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# Malnutrition in healthcare: treatment pays off

**A health economic analysis of  
malnutrition in the Netherlands**

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## Malnutrition is a common problem in all sectors of healthcare.

It causes a great deal of suffering amongst patients and leads to high healthcare costs. With an ageing population, this is a particularly rapidly growing challenge. In this report, you will read the results of a health economic analysis to provide insight into the costs of untreated malnutrition and the costs and benefits of the treatment of malnutrition in Dutch healthcare. The study shows that the treating of malnutrition contributes substantially to cost savings within the Dutch healthcare system.

The study shows that the direct medical costs of untreated malnutrition in the Netherlands amount to €3.0 billion in the year in which the malnutrition occurs. This is 3.4% of total healthcare costs in the Netherlands in 2023. When other costs such as indirect costs from lost productivity are included, the costs of untreated malnutrition total €5.4 billion in the year in which the malnutrition occurs.

These are partly unnecessary costs, since there is an approach available for this problem as described in the Malnutrition guideline (Richtlijn ondervoeding). The treatment of malnutrition consisting of dietary treatment with oral nutritional supplements when necessary can lead to fewer complications and better outcomes compared to no treatment of malnutrition. The treatment of malnutrition not only reduces the direct medical costs, but also contributes to lower non-medical costs, lower costs from lost productivity and lower costs due to a reduced loss of healthy life years (Quality-Adjusted Life Years or QALYs).

In numerical terms, the cost-benefit analysis shows that treatment of malnutrition results in significant net cost savings; an estimated €749 million in the year in which the malnutrition occurs up to €5.2 billion over a 5 year period. Each euro invested in the treatment of malnutrition yields €2.08 in the year in which the malnutrition occurs.

Extended to a five year period, this investment even yields a net saving of €14.44. Especially in the outpatient sector without home care, many direct medical costs can be saved (62.6%). If all costs are taken into consideration, the outpatient sector without home care (26.5%) and hospital sector (56.4%) offer the highest savings (total 82.8%).

The treatment of malnutrition is also very cost-effective: it costs an estimated €15,552 per gained healthy life year (QALY) compared to no treatment. This falls well below the Dutch willingness to spend €20,000 to €80,000 per QALY.

This study highlights the importance of a proactive approach to treating of malnutrition in all healthcare sectors, from hospital to nursing home/care home and in the elderly living at home with and without home care. Implementing dietary treatment with the use of oral nutritional supplements when necessary can not only improve the health and wellbeing of patients, but also offers a significant economic benefit to society.

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# Summary

## Background to the study

Malnutrition has been an important but also under-recognised problem in all sectors of healthcare for many years, and with an ageing population it is an issue of increasing concern in public health.<sup>1</sup>

In European Union countries, around 20 million patients are affected by disease-related malnutrition every year, costing European Union member states up to €120 billion a year.<sup>2,3</sup> These high costs are a consequence of both the high prevalence of malnutrition and the substantial economic consequences of the effects of malnutrition.

According to the Malnutrition guideline, the treatment of malnutrition should always start with a dietary treatment, the starting point being protein and/or energy enrichment of normal foods tailored to the individual patient.<sup>4</sup> If the treatment goals cannot be met with (modified) regular nutrition, use of oral nutritional supplements is indicated.<sup>4</sup>

The treatment of malnutrition consisting of dietary treatment\* with oral nutritional supplements when necessary can lead to fewer complications and better outcomes compared to no treatment of malnutrition.<sup>5</sup> Treatment of malnutrition is therefore not only important for the patient, but also relevant from a societal perspective.

SEO Amsterdam Economics surveyed the social costs of malnutrition in the Netherlands in 2014.<sup>6</sup> The total social costs of malnutrition were estimated at €1.8 billion a year. The SEO report also included a cost-benefit analysis for the hospital sector with a total net benefit of treatment of malnutrition ranging from €52 million to €112 million per year. Since a lot has changed in healthcare over the past 10 years, the commissioning parties have agreed to conduct a new analysis. This analysis extended the research scope from the hospital sector to also include the nursing home/care home sector and the outpatient sector (elderly living at home with or without home care).

\*Although the publication talks about dietary advice, the term dietary treatment is commonly used in the Netherlands. In this report we assume that this is the same.

## Objectives

The objectives of this cost-benefit study are:

### Objective 1

To determine the costs of untreated malnutrition in the Netherlands (based on healthcare costs in 2023).

### Objective 2

To determine the costs and benefits of the treatment of malnutrition, specifically dietary treatment with the use of oral nutritional supplements when necessary, in hospitals and care institutions (intramural) and at home (extramural, with or without home care) in 2023.

## Methods

A cost-benefit analysis is used in this health economic study. In a cost-benefit analysis, costs and benefits are expressed only in euros and the analysis is about the difference between the costs and benefits that occur in the relevant year. An extension to 5 years has also been included in the calculations. This health economic model distinguishes three sectors in which malnutrition occurs:

### Hospital

### Nursing home/care home

### Outpatient sector

'elderly living at home with home care' and  
'elderly living at home without home care'

In addition, the cost-effectiveness of the treatment of malnutrition over a lifetime period has also been examined, determined by not converting the gain in Quality Adjusted Life Years (QALYs) into monetary values. The cost-effectiveness is then calculated by dividing the net additional total costs of the treatment of malnutrition, but now without the monetary values of QALYs, by the gain in QALYs.

## Results

### Objective 1

#### To determine the costs of untreated malnutrition in the Netherlands (based on healthcare costs in 2023).

The direct medical costs of untreated malnutrition amount to €3.0 billion in the year in which the malnutrition occurs. The total costs of untreated malnutrition in the year in which the malnutrition occurs are even €5.4 billion due to non-medical costs (€230 million), indirect costs from lost productivity (€631 million) and costs due to loss of QALYs (€1.6 billion). There are no indirect medical costs because these only occur in the remaining years of life.

### Objective 2

#### To determine the costs and benefits of the treatment of malnutrition, specifically dietary treatment with the use of oral nutritional supplements when necessary, in hospitals and care institutions (intramural) and at home (extramural, with or without home care) in 2023.

The net savings for 2023 in the intramural and extramural sectors were determined by subtracting the costs of treatment of malnutrition from the benefits of specific dietary treatment with the use of oral nutritional supplements when necessary. The costs of treatment of malnutrition have been calculated at €360 million and the benefits in direct medical costs from treatment of malnutrition are €583 million, leading to a net saving in direct medical costs of €223 million. Including the other costs in the year in which the malnutrition occurs results in a total net cost saving of €749 million. These other savings result from - in addition to the direct savings from the treatment of malnutrition - lower non-medical costs (€39 million), lower indirect costs from lost productivity (€144 million) and lower costs due to less loss of QALYs (€343 million). There are no indirect medical costs, since these only occur in the remaining years of life.

Extending the analysis to 5 years, the total net savings are €5.2 billion. The savings in direct medical costs, non-medical costs and indirect costs from lost productivity remain the same, since these costs only arise in the year in which the malnutrition occurs.

If the analysis is extended to 5 years, the total costs of untreated malnutrition increases even further. The direct medical costs, non-medical costs and indirect costs from lost productivity remain the same, since these costs only arise in the year in which the malnutrition occurs. However, the loss of QALYs due to malnutrition leads to a total loss of €9.8 billion over 5 years. Higher mortality due to malnutrition leads to €1.4 billion in indirect medical costs. Together, this adds up to a total cost of €15.0 billion.

There is a cost saving of €4.8 billion through increased gains in QALYs over 5 years, but the longer survival by treatment of malnutrition leads to an additional €52 million in indirect medical costs in the remaining years of life gained by treatment of malnutrition.

Finally, the cost-effectiveness of the treatment of malnutrition over a lifetime period has been determined by not converting the gain in QALYs into monetary values. The cost-effectiveness is then calculated by dividing the net additional total costs of the treatment of malnutrition, but now without the monetary values of QALYs, by the gain in QALYs. The savings in direct medical costs (€223 million), non-medical costs (€39 million) and indirect costs of lost productivity (€144 million) still remain the same over a lifetime period, as in the analysis up to 5 years. However, longer survival through treatment of malnutrition results in €8.8 billion (€8,835 million) in indirect medical costs in the remaining years of life gained by treatment of malnutrition. The treatment of malnutrition therefore results in a net additional cost of €8,429 million and also an additional 0.542 million QALYs, giving a cost per QALY of €15,552 (€8,429 million/0.542 million).

### Conclusion

This health economic study shows the costs of untreated malnutrition on the one hand and the costs and benefits of treatment of malnutrition on the other hand. The total direct medical costs of untreated malnutrition are €3.0 billion in the year in which the malnutrition occurs, and €5.4 billion if the other costs are included.

