed.

Patient population

The patient population to which this guideline applies consists of adults at risk of malnutrition or already suffering from malnutrition in all sectors of Dutch healthcare. This guideline does not apply to children nor to adults who are not being treated by a healthcare professional. The contents of this guideline are in line with the contents of existing guidelines on related topics (for example, the malnutrition among geriatric patients guideline (2013), malnutrition and cancer guideline (2012), various ESPEN guidelines).

Users of the guideline

The target group for this guideline consists of all healthcare professionals who can recognise and treat adults suffering from or at risk of malnutrition. The last chapter addresses the multidisciplinary distribution of tasks and responsibilities.

The authors and approval by the members of the Malnutrition Steering Group

The authors come for the relevant professional groups: dietetics, internal medicine, gastroenterology, nursing, nutritional science and kinesiology. The guideline has been approved by the members of the adult section and the scientific advisory council of the Malnutrition Steering Group. These groups contain representatives from the fields of general medicine, dietetics, nursing, geriatrics, internal medicine, nutritional science, kinesiology, healthcare management, pharmacology and paediatrics.

The guideline was written without project financing, and its contents were not influenced by the opinions or interests of individuals or institutions. There are no conflicts of interests among the authors or the members of the Malnutrition Steering Group.

Methodology

This guideline is narrative in nature. No systematic literature review was done as the subject and the field are too broad. Not enough good-quality research has been done to be able to produce evidence-based conclusions. Nevertheless, it is necessary to offer suggestions for individual patient healthcare. This guideline can be helpful in that respect.

The most recent literature and insights have been included. Consensus was achieved after discussions and several written rounds of revision. The evidentiary value has not been specified for each recommendation, but scientific support is provided. When there is insufficient evidentiary value (only based on expert opinions or research that is not comparable), this is stated. The main recommendations in each chapter are summarised in boxes.

August 2017

1. MALNUTRITION

1.1 Definition and place in the spectrum of nutrition-related conditions

The European Society for Clinical Nutrition and Metabolism (ESPEN) defines malnutrition as 'a state resulting from lack of uptake or intake of nutrition leading 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'. (1,2)

In a consensus statement from ESPEN (2016) about the terminology of clinical nutrition and related aberrations and conditions, malnutrition is considered a nutrition-related disorder, alongside sarcopenia and frailty, overweight, obesity, micronutrient deficiencies and the refeeding syndrome (Figure 1). (2)

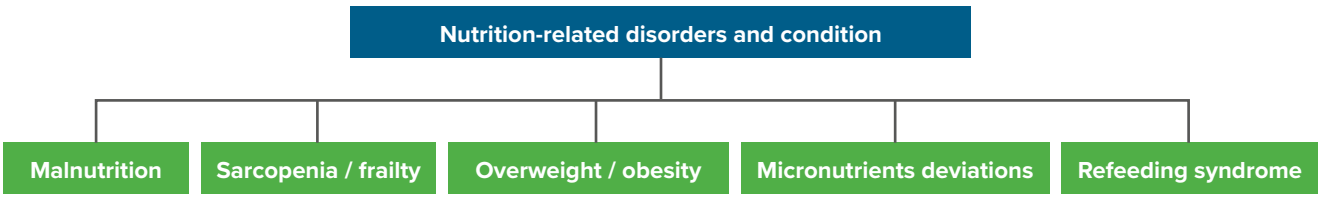


Figure 1 - Classification of nutrition-related disorders and conditions.(2)

1.2 Risk indicators for malnutrition

1.2.1 Basic set of risk indicators for malnutrition

In general, the following basic set of risk indicators for malnutrition is used in the Netherlands to diagnose malnutrition in adults (≥ 18 years): (3–7)

- BMI < 18.5 (18-69 years) and BMI < 20 (≥70 years) and/or
- Unintentional weight loss >10% in 6 months and/or
- Unintentional weight loss >5% in one month

In 2015, the European Society for Clinical Nutrition and Metabolism (ESPEN) proposed a new set of basic risk indicators for diagnosing malnutrition (2):

1. BMI < 18,5
2. OR >10% weight loss (no timeframe specified) or >5% weight loss in the last 3 months AND BMI <20 (70 years) or <22 (>70 years)
3. OR >10% weight loss (no timeframe specified) or >5% weight loss in the last 3 months AND FFM Index <15 kg/m2 for women and <17 kg/m2 for men.

These ESPEN indicators of malnutrition seem stricter than the previous indicators based on BMI and unintentional weight loss given above. According to the ESPEN indicators, a patient with a BMI >22 can only be classified as malnourished if there is unintentional weight loss in combination with a low FFM Index. This would mean that primarily overweight patients would only be diagnosed with malnutrition once their FFM Index passed a critical point. Several research groups are currently comparing the new set of risk indicators for malnutrition with other sets to uncover which one is best at characterising the malnourished patient. In the near future, this topic will be frequently addressed in articles and discussions.

1.2.2 Viewpoint of Malnutrition Steering Group

The Malnutrition Steering Group has so far only taken over the classification into categories of malnutrition from ESPEN (see figure 1). The ESPEN criteria for malnutrition have not yet been adopted. Until more research data are available, the Malnutrition Steering Group will continue using the standard basic set of risk indicators for malnutrition:

- BMI <18.5 (18-69 years) and BMI <20 (≥70 years) and/or
- Unintentional weight loss >10% in 6 months and/or
- Unintentional weight loss >5% in one month

Including the measurement of the lean body mass in the diagnostic work-up of the nutritional status is supported and encouraged by the Malnutrition Steering Group as it reflects the amount of muscle mass, which cannot be properly estimated just with weight. However, a measurement of the lean body pass is not always possible. This topic wil be considered in greater depth in section 2.1.4.

1.3 Types of malnutrition

The classification of types of malnutrition helps in clarifying the pathophysiology and determining the content of the treatment goals. Figure 2 illustrates the different types of malnutrition as described by ESPEN. Table 1 gives an overview of the diagnostic aspects for each type of malnutrition and the similarities, differences and examples of the types of malnutrition.

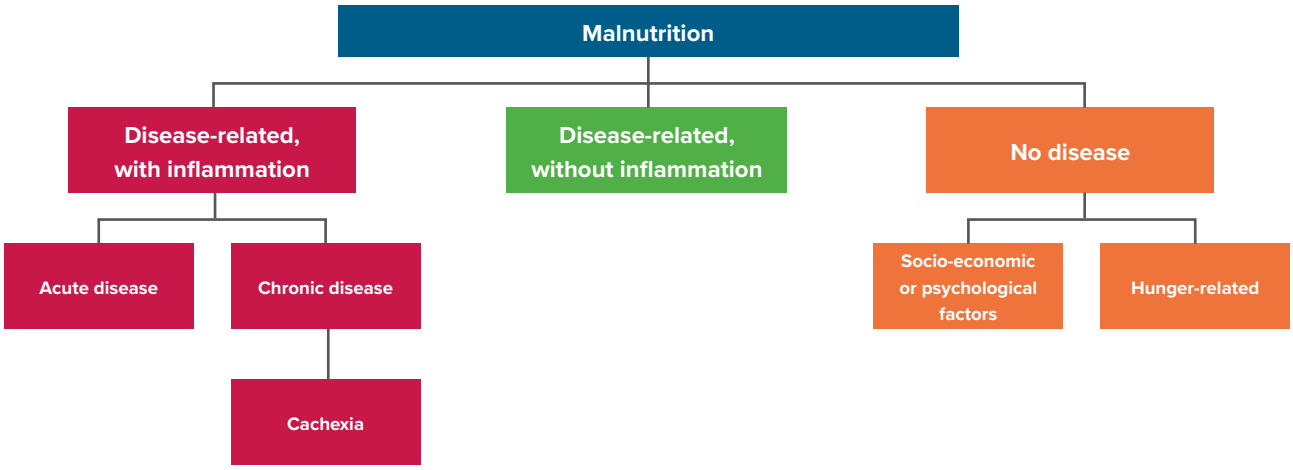


Figure 2 – Types of malnutrition (2)

Table 1 Characteristics of types of malnutrition (2,4)

	Disease-related malnutrition with inflammation - Acute disease / trauma	Disease-related malnutrition with inflammation – Chronic disease	Disease-related malnutrition without inflammation	Malnutrition without disease – Socio-economic factors
Inflammation	Yes	Yes	No	No
Insulin resistance	Yes	Yes	No	No
Reduced functionality	Yes	Yes	Yes	Yes
Examples	IC patients, trauma, exacerbation of an inflammatory disease	Chronic phase of an inflammatory disease (e.g. Crohn, rheumatism) or cancer	Dysphagia, CVA, anorexia nervosa	Too little intake of nutrition due to poverty, loneliness, neglect, grief, hunger strike, starvation

1.3.1 Cachexia

If disease-related malnutrition with inflammation is present, it could be a case of cachexia. Cachexia is characterised by a severe metabolic dysregulation with consequences for the muscle mass, energy consumption, functionality and appetite. Pathologies in which it can arise include cancer, COPD and other chronic inflammatory coditions. Distinctions are made between precachexia, occurring relatively early in the course of the disease, cachexia as the disease progresses, and refractory (irreversible) cachexia in the last period preceding death. With precachexia the weight loss is limited (≤ 5%), but there is anorexia and metabolic dysregulation. Cachexia is associated with severe (>10%) weight and muscle loss. Refractory cachexia does not respond to treatment, the Karnofsky index is ≤ 40 and life expectancy is ≤ 3 months. (8)

1.4 Causes of malnutrition

The causes of malnutrition can be classified into somatic, functional, psychological and social factors. Examples of somatic factors include the disease state (differing grades of inflammation) and symptoms/nutritional issues due to the disease or its treatment, such as diminished sense of taste or smell or appetite, dental problems, difficulty swallowing, dysregulation of a feeling of hunger or satiety, disorders of digestion and uptake in the gastrointestinal tract, and pain. Examples of functional factors include reduced mobility, limitations hindering or preventing the possibility of going shopping or preparing food, and fatigue. Examples of psychological factors include anxiety, grief, depression and impaired cognition. Social factors include, for example, loneliness, no social network that could arrange shopping, and poverty. The causes of malnutrition lead to distinctions between the different nutrition-related deviations and conditions and types of malnutrition as presented in Figures 1 and 2 and Table 1. Ascertaining the type of malnutrition is important because the diagnosis has prognostic implications. For example, a nutritional intervention will have much less effect on the recovery of muscle mass in a patient with inflammation-related malnutrition than in a malnourished patient without inflammation. (9)

1.5 Consequences of malnutrition

Malnutrition has negative consequences for the patient's state of health. In some studies, mostly associative ones (which search for links rather than cause-effect), it has been shown that malnutrition is associated with a slower recovery and more and severer complications. Insufficient food intake, illness and inactivity lead to a reduction in muscle mass, an important characteristic of malnutrition. This causes a deterioration in the patient's general condition and reduces their heart and lung capacity. Malnourished people often have a poorer immune status, delayed wound healing, a greater risk of developing decubitus, a lower quality of life and raised mortality. These factors contribute to a longer duration of admission, a poorer response to the medical treatment (chemotherapy, radiotherapy) and a greater use of medicines, which is associated with increased healthcare costs. (10–12)

