Oral Nutritional Supplements to Tackle Malnutrition

A SUMMARY OF THE EVIDENCE BASE

Medical Nutrition International Industry

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A summary of the evidence base

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Introduction

Health and social care systems face many challenges in the quest to provide patients with the best of care, not least in the face of increasingly tight fiscal times. Interventions that have been shown to improve patient outcome whilst providing economic benefits should be integral to the planning and provision of safe and effective patient care. Nutrition intervention with oral nutritional supplements (ONS) in the management of disease-related malnutrition has consistently been shown to have significant benefits both for patients and healthcare systems.

Policy makers, payers and care providers need access to information that helps them to make informed, evidence-based decisions about the types of care they recommend and provide. This report aims to synthesise all relevant information on the rationale for and value of ONS as a key nutritional intervention strategy in the management of disease-related malnutrition. It is intended to provide all stakeholders with an up-to-date and practical summary of the evidence base on disease-related malnutrition and the benefits of ONS.

The term 'malnutrition' encompasses overweight and obesity as well as under-nutrition, but in line with common practice internationally, the term 'malnutrition' is used in this report to refer to 'under-nutrition'. The term 'disease-related malnutrition' (DRM) is also frequently used since most malnutrition arises due to the consequences of disease.

This document is an updated version of previous reports prepared in 2009 and 2010. It draws on the key elements of a comprehensive systematic review of the scientific evidence base for the management of disease-related malnutrition.[i] Using a pragmatic approach to identify relevant additional publications (up to June 2012), this document builds on the systematic review by adding recent data on the prevalence, causes and consequences of malnutrition and the nutritional, functional, clinical and economic benefits of ONS. It includes new data from countries outside Europe as well as data specifically examining the paediatric area. Furthermore, this document includes a unique collation of relevant guidelines relating to ONS, as well as examples of the implementation of guidelines and good practice.

There is a growing body of evidence from individual studies and meta-analyses demonstrating the benefits of oral nutritional intervention with ONS in improving nutritional status, reducing adverse health outcomes, and reducing the economic burden of malnutrition on society. Evidence-based national, international and professional guidelines for oral nutritional intervention with ONS in general and specific patient populations are also widely available. However, the implementation of good nutritional practices remains ad hoc, and poor awareness of the value of nutritional care, and especially ONS, is prevalent. In combination with pressure on finite healthcare budgets which places nutritional care funding under threat, this will lead to poorer health outcomes and higher healthcare costs in the longer term.

On request of the Medical Nutrition International Industry (MNI) this document was compiled by a registered dietitian who is not affiliated with any medical nutrition company. All material cited is in the public domain.

This compilation aims to encourage further documentation and sharing of information, experience and practical tools in the fight against malnutrition. Contributions are welcomed to ensure that this remains a "living document" that ultimately aims to enhance patient care.

Dr Meike Engfer and **Dr Ceri Green**
On behalf of the MNI

[i]Stratton RJ, Green CJ, Elia M. Disease-related malnutrition: an evidence based approach to treatment. Wallingford: CABI Publishing; 2003.

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WRITER

The MNI would like to thank Fionna Page BSc (Hons), RD for the collation and writing of this report. Fionna is a registered dietitian with many years of experience spanning both clinical practice (in particular nutrition support in hospital and community care settings) and the medical food industry.

Fionna Page BSc (Hons), RD

Medical Nutrition International Industry (MNI)

The Medical Nutrition International Industry (MNI) is the international trade association of companies providing products and services that support patient management and rehabilitation by the appropriate use of specialised nutritional support, including enteral and parenteral nutrition. The members of MNI are leading international companies in the development, manufacture and provision of Medical Nutrition and supporting services, namely Abbott, Baxter, B. Braun, Fresenius Kabi, Nestlé Health Sciences and Nutricia.

MNI's mission is to support the quality of nutritional interventions and services to best serve the interests of patients, healthcare professionals and healthcare providers, and to work to make specialised nutritional solutions available to more people around the world.