The cost-benefit analysis shows that the costs of treatment of malnutrition are €360 million. The net quantified benefits are €749 million. This means that every euro spent on the treatment of malnutrition yields €2.08 (€749 million/€360 million) in the year in which the malnutrition occurs, based on the three sectors in this analysis. The analysis over 5 years for all sectors leads to a net cost saving of €5.2 billion, meaning that every €1 invested in treatment of malnutrition leads to a net saving of €14.44 over this 5 year period.

Finally, the cost-effectiveness of the treatment of malnutrition was determined, giving a cost per QALY of €15,552. In the Netherlands, we as a society are willing to spend €20,000 to €80,000 per QALY depending on the burden of disease, and therefore the treatment of malnutrition with a cost per QALY of €15,552 can be considered very cost-effective.

The conclusion of this health economic study is that the treatment of malnutrition is cost-saving for both medical costs and total costs in both the short and longer term. In addition, the treatment of malnutrition is very cost-effective over a lifetime period.

# Background

Malnutrition has been an important but also under-recognised problem in all sectors of healthcare for many years, and with an ageing population it is an issue of increasing concern in public health.<sup>1</sup> The term 'disease-related malnutrition' is also commonly used and reflects malnutrition that occurs with diseases.<sup>6,7</sup> In this report, we use the term 'malnutrition'. In European Union countries, around 15 to 20 million patients are affected by disease-related malnutrition every year, resulting in costs to society of €120 to €170 billion a year for European Union member states.<sup>2,3</sup> These high costs are a consequence of the high prevalence of malnutrition and of the major economic consequences of the implications of untreated malnutrition.

The prevalence of malnutrition is high in all sectors of Dutch healthcare. The Malnutrition guideline describes that, on average, one in four to five patients in hospitals, care institutions and home care is malnourished.<sup>4</sup> Risk groups for malnutrition are frail elderly, chronically ill people, oncology patients, patients undergoing or who have undergone major surgery, and patients with major physical trauma.<sup>4</sup>

The total additional direct medical costs of caring for adult patients with malnutrition were estimated at €1.9 billion in 2011. This corresponded to 2.1% of total Dutch national healthcare expenditure and 4.9% of the total costs of the healthcare sectors analysed in this study.<sup>1</sup>

There is growing evidence for the cost-effectiveness of medical nutrition in various types of patients with malnutrition across the various healthcare sectors and all ages. Medical nutrition leads, among other things, to weight gain, improvement of muscle mass and muscle function, reduction of mortality, and reduction of complications of malnutrition (such as sepsis, pressure ulcers and pneumonia). Treatment of malnutrition results in a reduced risk of readmission after treatment of malnutrition during hospitalisation, improvement in wound healing, an improved quality of life and significantly lower mortality rates.<sup>8,9,10,11,12,13</sup>

The treatment of malnutrition consisting of dietary treatment with oral nutritional supplements when necessary can lead to fewer complications and better outcomes compared to no treatment of malnutrition.<sup>5</sup> Treatment of malnutrition is therefore not only important for the patient, but also relevant from a societal perspective.

SEO Amsterdam Economics surveyed the social costs of malnutrition in the Netherlands in 2014.<sup>6</sup> The total social costs of malnutrition were estimated at €1.8 billion per year. The SEO report gave a cost-benefit analysis for the hospital sector. A broad estimate gave the total net benefits of treatment of malnutrition as €52 million to €112 million per year in this specific sector. Since a lot has changed in healthcare over the past 10 years, the commissioning parties have agreed to conduct a new analysis. The update was done for the prevalence rates of malnutrition and clinical and economic data relating to malnutrition and its treatment. The research scope was also extended from the hospital sector to also include the nursing home/care home sector and the outpatient sector.

# 1

# Introduction

## 1.2

### Malnutrition

The European Society for Clinical Nutrition and Metabolism (ESPEN) defines malnutrition as 'an acute or chronic condition in which a deficiency or imbalance of energy, protein and other nutrients leads to measurable, adverse effects on body composition, function and clinical outcomes.<sup>14,15</sup> A consensus statement by ESPEN on the terminology of malnutrition and related abnormalities and conditions sees malnutrition as a nutrition-related disorder, alongside sarcopenia and frailty, overweight, obesity, micronutrient abnormalities and refeeding syndrome.<sup>15</sup>

## 1.2

### Causes of malnutrition

The Malnutrition guideline divides the causes of malnutrition into somatic, functional, psychological and social factors.<sup>4</sup> Examples of somatic factors include the disease state (various degrees of inflammation) and symptoms/feeding problems resulting from disease or its treatment, such as pain, decreased taste, smell, appetite, dental problems, swallowing problems, disruption of the sense of hunger and satiety, impaired digestion and absorption in the gastrointestinal tract. Examples of functional factors include fatigue, reduced mobility and reduced or no ability to do shopping and prepare food respectively. Examples of psychological factors include anxiety, sadness, depression and impaired cognition. Social factors include loneliness, no social network to have shopping done and poverty.<sup>16</sup>

## 1.3

### Consequences of malnutrition

Consequences of malnutrition can be divided into clinical and economic consequences.

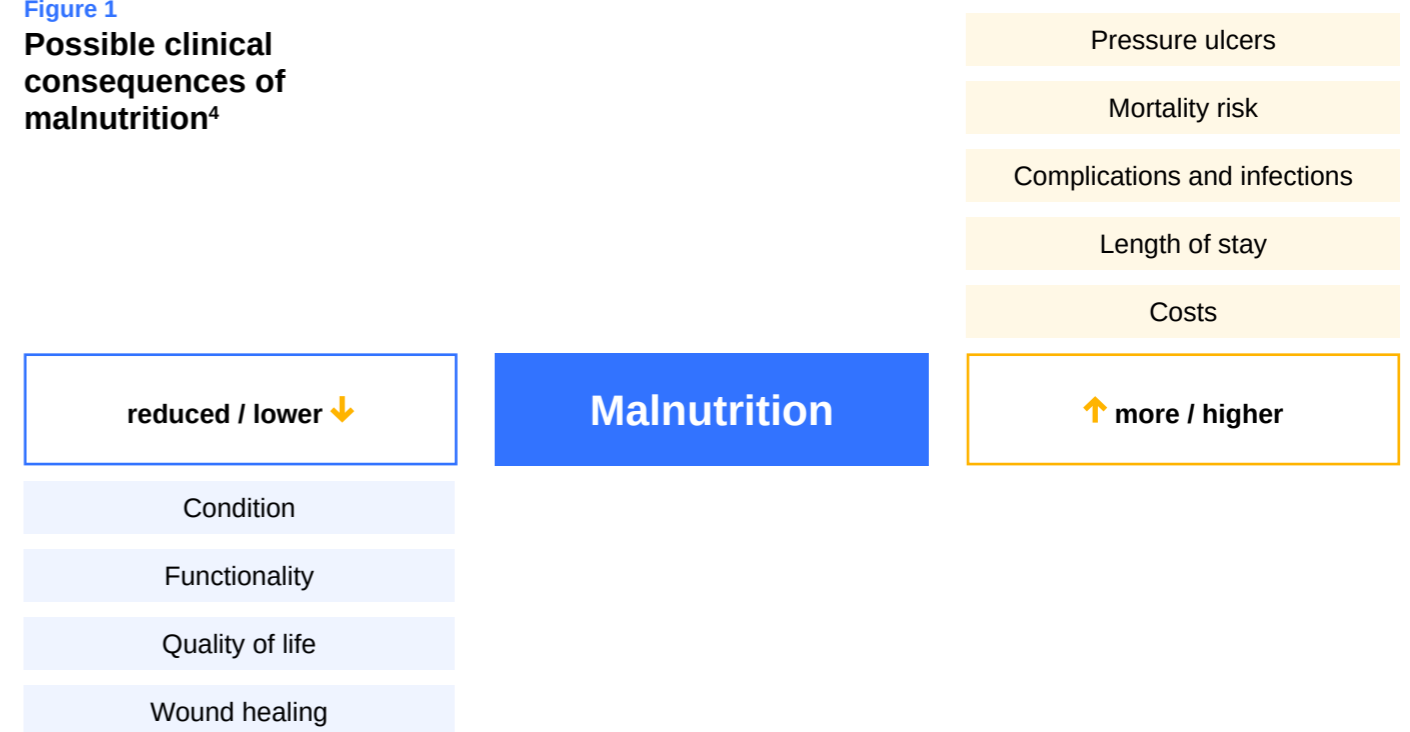
#### Clinical consequences

If left untreated, the consequences of malnutrition are severe, which can lead to marked deterioration in physical, psychological and social health and function. Malnutrition is related to slower recovery and more frequent and more severe complications.<sup>4</sup> Insufficient nutritional intake, disease and inactivity lead to reduced muscle mass and muscle strength which are often also key features of malnutrition. This decrease in muscle mass and strength leads to a decrease in overall fitness and reduced heart and lung capacity. Finally, malnourished patients are more likely to have poorer immune status, poorer wound healing, a greater chance of developing pressure ulcers, increased mortality and a reduced quality of life.<sup>4,17</sup> Figure 1 shows the possible clinical consequences of malnutrition.<sup>4</sup>

