

# Chapter 16

## Malnutrition: Consequences for Clinical Outcomes in the Context of German Hospitals

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**Abstract** Some 70–75% of diseases are primarily caused by diet and lifestyle-induced problems. Undernutrition and malnutrition affect all relevant clinical factors: mortality, length of hospital stay, morbidity, and thus the quality of life. Undernutrition and malnutrition are common in hospitals, and are a growing problem. They are costly and have clinical consequences. Europe-wide studies and meta-analyses testify to the significance of the therapeutic provision of nutrition for patients admitted to hospital, and also demonstrate its cost-effectiveness. For the therapy to be successful, early, targeted assessment of the patient's status is necessary in order to ensure the guideline-based implementation of recognized dietary concepts. This requires a qualified nutrition support team consisting of medical nutritionists, general nutritionists, dietitians and other qualified nutrition professionals. Every patient admitted to hospital should be examined and documented in accordance with the established parameters for undernutrition and malnutrition, and a diet plan developed for his or her specific needs. Undernutrition and malnutrition cost €9 billion per year in Germany alone. These costs could be reduced by the application of medical nutrition therapy in hospitals. Individuals can also protect themselves by adopting a healthy lifestyle. This begins with the consumption of healthy foods.

**Keywords** Undernutrition · Malnutrition · Dietary concept · Staging system · ERAS · DGEM · Cancer · Hospital · Patient · Supplementary drinks and foods · Artificial feeding

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## 16.1 The Vital Role of Nutrition in Medicine

Nutrition plays a central role in the prevention and prophylaxis of diseases in patients of all ages [1]. The relationship between ‘food’ and ‘wellbeing’ has been known for thousands of years. All previous cultures had to look for food, and they used certain of these foods to heal the sick and the infirm. Unfortunately, the nutritional medicine that is practiced in the day-to-day life of German hospitals does not reflect its true potential for offering promising cures.

Three out of four cases of disease requiring medical treatment are essentially nutrition- and lifestyle-related [2]. Only 20% of patients who are admitted to hospital for treatment present with a normal nutritional status. They form the smallest group. Approximately 55% of patients admitted are overweight, and another 25% suffer from undernutrition or malnutrition. On top of this comes the fact that approximately 75% of all hospitalized patients experience significant weight loss during their time in hospital [2, 3]. Thus the aim must be not only to identify as quickly as possible patients with increased nutritional and metabolic risk, but also to immediately initiate a nutrition-based medical treatment.

No standard definition for the terms ‘undernutrition’ and ‘malnutrition’ exists worldwide. The DGEM (German Society for Nutritional Medicine) has created guidelines on the topic, and explains malnutrition as a reduction of energy storage (resulting in a reduction in fat mass). Malnutrition can be defined as a disease-associated weight loss or loss of protein (resulting in a reduction in muscle mass) or else as a lack of specific essential nutrients [4].

## 16.2 The Importance of Early Detection and Treatment

The early detection and treatment of malnutrition in hospital patients affects the entire course of the conditions from which they suffer. An early intervention can have a significant impact on morbidity, the treatment chosen, the length of hospital stay, mortality, and—a point not to be underestimated—the patient’s quality of life [5–8]. Early intervention also reduces the cost of treatment for the individual patient, and well as having a broader impact on healthcare budgets. The cost of treating malnutrition, including the costs of the associated complications, approximates to €9 billion annually. Clinical studies show that treatment by means of nutritional medicine generates considerable savings [2]. This means that the diet must be an integral part of the preoperative and postoperative therapeutic treatments.

Over 200 studies demonstrate the presence of undernutrition or malnutrition since the 1970s. Patients were recorded before admission to the hospital, during treatment or after surgery.

### 16.3 The Causes of Undernutrition and Malnutrition

The causes of undernutrition and malnutrition are very varied and complex in our industrialized countries. They include low socio-economic status, social isolation, depression, alcoholism, poor dental status, ill-fitting false teeth, badly fitted dentures, other addictions, poverty, and lack of money. Last but not least, the inability to obtain adequate food or to prepare it properly presents problems that should not be underestimated.

It is essential to recognize early malnutrition and its causes and to initiate appropriate treatment measures. This is one of the tasks of the physician, besides the physical examination of the patient and the creation of a targeted medical history. This history should include documented nutrition-related factors, such as weight change, appetite pattern, food intake and gastrointestinal symptoms.