MNI nurtures and supports further research to fully explore the potential of Medical Nutrition in improving the health of patients suffering from acute or chronic disease. Working alongside the European Nutrition for Health Alliance (ENHA), an independent organisation that pursues a multi-stakeholder partnership in the European Union healthcare arena, the European Society for Clinical Nutrition and Metabolism (ESPEN) and the European Union Geriatric Medicine Society (EUGMS), MNI promotes the transition of clinical nutrition research into standard practice through dissemination, support and implementation of best practices and guidelines related to malnutrition and Medical Nutrition. Through constructive engagement with policy makers, MNI aims to promote a balanced policy environment that enables the Medical Nutrition industry to meet the growing healthcare needs and expectations of its stakeholders. In collaboration with regulatory authorities and scientific bodies, MNI strives to shape a regulatory and reimbursement framework capable of meeting the needs of patients, healthcare professionals, payers and healthcare providers.

MNI is committed to the fight against disease-related malnutrition. Acutely aware of the pressures faced by healthcare organisations and that nutritional care is not always considered as an integral part of patient care, MNI aims to ensure that the evidence base for oral nutritional supplements (ONS) is available to decision makers and practitioners, thereby demonstrating the value of ONS in improving patient outcomes and lowering the significant financial costs associated with malnutrition.

MNI also offers an annual grant for the most innovative national initiative to fight malnutrition and increase awareness of malnutrition. The grant selection is supported by ESPEN and the grant is awarded at the ESPEN Congress each year. Outlines of the annual submissions and winners as well as general information are available to view on the MNI website http://www.medicalnutritionindustry.com/mni-grant/ or contact **secretariat@medicalnutritionindustry.com**

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Foreword from ESPEN, EUGMS and ESPGHAN

Representatives of the European organisations ESPEN, EUGMS and European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) share the same vision as the MNI in striving to ensure that there is wide awareness of the issue of malnutrition, that its identification and effective management is integrated into everyday patient care across specialities and that an environment is created that nurtures research to fully explore the potential of Medical Nutrition in improving the health of patients. Dissemination of information about malnutrition and its management including nutritional support plays a key role in these efforts.

This document provides an up-to-date, easy to access, practical compilation of the prevalence, causes and consequences of disease-related malnutrition in all age groups across many regions of the world. It presents the evidence base for oral nutritional supplements (ONS), organised with particular emphasis on different age groups and care settings. For the first time the many national, international and professional guidelines that recommend the use of ONS have been collated and grouped according to age group and clinical condition. This resource illustrates the wealth of organisations that have recognised the value in ensuring that nutritional support is integrated into patient care. Finally, the report showcases examples of good practice both in terms of innovative national efforts to raise the awareness of the issue of malnutrition but also in terms of the use of ONS in practice to benefit patients and healthcare systems.

Access to relevant, evidence-based and thoughtfully constructed information poses a challenge for policy makers, payers and care providers so it is with pleasure that we commend this resource to all involved in delivering the best in nutritional care for patients and healthcare systems. The unique collation of topics on this subject makes this report essential reading for all involved.

EUROPEAN SOCIETY FOR CLINICAL NUTRITION AND METABOLISM (ESPEN)

ESPEN promotes the need for research, education and the use of evidence-based practice and guidance in the field of Medical Nutrition and metabolism and in particular in the identification and management of malnutrition.

Advances in modern medicine have revolutionised patient care. However, the focus of care has often emphasised the system or organ that gives rise to the disease. Therefore managing a patient's needs in a truly holistic way has become more challenging. ESPEN has recognised this challenge. Medical Nutrition provides an opportunity for integration in the way in which it can bring many disciplines of medicine together to tackle a multi-faceted issue such as malnutrition.

Central to this is the need for organisations to work together to identify and share information and good practice. This document, helping the practitioner to use ONS, is an excellent example of how this can be achieved.

Professor Pierre Singer
Chairman, ESPEN

Professor Alessandro Laviano
Chairman, Educational and Clinical Practice Committee, ESPEN

EUROPEAN UNION GERIATRIC MEDICINE SOCIETY (EUGMS)

An ageing population is a sign of true advances in public health and in healthcare but brings with it real challenges in terms of ensuring 'healthy ageing'. Frailty and malnutrition are inextricably linked and are often viewed as an inevitable consequence of disease and ageing. This view, held by healthcare providers but also by older people and their carers must be challenged.