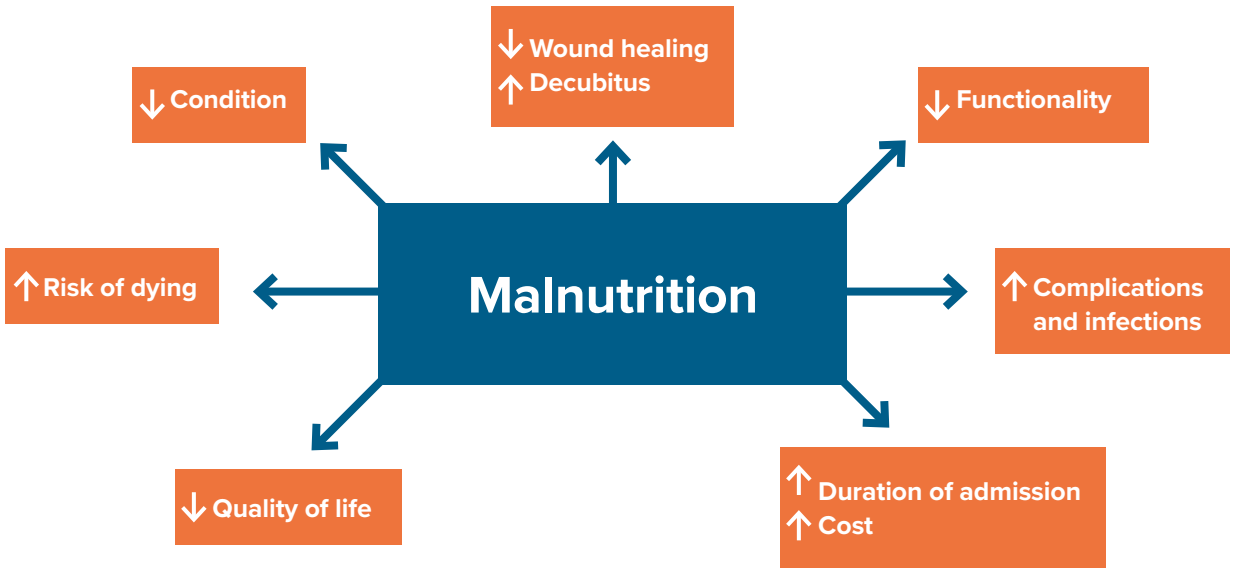


Figure 3 – Possible consequences of malnutrition

1.6 Prevalence of malnutrition

The prevalence of malnutrition is high in all sectors of the Dutch healthcare system. On average, one in four or five patients in hospitals, healthcare institutions and home care is malnourished. Risk groups for malnutrition are vulnerable elderly, chronically ill patients, oncological patients, patients who have undergone major surgery (or are about to undergo it), and patients with a major physical injury. When interpreting prevalence figures, we must realise that they are based on different sets of criteria. The criteria used are presented in the figures below.

Since 2004 the prevalence of malnutrition in the Netherlands has been measured annually as part of the National Prevalence Measurement of Care Problems (LPZ, figure 4). An overview of the current prevalence figures from the LPZ can be found at **https://nl.lpz-um.eu/nl**. In the residential, care and welfare institutions (nursing and retirement homes), the prevalence of malnutrition has varied between 15% and 20% in the past few years.

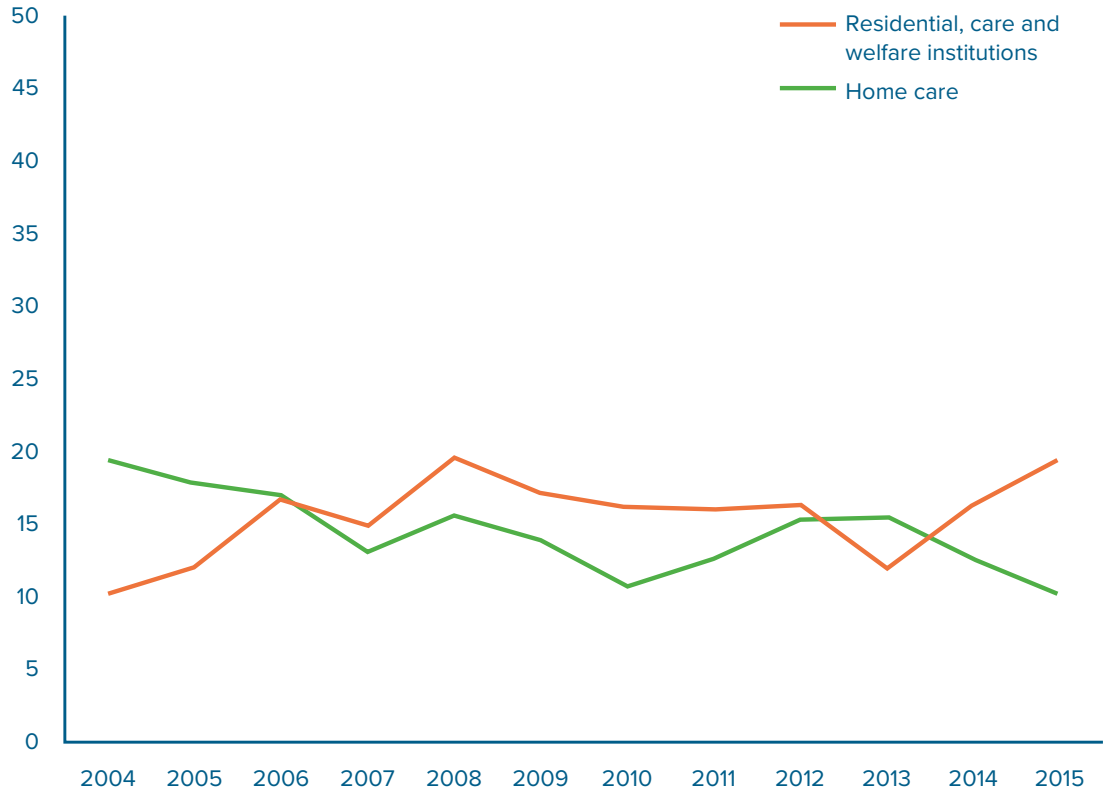


Figure 4 - Prevalence of malnutrition in the Netherlands in 2004-2015, LPZ
Criteria used: A client is malnourished if he or she meets one of the following two criteria: BMI (Body Mass Index) less than 18.5 (clients aged 65 years plus BMI ≤ 20.0); unintentional weight loss exceeding 6 kg in the last 6 months or exceeding 3 kg in the last month. (13)

In 2016 the Malnutrition Steering Group and the Dutch Association of Dietitians (NVD) analysed the screening results (SNAQ and MUST) upon admission of 564,063 patients from 13 hospitals in the period 2007 to 2015. On the first day of admission, the screening outcome revealed 14 - 15% of the patients were “malnourished”. This percentage varied according to medical specialism from 2% to 38%. The prevalence of the screening outcome “malnourished” was highest among patients from the specialisms geriatrics (38%), oncology (33%), gastroenterology (27%) and internal medicine (27%) (figure 5). (14)

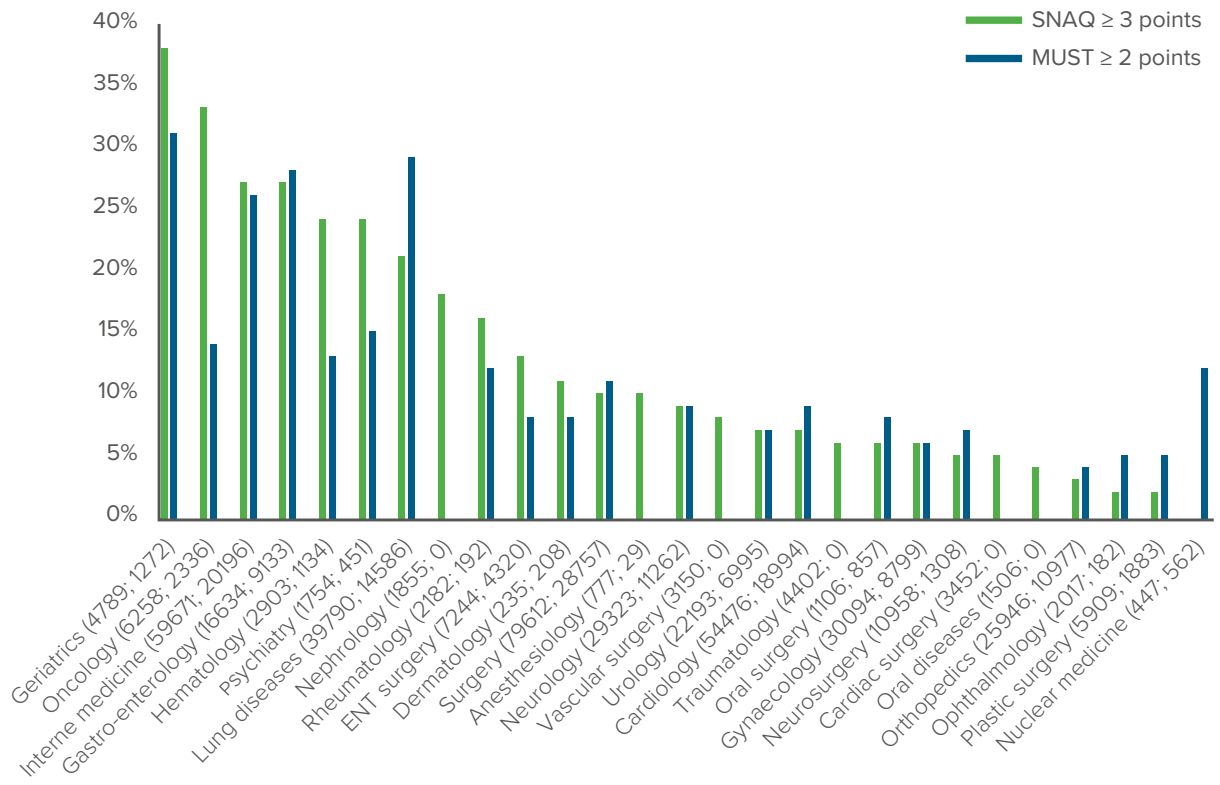
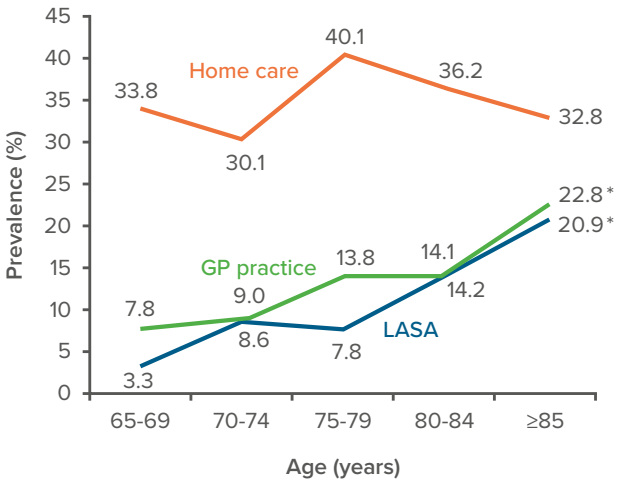


Figure 5 – Prevalence upon hospital admission of screening outcome malnourished by medical specialism. Criteria used: SNAQ and MUST score malnourished (14)

The prevalence of malnutrition in the home situation has hardly been examined. In a study from 2012 of a large group of community-dwelling elderly, 30-40% of those with home care had a red SNAQ65+ score (screening outcome malnourished). Among community-dwelling elderly who visited their GP for a flu shot and community-dwelling elderly in the LASA cohort (Longitudinal Aging Study Amsterdam), the prevalence of a red SNAQ65+ score (screening outcome malnourished) rose with increasing age to a prevalence of 20% in the oldest age group. (15)



Home care: Community-dwelling elderly with home care

LASA: Community-dwelling elderly LASA cohort

GP practice: Community-dwelling elderly going to GP for flu shot

* P < 0.001 for age group trend

Age (years)	LASA (n)	GP (n)	Home care (n)
65-69	209	476	71
70-74	336	502	93
75-79	269	428	157
80-84	247	305	188
≥85	206	167	305

Figure 6 – Screening outcome malnourished according to SNAQ65+

Malnutrition = an acute or chronic condition in which a shortage or imbalance of energy, protein and other nutrients leads to measurable, detrimental effects on body composition, functioning and clinical results

Risk indicators for malnutrition:

- BMI < 18.5 (18-69 years old) and BMI < 20 (≥70 years) and/or
- Unintentional weight loss >10% in 6 months and/or
- Unintentional weight loss >5% in one month

Prevalence of malnutrition

On average, one in four or five patients in hospitals, care institutes and home care are malnourished.