### 16.4 Determining the Patient's Nutritional Status

Various options exist for determining the patient's nutritional status. In recent years, the Subjective Assessment (SGA), the Nutritional Risk Score (NRS 2002) and the Mini Nutritional Assessment score (MNA) have all come to the fore. The latter is used in the context of elderly patients. The use of this score and the determination of BMI (Body Mass Index) should be a routine part of the hospital admissions procedure, so that targeted nutritional medicine measures can be applied as soon as possible [9].

Especially in the surgical disciplines, new challenges are presenting themselves because demographic change in Germany is producing more and more elderly and geriatric patients. Not just the responsible physician but an entire team is required to meet these requirements with regard to undernourishment and malnutrition. In German hospitals, such 'nutrition teams' are already achieving good results. These teams are essential for the implementation of nutritional and medical knowledge in the hospital. They consist of nutritional doctors, care staff with qualifications in nutrition, specialists in nutritional and domestic science, and dieticians. Their structure, tasks and organization are defined in guidelines and are entirely practicable [9]. The cost-efficiency and clinical effectiveness of these teams have also been proven in studies [10–15]. The provision of supplementary artificial nutrition is one of the most important preparations for surgery, so that the patient can be operated on in a good nutritional state.

## 16.5 ERAS (Enhanced Recovery After Surgery)

ERAS (Enhanced Recovery After Surgery)—a program to improve rehabilitation after operations—aims to reduce the time patients spend in hospital. Nutritional medicine has an important contribution to make here. It must be fully integrated into the overall therapeutic concept. On admission, the patient is screened, and the metabolic risk is assessed. Periods of fasting should be avoided if possible, and the intake of food should be resumed as quickly as possible following surgery [16].

Nutrition is a component of the ERAS program, with a metabolic concept. It involves early build-up of food intake, and no long-term reduction in calorie provision: major operations especially can lead to post-operative complications. There is no rigid program for the procedure. In the case of patients who are at risk, a flexible approach is required. This means that the use of enteral or parenteral nutrition should be considered. For the ERAS program, this means that a nutritional risk screening takes place when a patient is admitted to hospital.

## 16.6 The Staged Therapeutic Approach

The staged therapeutic approach has proved its value in the case of patients who, on admission to hospital, have difficulty ingesting food or are incapable of doing so.

After the patient's medical history has been drawn up, detailing nutritionally relevant content and analysis of underlying causes, an individual nutritional anamnesis must be carried out. This should include a description of a diet that is both high in energy and easily digestible. It is also worth providing training in nutrition to the family and friends who have the patient in their care. This includes the provision of small snacks such as finger food, energy drinks, and savory morsels throughout the day, as well as modest physical activity between meals.

The meals are enriched with cost-effective, high-energy, flavorless food additives such as maltodextrin, as well as protein concentrates. Studies on drinking high-calorie beverages and consuming supplementary foods have shown that the administration of these nutritional supplements clearly reduces the incidence of complications and mortality in patients with undernutrition and malnutrition. This also holds true for patients who stay in hospital for only a short time. Especially in this group, in fact, a reduction in the incidence of complications and mortality has been shown [17]. These supplementary drinks and foods should be offered between meals and in the evening as well. If there is a medical indication, supplementary foods may be prescribed for the patient. Medical insurance companies are duty-bound to cover the associated costs.

Artificial feeding of the patient should only be a course of last resort, when all the other measures described have failed. Both medical and ethical considerations need to be taken into account here. These include the disease(s) from which the patient is suffering, the current condition of the patient, the psychosomatic situation,

comorbidity, the patient's personal wishes, and the expected prognosis. The option of tube feeding has shown its value in such cases. It improves the patient's nutritional status, reduces complications, has a positive effect on the individual prognosis, and thus improves the patient's quality of life [4, 9]. The PEG-probe is the method of choice for artificial-enteral nutrition of more than two weeks' duration. It may be broken off at any time and normal feeding procedures resumed.