#### Economic consequences

The clinical consequences cited before also lead to economic consequences, as they contribute to issues such as longer length of stay during hospitalisation, poorer response to medical treatment (e.g. chemotherapy, radiotherapy) and increased use of drugs. This results in an increase in healthcare costs.<sup>8,18,19,20</sup> In addition, the treatment of pressure ulcers, complications and infections can also result in additional medical costs.<sup>21,22</sup> Increased mortality risk and loss of quality of life can also be converted into monetary values (euros) and therefore also have economic consequences.<sup>21,22,23</sup>

**Figure 1**  
Possible clinical consequences of malnutrition<sup>4</sup>





1.4

**Treatment of malnutrition**

The description of screening and treatment in this section is based on the Malnutrition guideline in consultation with a number of Dutch (para)medical experts.<sup>4</sup> Basic objectives in the nutritional and exercise treatment of malnutrition are adequate intake of protein, energy and micronutrients, sufficient exercise and the resolution of nutrition-related complaints (see box).<sup>4</sup>

According to the Malnutrition guideline, the treatment of malnutrition should always start with a dietary treatment, the starting point being protein and/or energy enrichment of normal foods tailored to the individual patient.<sup>4</sup> If treatment goals cannot be met with (modified) regular nutrition, use of oral nutritional supplements is indicated.<sup>4</sup> See figure 2 for a flowchart of the screening, diagnosis and treatment of malnutrition.

Endpoints for measuring the cost-effectiveness of the treatment of malnutrition are adequate nutritional intake, muscle mass/strength and weight gain, movement and functionality.<sup>4</sup> Medical nutrition includes oral nutritional supplements (ONS), tube feeding (via gastrointestinal tract) and total parenteral nutrition (TPN) (intravenous). The cost-benefit analysis in this health economic study focuses on dietary treatment with oral nutritional supplements when necessary.

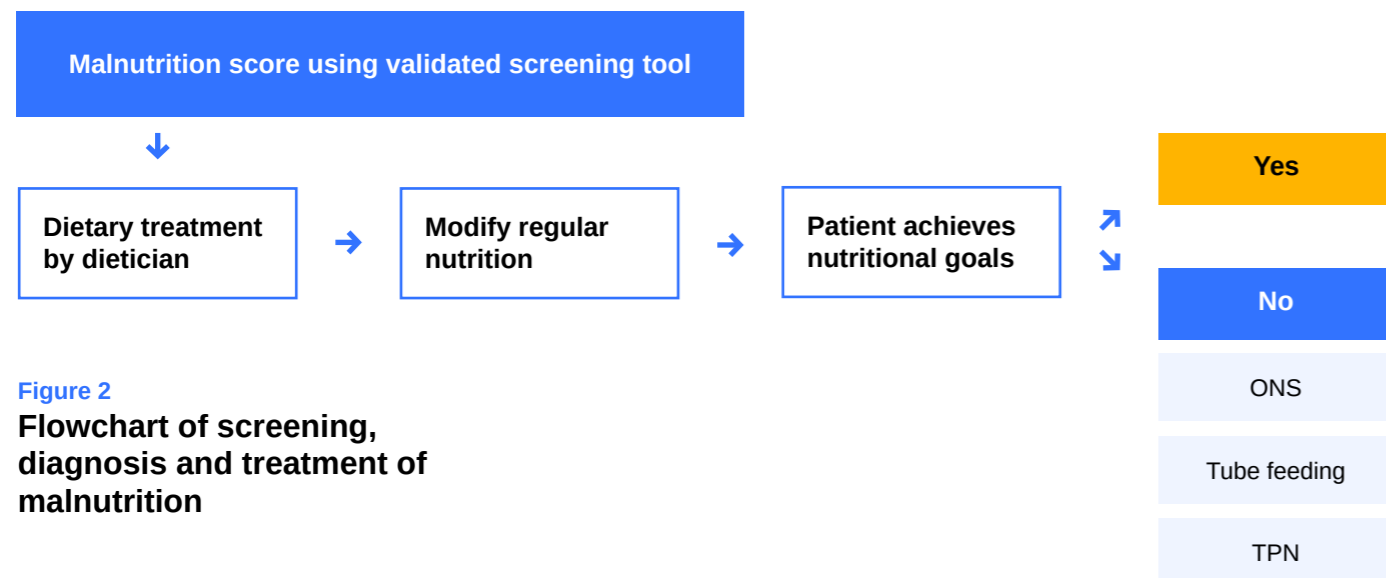
**Treatment of malnutrition according to the Malnutrition guideline <sup>4</sup>**

With an **intake of 75% - 100%** of the determined need, the treatment plan consists of protein-rich and energy-rich food in the form of enriched main meals, interim provisions and possibly oral nutritional supplements (ONS).

With an **intake of 50% - 75%** of the determined need, the recommendation is ONS and/or tube feeding in addition to protein-rich and energy-rich foods.

With an **intake of less than 50%** of the need and there is no chance of rapid improvement in intake, then complete tube feeding is indicated, supplemented by what is possible orally.

**Total parenteral nutrition (TPN)** is indicated when adequate nutrition cannot be provided via the gastrointestinal tract for more than seven days because enteral nutrition is not or insufficiently possible or is contraindicated.



**Figure 2**  
**Flowchart of screening, diagnosis and treatment of malnutrition**

# 2 Objectives

The objectives of this cost-benefit study are:

**Objective 1**

To determine the costs of untreated malnutrition in the Netherlands (based on healthcare costs in 2023).

**Objective 2**

To determine the costs and benefits of the treatment of malnutrition, specifically dietary treatment with the use of oral nutritional supplements when necessary, in hospitals and care institutions (intramural) and at home (extramural, with or without home care) in 2023.

We examine the treatment of malnutrition, specifically dietary treatment with the possible use of oral nutritional supplements, as described in the Malnutrition guideline.<sup>4</sup> In this report, from now on we refer to treatment of malnutrition, by this we mean from now on dietary treatment with the use of oral nutritional supplements when necessary.

*NOTE: In this report we refer to 'untreated malnutrition'. By this we mean that there would be no intervention (such as dietary treatment with the use of oral nutritional supplements when necessary), which is certainly no longer the reality in the Netherlands.*



# 3 Methods

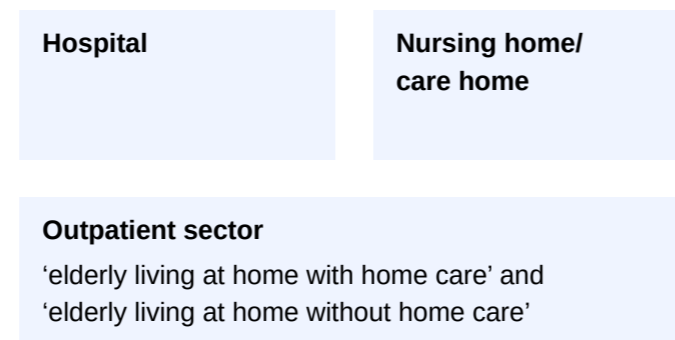
This section describes the health economic model to determine the costs of untreated malnutrition in 2023. It also determines the costs and benefits of the treatment of malnutrition in the Dutch healthcare system in 2023. In a cost-benefit analysis, costs and benefits are expressed only in euros and the analysis is about the difference between the costs and benefits. A cost-benefit analysis can be used to determine the economic benefits of the treatment of malnutrition, with the benefits of the treatment of malnutrition deducted from the costs associated with the treatment of malnutrition.

In this cost-benefit analysis, the costs are the costs of treatment of malnutrition and the benefits are the savings from reduced costs for the clinical consequences of malnutrition. This cost-benefit analysis also includes intangible benefits, like the gain in quality-adjusted life years (QALYs), which are converted into monetary values (euros). Finally, the cost-effectiveness of the treatment of malnutrition over a lifetime period has been determined by not converting the gain in QALYs into monetary values. The cost-effectiveness is then calculated by dividing the net additional total costs of the treatment of malnutrition, but now without the monetary values of QALYs, by the gain in QALYs, which gives the cost per QALY.

