

## REVIEW ARTICLE

# Malnutrition in Hospital

The Clinical and Economic Implications

Christian Löser

## SUMMARY

**Background:** Undernutrition and malnutrition are common in hospitalized patients. Their combined prevalence on admission is estimated at 25% and is rising.

**Methods:** Selective literature review with special consideration of current guidelines and meta-analyses.

**Results:** The nutritional state of every patient should be assessed on admission with simple, established parameters, and patients suffering from under- or malnutrition should be treated with a targeted nutritional intervention based on the established stepwise treatment algorithm. Under- and malnutrition are an independent risk and cost factor with a significant influence on mortality, morbidity, length of hospital stay, and quality of life. Their direct costs alone amount to some 9 billion Euros in Germany each year. Therapeutic trials and meta-analyses have clearly documented the therapeutic benefit and cost-effectiveness of oral nutritional supplements and tube feeds. Targeted nutritional intervention is an integral part of medical treatment and prevention.

**Conclusion:** Undernutrition and malnutrition are common in hospitalized patients and are both medically and economically harmful. If they are detected early by targeted assessment and then treated appropriately according to the established stepwise treatment algorithm, better clinical outcomes and lower costs will result.

► **Cite this as:**

Löser Chr: Malnutrition in hospital—the clinical and economic implications. *Dtsch Arztebl Int* 2010; 107(51–52): 911–7. DOI: 10.3238/arztebl.2010.0911

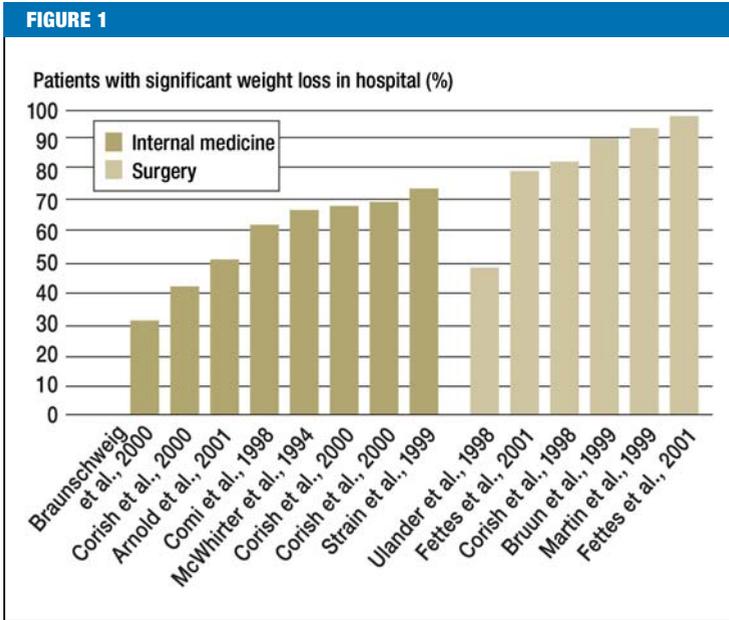
Undernutrition and malnutrition are a common (prevalence above 25%) and increasing problem in German hospitals. Its medical and financial consequences are significant and have been well demonstrated scientifically. They are at least as significant for the German health and social service system as the well-known consequences of excess weight and obesity (1, 2).

There are still no universal definitions for the terms undernutrition or malnutrition. Unfortunately, there is also no established gold standard for standardized detection and quantification. The current guidelines of the German Society for Nutritional Medicine (*Deutsche Gesellschaft für Ernährungsmedizin*, DEGM) define undernutrition as a reduction in the body's energy stores (primary target parameter: reduced fat mass) and malnutrition as either illness-associated weight loss, lack of protein (decreased muscle mass) or a deficit of specific essential nutrients (e1). According to current knowledge, early detection of under- or malnutrition and subsequent basic treatment using nutritional medicine not only has a significant effect on the individual patient's mortality, morbidity, tolerance of treatment, and complication rate, and therefore prognosis and quality of life, but in prospective clinical trials and meta-analyses also results in substantially shorter hospital stays and a significant reduction in individual costs (1, 3–8).

Almost no other area of medicine has seen such fundamental paradigm shifts in recent years as nutritional medicine. Today targeted nutrition is no longer considered as meeting a basic need: it is one of physicians' therapeutic and preventive treatment options. This selective literature review will discuss the medical and economic consequences and the established treatment strategies for under-/malnutrition on the basis of trials, meta-analyses, and guidelines of the relevant medical societies published to date, providing a practice-oriented summary.