## 16.7 The Costs of Undernutrition and Malnutrition

Undernutrition and malnutrition always drive up morbidity and mortality rates, and the associated costs in the Federal Republic of Germany run into the millions annually (see above). Numerous studies demonstrate and, indeed, emphasize the fact that the results are even more relevant from a health budget perspective. The provision of supplementary beverages and food to patients suffering from undernutrition and malnutrition is highly cost-effective, and above all relieves the pressure on hospital budgets [18, 19]. Early nutritional intervention in the case of malnourished patients shortens hospital stays: a reduction of 2.5 days [20] vis-à-vis patients without this additional food has been demonstrated. Also proven is the saving of €1,000 per patient when liquid nutrition is administered preparatory to operations. In the light of the results of these studies and meta-analyses, the earliest possible treatment of malnutrition should be prioritized within the framework of cost-saving measures in the German health care system. The EU has criticized the high number of malnourished patients in European hospitals, describing the situation as totally unacceptable, and fully endorses the clearly documented medical consequences for the health system. Unintentional weight loss is often the first indication of cancer. As the disease progresses, this can develop into irreversible malnutrition (cachexia). It is impossible to determine at what point in the disease process malnutrition occurs. It leads to loss of strength on the part of the patient, longer hospital stays, poor response to therapies, and increased morbidity and mortality. Following the DEGEM guideline 'Enteral Nutrition', an overview of basic medical nutritional considerations in operational disciplines has been drawn up [13]. Organ insufficiency and tumor diseases lead to poor nutritional intake and malnutrition in patients. Empirical observations show that the prevalence of malnutrition depends on the type of tumor involved [21]. Above all, patients suffering from colonic and gastrointestinal tumors, as well as head and neck tumors, are more likely to present with malnutrition than patients with breast carcinomas.

The risk factors that this malnutrition encourages have already been described. If the malnutrition continues, it is not possible for the patient's body to build back healthy muscle and organ tissue. Generally, any delay in food intake following surgery is not recommended. The type of food supply will depend on the general condition of the patient. Operations on the upper digestive tract permit the administration of food enterally, e.g., via a probe, while patients undergoing

operations on the lower digestive tract can usually take in food orally immediately after the surgical intervention.

## 16.8 The Causes of Malnutrition in Hospital Patients

The DGEM guidelines (2013 update) [22] describe the various forms of deficiency and malnutrition. They are:

1. Disease-specific nutritional deficiencies (malignant tumors);
2. Disease-specific malnutrition (dementia, anorexia nervosa);
3. Chronic disease-specific nutritional deficiencies (organ disease, CED); and
4. Acute disease-specific malnutrition (severe infections).

The causes of malnutrition vary widely from patient to patient. Tumor patients have difficulty ingesting food, have an insufficient digestive capacity and often suffer from diarrhea. They have loss of appetite due to nausea and vomiting, suffer pain when eating, and experience malabsorption and diarrhea. The tumor changes the metabolism of the patient, increasing his or her requirement for energy and nutrients. Patients with tumors suffer from weight loss. They lose not just body fat but also muscle and organ mass. Significant investigations have shown that muscle strength diminishes even before the loss of muscle mass can be measured, and that weight loss leads to a reduction in the muscular strength of the hand [23]. As cancer patients also suffer from edema and/or ascites, the weight loss is often not immediately noticed. Only when volumes of liquid are excreted does it become apparent. A loss of more than 15% bodyweight affects the physique, and a loss of more than 30% leads to death.

## 16.9 Immunonutrition

The need for additional nutrition before surgery exists even in the case of patients who do not suffer from malnutrition. Mortality rates are higher in patients who are unable to meet their energy requirements via an adequate diet for approximately 14 days, and also in the case of patients who are unable to take in food orally for approximately seven days [24, 26]. Patients who receive supplementary food (orally, in the form of fortified beverages) have better operative outcomes. This has been shown by over 30 studies in the fields of digestive surgery and traumatology [23, 26]. For interventions of this type, the preoperative intake of additional liquid food for 5–7 days is recommended: this strengthens the immune system. Both morbidity and time spent in hospital are reduced [25, 26]. These nutrition-medical ‘interventions’—immunonutrition—strengthen the body and positively influence the patient’s physical capability, mobility, and quality of life. These days one

speaks of comprehensive nutrition, which means that not only sufficient energy is supplied to the body, but also sufficient proteins and/or amino acids. This is especially important for oncology patients. A lack of requisite protein in the diet also has a negative impact on muscle mass, connective tissue, the synthesis of neurotransmitters, and the immune system. Protein intake controls the work of the digestive enzymes and influences the formation of edema, susceptibility to infections, insulin resistance, pain regulation, and stress states such as anxiety, depression and moods [21]. All cancer patients are at risk of malnutrition or inadequate nutrition. Therefore a diet concept should be created for each patient individually, depending on the specific parameters of his or her condition. The DGEM has created criteria for such a concept in its guidelines [22].