As illustrated by this report malnutrition is currently widespread in older people in hospitals, care homes and in older people living independently. However data from all over the world shows that malnutrition can be effectively managed using nutritional intervention with ONS, particularly in older people. The EUGMS is committed to working with other organisations to ensure that the message that malnutrition can be effectively managed is heard by policy makers, payers, healthcare providers and patients themselves.

Professor Jean-Pierre Michel
President, EUGMS

EUROPEAN SOCIETY FOR PAEDIATRIC GASTROENTEROLOGY, HEPATOLOGY AND NUTRITION (ESPGHAN)

Malnutrition is not 'expected' in our affluent, developed society. This is true in all age groups, but particularly in infants and children where malnutrition is considered by many to be limited to war-torn or famine-stricken developing countries. This document highlights that this is not the case and that malnutrition affects children and young people in many developed countries. The prevalence of disease-related malnutrition has not decreased over the last 30 years. Yet like in adults and older people, the problem is often overlooked or not treated. Efforts continue to look for reliable ways to identify risk of malnutrition with practical screening tools specifically designed for use in children.

Although there are gaps in our knowledge of some topics in paediatric malnutrition such as the specific clinical and economic effects of ONS in children, there is a wealth of data from good quality studies and meta-analyses in adults from which to draw on that demonstrate clear benefits for paediatric patients and healthcare systems.

ESPGHAN seeks to influence standards of care and education and does so in collaboration with other key organisations. We welcome the inclusion of information on malnutrition in children in this document and see its dissemination as an ideal opportunity to further our aim of achieving clinical excellence for children and their families.

Dr Jessie Hulst
Chairman, ESPGHAN Working group on Malnutrition

Foreword from The European Nutrition for Health Alliance (ENHA)

In recent years, the most attention by far in affluent countries has been paid to the problem of overweight and obesity – both of which are very visible in our communities. What may surprise many to know is that the issue at the other end of the spectrum, under-nutrition, also constitutes a major problem – which is at least as big a problem as obesity – particularly in hospitals, care homes and communities, where diseases and disabilities are common.

The issue of malnutrition has begun to be recognised at European level. Already back in 2003, the Council of Europe Committee of Ministers adopted a resolution on food and nutritional care in hospitals. In 2008, malnutrition was incorporated in two White Papers, where traditionally attention on nutrition was restricted to the problem of obesity. In June 2009, representatives of health ministries from the EU member states and several other stakeholder groups met in Prague and issued a declaration and a set of action points under the banner 'Stop disease-related malnutrition and diseases due to malnutrition!' The 2009 'Prague Declaration' called for the following actions to fight malnutrition:

- public awareness and education;
- guideline development and implementation;
- mandatory screening;
- research on malnutrition;
- training in nutritional care for health and social care professionals;
- national nutritional care plans endorsed and their implementation and funding across all care settings secured;
- consideration of malnutrition as a key topic for forthcoming EU Presidencies.

Later in 2009, the Council of Europe's Belgian delegation of the Committee of Experts on Nutrition, Food and Consumer Health published 'Nutrition in care homes and home care. Report and recommendations: from recommendations to action'. This report contains an analysis of the major barriers to appropriate nutritional care and explores the roles and responsibilities of all care givers in these specific settings. With the purpose to improve awareness, screening and management of malnutrition, recommendations for action on various levels have been compiled by experts from several Council of Europe member states.

In November 2010, at a Nutrition Day Conference in the European Parliament, leading policy makers and nutrition experts called for routine nutritional risk screening for all hospital patients and pointed out the enormous economic burden for the healthcare system related to malnutrition.

In October 2011 in Warsaw, the ENHA joined with representatives from the European Parliament, the Ministry for Health in Poland, the Polish Presidency of the European Union, ESPEN, the Polish Society for Parenteral and Enteral Nutrition (POLSPEN), scientific and professional associations, and industry, patient and health insurance groups to issue a declaration calling for action on the 4 key areas to address disease-related malnutrition:

- screening;
- awareness;
- reimbursement;
- education.

As a result screening for nutritional risk began in all hospitals in Poland in January 2012.

All documents mentioned above can be accessed via http://www.european-nutrition.org/. Activities are ongoing at national and European level to drive for routine screening in a range of healthcare settings.