## Prevalence

Since the mid-1970s there have been more than 200 published clinical trials which have systematically researched the prevalence of under-/malnutrition in hospital patients: according to the investigated patient



Extent of deterioration in nutritional status during hospital stay: conclusions of large published studies within the specializations internal medicine and surgery (modified according to R.J. Stratton et al. [4])

population, the definition of undernutrition used, and the assessment parameters used as a result, these clinical trials show a prevalence of between 20% and 60% on hospital admission (3, 4, 9–11, e2–e6). For the German-speaking world specifically, many large-scale prospective studies on the prevalence of under-/malnutrition have been published in recent years: in 2001 the author’s working group published a single-center study which is still the largest ever conducted on the subject (9). Of a total of 1917 prospectively examined patients, 22% were found to be undernourished when admitted to the hospital. The proportion was significantly higher (25%) in patients receiving regular hospital care than in those at a university institution (20%). A multicenter study conducted all over Germany in a total of 1886 patients found that an even higher proportion, 27%, of patients were under-/malnourished (10). The study of Kyle et. al (11) (n = 1760) showed a prevalence as high as 31%.

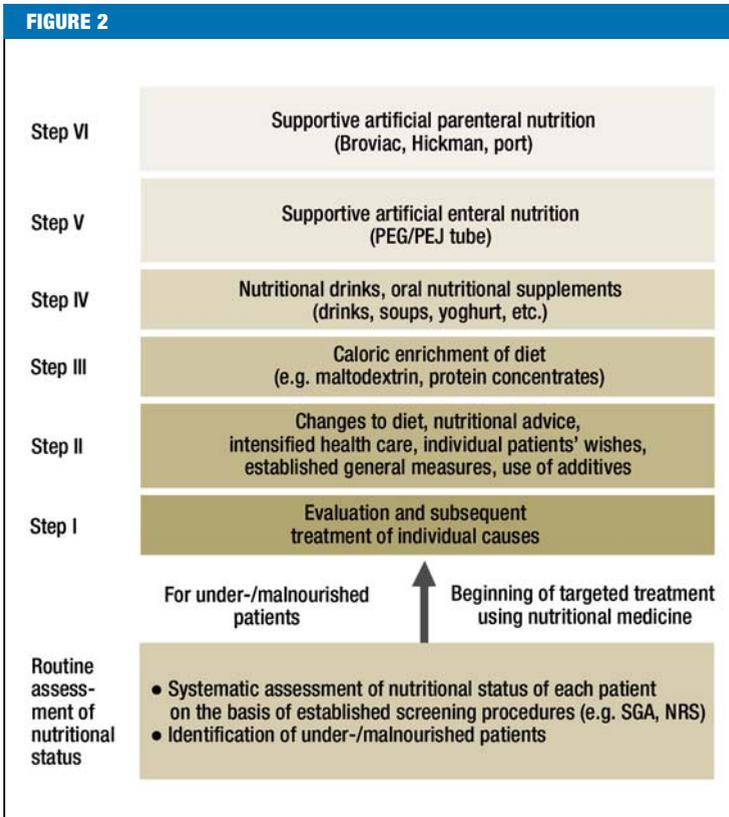
In addition, further significant problems regarding patients’ nutritional status occur during hospital stays. Clinical studies reveal that between 30% and over 80% of inpatients, depending on the specialty and the patient population investigated, progressively lose a substantial amount of weight during their hospital stay (Figure 1). The prevalence of under-/malnutrition is significantly correlated with social factors (e.g. family and care status, educational level), patient age, and medical factors (malignant underlying diseases, multiple drug treatment) (9–11, e2–e5).

**Causes**

The causes of malnutrition in patients in Germany are complex (3, 4, 12, 14). The main cause is the patient’s illness itself (disease-related malnutrition), which can interfere with adequate absorption and metabolism of food via a variety of mechanisms, such as infection-dependent changes in metabolism, loss of appetite, absorption or digestion disorders, disease-specific catabolism, etc. However, there are also many other major causes, such as poor dental health, poorly-fitting false teeth, social isolation, gastrointestinal symptoms, addictions, poverty/lack of money, mental illness (e.g. depression, dementia), swallowing disorders, changes in taste perception, complex medication, or an individual’s inability to purchase or prepare food. Systematic early evaluation and the resulting treatment of potential underlying causes is an essential medical task as part of suitable treatment of patients at risk of under-/malnutrition (Figure 2).