For disease-specific malnutrition:

- BMI <18.5 or
- Unintentional weight loss >10% in the last three to six months, or
- BMI <20 and unintentional weight loss >5% in the last three to six months.

For adults >65% years:

- BMI <20, >5% weight loss in three months
- Fasting period/fasting for more than seven days.

In surgical patients:

- Serum albumin concentration <30 g/l—independent risk of complications.

Weight loss in cancer patients is not a new phenomenon (Table 16.1).

Studies and works by Dewys, Ballmer et al. as well as by Arends have demonstrated this. Immediately after diagnosis, the majority of patients experience a significant weight loss. All cancer patients are exposed to the risk of cancer cachexia. This occurs when the weight loss caused by the disease is at least 5% over a period of up to 12 months or is detected in cancer patients between three and six months after diagnosis, and when three of the following criteria are met:

- Reduced muscle strength
- Fatigue
- Anorexia
- Low fat-free body mass

**Table 16.1** Oncology weight loss and tumor entity weight loss [31–33]

Oncology weight loss	Tumor entity weight loss (in %, before diagnosis)
Breast cancer	36
Colon cancer	54
Bronchial cancer	61
Esophageal cancer	69
Pancreatic cancer	83
Gastric cancer	85

- Abnormal laboratory parameters: increased inflammatory markers—CRP >5 mg/dl, IL-6 <4 pg/ml, anemia (Hb <12 g/dl), serum albumin (<3.2 g/dl).

A BMI under 20 also points to cachexia, even if no weight loss is measured. If malnutrition is either diagnosed or else expected in a patient, a diet plan must immediately be created. The food helps to maintain or improve the patient's nutritional status, quality of life, and clinical outcome. The means by which the food is administered (orally, enterally, or parenterally) should be adapted to the circumstances of the patient. Particularly in need are patients receiving chemotherapy or undergoing other onerous therapies. They require special care.

The patient's nutritional needs are not covered when:

- the energy deficit is >10 kcal/kg of body weight;
- 500 kcal/day for seven days;
- a deterioration of nutritional status and a weight loss of 5–10% is present;
- oral food intake is <75% of requirements (low);
- oral food intake is <50% of requirements (moderate); and
- oral food intake is <25% of demand (strongly) [27].

Comprehensive nutrition regulates the energy flow and nutrient supply. The attempt to optimize it must be made in the case of each patient, taking into account the above-mentioned parameters and criteria. The DGEM has created a staging system and makes recommendations for the selection of the necessary nutritional and medical measures [22]. Oral food intake (drinking high-calorie food) is most important of all. If this not possible, artificial feeding must be initiated at once, regardless of whether the patient is an inpatient or an outpatient.

The nutrition team decides what level of nutrition therapy is used (Table 16.2). Tumor patients who have no difficulty swallowing or chewing and have no digestive disturbances are fed orally with liquid food.

Additional parenteral nutrition must be initiated if the patient's condition worsens and weight loss occurs (cancer patients). Artificial feeding should be continued for as long as it serves to improve the patient's nutritional status and quality of life. Periodic monitoring is required.

**Table 16.2** Stage scheme of diet after DGEM [22]

Stage	Form of diet or nutrition support
I	Normal diet Special diet form Food enrichment (macro, micro nutrients) Diet counseling
II	I + oral balanced diets (OBD)
III	(I, II) + supplementary enteral/parenteral nutrition
IV	Total enteral nutrition
V	Enteral nutrition + parenteral nutrition
VI	Parenteral nutrition + minimal enteral nutrition
VII	Total parenteral nutrition

Cancer cachexia arises from a combination of malnutrition and its underlying causes, such as permanent loss of appetite or insulin resistance. From a nutritional therapy perspective, this has the following consequences.

At the latest in the event of a weight loss of 5% or more vis-à-vis an original healthy starting weight, a nutrition diagnosis with a diet history and individual nutrition counseling must take place. Regular follow-up appointments for further nutritional support must be set up. Routine nutritional support is necessary. Changes may be made to the food intake, ultimately using parenteral nutrition if this is necessary.