- Nursing and retirement homes: 15-20%
- Hospitals: on average, 14-15% are screened as malnourished on admission. This percentage varies according to medical specialism from 2-38%
- Community-dwelling elderly: 20% for 75+ years
- Elderly with home care: 30-40%

2. RECOGNITION AND DIAGNOSIS OF MALNUTRITION

In the process of the recognition and treatment of malnutrition, the steps in methodical treatment are followed: screening and reporting, diagnosis, formulating treatment goals, treatment plan and evaluation. In this chapter the recognition and diagnosis of malnutrition are described.

2.1 Screening and reporting

Early recognition and treatment of malnutrition and its risk factors are essential. Detection and intervention in the home situation and early in the disease process can ensure that the severity of the malnutrition remains low, as do the consequences for the complexity of care and care requirements. There is a screening instrument for malnutrition available for each healthcare sector. Some screening instruments can be used in all healthcare sectors. The basic set of risk indicators for malnutrition (section 1.2.1) can also be used, while it is most suitable for the outpatient clinic setting. (16)

Table 2 - Screeningsinstrumenten en hun toepassing

Screening instrument	For use in
MUST (5)	All sectors
MNA-SF (17)	All sectors for elderly
PG-SGA Short Form (18)	All sectors
SNAQ (19)	Hospital (clinical)
SNAQ^{65+} (20)	Community-dwelling elderly, rehabilitation centres
SNAQ^{RC} (21)	Residential care (nursing and retirement homes)
NUTRIC Score (22)	Intensive Care

Screening for malnutrition and its risk factors is indicated upon admission in a healthcare institution, or when preparing the needs assessment in home care as part of the nursing anamnesis, but preferably also in GP practices and/or the first visit to the hospital's outpatient clinic.
The screening can be conducted by the nurse or caregiver, and in the case of the PG-SGA SF the patient should fill in the details if possible.
Screening without a treatment plan is futile. Documentation of the procedure for screening and communication of the screening outcome to the doctor in charge and the dietitian are essential.

The Subjective Global Assessment (SGA) (23), the Patient-Generated Subjective Global Assessment (PG-SGA) (24) and the Mini Nutritional Assessment (MNA) (25) are assessment instruments that collect more information than the above-mentioned screening instruments. They result in a score that gives indications for multidisciplinary collaboration.

2.2 Diagnosis

After screening comes diagnosis. That is generally the task of the doctor and the dietitian. The diagnosed nutritional status has several components: determining the needs assessment, expectations and motivation, data about the disease or condition and the anamnesis, determining the metabolic status, nutritional assessment, and recording the social and psychological factors. These factors are presented in figure 7. The data can be collected in the ICF flowchart (International Classification of Function, Disability and Health (26), figure 8).

Determining the needs assessment and recording the relevant disease, social and psychological factors are generic diagnostic components. In this guideline only the components that specifically apply to the diagnosis of the nutritional state have been elaborated.
To assess the nutritional state, certain information is required:

1. food intake, consumption and losses
2. body composition and nutrient reserves
3. functional parameters
4. disease state

The first three points form part of the nutritional assessment. Information about the disease state (metabolic status/ inflammation, as indicator of the severity of the disease) provides supplementary information about the type of malnutrition (see also Table 1).

Figure 7 – Diagnostic components, with disease factors / metabolic status and nutritional assessment being specific for the diagnosis of the nutritional state.

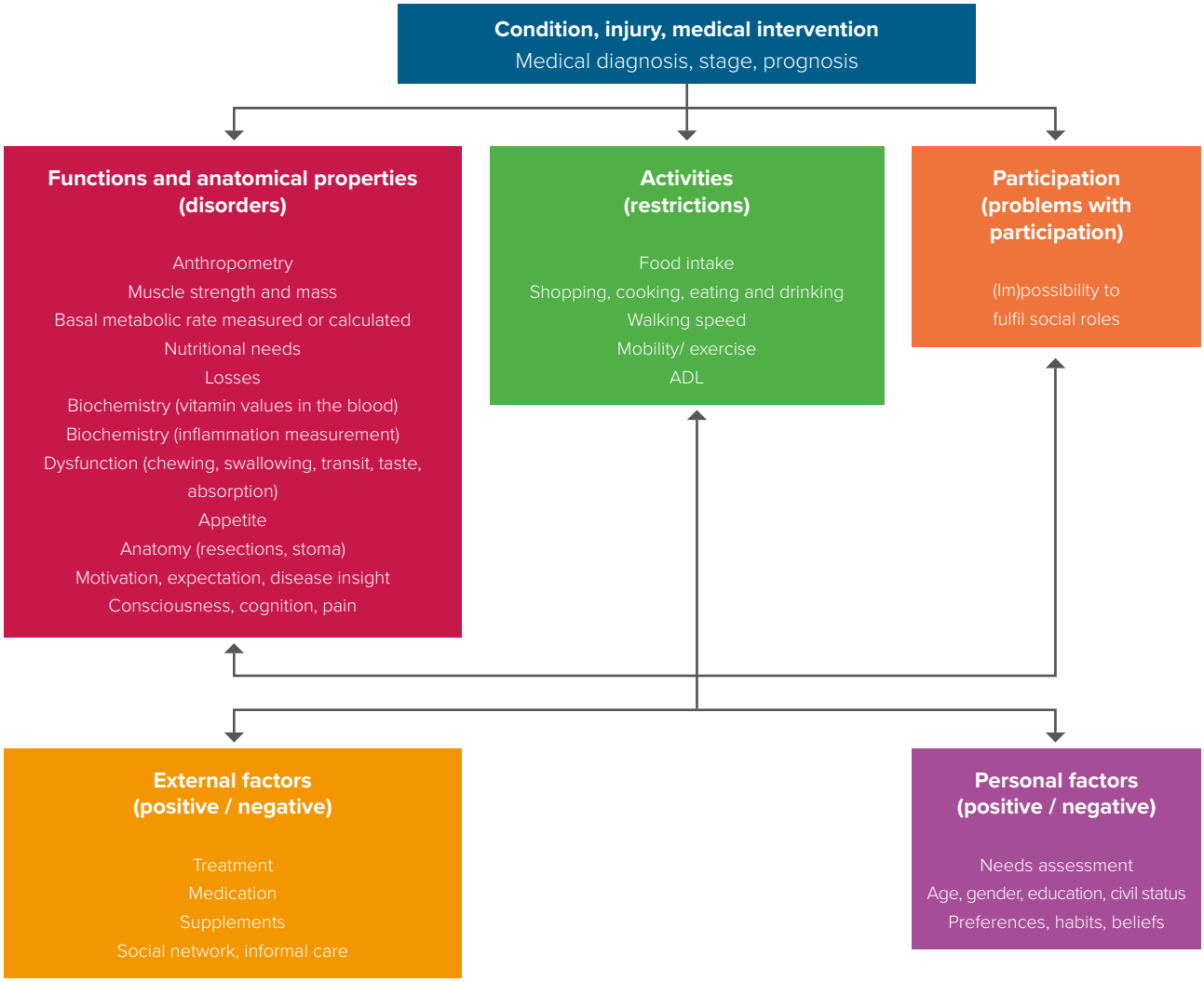


Figure 8 – The ICF flowchart (26)

2.2.1 Nutritional assessment

With nutritional assessment, measurements are done in a structured manner (subjective and objective). A complete nutritional assessment measures the food intake, consumption and losses, body composition, nutrient reserves and functional parameters.

A minimum and optimal set of parameters cannot be established for a generic nutritional assessment. It depends on the patient's disorders and restrictions. An indirect calorimetric measurement, a bomb calorimetric measurement or a measurement of the body composition is not required in all cases but is essential in some.

2.2.1.1 Food intake

Weight change is a fundamental measure. If the hydration status has not changed, it provides an indication of the balance between need and intake of energy and possibly of associated nutrients.

Food intake is difficult to measure, and there is not one technique that is suitable for every purpose and application. If a technique is carefully chosen to measure food consumption, however, and if the consequences of potential errors are taken into account when interpreting the data, a nutrition anamnesis can provide valuable information. Questions can be posed about food intake with the dietary history method or a 24-hour recall. Alternatives include a food journal or a food frequency questionnaire. (27)

2.2.1.2 Consumption

A reliable method that is available in more and more places for the measurement of energy consumption at rest is indirect calorimetry. As the energy calculation formulas provide only an estimate, indirect calorimetry is preferred for the calculation of requirements. The calorimeter measures the excess over the basal metabolic rate for the disease. The excess activity can be estimated with an activity questionnaire or an actometer. Actometers are small, wireless devices that can be worn on the ankle, hip or arm and measure activity.
The nitrogen balance measures the difference between intake and loss of nitrogen. With a normal renal function, the nitrogen balance provides a snapshot of the extent to which net loss and synthesis of body proteins are taking place.
The energy and protein requirement can by estimated by using formulas. There are several energy calculation formulas. For protein there are recommendations for each indication. In general, the guidelines of the World Health Organisation and the Health Council of the Netherlands are followed. This is clarified in section 3 on treatment.

2.2.1.3 Losses

Nutrients can be lost through vomiting and in stools and urine. To gain an impression of the bowel habit, the patient's subjective report is scanned for details of frequency, undigested food remains, stickiness, colour and consistency. The Bristol Stool Chart (28) and faeces analysis can be used for an objective result. The extent of loss of energy, protein and glucose via the urine, and of nutrients via vomiting, can be estimated roughly and subjectively. If the losses are chronic, it is advisable to conduct laboratory testing. The gastroenterologist and gastroenterology dietitian are then involved in the treatment.

Losses can be objectively estimated in several ways. The stool can be tested for fat (Van der Kamer), nitrogen (Kjehldahl) and energy (bomb calorimetry). Loss of protein, ketones and glucose can occur via the urine. The average composition of pleural fluid, ascites, chyle, exudate, blood, dialysis fluid, and breast milk is known. If the volume lost is measured, the loss of nutrients can be calculated. (29)

2.2.1.4 Body composition and nutrient reserves

To measure the body composition, one measurement with an indirect method or two measurements with two different double indirect methods are preferred. Examples of indirect methods include Dual Energy X-ray Absorptiometry (DEXA), densitometry (underwater weighing or the BodPod), MRI and CT scanning. Examples of double indirect methods include skinfold measurements, circumference measurements (mid-upper arm, waist, upper arm muscle), bio-electrical impedance analysis (BIA), and Body Mass Index (BMI). These measures have been elaborated by the Nutritional Assessment Platform (NAP) in Standard Operating Procedures, which can be found at http://nutritionalassessment.nl.