**Determining nutritional status**

Targeted clinical history (central question: loss of weight, dietary habits) and overall physical examination (muscle mass, subcutaneous fat) are certainly the most important general measures in detecting under-/malnutrition. Documenting dynamic parameters which are relevant to nutritional medicine, such as weight changes, appetite, gastrointestinal symptoms, or assessment of daily nutritional intake, is an important part of taking a patient’s general clinical history.



Systematic assessment and treatment strategies using nutritional medicine for under-/malnourished patients (modified according to current guidelines [17–19])

**TABLE 1**

**Established evaluation scores recommended in guidelines for simple detection of under-/malnutrition (3)**

Subjective Global Assessment (SGA) [e39]	Nutritional Risk Score (NRS) [e40]			
Weight changes in the last 6 months (<5% = slight; >10% = significant)	Initial screening: – BMI <20.5 kg/m <sup>2</sup> – Weight loss (last 3 months) – Reduced nutritional intake/day (past week) – Severe illness			
Appetite, amount and type of nutritional intake	If the answer to any question is Yes, screening follows:			
Gastrointestinal symptoms – Nausea, vomiting, flatulence, pain, diarrhea	Nutritional status, weight loss, amount of nutritional intake			
		1 point	2 points	3 points
Functional capacity – Ability to function, mobility, ability to work	Weight loss >5%	In 3 months	In 2 months	In 1 month
	BMI (kg/m <sup>2</sup> )		18.5–20.5	<18.5
	Nutritional intake (% of need)	50–75	25–50	0–25
Stress caused by underlying disease – Severity of disease	Severity of disease, metabolic stress			
		1 point	2 points	3 points
Physical examination – Muscle mass, subcutaneous fat – Edema, ascites		e.g. hip fracture, cirrhosis of the liver, COPD	e.g. apoplexy, major abdominal surgery, leukemia	e.g. head trauma, bone marrow transplant, intensive care patients
	Age >70 years: add 1 point			
A = normal B = slight malnutrition C = severe malnutrition	Score 0–3 = reduced nutritional status, monitoring needed Score >3 = begin nutritional intervention			

In the SGA the assessor must consider asking the six subquestions individually and choose A, B or C on the basis of his/her resulting subjective impression alone

Of the many publicized parameters for specific diagnosis of nutritional status, the Subjective Global Assessment (SGA) score, Nutritional Risk Score (NRS 2002), and for older patients the Mini Nutritional Assessment score (MNA) have been established in recent years as reliable, reproducible, easy-to-learn methods (Table 1) (3, 4, 12, e7–e9). Using one of these scores and body mass index (BMI), the individual nutritional status of each patient should be ascertained routinely when patients are hospitalized so that patients at risk of under-/malnutrition can be identified early, on admission, and be treated using targeted nutritional medicine.

**Clinical consequences**

The complex clinical consequences of under-/malnutrition are obvious and have been well demonstrated scientifically for some years in many prospective clinical trials and meta-analyses (1, 3, 4, 7, 8, 12–14, e7–e10). According to the available data, under-/malnutrition is an independent risk factor with a significant effect on the important clinical parameters of mortality, morbidity, complication rates, length of hospital stay, tolerance of treatment, quality of life, and prognosis (Table 2) (3, 4, 7, 8, 12, 14, e7–e10).

EuroOOPS (13), a Europe-wide multicenter clinical study conducted in more than 5000 patients in 26 hospitals, shows higher mortality (12% versus 1%), significantly longer hospital stays (9 versus 6 days; p<0.001), and a significantly higher complication rate (odds ratio 3.47; p<0.001) for under-/malnourished patients and patients at risk of under-/malnutrition according to the NRS. A current review article by Norman et al. (14), published in 2008, summarizes and explores the significant correlation between malnutrition and morbidity, mortality, and length of hospital stay and the consequently higher treatment costs.

**Treatment strategies**

A stepwise treatment algorithm (Figure 2) has been established for practice in nutritional medicine for patients no longer able to eat adequately because of their illness.