## 16.10 The Treatment of Patients at Greatest Risk

The diet administered must be high in fat and protein in order to strengthen the organism. Particular attention is necessary in the case of chemotherapy patients. The side effects of chemotherapy reinforce the action of malnutrition. Chemotherapy always affects the patient's nutritional status. Here it is important to restore or maintain by means of a diet plan the patient's ability to undergo therapy. Patients at greatest risk are found in the contexts of surgery, oncology, geriatric care and intensive care. The risk factors for complications are the severity of the disease, age >70 years, the presence of a tumor, and the surgery itself [27]. Screening for malnutrition on first contact with the patient is essential. If there is a weight loss >10–15% within six months, a BMI <18.5 kg/m<sup>2</sup>, the Subjective Global Assessment (SGA)—Grade C or NRS >3, the serum albumin <30 g/l (liver and kidney disorder excluded), a 'severe metabolic risk' exists [27]. The oral intake of food must be strictly observed, and the patient's weight BMI constantly monitored. In most cases, oral intake of food is not sufficient to stabilize the metabolism of tumor patients, despite the provision of additional energy and protein-rich liquid food. Here, artificial feeding must be considered. The artificial diet is also necessary in the case of patients who are not suffering from disease-related malnutrition, but who are judged unlikely to be able to take food orally for a long time after the operation. The nutritional therapy should always start early, and only after the presence of malnutrition has been ascertained. It is used in the case of high-risk patients, major surgical operations, and severe complications that arise following surgical intervention or other treatment despite good care.

## 16.11 Nutrition: A Discipline in its Own Right

Nutrition is not a paramedicine but a discipline in its own right. What we achieve with nutritional medicine cannot be achieved by administering a single drug.

Some 70–75% of diseases are primarily caused by diet and lifestyle-induced problems. Undernutrition and malnutrition are common in hospitals, and are a

growing problem. They are costly and have clinical consequences. Each patient admitted to hospital must be examined and documented in accordance with the established parameters for undernutrition and malnutrition. A nutritional medical intervention is necessary at the outset in the case of patients with cancer. The object is the maintenance of healthy cell mass, stabilization of the metabolism, the improvement of the patient's general condition, and thus a good preparation for all oncological measures.

Undernutrition and malnutrition affect all relevant clinical factors: mortality, length of hospital stay, morbidity, and thus the quality of life.

Drinking high-calorie food, food additives and artificial nutrition via probe have a high therapeutic benefit [28]. Dozens of studies testify to the significance of therapeutic provision of nutrition and demonstrate its cost-effectiveness for hospitals. For the therapy to be successful, the early, targeted assessment of the patient's status is necessary in order to ensure the guideline-based implementation of the dietary concepts based on the staging system. This requires a qualified team consisting of medical nutritionists, general nutritionists, dietitians and other qualified nutrition professionals. This team is responsible for the implementation of the guidelines [23]. The evaluation scores are a reliable basis for the detection of undernutrition and malnutrition (Table 16.2) [29, 30].

Europe-wide studies and meta-analyses powerfully confirm the importance of medical nutritional analysis for patients admitted for hospital treatment [8].

Malnutrition is a risk factor for hospitals and clinics that affects all clinical factors—above all, mortality, morbidity, length of hospital stay, complications, the therapeutic outcome, and, last but not least, the patient's quality of life. Only the thoroughgoing implementation of established nutritional concepts designed to maintain and improve the patient's energy and protein balance will guarantee success. Undernutrition and malnutrition cost €9 billion per year in Germany alone. Politicians and health care providers agree that it is possible to reduce these costs. Individuals can also protect themselves by adopting a healthy lifestyle. This begins with the consumption of healthy foods.

## 16.12 Summary: Key Messages

- Undernutrition and malnutrition affect all relevant clinical factors.
- Undernutrition and malnutrition are common in hospitals, and are a growing problem.
- Studies and meta-analyses testify to the significance of the therapeutic provision of nutrition for patients admitted to hospital, and also demonstrate its cost-effectiveness.
- For the therapy to be successful, early, targeted assessment of the patient's status is necessary in order to ensure the guideline-based implementation of recognized dietary concepts.
- This requires a qualified nutrition support team.

- Every patient admitted to hospital should be examined, and a diet plan developed for his or her specific needs.
- Undernutrition and malnutrition cost €9 billion per year in Germany alone. These costs could be reduced by the application of medical nutrition therapy in hospitals.

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