### 3.1

## Sectors

This health economic model distinguishes between three sectors where malnutrition can occur:



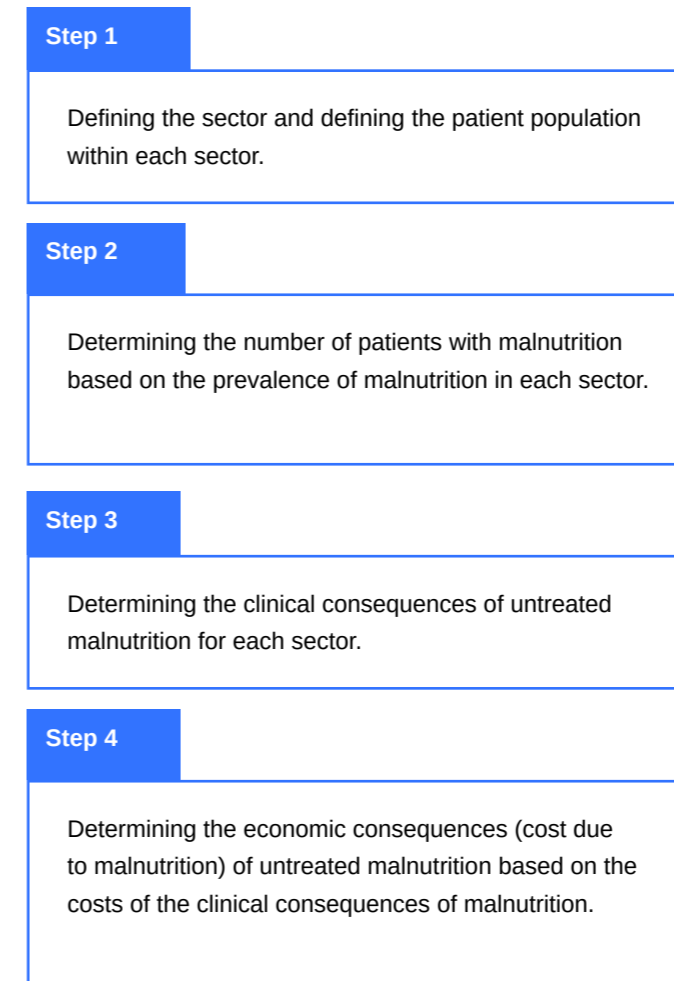
### 3.2

## Description of the economic model for the cost-benefit analysis

Figure 3 shows the structure of the cost-benefit model and which steps make up this cost-benefit analysis. The structure is the same for each sector and therefore only the structure for the nursing home/care home sector is shown to avoid making the diagram unnecessarily complex. However, sector-specific clinical and economic consequences of malnutrition are included in the model within the same structure for each sector.

### Objective 1:

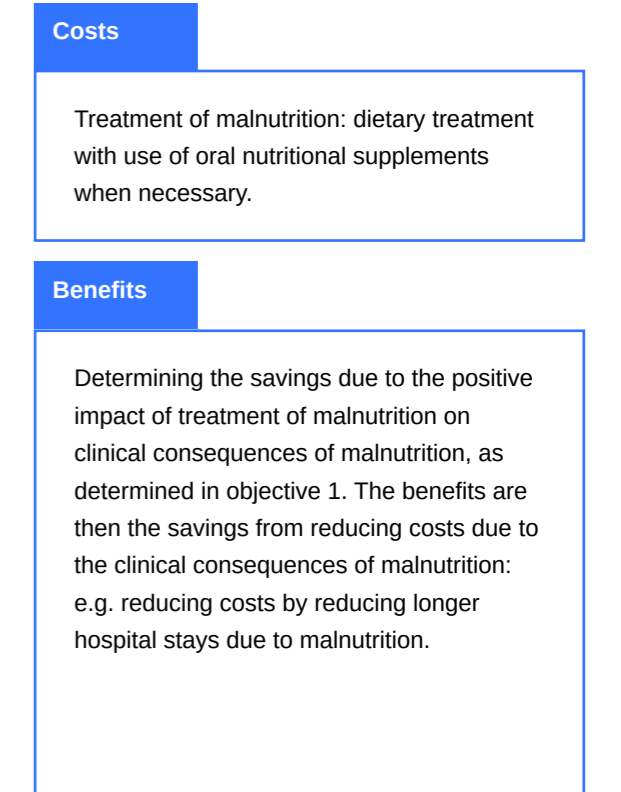
Determining the costs of untreated malnutrition in the Netherlands (based on healthcare costs in 2023) consists of the following steps:



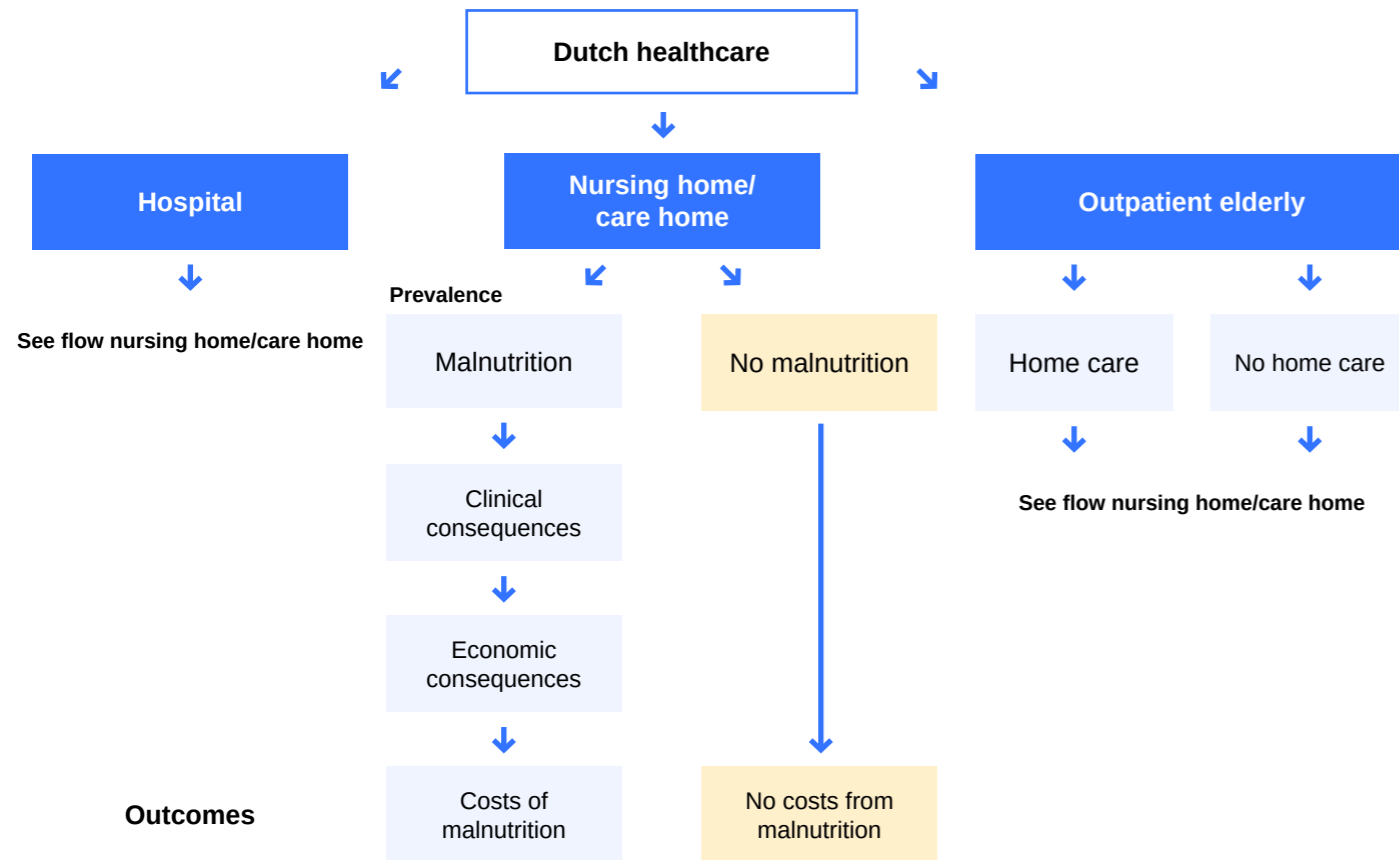
The final step for objective 1 'Economic consequences of untreated malnutrition' determines the costs as a result of untreated malnutrition in the Netherlands in 2023.

### Objective 2:

To determine the costs and benefits of the treatment of malnutrition, specifically dietary treatment with the use of oral nutritional supplements when necessary, in hospitals and care institutions (intramural) and at home (extramural, with or without home care) in 2023.