After individual evaluation and treatment of underlying causes, the next step is an individual nutritional clinical history with changes made to patients' diets with consideration of patients' individual wishes using easy-to-digest, high-energy options. Also, there are many other general measures established in practice,

**TABLE 2**

**Clinical consequences of progressive under-/malnutrition demonstrated in scientific studies**

Immunocompetence	↓
Rate, duration, and severity of infections	↑
Overall complication rate	↑
Healing disorders, decubitus ulcers	↑
Immobility, risk of falling	↑
General health	↓
Mental state	↓
Need of help and care, infirmity	↑
Tolerance of treatment	↓
Quality of life	↓
Morbidity	↑
Mortality	↑
Prognosis	↓

**TABLE 3**

**The effect of nutritional drinks/oral supplements on mortality and complication rates according to various published meta-analyses (modified according to 8)**

Meta-analyses	Complication rate	Mortality
Potter et al. (2001)		0.61 (CI 0.45–0.82)* <sup>1</sup>
Stratton et al. (2003)	0.29 (CI 0.18–0.47)* <sup>1</sup>	0.62 (CI 0.49–0.76)* <sup>1</sup>
Stratton et al. (2005) * <sup>3</sup>	0.79 (CI 0.62–0.89)* <sup>1</sup>	
NICE (2006)	0.71 (CI 0.61–0.82)* <sup>1</sup>	0.81 (CI 0.68–0.97)* <sup>1</sup>
Milne et al. (2006)* <sup>2</sup>	0.72 (CI 0.53–0.79)* <sup>1</sup>	0.66 (CI 0.49–0.90)* <sup>1</sup>
Stratton et al. (2007)	0.37 (CI 0.23–0.60)* <sup>1</sup>	
Milne et al. (2009)		0.79 (CI 0.64–0.97)* <sup>1</sup>

Odds ratios with 95% confidence intervals;  
<sup>1</sup> statistically significant result;  
<sup>2</sup> only patients with under-/malnutrition during hospitalization;  
<sup>3</sup> specific evaluation concerning pressure sores/decubitus ulcers  
 CI: 95% confidence interval

such as the use of special flavor enhancers, eating in pleasant surroundings and good company, special nutritional education for family members providing care, encouraging physical activity between meals, or prescribing small, frequent portions of high-energy food between meals (finger food, snacks, high-energy drinks) throughout the day. Extra energy can also be added to patients' diets using economical, energy-rich additives with no odor or flavor, such as maltodextrin or specific protein concentrates.

In order to make good use of today's knowledge of nutritional medicine, nutritional support teams are needed in hospitals. These teams must consist of doctors in charge of nutrition, care staff trained in nutrition, dietary assistants, and/or dieticians. The structure, organization, and tasks of a nutritional support team have been established; the clinical and financial efficiency of a qualified nutritional support team has also been shown in studies and one meta-analysis (15, e11–e15).

**Nutritional drinks/oral nutritional supplements**

There is almost no pharmacological treatment established in medical practice in which so many clinical studies (more than 200) and meta-analyses have been published in the literature as in therapeutic benefit of nutritional drinks and additional oral nutrition: to date there are 14 published meta-analyses (4, 5, 8, 16, e16–e23), and there is already a summary analysis, or review of reviews (8), on the available review articles and meta-analyses (1, 3–5, 8, 12, 16–18).

In a meta-analysis, Stratton et al. (4) were able to ascertain that the addition of nutritional drinks to the diets of patients with under-/malnutrition significantly reduced both the complication rate (odds ratio 0.29

[95% confidence interval [CI] 0.18–0.47]) and mortality (odds ratio 0.62 [95% CI 0.49–0.76]). These significant effects are also seen in malnourished patients who receive additional nutritional drinks or oral nutritional supplements during short hospital stays. Milne et al. (16) also found a significant decrease in the complication rate, by 28%, in these patients, and a drop in mortality as large as 34% after prescription of additional nutritional drinks. *Table 3* summarizes the relevant conclusions of the most important available meta-analyses.

Nutritional drinks and oral nutritional supplements are available in more than 30 different flavors. They should be given between rather than at mealtimes, or even better in the evening as supplements to patients' diets. If a patient is only able to eat a little (e.g. geriatric patients, tumor patients), high-calorie nutritional drinks with an enriched calorie content of 1.5 to 2.7 kcal/mL can also be offered. If medically indicated, nutritional drinks/oral supplements can be prescribed by physicians and must be funded by statutory health insurance in Germany (German Federal Gazette, issue 188, dated September 1, 2005).