In Maastricht the Short Nutritional Assessment Procedure (SNAP) method was developed. It consists of anthropometric measurements (height, weight, arm circumference, triceps skinfold, wrist circumference, waist circumference) and hand grip strength (to represent muscle function). The evaluation consists of comparing the absolute values with percentile distributions in a pre-programmed Excel sheet. An estimate can be made of whether a patient scores too low (<P5), normal or high for weight, muscle mass, fat mass and muscle strength. (30)

If the anamnesis and symptoms are suspicious, the vitamin status can be determined in the blood.
Fluctuations in the weight can be caused by disruptions in hydration. Given a general and rapid (acute) weight loss exceeding 3% of the body weight, or exceeding 1 kg per day, dehydration must always be suspected. (31, 32)

2.2.1.5 Functional parameters

To get an idea of functionality, questions must be asked about the exercise pattern, functional limitations and symptoms of fatigue. Functionality can be ascertained on the basis of at least two independent measures. Strength can be measured with the hand grip strength or leg muscle strength. Other formats include a treadmill test and an exertion test. There are also questionnaires available that can estimate functionality. (33)

2.2.2 Metabolic status and disease factors

With inflammation, neutrophils and macrophages produce cytokines. This affects the synthesis of acute-phase proteins by the liver. There are positive acute-phase proteins (blood concentration rises with inflammation) and negative acute-phase proteins (blood concentration decreases with inflammation). Examples of positive acute-phase proteins are C-reactive protein (CRP), D-dimer, fibrinogen, ferritin complement factors and plasminogen. Examples of negative acute-phase proteins which can be used as a measure of inflammation are albumin, transferrin, transthyretin (pre-albumin) and anti-thrombin (1, 29).

With inflammation (due to acute disease, fever or trauma, for example), the physiological response to fasting changes as a result of circulating cytokines, inflammatory mediators and stress hormones. The resting metabolism does not decrease but rather increases, and the breakdown of amino acids is higher due to gluconeogenesis, synthesis of acute-phase proteins (CRP, albumin), wound healing and the immune response. Due to the presence of cytokines and high levels of insulin, the synthesis of ketones in the liver declines. The body uses ketones less as an energy source. (1) An overview of the metabolic changes during fasting, with or without inflammation, is presented in table 3.

Table 3 Metabolic changes during fasting with or without inflammation (29)

	Fasting without inflammation	Fasting with inflammation
Resting metabolism	↓	↑
Muscle protein breakdown	↑	↑↑↑
Protein synthesis	↓	↑
Plasma albumin	±	↓↓
Nitrogen balance	↓	↓↓
Ketones	↑↑↑	↑
Gluconeogenesis	↑	↑↑
Blood glucose	↓	↑
Plasma insulin concentration	↑	↑
Insulin resistance	↑↑↑	↑↑↑
Salt and water retention	↑	↑↑↑

2.3 Refeeding syndrome

The refeeding syndrome is a complication arising when starting to feed malnourished patients who have not had any oral intake for a long period (>3 days). Recognition and timely intervention are the joint responsibility of the doctor and dietitian. The Dutch consensus statement on Refeeding syndrome was written in 2012 by the Dutch Association of Nutritional Care teams. This manual provides background information and direction for diagnosis and intervention. (34)

Screening for malnutrition and its risk factors is indicated

- upon admission in the healthcare institution
- in the needs assessment done by home care as part of the nursing anamnesis
- in the GP practice
- at the first visit to the hospital's outpatient clinic.

Screening without a treatment plan is futile. Documenting the procedure for screening and communicating the screening outcome to the doctor in charge and the dietitian are essential

To diagnose nutritional status, the minimum amount of information required concerns:

1. food intake, consumption and losses
2. body composition and nutrient reserves
3. functional parameters
4. disease status

3. TREATMENT, EVALUATION AND MONITORING

The treatment of malnutrition is tailored to the individual. Based on the diagnostic data, mono- and multidisciplinary treatment goals are formulated. Nutritional intake, disease, treatment and related nutritional problems, exercise, ageing, psychological and social status are important factors in developing malnutrition and thus also the factors determining the success of the treatment.

3.1 Nutritional requirement

3.1.1 Energy

3.1.1.1 Measuring the resting metabolism

The energy consumption at rest (Resting Energy Expenditure, REE, or resting metabolism) can be estimated with indirect calorimetry. It measures the quantity of oxygen consumed by the body (VO2) and the quantity of carbon dioxide produced (VCO2). With these data, REE can be calculated with the Weir formula:

Energy consumption at rest (kcal/day) = [(VO2 x 3.941) + (VCO2 x 1.11)] x 1440

3.1.1.2 Estimating the resting metabolism

The total energy requirement varies greatly between patients, due to differences in both resting metabolism and energy consumption through physical activity and disease. To determine the resting metabolism, measurement using indirect calorimetry is preferred to estimating it using a formula. The evaluation of clinical and outpatient clinic patients revealed that among the most common formulas, the WHO formula based on weight and height (1985) can best predict the energy requirement at rest (compared with a measurement using indirect calorimetry). With overweight patients, the Harris & Benedict formula (1919) provides the best estimate. The precision of these calculations is limited, however. The overestimate or underestimate from the formula is acceptable (within a range of 10% under and over the measured resting metabolism) for only half of the patients. (35)
Evaluation found that set factors, like 25 or 30 kcal/kg, were not suitable. They tended to exaggerate the result, leading to the resting metabolism of underweight patients being assessed too low and that of overweight patients too high. Adjustment of the weight in the formula did not improve the estimate. (35,36)

WHO formula 1985 (37)

Men

- 18-30 years: Resting metabolism (kcal) = 15.4 weight (kg) - 27 height (m) + 717
- 30-60 years: Resting metabolism (kcal) = 11.3 weight (kg)-16 height (m) + 901
- >60 years: Resting metabolism (kcal) = 8.8 weight (kg) + 1128 height (m) - 1071

Women

- 18-30 years Resting metabolism (kcal) = 13.3 weight (kg) + 334 height (m) + 35
- 30-60 years: Resting metabolism (kcal) = 8.7 weight (kg) - 25 height (m) + 865
- >60 years: Resting metabolism (kcal) = 9.2 weight (kg) + 637 height (m) - 302

Harris & Benedict formula 1919 (39)

Men

- 1919: Resting metabolism (kcal) = 13.7516 weight (kg) + 5.0033 height (m) - 6.7550 age (years) + 66.4730

Women

- 1919: Resting metabolism (kcal) = 9.5634 weight (kg) +1.8496 height (m) - 4.6756 age (years) + 655.0955

3.1.1.3 Adjustment factor

To convert the resting metabolism into the total energy requirement, adjustment factors are used. There are two methods available:

1. General: 30% adjustment. This is a very generic method that does not distinguish between adjustment for disease and for activity. It is applied because as the severity of the disease increases, the amount of physical activity generally declines. For the majority of clinical patients, an adjustment of 30% will be sufficient, but that should be evaluated for each individual patient. Little research has been done about this aspect.
2. Specific: adjustments have been examined for a small number of diseases. An upper limit of 50% adjustment can be used to prevent an accumulation of adjustment factors. There are exceptions, such as patients with extensive burns (39).

3.1.1.4 Which weight should be used in the formula?

With the formulas given above, gender, age, weight and height are entered. For weight, it is recommended to use the actual weight. For overweight, adjusting the weight to be entered downwards results in an underestimate of energy consumption. For underweight, the patient's energy consumption per kg body weight is raised by selective retention of organ mass. Adjustment of the weight likely produces in that case a better estimate of energy consumption, but without adequate proof, it cannot be applied. (35, 39, 40)

3.1.2 Protein requirement in different groups

A patient's protein requirement depends on age, quantity of lean BM, amount and type of physical activity, disease severity and use of corticosteroids. Table 4 presents an overview of the current protein recommendations from the available international guidelines. These recommendations are based on nitrogen balance studies and expert opinion, with limited scientific support.

To achieve an increase in muscle mass, the synthesis of muscle protein must exceed muscle breakdown. In a healthy situation, protein synthesis and breakdown are balanced. With disease and ageing, this balance can be negative due to:

- insufficient protein intake
- reduced utilisation of protein (anabolic resistance)
- reduced sensitivity of the muscle through inactivity (anabolic resistance)
- raised protein requirement due to inflammation
- changes in digestion and absorption

There is a consensus that in these situations more protein is needed than in a healthy situation. In general, a minimum quantity of 1.2 g protein/kg body weight is recommended when the patient is ill.

For protein synthesis sufficient exercise is essential. In addition, the quantity of essential amino acids in the diet is important. For a good anabolic response, around 10 g of essential amino acids are required in each meal. To achieve this, 20 g of high-quality protein (animal protein) is required in each meal, or 25-30 g of average dietary protein. (41)

Table 4 Protein requirement in different adult groups

Group	Protein requirement
Healthy adults (18-64 years) (37)	0.8 g/kg body weight
Healthy elderly (>65 years) (42, 43)	1.0 g/kg body weight
Acutely ill patients (43, 44)	1.5-1.7 g/kg body weight
Chronically ill patients (43)	1.2-1.5 g/kg body weight

The recommended quantity of protein can also be expressed as a recommendation per kg lean BM. This method accounts for the differences in body composition between men and women and the variability in the ratio of fat and muscle mass in, for example, athletes, people with an extreme body weight, and those with sarcopenia. The following ratios can be used.

- 1.1 g protein per kg FFM is roughly equivalent to 0.9 g protein/kg body weight
- 1.5 g protein per kg FFM is roughly equivalent to 1.2 g protein/kg body weight
- 1.9 g protein per kg FFM is roughly equivalent to 1.5 g protein/kg body weight

3.1.2.1 Protein requirement for underweight and overweight patients

The underweight body in general has more protein per kg body weight, and the requirement is underestimated. The protein requirement is overestimated for an overweight body with a high fat mass if the current body weight is used. This can be compensated by calculating the protein requirement on the basis of the measured lean BM.

3.1.2.2 Protein requirement with parenteral nutrition

Parenteral nutrition contains single amino acids. Single amino acids are heavier than protein because a water molecule is released when two amino acid molecules bind together. Hoffer calculated that 100 g amino acids is equivalent to 83 g protein and that 100 g protein is equivalent to 120 g amino acids. Parenteral provision of amino acids therefore provides on average 17% less protein than oral or enteral provision of unhydrolysed protein. Thus, if you want to administer 0.8-1.5 g protein/kg, it is necessary to give 1.0-1.8 g amino acids per kg. Plus the Atwater factor of 4 kcal/g protein does not apply with parenteral nutrition. For amino acids a factor of 3.3 kcal/g (average) is used. (46)

3.1.2.3 Nutrition in the acute phase of disease

The Nutrition policy followed in the Intensive Care ward for patients in the acute phase of a disease differs by institution and country. There are still too many controversies about the use of enteral or parenteral nutrition and the quantity of energy and macronutrients in the first phase of acute disease. Arabi et al. (47) recently analysed the current state of science and formulated ten research questions that need answering in the coming ten years. Preiser et al. (48) listed the topics under the headings of consensus and controversy:

Consensus exists about:

- Enteral nutrition is preferred to parenteral nutrition because it retains the integrity of the intestinal tract
- The energy requirement cannot be estimated with formulas; measuring it with indirect calorimetry is necessary
- Do not give too much nutrition, never more than the measured requirement.
- Arginine is ineffective in the acute phase of a disease

Controversy exists about:

- Energy according to requirement versus less energy
- Protein according to requirement versus less protein
- Use of parenteral nutrition if enteral nutrition is not adequate versus no parenteral nutrition
- If there is a risk of refeeding syndrome, build up the nutrition slowly versus rapid build-up with good monitoring and supplementing deficits

3.1.3 Micronutrients

The recommended quantities of micronutrients like vitamins, minerals and trace elements were prepared by the Health Council of the Netherlands and intended for a healthy person. It is unclear, due to a lack of sound research, to what extent there is a changed need for micronutrients during disease states. A shortage of vitamins and/or minerals in patients is difficult to ascertain, as the plasma levels of micronutrients do not always reflect the body's store and are strongly influenced by the changing requirements during disease. Until sufficient research data are available, the recommended daily allowance for healthy people will be retained as a baseline. It is advisable to pay additional attention to vitamin B1 (thiamine). The body's store of this vitamin is small, and the consequences of a deficiency are great. If a shortage of micronutrients is suspected:

- Supplement all micronutrients according to the recommended daily allowance (RDA)
- Supplement vitamin B1: 100-300 mg orally, enterally, intramuscularly or intravenously
- Specific determination of micronutrient values in the blood and supplement according to the outcomes. (49)

Another point of concern is vitamin D. The Health Council of the Netherlands recommends men and women with a dark skin in all age groups, pregnant women and women between 50 and 70 years take 400 IU (10 µg) of vitamin D. For elderly men and women (70+ years), the recommendation is 800 IU (20 µg) of vitamin D. (50)

When using a multivitamin/mineral supplement, it is important not to exceed the dosage of 100% of RDA (this does not apply in the case of losses). The dietitian can evaluate the intake. With tube feeding and/or parenteral nutrition, the provision of micronutrients is usually good. A bottle of fluid nutrition generally contains a third of RDA. If the patient does not drink three bottles of fluid nutrition each day, it is advisable to prescribe a multivitamin supplement or monitor the patient with blood testing.