Objective 1 Costs of untreated malnutrition



Objective 2 Costs and benefits of treatment of malnutrition

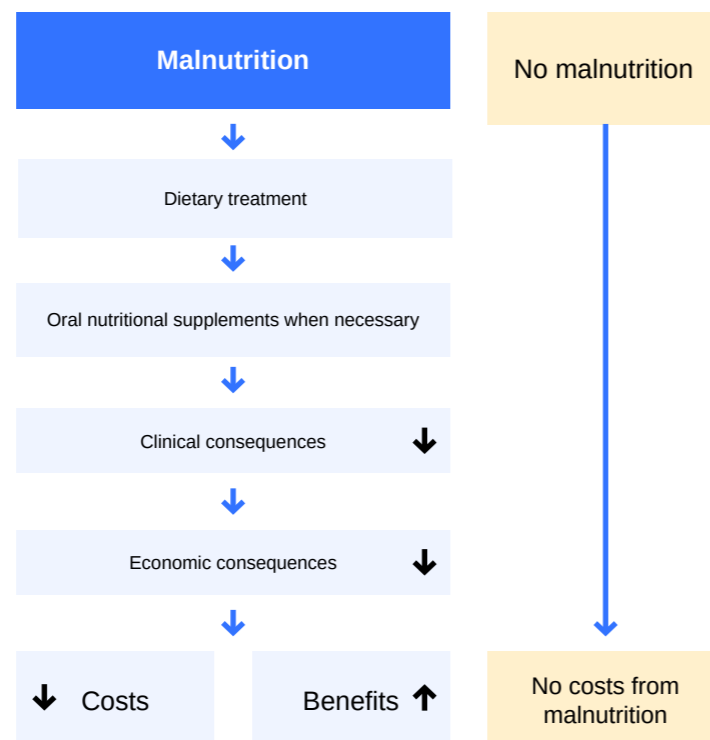


Figure 3 The structure of the model for the cost-benefit analysis

3.3

Economic outcomes - costs and benefits

The costs and benefits in this health economic analysis are determined by the volume measurement of units of medical resource utilisation and reference prices for treatment of malnutrition and the treatment of the clinical consequences of malnutrition in the Netherlands. See box for the cost and benefit categories distinguished in this analysis.

The relevance of each cost category varies by sector. For example, informal care is relevant to the outpatient sector but not to the hospital and nursing home/care home sectors.

The benefits are the total of the reduction in the costs of malnutrition by treatment of malnutrition determined in the above categories.

The costs were valued according to the Nederlandse richtlijn voor economische evaluatie in de gezondheidszorg (Dutch guideline for economic evaluation in healthcare) and the associated Kostenhandleiding (Cost Manual).<sup>24 25</sup>

The following cost and benefit categories are distinguished:

Medical costs

- Medical costs due to clinical consequences of malnutrition.
- Cost of treatment of malnutrition (dietary treatment, oral nutritional supplements).

Non-medical costs

Non-medical costs due to malnutrition, such as informal care.

Indirect costs

Indirect costs from lost productivity due to malnutrition.

Indirect medical costs

Indirect medical costs that occur in years of life gained after recovery from malnutrition, e.g. cost of a broken hip in a gained year of life. These costs are age-specific and gender-specific and consist, on the one hand, of the average cost for someone who lives for a year and, on the other hand, of the end-of-life costs of someone who dies in a year.

The monetary values of lost QALYs

# 4

## Data and sources

### 4.1

#### Literature review and consultation of Dutch expert group

Data sources for the model for this health economic analysis are published literature, official Dutch price/tariff lists, population statistics, data from a home care organisation and dieticien organisations. This study also made use of consultation of a Dutch expert group, which consisted of 5 Dutch medical and paramedical experts in the field of malnutrition.

### 4.2

#### Prevalence of malnutrition

##### Hospital

The analysis is based on a prevalence of 13.7% after screening with a validated screening tool in an observational study by Kruizenga. This study was conducted on 27 wards in 2 academic, 3 teaching hospitals and 8 general hospitals with an average age of 62 years for the patients.<sup>26</sup>

##### Nursing home/care home

The analysis is based on a study by De van der Schueren in 5 different nursing homes.<sup>27</sup> In this study, 21.0% of patients with an average age of 85 years were categorised as malnourished after screening with a validated screening tool.

##### Outpatient sector

In September 2023 a publication with new Dutch prevalence rates of malnutrition for the outpatient sector has been published.<sup>28</sup> Based on this data, a recent Dutch report (on the value of care for malnutrition in (frail) elderly uses the data in the adjoining box.<sup>29</sup>

Table 1 shows that the prevalence of malnutrition varies across sectors with ranges from 8.5% to 21.0%.

##### Outpatient sector elderly living at home

###### Without home care

8.5% (65+)

###### With home care

15.5% (65+)

Table 1

#### Prevalence of malnutrition in the Netherlands

Sector	Prevalence of malnutrition	Source
<b>Hospital</b>		
	13.7%	Kruizenga <sup>26</sup> & validation by expert group
<b>Nursing home/care home</b>		
	21.0%	De van der Schueren <sup>27</sup> & validation by expert group
<b>Outpatient sector</b>		
Elderly living at home <u>without</u> home care	8.5%	Zügül <sup>28</sup> & validation by expert group
Elderly living at home <u>with</u> home care	15.5%	Zügül <sup>28</sup> & validation by expert group

4.3

### Clinical and economic consequences of malnutrition

Table 2, Table 3 and Table 4 describe the clinical and economic consequences which have been included in this cost-benefit analysis including underlying sources. Clinical data is not country-specific, and the studies used are therefore not confined to Dutch publications. On the other hand, economic data is country-specific and therefore only Dutch publications were used for this data.<sup>30</sup> Treatment costs are determined by national clinical guidelines and healthcare funding policies and are therefore country-specific.

#### Hospital

This report uses Lim's publication as a starting point for data on mortality of patients with malnutrition in hospital.<sup>31</sup> These patients had an additional mortality of 29.9% after one year compared to patients without malnutrition (34.0% versus 4.1%). This rises to as much as 38.6% after 3 years (48.5% vs 9.9%).

For the Dutch population aged over 65, Mangel provides the QALY for different age groups, from which the QALY can be determined for any age by linear extrapolation.<sup>32</sup> These data have been combined with the annual mortality rate for each age from the CBS (Statistics Netherlands) to determine the total remaining QALYs for patients with untreated malnutrition.<sup>33</sup> At an average age of 62 years with 48% men, as described for the population in Kruizenga's study, 4.64 QALYs remain for patients with untreated malnutrition.<sup>26</sup> These remaining QALYs determine the level of the burden of disease, leading to a value of €50,000 per lost QALY.<sup>34 35</sup>

Next to the clinical consequences, economic consequences of malnutrition were also included based on longer hospital stays. In Kruizenga's study, patients with malnutrition had a 1.4 day longer length of stay on average than patients without malnutrition (5.4 versus 4.0). This leads to additional costs of €814 per patient at a per diem of €581.55.<sup>26</sup>

Based on the average age of 62 years and the fact that 40% are older than 70 years in Kruizenga's study, indirect costs from lost productivity were also included for employed patients.<sup>26</sup> Table 2 shows that malnutrition leads to €179 higher costs from lost productivity due to the longer length of hospital stays of 1.4 days per patient.

Higher mortality due to malnutrition also leads to higher indirect costs from lost productivity (€3,242), based on the assumption that 73.2% of the population aged 15 to 75 is gainfully employed in 2023.<sup>36</sup> Furthermore, the maximum period of lost productivity is only 85 days, since this is the period needed to fill the created vacancy according to the Nederlandse Kostenhandleiding.<sup>25</sup>

Readmission after discharge from hospital is also included in the economic analysis. Norman studied the effect of oral nutritional supplements in German malnourished patients after discharge from hospital.<sup>37</sup> Readmissions were 22% higher in the control group than in the intervention group (48% and 26%, respectively) within three months after discharge. This German data can be used in this economic analysis for the Netherlands, as readmissions can be considered a clinical non-country-specific outcome, as previously shown in a study by Freijer.<sup>23</sup> The assumption is that readmissions (48%) in the control group correspond to untreated malnutrition in patients with malnutrition.

Finally, the annual indirect medical costs are included from the age of 62 on average as per Kruizenga's study according to the Nederlandse Kostenhandleiding.<sup>24 25</sup>

Table 2 shows that medical costs and lost productivity due to malnutrition are caused by both longer length of hospital stays and higher mortality. Non-medical costs are not described for the hospital sector.

Table 2  
Clinical and economic consequences - hospital

Hospital				
Clinical consequences	No MN	MN	Difference	Source
<b>Mortality</b>				Lim <sup>31</sup>
Year 1	4.1%	34.0%	29.9%	
Year 2	6.7%	42.6%	35.9%	
Year 3	9.9%	48.5%	38.6%	
Economic consequences (2023)	No MN	MN	Difference	Source
<b>Length of stay</b>				Kruizenga <sup>26</sup>
Days	4.0	5.4	1.4	
Euro	€2,326	€3,140	€814	
<b>% Working population (age 15 - 75)</b>	73.2%			CBS <sup>36</sup>
<b>Lost productivity</b>				
Days of stay	€510	€689	€179	
Mortality	€445	€3,687	€3,242	
<b>Readmission</b>				Norman <sup>37</sup>
No ONS		48%		
ONS		26%		
<b>Threshold (cost per QALY)</b>	€50,000			Ziektelast in de praktijk (Burden of disease in practice) <sup>34</sup>

MN: Malnutrition  
ONS: oral nutritional supplements

**Nursing home/care home**

Mortality is less relevant in this sector because of the short life expectancy, and therefore only the economic consequences of malnutrition are included which result from the underlying clinical consequences of malnutrition. Meijers was recommended by the expert group because the data from this 2012 study is also relevant for 2023.<sup>38</sup> The additional costs of supporting nursing home residents with malnutrition are €13,923 for patients with malnutrition (Table 3) after adjusting for inflation from 2012 to 2023.