**Artificial nutrition**

If all the measures mentioned above (*Figure 2*) have been tried with no lasting therapeutic benefit, supportive artificial nutrition must be considered (3, 4, 12, 19). In addition to medical indications (underlying disease, patients' individual health status, any comorbidities, expected prognosis, mental/psychological status, individual patients' wishes), ethical issues (particularly in the case of elderly patients with multiple disorders and tumor patients in advanced stages of illness) must also be considered on an individual basis. Clinical trials

show significantly better quality of life, in addition to a significant improvement in nutritional status, reduced complication rates, and improved individual prognosis, for supportive nutritional therapy via PEG/PEJ tube (4, 19–21, e24–e27). *Figure 3* shows changes in weight in a prospective clinical study (20) in 210 consecutive patients with various benign and malignant underlying diseases who were closely observed for one year after a PEG was fitted. The main conclusions of this study, which have been confirmed several times since then, are as follows:

- Both patient groups lost an average of 12 kg of weight in the last three months before the possibility of supportive PEG tube nutrition was considered.
- Supportive nutrition via PEG tube can halt this massively progressive catabolism very efficiently. This is also also true for many patients with malignant underlying diseases.
- However, supportive PEG tube nutrition is unable to regain weight already lost by patients, even with benign underlying diseases, according to the statistical average (*Figure 3*).

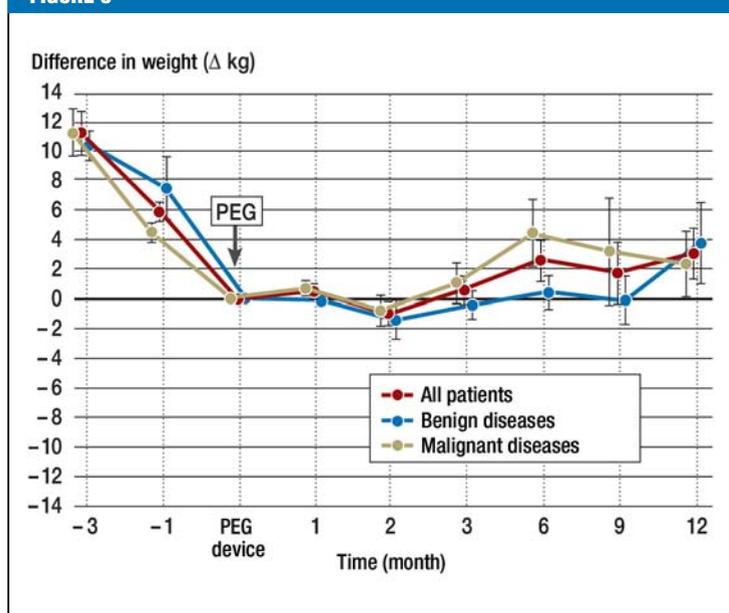
According to today’s medical understanding, nutrition via PEG tube is supportive, preventive, and usually temporary; it is the first-choice method worldwide for artificial nutrition expected to be needed for more than two weeks, and can be ended at any time after normal oral intake has been resumed (4, 19–21, e24–e27). The dilemma of PEG (12, 19), which is often used as a synonym for artificial nutrition, is that discussion of PEG systems within the medical profession and by the public is usually one-sided, concentrating on problems with patients who are elderly, have multiple disorders, and/or suffer from dementia, in whom it has been shown that enteral tube systems are actually used too uncritically and often without good ethical grounds (we fit too many PEG tubes in the wrong patients). In patients who the evidence shows benefit significantly from supportive PEG tube nutrition (e.g. patients receiving chemotherapy or radiotherapy), it is considered far too rarely and usually far too late (we insert too few PEG tubes far too late in the right patients) (3, 4, 12, 18–21, e24–e33).

If there are contraindications against enteral nutrition, which is rare, parental catheter systems (Broviac or Hickman catheters) can also be used. In patients receiving chemotherapy who have port systems, supportive nutrition can be given in addition (12, 18, 19).

### Costs/budgeting: a paradigm shift

Under-/malnutrition not only significantly worsens morbidity and mortality but is also a disease-independent, highly significant cost factor (1, 3, 4, 6–8, 12, 14, 22–24). The CEPTON study, published in 2007 (25), has calculated on the basis of the available scientific literature that additional costs to the German health-care system which are directly associated with under-/malnutrition are approximately 9 billion euros annually.