To further strengthen the position of nutritional care, awareness of the added value of evidence-based practical nutritional care (economic as well as clinical benefits) must be explicit, and decision makers must be convinced. The increasing recognition of malnutrition as a public health issue on the political agenda means that the time is right for action by governments, health and social care organisations, and healthcare professionals.

In line with these aims supported by ENHA, the MNI has compiled data on the prevalence, causes and consequences of malnutrition and the evidence base for the clinical and economic benefits of oral nutritional supplements.

Professor Olle Ljungqvist
Chair, ENHA

The European Nutrition for Health Alliance

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How to use this document

NAVIGATION

To aid navigation when using an electronic version of the report, 4 different types of **hyperlinks** have been included:

- links from the Contents to the start of each Section/Appendix;
- links within the document. e.g. to Appendices, where 'BACK' buttons will take the user back to the respective section;
- tabs on the right-hand side of the page link to the Contents and the selected Section/Appendix;
- links to external web pages for more information.

The '**bookmark**' function can be used as an alternative way to navigate between Sections of the document. When you open the document as a PDF you will see a toolbar on the left hand side of the screen. Click on the bookmark icon. This opens a navigation toolbar where you can expand and collapse a comprehensive contents list. Click on the Section or subsection title to move to that part of the document.

STRUCTURE

The report has been structured as follows:

- **SECTIONS 1 to 3:** Identifying malnutrition, Prevalence, Causes: Data has been presented primarily by **age group** and **healthcare setting**. Symbols help the reader to identify relevant information.
- **SECTIONS 4 and 5:** Consequences of malnutrition and Benefits of ONS: The primary focus is on **nutritional, functional, clinical and economic effects** and **outcomes**. Where possible, data is also grouped by healthcare setting and age group.
- **SECTIONS 6 and 7:** Guidelines and Good practice: This unique collation of guidelines and examples of good practice related to the use of ONS in the management of disease-related malnutrition (DRM) is structured according to **country, healthcare setting** and **patient group**.

SYMBOLS

Throughout the document the symbols shown below are used to indicate the focus of the information in terms of the **healthcare setting** and **age/patient group**. Most data relates to **adults in general** and therefore the symbols are used to highlight when data relates specifically to **older people, children or patients with cancer**.

Healthcare setting*	Symbol	Age/patient group*	Symbol
Hospital		Older people (in general people aged > 65 years of age)	
Community		Children (in general anyone aged < 18 years of age)	
Across healthcare settings**		Patients with Cancer	

*It is recognised that definitions of healthcare settings and age groups differ across countries, in national and professional guidelines and reports, and in studies. Every attempt has been made to include descriptions of age groups and healthcare settings in this report (either within the body of the text or in the related tables and Appendices), but in some cases this detail was not available. For more information about healthcare settings, refer to Definition of terms on page 13.
**Used to indicate that the data from studies in hospital or the community was combined, e.g. in meta-analyses, or that the studies included interventions that started during hospital admission and continued after discharge

Definition of terms

Adherence A term used to describe how well a patient or client is following the advice of his/her healthcare professional or treatment plan. Also known as compliance or concordance.

Cachexia A number of definitions of cancer cachexia have been proposed[1-3] and a practical, easy-to-use classification of cancer cachexia has been developed (defined as ≥ 10% weight loss associated or not with anorexia, early satiation and fatigue; weight loss of < 10% is defined as pre-cachectic).[4]

Care settings These terms are not used consistently across different countries. For the purposes of this document:

- **Hospital** The term 'hospital' refers to care in a hospital as an inpatient;
- **Outpatient** The term 'outpatient' refers to a patient who attends a hospital or clinic for diagnosis or treatment but does not occupy a bed;
- **Community** The term 'community' refers to care outside the hospital setting and can include people in institutions, in sheltered housing or in their own homes:
  - sheltered housing – groups of housing units provided for older or disabled people who require occasional assistance from a resident warden but who do not need full residential care;
  - institution – refers to care which does not take place in hospital or at home, i.e. it includes care in nursing homes, residential homes, long-term care institutions and mental health units (all of these are sometimes referred to informally as 'care homes');[ii]
  - nursing home – residents usually require nursing care and are more dependent than residents in residential care;
  - residential home – residents may need assistance with meals or personal care. Qualified nurses are not required to be present.