The expert group considers that the quality of life for patients in a nursing home/care home is already so low that malnutrition will lead to little additional loss of QALYs, also due to the limited life expectancy. The monetary value of lost QALYs due to malnutrition is therefore not included in this health economic study for this sector. The nursing home costs have also been used for care homes.

**Outpatient sector**

Van Wijnhoven shows an increased risk of mortality for patients with malnutrition, using existing data from two ongoing longitudinal epidemiological studies in elderly (aged over 65) in the Netherlands and Italy.<sup>39</sup> Only the increased risks, the 'hazard ratios', for the Dutch patients were used in this health economic study. The hazard ratio of 2.64 after 6 years for patients with malnutrition means that there is a 2.64 higher probability of death for these patients compared to patients without malnutrition. After 15 years, the hazard ratio has fallen to 2.22, but still shows increased mortality.

Van der Pols provides useful data on costs in the outpatient sector.<sup>40</sup> Van der Pols examined the cost-effectiveness of a multifactorial personalised intervention aimed at eliminating or controlling the underlying causes of malnutrition in 155 elderly living at home to reduce or prevent malnutrition. Table 4 shows that the annual medical costs after inflation correction for untreated patients are €6,764 and the annual non-medical costs are €672.<sup>40</sup> The non-medical costs cover informal care, social work and interventions such as 'meals on wheels'. No

**Table 3**  
**Economic consequences - nursing home/care home**

Nursing home/care home		
Additional annual costs	2012	2023*
Diagnostics	€834	€1,106
Monitoring	€58	€76
Treatment	€9,605	€12,739
MDC	€100	€133
<b>Total**</b>	<b>€10,498</b>	<b>€13,923</b>

Source: Meijers<sup>38</sup>  
MDC: multidisciplinary consultation  
\* Rounded after correction for inflation  
\*\* The total costs as described in Meijers' study<sup>38</sup> are not exactly equal to the sum of the various costs.

distinction was made in this study between patients with and without home care, so the same costs were used for both categories.

The monetary value of QALYs lost due to malnutrition was converted into a monetary value of QALYs using the same method as described in the hospital section. The average age in Schilp's epidemiological study was 81.6 years in the group with home care and 75.3 years in the group without home care, and the percentage of men was 30.7% and 42.3% respectively.<sup>41</sup> Combining QALYs from Mangel's study and mortality data from the CBS gave 3.29 (home care) and 6.78 (no home care) remaining QALYs for people aged 81.6 years (30.7% men) and 75.3 years (42.3% men) with untreated malnutrition respectively (Table 4).<sup>32,33</sup> These remaining QALYs were then converted to a monetary value of €50,000 (home care) and €20,000 (no home care) per lost QALY respectively through an intermediate step of burden of disease.<sup>34,35</sup> The burden of disease for those with home care is higher than for those without home care, so a higher monetary value per lost QALY should be used.

**Table 4**  
**Clinical and economic consequences - outpatient sector**

Outpatient sector			
Clinical consequences	MN	Source	
<b>Mortality - hazard ratio (HR)</b>		Wijnhoven <sup>39</sup>	
6 years	2.64		
15 years	2.22		
Economic consequences (2023)	MN	Source	
Medical costs	€6,764	Van der Pols <sup>40</sup>	
Non-medical costs	€672		
Epidemiology	Average age	% Men	Source
Home care	81.6	30.7	Schilp <sup>41</sup>
No home care	75.3	42.3	
Threshold (cost per QALY)			Ziektelast in de praktijk <sup>34</sup>
Home care	€50,000		
No home care	€20,000		

MN: Malnutrition

Table 4 shows that in addition to the medical costs, the monetary value of lost QALYs is also substantial for malnutrition for elderly living at home in the outpatient sector. The indirect costs from lost productivity are not included because the individuals are aged over 65 (average age 81.6 years (home care) and 75.3 years (no home care)) and it is therefore assumed that they are no longer working.

Finally, the annual indirect medical costs were included according to the Nederlandse Kostenhandleiding based on average ages of 82 years (81.6 rounded) and 75 (75.3 rounded) for patients with and without home care respectively.<sup>25</sup> The ages were rounded because the indirect medical costs are only available by year of age.<sup>25,41</sup>



## Treatment of malnutrition

According to the Malnutrition guideline, the treatment of malnutrition should always start with a dietary treatment, the starting point being protein and/or energy enrichment of normal foods tailored to the individual patient.<sup>4</sup> If the treatment goals cannot be achieved with (modified) normal food, the use of oral nutritional supplements is indicated.<sup>4</sup>

### Use of oral nutritional supplements

Seven studies included in a recent Cochrane review by Baldwin report the percentage of patients using oral nutritional supplements among patients with dietary treatment and oral nutritional supplements when necessary ('dietary advice plus ONS if required').<sup>42</sup> Based on six studies in the outpatient sector, we arrive at a figure of 44%, both for the outpatient sector of elderly living at home with home care and for the outpatient sector of elderly living at home without home care.<sup>43 44 45 46 47 48</sup> The seventh study, conducted in a hospital, reported a percentage of 53%.<sup>49</sup> The assumption is that the percentage of 53% for the hospital sector can also be applied to the nursing home/care home sector.

### Costs of oral nutritional supplements

The costs of oral nutritional supplements are determined by the number of days of treatment with oral nutritional supplements x number of bottles per day x price per bottle, see boxes.

### Dietitian consultations

The number of dietitian hours for extramural treatment of malnutrition averages 4 hours (240 minutes) for a patient with malnutrition according to two consulted dietitian representing dietitian organisations that work nationwide (despite the fact that reimbursed care under the Health Insurance Act (Zorgverzekeringswet) is 3 hours for dietetics). At an hourly rate of €80 for a dietitian, this corresponds to €320 for treatment of malnutrition in adults.<sup>29</sup> The costs from the outpatient sector can be used as a proxy for the actual costs in the other sectors, since the study has a broad societal perspective.

### Impact of the treatment of malnutrition

Different values have been reported in the literature for the impact of the treatment of malnutrition on various parameters. In this analysis the choice has been made to use the effect values described in the aforementioned Cochrane review by Baldwin as the primary source for calculating the cost-benefit resulting from the treatment of malnutrition (Table 5).<sup>42</sup> This review included a selection of studies based on very strict criteria.

The review shows that 'dietary advice plus oral nutritional supplements if required' leads to a significant improvement in energy intake, in protein intake to a lesser extent and to weight gain. For the more clinically relevant endpoints (such as mortality, complications, length of hospital stay or readmissions), the high heterogeneity of the data diminished the degree of certainty of the evidence as concluded by the authors. However, other studies not included in the review show statistically significant effects on such parameters, such as Schuetz's study<sup>53</sup> (large number (2,088) of patients) on mortality, for example, or on the decrease in readmissions in Yang's study<sup>54</sup> and reduction in consultations, emergency admissions and length of stay in Smith's study.<sup>51</sup>

**Table 5**  
**Impact of the treatment of malnutrition**

Impact	Relative effect	
	<b>Baldwin<sup>42</sup></b>	
	'Dietary advice plus oral nutritional supplements if required'	
	<i>versus</i>	
	'No dietary advice and no oral nutritional supplements'	
<b>Clinical</b>	Mortality	0.82
<b>Economic</b>	Readmission	0.83

## Number of days of treatment

Based on examination of treatment duration based on prescriptions of oral nutritional supplements starting in 2019 by a home care organisation, an extramural treatment duration of 183 days on average was found.<sup>50</sup> It should thereby be noted that in 2023, 3% of 2019 starters were still using oral nutritional supplements.

Patients who did not use oral nutritional supplements for more than 3 months during the aforementioned period but then restarted were not included in the analysis. This average treatment duration has also been used for other sectors.

## Number of bottles

Bottle consumption was estimated to average 1.75 per day by two consulted outpatient dietitian organisations that work nationwide, which rounds up to 2 bottles per day.

This average number of bottles was confirmed by two home care organisations. Smith et al shows in an English study that the average number of daily bottles is between 1 and 3.<sup>51</sup> The same number of bottles per day has been assumed for all sectors.