The Dietetic Pocket Guide contains information about RDA, the maximum safe upper limit, toxic value, body's stores and normal values. In table 5 recommendations are made to supplement shortages. This table must be applied with care as such a general recommendation may not always be applicable in individual cases.

Table 5 – Options for suppletion of vitamins, minerals and trace elements in deficiencies (29)

Type	Normal values serum (VUmc)	Deficiency (mmol/L)	Supplement form (Oral and IV)	Possible type of supplement	Possible dosage	Remarks
Water-soluble vitamins						
Thiamine	80-160 nmol/L	<60 nmol/L Ernstig <20 nmol/L	Oral	Tablet 25 /50/ 100 mg	12.5-25 mg/g, with severe deficiency 100 mg/d	Possibly see refeeding syndrome See also acute manual for internal medicine in the case of alcoholism
			IM/SC	njection fluid 50/100 mg/ml, 1 ml	25-100 mg	
			IV		Added to TPN 0.5 mg/4180kJ	
Pyridoxine	13-80 nmol/L	<13 nmol/L	Oral	Tablet 20/ 50/ 100 mg	50-100 mg/d	Risk of overdose: neurological symptoms
			IM/IV	Injection fluid 1 ml = 50 mg		
Folic acid	>6 nmol/L	<3 µg/L, <150 ng/L in red blood cells	Oral	Tablet 0,5 / 5 mg	0.5-1 mg/d curative, preventive/ maintenance 0.25-0.5 mg/d, max 1 mg/d in 2 doses	Preventive against neural tube defect: 0.4-0.5 mg/d 4 weeks before until 8 weeks after conception
			IM/IV	Injection fluid 5 mg/ml		
Cobalamin	150-700 pmol/L	<150 pmol/L	IM	Injection 1000 µg	Start dosage 1 x week/month Maintenance dosage 1000 µg/ 2 months or 300 µg/month	dication: >60 cm terminal ileum resection. Possibly methylmalonic acid determination
B-complex			Oral	Cardox5 (B6 50 mg, folic acid 5 mg, B12 400 µg)	1 tablet/d or 3 x / week	Tablet is gluten-free
B-complex Ascorbic acid	11-100 µmol/L		Oral	Tablet 250 / 500 mg	≥12 years: 500 mg/d, in severe cases 1 g/d	Not for premature infants
			IV/IM	Injection fluid ampul 5 mg: 100 mg/ml	500 mg/d, possibly 1-2 g infants 100 mg/d IV children: 100-500 mg/d in 2-3 doses IV	

Type	Normal values serum (VUmc)	Deficiency (mmol/L)	Supplement form (Oral and IV)	Possible type of supplement	Possible dosage	Remarks
Fat-soluble vitamins						
Retinol	1,2-3 µmol/L			Vitamin A drink FNA 50.000 IE/ml	25,000-50,000 IU/d, children <8 years 10,000-20,000 IU/d	
Ergocalciferol, cholecalciferol	1,25-dihydroxy: 50-60 pmol/l 25-hydroxy: >50 nmol/L	<50 nmol/L	Oral	Cholecalciferol 800 IU Calcichew D3 (500/400, 500/800, 1000/800)	400-880 IU/d, children >4 years 400 IU	
				Cholecalciferol FNA drink 50,000 IU/ml	for 8-12 weeks 10,000 IU/d or 50,000-60,000 IU/week	
Tocopherol	20-39 µmol/L	<20 µmol/L	Oral	Tocofersolan 400 IU, α-tocopherol tablet 50 mg	1x d 1 tablet, α-tocoferol 100-200 mg/d	

Type	Normal values serum (VUmc)	Deficiency (mmol/L)	Supplement form (Oral and IV)	Possible type of supplement	Possible dosage	Remarks
Fat-soluble vitamins						
Magnesium	0,7-1,0 mmol/L	Mild to moderate 0.5-0.7	Oral	Magnesium hydroxide (Maalox chew tablet: aluminium oxide 200 mg, magnesium hydroxide 400 mg). Maalox drink (forte)	3 x daily 1 tablet or 13-34 mmol/d oral	Not with severe renal insufficiency or hypophosphatemia
				Magnesium carbonate (Magnesiocard forte (sachet per 5-10 mmol) Mg-aspartate -hydroxide)	10-60 mmol/d (or 13-34 mmol)	No magnesium oxide due to laxative effect and limited uptake
				Magnesium lactaat 8 mg tablet	3 x daily 1-2 tablet	
				Magnesium gluconate 1000 mg tablet. Magnesium gluconate drink 43.6 mg Mg/ml (FNA)	3 x daily 1-3 tablet 3 x daily 10-15 ml (at night 20-30 ml for better absorption)	Risk of deficiency with diarrhea
			IV	Magnesium sulphate (100 or 150 mg/ml)	10-15 mmol/d	
		Severe <0.5		Magnesium sulphate (100 or 150 mg/ml)	Every 6 hours 1.5-3 mmol/h IV or with very severe hypomagnesemia 4 mmol/h IV	
Phosphate	0,7-1,4 mmol/L	Mild to moderate 0.3-0.8	Oral	Phosphate drink (1 mmol/ml)	15-30 mmol/d	
				NeutraPhos 250 mg	1x daily 1	
			IV	Glycerophosphate	15-30 mmol/d	
		Severe <0,3		Glycerophosphate	0.25-1.0 mmol/kg over 8-12 h For a rapid drop (<0.3 mmol/L/d) or with life-threatening hypophosphatemia: 4.5 mmol/h for 3 h IV followed by 2-3.5 mmol/h IV with max 90 mmol/d and frequent monitoring	

Type	Normal values serum (VUmc)	Deficiency (mmol/L)	Supplement form (Oral and IV)	Possible type of supplement	Possible dosage	Remarks
Minerals and trace elements						
Calcium	2,20-2,60 mmol/L	Depends on multiple findings	Oral	Calcium-citrate tablet 500-600 mg	3 x daily 1-2 tablet	Calcium citrate is better than calcium carbonate (like Calci-Chew)
				Calci-Chew D3 1000 mg/880 IE or 500 mg/800 IE	1 x daily 1-2 tablet	Especially supplement with colon in situ to prevent nephrolithiasis (kidney stones)
Zinc	10-19 µmol/L	<10	Oral	Zinc sulphate drink 13.3 mg/ml zinc sulphate (is 3 mg/ml = 0.045 mmol/ml zinc).	3 x daily 200 mg (= 15 ml) after a meal.	With SBS: 220-440 mg zinc sulphate
Iron	M: 12-35 µmol/L F: 9-30 µmol/L	Ferritin <15 µg/l Transferrin saturation <15%	Oral	Ferrofumarate: tablet 100 mg (32.5 mg Fe++), 200 mg (65 mg Fe++).	3 x daily 200 mg 30 minutes before a meal	Menstruating women lose around 30 mg of iron per month. Do blood sampling preferably in the morning
				Suspension 20 mg/ml = 6.5 mg Fe++/ml	3 x daily 10 ml	nflammation and chronic diseases lead to lower iron levels and transferrin concentrations
			IV	Ferinject 50 mg Fe+++/ml injection vial 2 or 10 ml	15-20 mg/kg body weight max 1 g/d, max 1 g/week.	Give a test dose the first time

3.2 Exercise and health

Exercise is important for all age groups. In this guideline the emphasis lies on exercise for the elderly. Many of these recommendations apply equally well to the general adult population.

3.2.1 Exercise for elderly

There is no longer any doubt about the health benefits of physical activity for the elderly (51–53). Various studies have shown that physical activity is associated with lower morbidity and mortality from different conditions, or in other words, physical inactivity leads to numerous complications (53–57). Physical inactivity is associated with chronic diseases like diabetes type 2, cardiovascular diseases, blood pressure, obesity and cancer (58–62). It is also associated with frailty and/or sarcopenia, the age-related loss of muscle mass, strength and physical function (54, 63, 64). This leads to the elderly being dependent on care earlier and at greater risk of admission to a nursing home or hospital and a lower quality of life (65). During hospital admission the physical inactivity results in enormous losses in muscle mass and strength. This in turn delays recovery and increases the risk of readmission after discharge (57,66–69).

3.2.2 Exercise participation of elderly

According to the Sport knowledge centre, 58% of Dutch people over 65 meet the Dutch exercise norm for the elderly of 30 minutes of moderate exercise five times a week. Less than half of those over 75 meet this norm, and only 7.4% meet the fitness norm of intense exercise at least three times a week. It is also recommended to do strength-training exercises at least 2 times a week (the strength norm), but it is not known whether this norm is met or not. (70) In hospital, the level of physical activity is very low; it is estimated at 4% daily. (71)

3.2.3 Current physical activity guidelines

The current guidelines for exercise for the elderly consist of the Dutch exercise norm, the fitness norm and the strength norm. To prevent or alleviate the majority of negative consequences of inactivity among the elderly, it seems moderate to intensive exercise at least 5 times a week with weight training 2 times a week is essential. There is no exercise guideline for malnourished elderly people, but an increase in physical activity consisting of strength (light), endurance and/or functional exercises would appear to offer many health benefits.

3.3 Treatment plan

The treatment goals differ from patient to patient, depending on the medical diagnosis and the dietitian's diagnosis and the needs assessment. Basic goals in the nutrition and exercise treatment of malnutrition are sufficient intake of protein, energy and micronutrients, sufficient exercise and alleviating nutrition-related symptoms. Endpoints for the measurement of effectiveness are a complete nutritional intake, muscle mass, muscle strength and weight change, functionality and decrease of nutrition-related symptoms.

3.3.1 Nutrition

The dietitian will optimise the nutrition, taking into account the patient's preferences and habits. If the treatment goals cannot be achieved with a standard diet, the use of dietary nutrition for medical use is indicated.

The general rule of thumb for the introduction of dietary nutrition for medical use (protein powder, drink nutrition, tube nutrition, parenteral nutrition) is:
With an intake of 75 – 100% of the ascertained requirement, the treatment plan consists of protein- and energy-rich nutrition in the form of enriched main meals and snacks, possibly supplemented with drink nutrition. The treatment plan is evaluated within 7-10 days and adjusted as necessary. Even after the evaluation of the treatment plan, monitoring of the intake is desirable.