Cost-effectiveness The difference in costs is compared with the difference in consequences in an incremental analysis.[5]

Dietary advice /counselling The provision of information with the aim of increasing the frequency of consumption of food and fluids and increasing the energy and nutrient content of the foods and fluids consumed.

Economic evaluation The comparative analysis of alternative courses of action in terms of both their costs and consequences.[5]

Enteral nutrition The term enteral nutrition comprises all forms of nutritional support that are regulated as 'dietary foods for special medical purposes' as defined by the European Commission Directive 1999/21/EC. It includes ONS as well as tube feeding administered via nasogastric, nasoenteric or percutaneous tubes. Note this ESPEN definition of enteral nutrition includes ONS.[6]

Failure to thrive/ Faltering growth Inadequate growth in early childhood. Although no agreed consensus exists for the definition of faltering growth,[7] in practice, abnormal growth patterns such as a fall across centiles, plateauing or fluctuating weight should trigger further assessment.[8] The term 'failure to thrive' is also used in older people and is defined as 'a syndrome involving poor nutrition, including decreased appetite and weight loss (often with dehydration), inactivity, depression, impaired immunity, and low cholesterol.'[9]

[ii]Where details of the care setting have been provided in original reports, this information has been included in this report to help to establish the exact setting where studies, care or interventions have taken place. However, in some cases the detail is incomplete as this information was not available.

Food fortification

Food fortification aims to increase the energy and nutrient density of foods and fluids without significantly increasing their volume.

Foods for Special Medical Purposes (FSMP)

'Dietary foods for special medical purposes means a category of foods for particular nutritional uses specially processed or formulated and intended for the dietary management of patients and to be used under medical supervision. They are intended for the exclusive or partial feeding of patients with a limited, impaired or disturbed capacity to take, digest, absorb, metabolise or excrete ordinary foodstuffs or certain nutrients contained therein or metabolites, or with other medically-determined nutrient requirements, whose dietary management cannot be achieved only by modification of the normal diet, by other foods for particular nutritional uses, or by a combination of the two'.[10]

Healthcare system

A healthcare system is the sum total of all of the organisations, institutions and resources whose primary purpose is to improve health.[11] In the UK, for example, healthcare includes hospitals, maternity units and services provided by district nurses.

Malnutrition

There is no universally accepted definition of malnutrition. The following definition is now widely acknowledged by many, including ESPEN[6]**:**

'A state of nutrition in which a deficiency, excess (or imbalance) of energy, protein, and other nutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function, and clinical outcome.'[12]

Furthermore, the term "malnutrition" is used in this report to encompass the additional concept of nutritional risk (see definition below), reflecting common practice whereby these terms are often used interchangeably. Where possible in relation to studies and trials, attempts have been made in this report to describe in detail the definitions and methods used for detecting malnutrition/nutritional risk where feasible.

Medical nutrition

A term used to describe commercially available products for nutritional intervention, including ONS, tube feeds and parenteral nutrition.

Nutritional assessment

A detailed, more specific and in-depth evaluation of a patient's nutritional state, typically by an individual with nutritional expertise (e.g. a dietitian, a clinician with an interest in nutrition or a nutrition nurse specialist) or by a nutritional support team. This will usually be conducted in the case of nutritional problems identified by the screening process or when there is uncertainty about the appropriate course of action. The assessment process allows more specific nutritional care plans to be developed for the individual patient.[13]

Nutritional care programme

A range of activities, including nutritional screening, care planning, nutritional interventions (food, ONS, tube and/or parenteral feeding) and follow-up, designed to ensure that patients' nutritional needs are evaluated, met and regularly reviewed.