## Price per bottle

There is a lot of variation in the type of oral nutritional supplements used in the dietary treatment of malnourished patients. For this study, an average reimbursement price per bottle of €1.92 including 9% VAT in 2023 was assumed.<sup>52</sup> This average reimbursement price is an assumption. Since there is no publicly available data regarding reimbursement prices for oral nutritional supplements, the VAT in 2023 is assumed.

Reimbursement prices may vary between health insurance companies for each supplier (depending on the contract between the health insurance company and the supplier). The top 5 has been provided by a home care organisation. The reimbursement price relates to the use of oral nutritional supplements in the home setting. This price from the outpatient sector is used for the actual cost of oral nutritional supplements in the other sectors, since the study has a broad societal costs perspective.

Because the values in Baldwin's Cochrane review describe more limited effects on the one hand, and therefore rather reflect an underestimate of the effects found, and on the other hand the review reflects data from different sectors, these values have been used for the underlying analysis. The high external validity makes this Cochrane review more relevant for an economic analysis of the impact of 'dietary advice plus oral nutritional supplements if required'. The better outcomes from the individual studies show that an economic analysis based on the Cochrane review is conservative.

Mortality after three months was lower in the Cochrane review for 'dietary advice\* plus oral nutritional supplements if required' versus 'no dietary advice and no oral nutritional supplements' (8.6% vs. 10.5%), corresponding to a relative effect of 0.82 (8.6%/10.5%) and 18% lower mortality.<sup>42</sup> This is in contrast to Schuetz's study, where the effect on mortality showed a larger effect of 0.70 (7%/10%).<sup>53</sup>

The frequency of readmission was also lower for 'dietary advice plus oral nutritional supplements if required' versus 'no dietary advice and no oral nutritional supplements' (32.0% vs. 38.5%) with a relative effect of 0.83 (32.0%/38.5%), and thus 17% fewer readmissions. Complications as a whole have not been included due to the risk of double-counting costs, since the costs of complications are already included in the reported economic outcomes (such as length of stay in the

hospital sector). The relative effect of mortality (0.82) was applied to clinical consequences of malnutrition. The relative effect of readmission (0.83) was used to adjust the economic consequences of malnutrition.

### Number of admissions and patients with malnutrition

Table 6 shows the epidemiological data to determine the impact of malnutrition for hospital and nursing home/care home, adjusted when necessary for 2023 based on annual population growth.<sup>55</sup> For outpatient, the number of 474,621 patients aged over 65 receiving home care and the total number of elderly aged over 65 was adopted.<sup>56,57</sup> We can then subtract this number (474,621) from the number of people aged over 65 (3,627,484) to determine the number of outpatient elderly without home care (3,152,863). For each sector, prevalence of malnutrition was multiplied by epidemiological numbers from Table 6 to determine the annual number of patients with malnutrition in each sector.

**Table 6**  
**Number of yearly patients and admissions in different sectors in the Netherlands**

Sector	2017	2023	Source
<b>Outpatient setting</b>			
Home care	455,000	474,621	patients (2017)
No home care		3,627,484	people > 65 years (2023)
		3,152,863	people without home care
<b>Hospital</b>	1,313,410	1,346,975	admissions (2020)
<b>Nursing home/care home</b>	115,394	118,804	admissions (2019)
<b>Annual population growth</b>			
			CBS <sup>55</sup>
2017 - 2023		4.31%	
2019 - 2023		2.96%	

\*Although the publication talks about dietary advice, the term dietary treatment is commonly used in the Netherlands. In this report we assume that this is the same.

### Other costs

Table 7 shows the other costs used in the cost-benefit model with inflation correction for 2023.

**Table 7**  
**Data other costs**  
adjusted to 2023 for inflation

		Source
<b>Costs of oral nutritional supplements</b>		
Price per bottle (incl. 9% VAT)	€1.92	Data on file including home care organisation
<b>Dietitian consultation</b>		
Per hour	€80.00	SROI Rapport, 2023 <sup>29</sup>
<b>Day in hospital</b>		
Academic	€784.36	Nederlandse Kostenhandleiding, 2016 <sup>25</sup>
General	€541.23	
Average*	€581.55	
<b>Lost work</b>		
In hours	€42.46	Nederlandse Kostenhandleiding, 2016 <sup>25</sup>
<b>Friction period</b>		
In days	85	Nederlandse Kostenhandleiding, 2016 <sup>25</sup>
<b>Workable hours</b>		
Per year	1,822	CAO Rijk <sup>60</sup>
<b>Threshold (cost per QALY)</b>		
Burden of disease	0.10 - 0.40	€20,000
	0.41 - 0.70	€50,000
	0.71 - 1.00	€80,000

\*Weighted average stated in Nederlandse Kostenhandleiding based on distribution of number of academic and general hospitals.



# 5 Results

5.1

## Objective 1

### Objective 1

To determine the costs of untreated malnutrition in the Netherlands (based on healthcare costs in 2023).

Table 8 and Table 9 show not only the total costs but also the different costs of untreated malnutrition for each cost category. The tables report the costs of untreated malnutrition as positive numbers, with negative values therefore being cost savings. A distinction is made between costs in the year in which the malnutrition occurs and costs in subsequent years. The amounts when summed may differ from the reported summed numbers because numbers are presented in millions or due to rounding. Percentages may vary due to rounding.

The direct medical costs of untreated malnutrition are €3.0 billion in the year in which the malnutrition occurs. The total costs of untreated malnutrition in the year in which the malnutrition occurs are even €5.4 billion due to non-medical costs (€230 million), indirect costs from lost productivity (€631 million) and costs due to loss of QALYs (€1.6 billion). There are no indirect medical costs, since these only occur in the remaining years of life.

**Table 8**  
Costs of untreated malnutrition, year in which the malnutrition occurs in 2023

Costs (million euro)	Direct medical	Non-medical	Indirect lost productivity	Indirect medical	QALYs	All costs
Hospital	356	0	631	0	1,331	2,319
Nursing home/care home	333	0	0	0	0	333
Outpatient - home care	498	49	0	0	145	692
Outpatient - no home care	1,813	180	0	0	98	2,091
<b>Total</b>	<b>€3,000</b>	<b>€230</b>	<b>€631</b>	<b>€0</b>	<b>€1,575</b>	<b>€5,435</b>

The total does not always equal the sum, because numbers are shown in millions with rounding.

Direct medical costs and costs due to loss of QALYs are the largest cost drivers at 55.2% and 29.0% respectively, together totalling 84.2% of costs. The results also show that most of the direct medical costs (77.0%) are incurred in the outpatient sector, with 60.4% for patients without home care and 16.6% for patients with home care respectively. If all costs are considered, most costs occur in the hospital sector (42.7%) followed by the outpatient sector without home care (38.5%).

If the analysis is extended to 5 years, the total costs rise to €15.0 billion. The direct medical costs, non-medical costs and indirect costs from lost productivity remain the same, since these costs only arise in the year in which the malnutrition occurs. However, the loss of QALYs due to malnutrition leads to a total loss of €9.8 billion over 5 years. Higher mortality due to malnutrition leads to €1.4 billion in indirect medical costs. Together, this adds up to a total cost of €15.0 billion. For the nursing home/care home sector, there is no difference when the analysis is extended to 5 years, since no extrapolation took place due to limited life expectancy.

The indirect medical costs are the costs in the remaining years of life. Table 9 shows that for the hospital sector and outpatient sector without home care there are additional costs resulting from untreated malnutrition, but for the outpatient sector with home care there are fewer costs resulting from untreated care. Higher mortality due to malnutrition leads to lower indirect medical costs in remaining years of life for younger rather than older individuals, as these costs increase with age. The end-of-life costs are higher in patients with untreated malnutrition due to higher mortality. In the hospital and outpatient sector without home care, the end-of-life costs in the 5 year period are higher than the indirect medical costs for people who do not die, resulting in total higher indirect medical costs for untreated malnutrition. In the outpatient sector with home care, medical costs for people who do not die are higher than end-of-life costs, resulting in lower indirect medical costs in total. The difference can be explained by the fact that the patients in the outpatient sector with home care (average age 82 years) are older than the patients in the hospital sector (average age 62 years) and the outpatient sector without home care (average age 75 years) and therefore there are higher annual medical costs for people who do not die.

**Table 9**  
Costs of untreated malnutrition, 5 years from occurring of malnutrition in 2023

Costs (million euro)	Direct medical	Non-medical	Indirect lost productivity	Indirect medical	QALYs	All costs
Hospital	356	0	631	1,033	4,272	6,293
Nursing home/care home	333	0	0	0	0	333
Outpatient - home care	498	49	0	-438	2,763	2,872
Outpatient - no home care	1,813	180	0	751	2,720	5,463
<b>Total</b>	<b>€3,000</b>	<b>€230</b>	<b>€631</b>	<b>€1,346</b>	<b>€9,755</b>	<b>€14,961</b>

The total does not always equal the sum, because numbers are shown in millions with rounding.