FIGURE 3



Changes in body weight in all patients (n = 210) and separately for patients with benign and malignant underlying diseases retrospectively for three months before and prospectively twelve months after a PEG tube is fitted (20)

Still more relevant from a medical/financial point of view are the results of the many intervention studies which show that the subsequent treatment of under-/malnutrition, e.g. using nutritional drinks/oral nutritional supplements, are highly cost-effective and economical (1, 3, 4, 6, 22–25, e34–e38). Amaral et al. (23) successfully demonstrated in a total of 469 patients that under-/malnourished patients and patients at risk of under-/malnutrition incurred an average of 19.3% higher costs than the average for corresponding diagnosis-related groups (DRGs), where the 95% confidence interval for the resulting additional costs was between 200 and 1500 euros per case. Kruizenga et al. (22) showed in their study, which involved 588 patients, that early nutritional intervention in malnourished patients reduced the length of hospital stays by 2.5 days when compared to patients cared for in the routine way; in other words, only an additional 76 euros per patient needs to be found to reduce the patient’s hospital stay by one day. Russell (1) systematically analyzed the available studies into the efficiency of oral nutritional drinks perioperatively and found that prompt intervention could effectively save approximately 1000 euros per patient. This is an example of medical needs being absolutely hand-in-hand with operational and health economics–based considerations and requirements.

The high number of available studies have led to a paradigm shift in attitudes to supportive enteral nutrition. It used to be assumed across the board that resources needed to be invested in clinical nutrition of patients while the extent to which these expenses contributed to cost-efficiency by shortening hospital stays

could not be foreseen. Today, however, the available studies and meta-analyses lead to the opposite argument: early treatment of malnutrition is one of the last remaining effective ways to save money in health care (1, 2, 4, 6–8, 22–25, e34–e38).

Health policy is also being re-thought. In both the major Council of Europe resolution (7) and very new programs (Stop Malnutrition), the EU describes the high number of undernourished patients in European hospitals as completely unacceptable and decisively confirms the unequivocally demonstrated medical/clinical consequences and the huge unnecessary additional costs for health care (2, 7, e38).

### Practical application

The medical societies have made specific suggestions and proposals to apply today's knowledge of nutritional medicine in order to diagnose and treat under-/malnutrition (17–19):

- A qualified nutritional support team must be established: the structure, organization, tasks, and cost-efficiency of a nutritional support team have been established (15, e11–e15).
- Immediately on admission, all patients' nutritional status must be systematically evaluated using established, simple, quick-to-use parameters. Specific recommendation: SGA/BMI or NRS/BMI as routine assessment for all newly admitted patients.
- Patients with under-/malnutrition should then receive standardized nutritional intervention on the basis of the established stepwise algorithm (Figure 2) (internal hospital standards).
- Hospitals must compile a binding list of diet types which also contains special energy-rich menu items, including energy-rich snacks (shakes, soups, finger food).
- According to evidence-based knowledge available to us, nutritional intervention such as nutritional drinks/oral supplements and, where applicable, supportive additional tube feeding must be considered an integral part of medical treatment and prevention in under-/malnourished patients. It must also be used much more aggressively in individual cases.
- In view of its great significance, nutritional medicine must finally become an essential part of the training of medical students and specialized physicians.

#### Conflict of interest statement

The author declares that no conflict of interest exists according to the guidelines of the International Committee of Medical Journal Editors.

Manuscript received on 23 October 2009, revised version accepted on 19 January 2010.

Translated from the original German by Caroline Devitt, MA.

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#### KEY MESSAGES

- Under-/malnutrition is an increasingly common problem (prevalence 25%) in German hospitals, with scientifically-established significant clinical and economic consequences.
- Under-/malnutrition is an independent risk factor which significantly worsens patients' morbidity, mortality, tolerance of treatment, complication rates, and quality of life.
- Clinical intervention studies and meta-analyses establish decisively that giving supportive nutritional drinks/oral supplements or tube feeding via an enteral nutrition system can significantly improve the mortality, morbidity, complication rates, length of hospital stay, and quality of life of patients with under-/malnutrition.
- Artificial nutrition (e.g. via a PEG tube) has always required a medical and ethical indication and depends on individual circumstances; it is supportive, preventive, and usually temporary and should therefore be considered promptly for relevant patients.
- According to the knowledge and understanding available to us today, nutrition and targeted nutritional intervention are an integral part of medical treatment and prevention and are not primarily the satisfaction of a basic need.

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