Nutritional risk

Severe malnutrition (under-nutrition) is clinically obvious. However, there is uncertainty about recognising lesser degrees of malnutrition. In the absence of universally accepted criteria for identifying malnutrition with high sensitivity and specificity, the concept of risk is invoked. Risk is a measure of likelihood that malnutrition is present or likely to develop.[13] It also reflects the risk of a poor outcome as a result of impaired nutritional status.[14]

Nutritional screening

A rapid, simple and general procedure used by nursing, medical or other staff, often on first contact with the patient, to detect those at risk of or with nutritional problems, so that action can be taken, e.g. simple dietary measures or referral for expert help. The screening process should be repeated at intervals.[13]

Nutritional support/ Nutritional intervention	Nutritional support includes food, ONS, tube feeding and parenteral nutrition.[6] These two terms are often used interchangeably.
Nutritionally complete	A product may be called 'nutritionally complete' if it contains all essential macronutrients and micronutrients in a quantity and balance that allows the product to be used as a sole source of nutrition.
Oral nutritional supplements (ONS)	Multi-nutrient liquid, semi-solid or powder products that provide macronutrients and micronutrients with the aim of increasing oral nutritional intake. ONS are typically used to supplement food intake which is insufficient to meet requirements. However, in many cases, ONS are nutritionally complete and could also be used as a sole source of nutrition. ONS are distinct from dietary supplements which provide vitamins, minerals and or/trace elements in a pill format (also known as food supplements) and they must comply with the labelling and compositional requirements of Directive 1999/21 EC on Foods for Special Medical Purposes (FSMP).[10]
Parenteral nutrition	Parenteral nutrition (PN) represents an alternative or additional approach for nutritional intervention when other routes are not succeeding (not necessarily having failed completely) or when it is not possible or would be unsafe to use other routes (i.e. oral or tube).[15]
Public health	Public health is concerned with improving the health of the population rather than treating the diseases of individual patients.[16]
Social care system	Social care includes nursing homes, residential homes, care at home and adult placement schemes.
Starvation	The term 'starvation-related malnutrition' has been proposed to describe when there is chronic starvation without inflammation. Examples of this include medical conditions like anorexia nervosa.[17]
Stunting (in children)	A deficit in height-for-age that signifies slowing of skeletal growth and reflects chronic malnutrition.[18]
Under-nutrition	Malnutrition includes both over-nutrition (overweight and obesity) and under-nutrition (underweight). For the purposes of this report the term malnutrition will be used to mean under-nutrition (also frequently referred to as disease-related malnutrition, see 'Malnutrition' above).
Wasting (in children)	A deficit in weight-for-height resulting from failure to gain weight or from weight loss. It reflects a process occurring in the recent past and it is indicative of acute malnutrition.[18]

Abbreviations

ADL	Activities of Daily Living
BAPEN	British Association for Parenteral and Enteral Nutrition
BMI	Body Mass Index
CD	Crohn's Disease
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
DHA	Docosahexaenoic acid
DRM	Disease-related malnutrition
EHNA	European Nutrition for Health Alliance
EPA	Eicosapentaenoic acid
ESPEN	European Society for Clinical Nutrition and Metabolism (formerly European Society of Parenteral and Enteral Nutrition)
ESPGHAN	European Society for Paediatric Gastroenterology, Hepatology and Nutrition
EU	European Union
EUGMS	European Union Geriatric Medicine Society
FFM	Fat-free Mass
FIM	Functional Independence Measure
FSMP	Food for Special Medical Purpose
GI	Gastrointestinal
GP	General Practitioner
HFA	Height-for-age
HIV	Human Immunodeficiency Virus
LBM	Lean Body Mass
LOS	Length of Stay (in hospital)
MAMC	Mid Arm Muscle Circumference
MUAC	Mid Upper Arm Circumference
MNA	Mini Nutritional Assessment
MNA-SF	Mini Nutritional Assessment-Short Form
'MUST'	'Malnutrition Universal Screening Tool'
MNI	Medical Nutrition International Industry
NHS	National Health Service
NICE	National Institute for Health and Clinical Excellence
N/R	Not Reported
NRI	Nutritional Risk Index
NRS-2002	Nutrition Risk Score 2002
ONS	Oral Nutritional Supplements
OR	Odds Ratio
QOL	Quality of Life
QALY	Quality Adjusted Life Year
RDBPCT	Randomised Double Blind Placebo Controlled Trial
RCT	Randomised Controlled Trial
RNI	Reference Nutrient Intake
RR	Relative Risk
SD	Standard Deviation
SGA	Subject Global Assessment
SGNA	Subjective Global Nutritional Assessment
TSFT	Triceps Skin Fold Thickness
WFA	Weight-for-age
WFH	Weight-for-height
WHO	World Health Organization