With an intake of 50% – 75% of the ascertained requirement, the recommendation is to add protein- and energy-rich nutrition to the drink and/or tube nutrition. The treatment plan is evaluated within 4-7 days and adjusted as necessary. Even after the evaluation of the treatment plan, monitoring of the intake is desirable.

If the intake is less than 50% of the requirement, and there is no possibility of a rapid improvement of intake, then full tube nutrition is indicated, supplemented with whatever is possible by mouth. The treatment plan is evaluated within 2-4 days and adjusted as necessary. Even after the evaluation of the treatment plan, monitoring of the intake is essential.

Total parenteral nutrition (TPN) is indicated when feeding through the gastrointestinal tract has been inadequate for longer than seven days because enteral nutrition is not possible or not fully possible or is contra-indicated; (72)
The above-mentioned rule of thumb is a general starting point, which can be deviated from depending on the specific characteristics and individual situation of the patient.

3.3.2 Exercise programmes

Considerable research has been done into different types of training to increase physical activity and prevent or treat the negative outcomes (62). These types of training can be classified into weight training, endurance training, the combination of strength and endurance training (concurrent) and functional and/or home training.

3.3.2.1 Weight training

Weight training consists of structured, progressive exercises conducted against resistance. It is very effective in preventing the loss of muscle mass and strength in elderly people or even increasing them (73–75). It stimulates muscle protein synthesis and hypertrophy, and reduces muscle protein breakdown (76, 77). It also makes muscles more sensitive to dietary proteins which, in combination with weight training and sufficient dietary proteins, stimulates muscle protein synthesis further, leading to an increase in muscle mass (78–80). Long-term studies combined in meta-analyses show that the lean BM increases by 1.1 kg and strength by ~30% after 4 months or longer of weight training (73, 75). In addition, weight training significantly improves physical function, like walking speed, getting up from a chair and balance (81).

3.3.2.2 Endurance training

Endurance training greatly improves the endurance of the elderly through mitochondrial adaptation and increasing cardiovascular capacity. These changes greatly improve physical functioning like, for example, the 6-minute walk test. (82)

The latest insights suggest that a combination of weight training and endurance training (done concurrently) is most effective in improving muscle mass and physical function. A new study by Villareal revealed that during caloric restriction, the combination of weight training and endurance training is superior in 1) retaining muscle mass and strength in comparison with endurance training alone, and 2) increasing the maximum oxygen uptake in comparison with weight training alone. The authors concluded that the combined training is superior in improving physical function than the individual training methods. (83,84)

3.3.2.3 Functional / home training

Functional training and/or home training contain strength and endurance training elements, but often also include exercises that target flexibility, balance and/or specific conditions. There is relatively little supportive evidence, but the majority of the data show positive effects on the physical functioning of the elderly. (85)

3.3.3 Exercise programmes for malnutrition: insufficient evidence

There is insufficient evidence of the effects of training on a malnourished person. Research has shown that physical effort stimulates protein synthesis, but also protein breakdown, so the protein balance at the body level, including the muscle protein balance, remains negative if insufficient protein is available. Malnutrition is significantly associated with a low protein intake, so it is likely that there are not enough proteins available for the muscle to recover from the physical exertion. There is also a lack of energy to carry out the physical exertion and to recover from it. A frequently raised practical question is whether patients who are malnourished should exercise. Campbell et al. found that weight training improved muscle mass and physical function even with a low protein intake (86). Comparable results were noted by Casteneda in nephrology patients. With a protein intake of 0.6 g/kg/d, positive effects of physical exertion were evident. (87) So despite a low protein intake, an exercise intervention seems to have added value. More research is clearly required.

3.3.4 Exercise programmes in the hospital

During a hospital admission, it seems difficult to increase physical activity. The disease and its associated limitations, including fatigue, open wound, fear of moving or falling, restricts physical activity. But even the smallest exertion increases protein synthesis and reduces muscle mass loss (88, 89). Observational research suggests that increasing physical activity from 4 minutes to 16 minutes shortens the hospital admission by a day. Unfortunately, little research has been done into which form and intensity of training would be optimal. An individual, progressive, safe programme with endurance, strength and functional exercises seems a promising intervention, but more research is required to confirm the effectiveness, feasibility and sustainability.

3.4 Evaluation and monitoring

The components of diagnosis, namely the balance of intake (protein and energy) and requirement, weight and changes in weight, muscle mass and strength, function and inflammation/disease state and nutrition-related symptoms, also form part of the evaluation of the effectiveness of the interventions employed (nutrition and exercise). Endpoints for measuring the effectiveness are a complete nutritional intake, muscle mass and changes in weight, exercise, function and decrease in nutrition-related symptoms.
During illness and treatment, the patient's clinical situation can change quickly, for example due to acute problems that disrupt the nutritional intake and acute changes in the extent of systemic inflammation. The patient's nutritional state and risk factors for malnutrition should be monitored systematically not only during hospital admission, but throughout the entire procedure from diagnosis to rehabilitation.

3.5 Transmural transfer

For the transmural transfer of the nutritional management (hospital, primary care, nursing or retirement home, or rehabilitation centre), a transmural transfer form for malnutrition has been developed to accommodate transfer between dietitians. (http://www.stuurgroepondervoeding.nl/wp-content/uploads/2015/02/TOAD-overdrachtsformulier.pdf). The GP and the doctor in charge receive a copy of this transfer form after obtaining the patient's consent. The Malnutrition Steering Group advises doctors to include a section about nutrition in the discharge letter for the GP: “Nutritional policy during admission and nutritional advice on discharge”.

The following aspects must at least be covered:

- Reasons for the transfer
- Medical diagnosis
- Dietitian's diagnosis
- Relevant medication and supplements
- Relevant laboratory results
- Anthropometric data upon discharge and progress in the past period
- Nutritional intake on discharge and progress in the past period
- Treatment goals
- Details from the evaluation of these treatment goals
- Interventions by the dietitian
- Use of medical nutrition
- Multidisciplinary collaboration

The doctor in charge at the hospital should state the evaluation of the patient's nutritional state in the discharge letter for the GP. The nurse should state the evaluation of the patient’s nutritional state in the discharge letter for the nurse practitioner or the technical multidisciplinary team.

3.6 Malnutrition in the palliative phase

3.6.1 Palliative care

Palliative care refers to care that does not aim at curing the underlying condition but focuses on the patient's welfare and comfort. This care is primarily used when the patient is nearing the end of his or her life. It targets quality of life, symptom management, a proactive approach to symptoms, the patient's autonomy, and pays attention to psychosocial, emotional and spiritual aspects, and to loved ones. Several phases of palliative care are distinguished: the predominantly disease-oriented palliation, the predominantly symptom-oriented palliation and the dying phase. (90) In practice these phases cannot be clearly separated, but there is a gradual transition to the next phase with disease progression. Sometimes this is only evident afterwards.

3.6.1.1 Nutrition in the palliative phase

When advising about nutrition, the expected length of survival and the medical policy/aim followed are important. A predominantly disease-oriented palliative treatment focuses on extending life expectancy. Maintaining the nutritional state can be a meaningful goal. When no life-extending treatments are possible and the treatment gradually shifts to predominantly symptom-oriented palliation, the patient can sometimes live for a reasonably long time and benefits from nutrition that conforms to his or her requirements (calculated). At some point, however, maintaining the nutritional state no longer takes priority. Then comfort nutrition is given. This involves advising nutrition, if the patient can and wants to eat, that the patient can tolerate and digest the best, and that suits his or her manner of coping with the progressing disease process. Screening, weighing and measuring are no longer advisable and should be stopped. In the dying phase, refraining from eating and drinking is part of the dying process. (91)

The changing role of nutrition when life expectancy is short and the social function of eating no longer applies can have radical consequences for the patient and his or her loved ones. Sometimes the patient is very focussed on nutrition, while in other cases the patient can decide not to be bothered with nutrition. Nutritional care can be an important part of the care provided by family members. The patient may feel guilty because s/he no longer enjoys eating the food that has been prepared with great care. The family members may feel helpless when eating is no longer possible. It is important to show understanding for the need of loved ones to care for the patient, especially in terms of nutrition. It is important to stress that refraining from eating and drinking is normal at the end. ‘The patient will not die because s/he no longer eats and drinks, but stops eating and drinking because s/he is going to die’. (91)

3.6.1.2 Dietary supplements for medical use in the palliative phase

Administering dietary supplements for medical use in palliative care demands special attention. When deciding on whether or not to start enteral or parenteral nutrition, it is important to know: the life expectancy, the patient's general condition, the potential disadvantages of the intervention, and the wishes and emotions of the patient, loved ones and caregivers. With weight loss due to refractory cachexia, clinical nutrition does not make sense. With obstructions situated high in the throat or oesophagus, tube nutrition can be a good option if the patient's intake is much too low despite individual dietary adjustments. Preconditions for starting clinical nutrition in this situation are a life expectancy of at least 2-3 months and a Karnofsky index score of at least 50. Parenteral nutrition is only given in palliative care if nutrition is impossible through the gastrointestinal tract for a short period, such as with a transient ileus. (90,91)

3.7 Conclusion of treatment

The nutritional treatment is stopped once the treatment goals have been achieved or as described above for the palliative phase. Agreements are made with the patient, informal carer and other caregivers about monitoring the patient's nutritional state and what would trigger the resumption of treatment. Advice is given about maintaining the nutritional state.

Nutritional requirements

- It is better to measure the energy requirement. If this is not possible, the WHO formula can be used, or the Harris & Benedict formula for an overweight patient. The actual weight is used in this formula
- The protein requirement is best calculated using the measured lean BM. If this is not possible, the Gallagher formula can be used to calculate the lean BM. Ill patients and the elderly have an increased protein requirement.
- With a suspected micronutrients deficiency, it is recommended to supplement all micronutrients according to the RDA and add 100-300 mg vitamin B1. Then specific micronutrient values are determined in the blood, and supplements prescribed on the basis of the results.

Transmural transfer

The doctor in charge at the hospital reports the evaluation of the nutritional status in the discharge letter for the GP. The nurse states the evaluation of the patient's nutritional state in the discharge letter for the nurse practitioner or the technical multidisciplinary team.
The dietitian is responsible for the transmural treatment transfer according to a set format. This transfer form is sent to the dietitian in another care sector, the GP and any concerned specialist and nurse or nurse practitioner.

Exercise

To prevent or alleviate most of the negative consequences of inactivity in the elderly, moderately intensive exercise at least 5 times a week with weight training 2 times a week seems essential. There is no exercise guideline for malnourished elderly people, but an increase in physical activity consisting of weight (light), endurance and/or functional exercises would appear to be favourable and supportive and offer many health benefits.

4. MULTIDISCIPLINARY TASK DISTRIBUTION

Malnourished patients are generally ones with a complex clinical picture. The treatment is therefore always multi-/interdisciplinary, requiring good collaboration. Caregivers always prepare the policy in consultation with the patient and any informal carers. They take the patient's specific circumstances into account. Caregivers emphasise the necessity for self-management and recognise the patient's own responsibility and align the policy appropriately.

The National Primary Care Collaboration Agreement (LESA) on Malnutrition (92) describes the multidisciplinary collaboration involved with the primary healthcare of malnourished patients. Table 6 presents the multidisciplinary collaboration in treatment, referral and consultation.