## Objective 2

## Objective 2

To determine the costs and benefits of the treatment of malnutrition, specifically dietary treatment with the use of oral nutritional supplements when necessary, in hospitals and care institutions (intramural) and at home (extramural, with or without home care) in 2023.

Table 10 and Table 11 show the results of the cost-benefit analysis of the treatment of malnutrition for the different sectors. The amounts when summed may differ from the reported summed numbers because numbers are presented in millions or due to rounding.

The net savings for 2023 in the intramural and extramural sectors were determined by subtracting the costs of the treatment of malnutrition from the benefits of dietary treatment with the use of oral nutritional supplements when necessary. The costs of treatment of malnutrition are €360 million and the benefits in direct medical costs from treatment of malnutrition are €583 million, leading to a net saving in direct medical costs of €223 million. Including the other costs in the year in which the malnutrition occurs results in a total net cost saving of €749 million. These other savings result from - in addition to the direct savings from the treatment of malnutrition - lower non-medical costs (€39 million), lower indirect costs from lost productivity (€144 million) and lower costs due to less loss of QALYs (€343 million). There are no indirect medical costs, since these only occur in the remaining years of life.

**Table 10**  
Costs and benefits of treatment of malnutrition, year in which the malnutrition occurs in 2023

Costs (million euro)	Direct medical		Non-medical	Indirect lost productivity	Indirect medical	QALYs	Total	
	Treatment*	Other medical					Direct medical	All costs
Hospital	128	-134	0	-144	0	-272	-6	-422
Nursing home/care home	17	-57	0	0	0	0	-39	-39
Outpatient - home care	46	-85	-8	0	0	-42	-38	-89
Outpatient - no home care	169	-308	-31	0	0	-28	-140	-199
<b>Total</b>	<b>€360</b>	<b>-€583</b>	<b>-€39</b>	<b>-€144</b>	<b>€0</b>	<b>-€343</b>	<b>-€223</b>	<b>-€749</b>

The total does not always equal the sum, because numbers are shown in millions with rounding.

\* Treatment of malnutrition.

The results also show that most direct medical costs (62.6%) are saved in the outpatient sector without home care (€140 million). If all costs are considered, most costs are saved in the hospital sector (56.4%) followed by the outpatient sector without home care (26.5%).

Extending the analysis to 5 years, the total net savings are €5.2 billion. The savings in direct medical costs, non-medical costs and indirect costs from lost productivity remain the same, since these costs only arise in the year in which the malnutrition occurs. There is a cost saving of €4.8 billion through increased gains in QALYs over 5 years, but the longer survival by treatment of malnutrition leads to an additional €52 million in indirect medical costs in the remaining years of life gained by treatment of malnutrition.

Table 11 shows that treatment of malnutrition in the hospital sector and outpatient sector with home care leads to higher indirect medical costs by €77 million and €152 million respectively. The treatment of malnutrition leads to lower mortality, resulting in more indirect medical costs in remaining years of life which exceed the savings from reduced end-of-life costs. In the outpatient sector without home care, treatment of malnutrition results in a cost saving of €177 million in indirect medical costs because patients are younger, so the saving in

end-of-life costs is greater than the additional medical costs in the remaining years of life, which are lower for a younger patient.

Finally, the cost-effectiveness of the treatment of malnutrition over a lifetime period has been determined by not converting the gain in QALYs into monetary values. The costeffectiveness is then calculated by dividing the net additional total costs of the treatment of malnutrition, but now without the monetary values of QALYs, by the gain in QALYs. The savings in direct medical costs (€223 million), non-medical costs (€39 million) and indirect costs of lost productivity (€144 million) still remain the same over a lifetime period, as in the analysis up to 5 years. However, longer survival through treatment of malnutrition results in €8.8 billion (€8,835 million) in indirect medical costs in the remaining years of life gained through treatment of malnutrition. The treatment of malnutrition therefore results in a net additional costs of €8,429 million and also an additional 0.542 million QALYs, giving a cost per QALY of €15,552 (€8,429 million/0.542 million).

**Table 11**  
Costs and benefits of treatment of malnutrition, 5 years from occurring of the malnutrition in 2023

Costs (million euro)	Direct medical		Non-medical	Indirect lost productivity	Indirect medical	QALYs	Total	
	Treatment*	Other medical					Direct medical	All costs
Hospital	128	-134	0	-144	77	-3,234	-6	-3,307
Nursing home/care home	17	-57	0	0	0	0	-39	-39
Outpatient - home care	46	-85	-8	0	152	-853	-38	-748
Outpatient - no home care	169	-308	-31	0	-177	-749	-140	-1,096
<b>Total</b>	<b>€360</b>	<b>-€583</b>	<b>-€39</b>	<b>-€144</b>	<b>€52</b>	<b>-€4,837</b>	<b>-€223</b>	<b>-€5,190</b>

The total does not always equal the sum, because numbers are shown in millions with rounding.

\* Treatment of malnutrition.

# 6

## Conclusion

This health economic study shows the costs of untreated malnutrition on the one hand and the costs and benefits of treatment of malnutrition on the other hand. The total direct medical costs of untreated malnutrition are €3.0 billion in the year in which the malnutrition occurs, and €5.4 billion if the other costs are included.

In 2014, SEO Amsterdam Economics came up with an estimate of €1.8 billion in annual costs for malnutrition in 2011.<sup>6</sup> Unlike this 2023 study, the SEO report confines itself to the hospital and nursing home/care home sectors to determine the costs of untreated malnutrition.<sup>6</sup> The costs for these sectors in this 2023 study are €2.3 billion and €333 million respectively, giving a combined cost of around €2.6 billion, which is comparable to the costs of untreated malnutrition from the 2014 SEO report.

The cost-benefit analysis shows that the costs of treatment of malnutrition are €360 million. The net quantified benefits are €749 million. This means that every euro spent on the treatment of malnutrition yields €2.08 (€749 million/€360 million) in the year in which the malnutrition occurs, based on the three sectors in this analysis. The analysis over 5 years for all sectors leads to a net cost saving of €5.2 billion, meaning that every €1 invested in the treatment of malnutrition leads to a net saving of €14.44 over this 5 year period. The SEO report reported that each euro spent on the treatment of malnutrition yields €1.90 for 65 to 69-year-olds and €4.20 for 80 to 84-year-olds for the hospital sector.<sup>6</sup> The €2.08 yielded by each euro of investment in the treatment of malnutrition in this study for all sectors is therefore in the same range (between €1.90 and €4.20) as reported in the SEO report for the hospital sector. The yield per euro for just the hospital sector in this study is €3.31, which is reasonably in line with the previously calculated yield per euro for this sector of €1.90 to €4.20.

The 2014 SEO report arrived at an estimate of net benefits for the hospital sector of €52 million to €112 million, equivalent to €75 million and €162 million after adjusting for inflation and population growth.<sup>6</sup> With net benefits of €422 million in

total costs for the hospital sector, this new 2023 study gives a significantly higher figure. However, the calculation in the 2014 SEO report is based only on costs due to mortality, readmissions and medical nutrition costs, while the current 2023 analysis also includes other parameters such as length of stay and lost productivity.

The cost-effectiveness of the treatment of malnutrition is €15,552 per QALY. In the Netherlands, we as a society are willing to spend €20,000 to €80,000 per QALY depending on the burden of disease, and therefore the treatment of malnutrition with a cost per QALY of €15,552 can be considered very cost-effective.

The conclusion of this health economic study is that the treatment of malnutrition is cost-saving for both medical costs and total costs in both the short and longer term. In addition, the treatment of malnutrition is very cost-effective over a lifetime period.

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Mark Nuijten is the first classical health economist to apply health economic methods to nutrition and further develop them conceptually with colleagues from universities and industry. He was the academic co-supervisor of PhD programmes at the University of Maastricht ('nutrition economics', 'health economics in obesity') and the University of Groningen (reimbursement policy for innovative medicines, 'economics of stratified medicine') and founder of the ISPOR Special Interest Group Nutrition Economics.

### Career

Managing Director, IQVIA (formerly Quintiles) Hoofddorp	<a href="#">1996 - 1999</a>
VP and Partner Evidera, Amsterdam	<a href="#">1999 - 2005</a>
Director ISPOR	<a href="#">2003 - 2004</a>
Managing Director Value in Health	<a href="#">2003 - 2004</a>
Partner and board Minerva International Health Economic Network, Amsterdam	<a href="#">2009 - 2022</a>
Supervisor PhD programmes University of Groningen	<a href="#">2010 - 2020</a>
Consultant Ars Accessus Medica (A2M)	<a href="#">2015 - present</a>
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# Malnutrition in healthcare: treatment pays off

A health economic analysis of malnutrition in the Netherlands

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