Executive summary

IDENTIFYING MALNUTRITION

'Malnutrition' includes both over-nutrition (overweight and obesity) as well as under-nutrition, but in the context of this report 'malnutrition' (and disease-related malnutrition) is used to mean under-nutrition and nutritional risk. Severe malnutrition may be clinically obvious but as uncertainty exists in detecting lesser degrees of malnutrition, screening for nutritional risk should be used to identify those individuals who are at risk of adverse outcome and who might benefit clinically from nutritional support. Despite the availability of screening tools, malnutrition still often goes undetected and thus untreated in hospitals, care homes and in people living in their own homes all across Europe and other parts of the world. Often less than 50% of patients identified as malnourished receive nutritional intervention. The opportunity for early identification and appropriate management of malnutrition or risk of malnutrition is therefore often missed.

PREVALENCE OF MALNUTRITION

Based on work done in the UK (showing > 3 million adults are at risk of malnutrition) and extrapolated to the rest of Europe, an estimated 20 million adults are at risk of malnutrition in the European Union (EU) and 33 million adults are at risk across Europe. Malnutrition is widespread in all healthcare settings; about 1 in 4 adult patients in hospital and more than 1 in 3 patients in care homes are malnourished or at risk of malnutrition. As many as 1 in 3 older people living independently are at risk. Almost 1 in 5 children admitted to Dutch hospitals has acute or chronic malnutrition.

CAUSES OF MALNUTRITION

Malnutrition is primarily caused by insufficient dietary intake with disability and disease at the heart of the problem. Food intake is often reduced because of the effects of disease and its treatment, for example poor appetite, swallowing problems and the side effects of drugs. Patients with cancer may have taste changes or nausea due to treatment and patients with neurological conditions or following a stroke may not be able to swallow or feed themselves. More than 50% of patients in hospital don't eat the full meal they are given and 30% of nursing home residents eat less than half their lunch, meaning that patients often fail to meet their nutritional needs. But there is more to malnutrition than poor food intake. Lack of a clear description of responsibilities for health authorities, institutions, and healthcare workers, and inadequate training and equipment for screening exacerbates the problem of malnutrition. Therefore a multi-disciplinary approach is needed to identify and implement appropriate and effective solutions.

CONSEQUENCES OF MALNUTRITION

Malnutrition leads to far-reaching physical and psycho-social consequences such as impaired immune response, impaired wound healing, reduced muscle strength and fatigue, inactivity, apathy, depression and self-neglect. In children, growth and development is adversely impacted by malnutrition. Malnutrition has a particularly high adverse impact in the older person impairing function, mobility and independence. Malnutrition is also associated with poorer quality of life.

Malnourished hospital patients experience significantly higher complication rates than well-nourished patients and the risk of infection is more than three times greater. Average length of hospital stay may be increased by 30% in malnourished patients. In community patients malnourished patients visit family doctors more often and have more frequent hospital admissions than well-nourished patients.

FINANCIAL COSTS OF MALNUTRITION

As a result of increased morbidity and healthcare resource use, malnutrition is costly to the individual, to society and to the economy. The estimated cost of managing patients at risk of malnutrition in the EU is €120 billion and €170 billion across Europe. This estimate is based on economic evidence from the UK showing costs for managing patients at risk of malnutrition exceed €15 billion. Failure to address malnutrition risk appropriately puts unnecessary additional pressure on already constrained healthcare systems and leads to sub-optimal quality of care. The application of evidence-based nutritional screening programmes should help to address this.

CLINICAL BENEFITS OF ONS

Good nutritional care is a vital part of overall care and includes screening for malnutrition and nutritional care planning which includes appetising and nutritious food and nutritional support such as oral nutritional supplements (ONS). Decisions about which form of nutritional support is most suitable for patients should take account of whether good quality evidence shows it to be effective. There is extensive, good quality clinical evidence that ONS are an effective and non-invasive solution to malnutrition in patients who are able to consume some normal food but not enough to meet nutritional requirements. ONS have proven nutritional, functional, clinical and economic benefits in both the hospital and community setting in a wide variety of patient groups. Meta-analyses show that ONS lead to weight gain, reductions in mortality, reductions in complication rates and reductions in the proportion of patients admitted or readmitted to hospital. Intervention with high-protein ONS has been shown to reduce overall readmissions by 30%.