Table 6 – Task distribution between GP, dietitian and nurse in primary healthcare for malnourished patients (92)

Care provider	Risk of malnutrition	Malnutrition
GP	General advice and tips for protein and energy-rich diet and snacks (NHG patient letter). Consultation with the dietitian if treatment goal not met.	Referral to dietitian and concurrent general advice on protein and energy-rich diet and snacks. Consultation with dietitian if recovery stagnates.
Dietitian	Individual nutrition intervention. Consultation with the GP if recovery stagnates. Referral to the GP in the event of additional disease symptoms.	Individual nutrition intervention. Consult the GP in the event of: • Risk of refeeding syndrome • Stagnating recovery Referral to the GP in the event of additional disease symptoms.
Nurse	General advice on protein and energy-rich diet and snacks. Consult the GP in the event of: • additional disease symptoms • stagnating recovery Consult the dietitian in the event of stagnating recovery.	Referral to GP and/or dietitian. Implementation of the nutrition intervention and consult with dietitian in the event of problems. Consult the GP in the event of: • additional disease symptoms • stagnating recovery

In general, the following task distribution applies to all care sectors:

The dietitian is responsible for the nutritional treatment. S/he diagnoses malnutrition, prepares a treatment plan in consultation with the patient, formulates the treatment goals with the patient (SMART), evaluates the treatment and aligns the nutritional care with the other caregivers.

The physiotherapist is responsible for the exercise portion of the treatment plan. S/he considers the nutritional state in the diagnosis, and the dietitian and physiotherapist align their treatments.

The doctor warns about problems and integrates the nutritional treatment (objective and implementation) in the overall medical treatment.

The nurse is the coordinator of care. S/he points out the problems (risk of malnutrition, insufficient intake) and takes action. S/he also offers support in implementing the nutritional treatment plan, especially if tube nutrition is prescribed.

The care has a monitoring function and can motivate and help the patient to eat well and exercise.

The dietary assistant has a monitoring function and encourages and helps the patient to eat enough.

The logopedist provides prevention, care, training and advice for oral functions, swallowing and chewing.

The other medical and paramedical disciplines (ergotherapist, dental hygienist, dentist, etc.) have a monitoring function and report their suspicions of problems to the doctor in charge or the dietitian.

The Malnutrition Steering Group recommends arranging multidisciplinary consultation about complex patients with nutritional problems. In many hospitals, such meetings are organised weekly.

REFERENCES

1. Sobotka L. Basics in Clinical Nutrition. 4th ed. Allison SP, Forbes A, Ljungqvist O, Meier R, Pertkiewicz M, Soeters P, editors. Prague, Czech Republic: Galen; 2011.
2. Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Compher C, Correia I, Bischoff S, Higashiguchi T, Holst M, Jensen G, Malone A, Muscaritoli M, Nyulasi I, Pirlich M, Rothenberg E, Schindler K, Schneider S, de van der Schueren M, Sieber C, Valentini L SP. Definitions and terminology of clinical nutrition: an ESPEN Consensus Statement. Clin Nutr. 2017;Feb(1):49–64.
3. Gandy J. Manual Dietetic Practice. 5th ed. Wiley Blackwell and BDA The Association for UK Dietitians; 2014.
4. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition – An ESPEN consensus statement. Clin Nutr. 2015;34(3):335–40.
5. Elia M. The "MUST" report. Nutritional screening for adults: a multidisciplinary responsibility. Development and use of the "Malnutrition Universal Screening Tool" ("MUST") for adults. A report by the Malnutrition Advisory Group of the British Association for Par. Redditch, England, UK; 2003.
6. (NICE) NI for H and CE. Nutrition support in adults: oral nutrition support, enteral tube feeding and parenteral nutrition (clinical guideline 32). London; 2006.
7. Martin L, Senesse P, Gioulbasanis I, Antoun S, Bozzetti F, Deans C, et al. Diagnostic criteria for the classification of cancer-associated weight loss. J Clin Oncol. 2015 Jan 1;33(1):90–9.
8. Fearon K, Strasser F, Anker SD, Bosaeus I, Bruera E, Fainsinger RL, et al. Definition and classification of cancer cachexia: An international consensus. Lancet Oncol. Elsevier Ltd; 2011;12(5):489–95.
9. Jensen GL, Mirtallo J, Compher C, Dhaliwal R, Forbes A, Grijalba RF, et al. Adult Starvation and Disease-Related Malnutrition. J Parenter Enter Nutr. 2010 Mar;34(2):156–9.
10. Correia MITD, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr. 2003 Jun;22(3):235–9.
11. Kok L. The social costs and benefits of dietetics for malnourished patients in hospital. Amsterdam, The Netherlands; 2015.
12. Stratton RJ, Green C EM. Disease-related malnutrition: an evidence-based approach to treatment. Wallingford: CCABI publishing; 2003.
13. Halfens RJG, E. Meesterberends, JCL N, AALM, Rondas, S, Rijcken, S, Wolters JS. Landelijke prevalentiemeting zorgproblemen: Rapportage resultaten 2015. Maastricht: Universiteit. 2015.
14. Kruizenga H, van Keeken S, Weijs P, Bastiaanse L, Beijer S, Huisman-de Waal G, et al. Undernutrition screening survey in 564,063 patients: patients with a positive undernutrition screening score stay in hospital 1.4 d longer. Am J Clin Nutr. 2016;103(4)(Apr):1026–32.
15. Schilp J, Kruizenga HM, Wijnhoven HAH, Leistra E, Evers AM, van Binsbergen JJ, et al. High prevalence of undernutrition in Dutch community-dwelling older individuals. Nutrition. 28(11–12):1151–6.
16. Leistra E, Langius JAE, Evers AM, van Bokhorst-de van der Schueren MAE, Visser M, de Vet HCW, et al. Validity of nutritional screening with MUST and SNAQ in hospital outpatients. Eur J Clin Nutr. 2013 Jul;67(7):738–42.
17. Rubenstein LZ, Harker JO, Salvà a, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). J Gerontol A Biol Sci Med Sci. 2001;56(6):M366–72.
18. Ottery FD. Definition of standardized nutritional assessment and interventional pathways in oncology. Nutrition. 1996;12(1 Suppl):S15–9.
19. Kruizenga HM, Seidell JC, de Vet HCW, Wierdsma NJ, van Bokhorst-de van der Schueren MAE. Development and validation of a hospital screening tool for malnutrition: The short nutritional assessment questionnaire (SNAQ©). Clin Nutr. 2005;24(1):75–82.
20. Wijnhoven H a H, Schilp J, van Bokhorst-de van der Schueren M a E, de Vet HCW, Kruizenga HM, Deeg DJH, et al. Development and validation of criteria for determining undernutrition in community-dwelling older men and women: The Short Nutritional Assessment Questionnaire 65 +. Clin Nutr. 2012;31(3):351–8.
21. Kruizenga HM, De Vet HCW, Van Marissing CME, Stassen EEPM, Strijk JE, Van Bokhorst-De Van Der Schueren MAE, et al. The SNAQRC, an easy traffic light system as a first step in the recognition of undernutrition in residential care. J Nutr Heal Aging. 2009;1–7.
22. Heyland DK, Dhaliwal R, Jiang X, Day AG. Identifying critically ill patients who benefit the most from nutrition therapy: the development and initial validation of a novel risk assessment tool. Crit Care. 2011;15(6):R268.
23. Detsky AS, McLaughlin JR, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is subjective global assessment of nutritional status? JPEN J Parenter Enteral Nutr. Jan;11(1):8–13.

24. Home | Pt-Global [Internet]. [cited 2017 Mar 28]. Available from: http://pt-global.org/?lang=nl
25. Website Mini Nutritional Assesment [Internet]. [cited 2016 Dec 13]. Available from: www.mna-elderly.com/forms/mna_guide_english_sf.pdf
26. World Health Organization. How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF). Geneva: WHO; 2013.
27. Garrow J, James W, Ralph A. Human Nutrition and Dietetics. 10th ed. Churchill Livingstone; 2000.
28. Lewis SJ, Heaton KW. Stool Form Scale as a Useful Guide to Intestinal Transit Time. Scand J Gastroenterol. 1997 Jan 8;32(9):920–4.
29. Wierdsma NJ, Kruizenga, HM, Stratton R. The dietetic pocket guide adults. 1st ed. Amsterdam: VU University Press; 2017. Available from: www.dieteticpocketguide.com
30. Short Nutritional Assessment Procedure | MUMC TV | Maastricht UMC+ [Internet]. [cited 2017 Jan 10]. Available from: https://www.mumc.nl/actueel/mumc-tv/4833966410001-short-nutritional-assessment-procedure
31. Kruizenga, HM, Schols, JMGA, van der Sande J. Ondervoeding en dehydratie. In: Bakker, T, Habes, V, Quist, G, van der Sande, J, van de Vri W, editor. Klinisch redeneren bij ouderen. 1st ed. Amsterdam: Reed Business Education; 2015. p. 202–23.
32. Longo, D, Fauci, A, Kasper, D, Hauser, S, Jameson, J, Loscalzo J. Harrison's Principles of Internal Medicine. 18th ed. McGraw Hill Professional; 2011.
33. Questionaires and instruments in the functional domain « Dietetic Pocket Guide [Internet]. [cited 2017 Aug 28]. Available from: http://www.dieteticpocketguide.com/questionnaires-functional_domain/
34. ten Dam, s, Jonkers, C, Visser, S, Noordhoff, H, Hoekstra, R, Vedder, K, de Groot, S, van Bodegraven, AA, Thijs, A, Serlie M. Dutch consensus statement on Refeeding syndrome Introduction [Internet]. Amsterdam,; 2012. Available from: http://www.fightmalnutrition.eu/wp-content/uploads/2017/08/NVO-consensus-refeeding-syndrome.pdf
35. Kruizenga, HM, Hofsteenge, GH, Weijs P. Validity of resting energy expenditure predictive equations in underweight, normal weight, and overweight adult inpatients and outpatients. Nutr Metab (Lond). 2016;13:85.
36. Weijs P, Kruizenga H, van Dijk A, van der Meij B, Langius J, Knol D, et al. Validation of predictive equations for resting energy expenditure in adult outpatients and inpatients. Clin Nutr. 2008;27(1):150–7.
37. Food and Agricutural Organization. Human energy requirements: Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food Nutr Tech Rep Ser [Internet]. 2001;0:96. Available from: ftp://ftp.fao.org/docrep/fao/007/y5686e/y5686e00.pdf
38. Harris J, Benedict F. A Biometric Study of Human Basal Metabolism. Proc Natl Acad Sci. 1918;4(12):370–3.
39. Elia M. Insights into energy requirements in disease. Public Health Nutr. 2005;8(7A):1037–52.
40. Frankenfield DC AC. Estimating energy needs in nutrition support patients. J Parenter Enter Nutr. 2011;35(5):563–70.
41. Weijs PJM, Cynober L, DeLegge M, Kreymann G, Wernerman J, Wolfe RR. Proteins and amino acids are fundamental to optimal nutrition support in critically ill patients. Crit Care [Internet]. 2014;18(6):591.
42. Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, et al. Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the prot-age study group. J Am Med Dir Assoc. Elsevier Ltd; 2013;14(8):542–59.
43. Deutz NE, Bauer JM, Barazzoni R, Biolo G, Boirie Y, Bosy-Westphal A, et al. Protein intake and exercise for optimal muscle function with aging: Recommendations from the ESPEN Expert Group. Clin Nutr. Elsevier Ltd; 2014;
44. Ishibashi N, Lindsay D, Plank D, Kinya S HG. Optimal protein requirements during the first 2 weeks after the onset of critical illness. Crit Care Med. 1998;26(9):1529–35.
45. Weijs PJM, Sauerwein HP, Kondrup J. Protein recommendations in the ICU: g protein/kg body weight - which body weight for underweight and obese patients? Clin Nutr. Elsevier Ltd and European Society for Clinical Nutrition and Metabolism; 2012;31(5):774–5.
46. Hoffer LJ. How much protein do parenteral amino acid mixtures provide? Am J Clin Nutr. 2011;94(6):1396–8.
47. Arabi YM, Casaer MP, Chapman M, Heyland DK, Ichai C, Marik PE, et al. The intensive care medicine research agenda in nutrition and metabolism. Intensive Care Med. 2017 Apr 3;
48. Preiser J-C, van Zanten ARH, Berger MM, Biolo G, Casaer MP, Doig GS, et al. Metabolic and nutritional support of critically ill patients: consensus and controversies. Crit Care. BioMed Central; 2015 Jan 29;19(1):35.
49. ten Dam, S, Jonkers, C, Visser, S, Noordhoff H, Hoekstra, M, Vedder, K, de Groot, S, van Bodegraven, AA, Thijs, A, Serlie M. Dutch consensus statement on Refeeding syndrome. Available from: http://www.fightmalnutrition.eu/wp-content/uploads/2017/08/NVO-consensus-refeeding-syndrome.pdf
50. Gezondheidsraad. Evaluatie van de voedingsnormen voor vitamine D. 2012;149.
51. Layne AS, Hsu F-C, Blair SN, Chen S-H, Dungan J, Fielding RA, et al. Predictors of Change in Physical Function in Older Adults in Response to Long-Term, Structured Physical Activity: The LIFE Study. Arch Phys Med Rehabil. 2017 Jan;98(1):11–24.e3.

52. Morley JE, Abbatecola AM, Argiles JM, Baracos V, Bauer J, Bhasin S, et al. Sarcopenia with limited mobility: an international consensus. J Am Med Dir Assoc. 2011 Jul;12(6):403–9.
53. Morie M, Reid KF, Miciek R, Lajevardi N, Choong K, Krasnoff JB, et al. Habitual physical activity levels are associated with performance in measures of physical function and mobility in older men. J Am Geriatr Soc. 2010 Sep;58(9):1727–33.
54. Landi F, Abbatecola AM, Provinciali M, Corsonello A, Bustacchini S, Manigrasso L, et al. Moving against frailty: does physical activity matter? Biogerontology. 2010 Oct 10;11(5):537–45.
55. Stessman J, Hammerman-Rozenberg R, Cohen A, Ein-Mor E, Jacobs JM. Physical Activity, Function, and Longevity Among the Very Old. Arch Intern Med. 2009 Sep 12;169(16):1476.
56. Chambers MA, Moylan JS, Reid MB. Physical inactivity and muscle weakness in the critically ill. Crit Care Med. 2009 Oct;37(10 Suppl):S337–46.
57. Gill TM, Allore HG, Gahbauer EA, Murphy TE. Change in Disability After Hospitalization or Restricted Activity in Older Persons. JAMA. 2010 Nov 3;304(17):1919.
58. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol. NIH Public Access; 2012 Apr;2(2):1143–211.
59. Morley JE, Malmstrom TK, Rodriguez-Mañas L, Sinclair AJ. Frailty, Sarcopenia and Diabetes. J Am Med Dir Assoc. 2014 Dec;15(12):853–9.
60. Madeddu C, Maccio A, Mantovani G. Multitargeted treatment of cancer cachexia. Crit Rev Oncog. 2012;17(3):305–14.
61. deFilippi CR, de Lemos JA, Tkaczuk AT, Christenson RH, Carnethon MR, Siscovick DS, et al. Physical activity, change in biomarkers of myocardial stress and injury, and subsequent heart failure risk in older adults. J Am Coll Cardiol. 2012 Dec 18;60(24):2539–47.
62. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, et al. Physical Activity and Public Health in Older Adults: Recommendation From the American College of Sports Medicine and the American Heart Association. Circulation. 2007 Aug 7;116(9):1094–105.
63. Cesari M, Vellas B, Hsu F-C, Newman AB, Doss H, King AC, et al. A physical activity intervention to treat the frailty syndrome in older persons-results from the LIFE-P study. J Gerontol A Biol Sci Med Sci. 2015 Feb 1;70(2):216–22.
64. Evans WJ. Skeletal muscle loss: cachexia, sarcopenia, and inactivity. Am J Clin Nutr. 2010 Apr 1;91(4):1123S–1127S.
65. Rizzoli R, Reginster J-Y, Arnal J-F, Bautmans I, Beaudart C, Bischoff-Ferrari H, et al. Quality of Life in Sarcopenia and Frailty. Calcif Tissue Int. 2013 Aug 5;93(2):101–20.
66. Gill TM, Allore HG, Holford TR, Guo Z. Hospitalization, Restricted Activity, and the Development of Disability Among Older Persons. JAMA. 2004 Nov 3;292(17):2115.
67. Buurman BM, Hoogerduijn JG, van Gemert EA, de Haan RJ, Schuurmans MJ, de Rooij SE. Clinical characteristics and outcomes of hospitalized older patients with distinct risk profiles for functional decline: a prospective cohort study. Thiem U, editor. PLoS One. 2012 Jan 4;7(1):e29621.
68. de Morton NA, Keating JL, Jeffs K. Exercise for acutely hospitalised older medical patients. de Morton N, editor. Cochrane database Syst Rev. Chichester, UK: John Wiley & Sons, Ltd; 2007 Jan 24;(1):CD005955.
69. Suetta C, Magnusson SP, Rosted A, Aagaard P, Jakobsen AK, Larsen LH, et al. Resistance training in the early postoperative phase reduces hospitalization and leads to muscle hypertrophy in elderly hip surgery patients--a controlled, randomized study. J Am Geriatr Soc. 2004 Dec;52(12):2016–22.
70. Hildebrandt H, Ooijendijk M, Hopman M. Trendrapport Bewegen en Gezondheid. TNO Kwaliteit van Leven. 2010.
71. Smith P, Galea M, Woodward M, Said C, Dorevitch M. Physical activity by elderly patients undergoing inpatient rehabilitation is low: an observational study. Aust J Physiother. 2008;54(3):209–13.
72. Vanderheyden S, Casaer MP, Kesteloot K, Simoens S, De Rijdt T, Peers G, et al. Early versus late parenteral nutrition in ICU patients: cost analysis of the EPaNIC trial. Crit Care. BioMed Central Ltd; 2012;16(3):R96.
73. Peterson MD, Rhea MR, Sen A, Gordon PM. Resistance exercise for muscular strength in older adults: A meta-analysis. Ageing Res Rev. 2010 Jul;9(3):226–37.
74. Peterson MD, Gordon PM. Resistance exercise for the aging adult: clinical implications and prescription guidelines. Am J Med. 2011 Mar;124(3):194–8.
75. Peterson MD, Sen A, Gordon PM. Influence of resistance exercise on lean body mass in aging adults: a meta-analysis. Med Sci Sports Exerc. 2011 Feb;43(2):249–58.
76. Pennings B, Koopman R, Beelen M, Senden JMG, Saris WHM, van Loon LJC. Exercising before protein intake allows for greater use of dietary protein-derived amino acids for de novo muscle protein synthesis in both young and elderly men. Am J Clin Nutr. 2011 Feb 1;93(2):322–31.
77. Witard O, Tieland M, Beelen, M, Tipton K, van Loon, LJC, Koopman R. Resistance Exercise Increases Postprandial Muscle Protein Synthesis in Humans. Med Sci Sport Exerc. 2009 Jan;41(1):144–54.

78. Wall BT, Dirks ML, van Loon LJC. Skeletal muscle atrophy during short-term disuse: implications for age-related sarcopenia. Ageing Res Rev. 2013 Sep;12(4):898–906.
79. Wall BT, Snijders T, Senden JMG, Ottenbros CLP, Gijsen AP, Verdijk LB, et al. Disuse impairs the muscle protein synthetic response to protein ingestion in healthy men. J Clin Endocrinol Metab. 2013 Dec;98(12):4872–81.
80. Tieland M, Dirks ML, van der Zwaluw N, Verdijk LB, van de Rest O, de Groot LCPGM, et al. Protein supplementation increases muscle mass gain during prolonged resistance-type exercise training in frail elderly people: a randomized, double-blind, placebo-controlled trial. J Am Med Dir Assoc. 2012 Oct;13(8):713–9.
81. Giné-Garriga M, Roqué-Fíguls M, Coll-Planas L, Sitjà-Rabert M, Salvà A. Physical exercise interventions for improving performance-based measures of physical function in community-dwelling, frail older adults: a systematic review and meta-analysis. Arch Phys Med Rehabil. 2014 Apr;95(4):753–769.e3.
82. Kelley GA, Kelley KS. Effects of aerobic exercise on C-reactive protein, body composition, and maximum oxygen consumption in adults: a meta-analysis of randomized controlled trials. Metabolism. 2006 Nov;55(11):1500–7.
83. Eklund D, Häkkinen A, Laukkanen JA, Balandzic M, Nyman K, Häkkinen K. Fitness, body composition and blood lipids following 3 concurrent strength and endurance training modes. Appl Physiol Nutr Metab. 2016 Jul;41(7):767–74.
84. Villareal DT, Aguirre L, Gurney AB, Waters DL, Sinacore DR, Colombo E, et al. Aerobic or Resistance Exercise, or Both, in Dieting Obese Older Adults. N Engl J Med. 2017 May 18;376(20):1943–55.
85. Hill KD, Hunter SW, Batchelor FA, Cavalheri V, Burton E. Individualized home-based exercise programs for older people to reduce falls and improve physical performance: A systematic review and meta-analysis. Maturitas. 2015 Sep ;82(1):72–84.
86. Campbell WW, Trappe TA, Jozsi AC, Kruskall LJ, Wolfe RR, Evans WJ. Dietary protein adequacy and lower body versus whole body resistive training in older humans. J Physiol. 2002 Jul 15;542(Pt 2):631–42.
87. Castaneda C, Gordon PL, Uhlin KL, Levey AS, Kehayias JJ, Dwyer JT, et al. Resistance training to counteract the catabolism of a low-protein diet in patients with chronic renal insufficiency. A randomized, controlled trial. Ann Intern Med. 2001 Dec 4;135(11):965–76.
88. Agergaard J, Bülow J, Jensen JK, Reitelseder S, Drummond MJ, Schjerling P, et al. Light-load resistance exercise increases muscle protein synthesis and hypertrophy signaling in elderly men. Am J Physiol Endocrinol Metab. 2017 Apr 1;312(4):E326–38.
89. Dirks ML, Hansen D, Van Assche A, Dendale P, Van Loon LJC. Neuromuscular electrical stimulation prevents muscle wasting in critically ill comatose patients. Clin Sci (Lond). 2015 Mar 1;128(6):357–65.
90. Zorgmodule Palliatieve Zorg 15-10-2013. [cited 2017 Mar 28]; Available from: https://www.iknl.nl/docs/default-source/downloadbaar-open/zorgmodulepalliatievezorgversie1-0.pdf?sfvrsn=2
91. Kennis, M, Leermakers, M, Vogel J. Palliatieve zorg. In: Vogel,J, Beijer, S, Doornink, N, Delsink, P, Have ten, H, Lieshout van R, editor. In Handboek Voeding bij kanker. 2nd ed. Utrecht: De Tijdstroom; 2016.
92. Mensink, PJAS, De Bont, MAT, Remijnse-Meester, TA, Kattenmolle-van den Berg, S, Liefaard, AHB, Meijers, JJM, van Binsbergen J. National Primary Care Collaboration Agreement on Malnutrition. Available from: http://www.fightmalnutrition.eu/wp-content/uploads/2017/04/LESA_Ondervoeding_ENG_18_3_11.pdf