FINANCIAL BENEFITS OF ONS

Potential cost savings as a result of reduced healthcare use have been demonstrated in patients supplemented with ONS and can be realised in both the hospital and the community setting. Economic modelling undertaken by NICE (2006) showed ONS to be cost-effective as part of a screening programme (cost per QALY €8,024). Besides improving the well-being of patients, fighting malnutrition with ONS is an opportunity for healthcare providers to control costs. This is especially relevant in light of the ageing population and the high prevalence of chronic disease that adversely impacts nutritional status, which in turn contributes to increased cost burden. Controlling and managing malnutrition is an effective solution.

ONS AS AN INTEGRATED PART OF KEY GUIDELINES AND GOOD PRACTICE

Many national, international and professional guidelines exist that include ONS as an integral part of patient care. However, continued effort is needed to ensure guidelines are updated to reflect the evidence base, to integrate good nutritional care into guidelines for specific diseases (e.g. nutritional support as part of cancer care guidelines), and to ensure that these guidelines are embedded in practice. Consideration should be given to innovative ways to facilitate the sharing of good practice at local, national and international level.

Recommendations

The MNI is committed to supporting efforts to fight malnutrition.

OVER-ARCHING THEMES

In all aspects of the fight against malnutrition, from identifying malnutrition through to delivering the best care for individual patients in a cost-effective way, several key themes emerge. These are that there must be multi-stakeholder involvement at all levels, that awareness, training and education are central to success, that audit and quality improvement activities should be included in any initiative that strives to tackle malnutrition and that good practice should be routinely shared.

Specific Recommendations	
Identifying malnutrition	• National nutrition policy should be in place that addresses under-nutrition as well as obesity and overweight • Routine screening for vulnerable groups should be built into national nutrition policies and quality standards with audit and quality control measures included • Validated screening tools should be used to identify patients with malnutrition or risk of malnutrition • Appropriate equipment (weighing scales, stadiometers) should be made available to enable screening to take place • Agreement should be made about who is responsible for performing screening for malnutrition or risk of malnutrition • Evidence-based guidance (including nutritional care plans) should be used by healthcare workers to take action following screening and for monitoring
Prevalence	• A commitment should be made to systematically measure the prevalence of malnutrition and risk of malnutrition and the results widely disseminated • A common approach should ideally be taken to measuring and documenting malnutrition and risk of malnutrition, enabling comparisons to be made
Causes	• Evidence based approaches for nutritional care plans should be used, taking into account the causes of malnutrition, the objectives of intervention, and also environmental and practical constraints
Consequences	• Awareness should be raised about the wide ranging negative consequences of malnutrition for patients, for healthcare providers and for society in general • Evidence based screening programmes should be used to ensure that malnutrition and risk of malnutrition is identified early and appropriate action is taken to minimise its consequences
Benefits of ONS	• A wealth of evidence is available that demonstrates the benefits of ONS. This should be translated into practice to ensure that patients who need nutritional intervention receive it in a timely and appropriate manner
Guidance	• Guidance on managing malnourished patients or patients at risk of malnutrition should reflect current evidence and should provide health care providers and practitioners with clear and practical advice about how and when to use different forms of nutritional intervention, including ONS
Good practice	• Examples of good practice should be shared widely to facilitate the implementation of nutritional guidelines and ensure best use of resources.

1 IDENTIFYING MALNUTRITION

Summary

'Malnutrition' includes both over-nutrition (overweight and obesity) as well as under-nutrition, but in the context of this report 'malnutrition' (and disease-related malnutrition) is used to mean **under-nutrition and nutritional risk**.

Due to inadequate nutritional intake to meet requirements which frequently occurs in acute or chronic disease, an individual may move from a good nutritional status to frank malnutrition in a matter of weeks, months or years. Severe malnutrition may be clinically obvious but as uncertainty exists in detecting lesser degrees of malnutrition screening for nutritional risk should be used **to identify those individuals who are at risk of adverse outcome and who might benefit clinically from nutritional support**.

A variety of **nutritional risk screening tools** have been developed to help identify adults and children who are malnourished or at risk of malnutrition and in most cases the tool prompts the healthcare worker to take action, i.e. to conduct or refer for in-depth nutritional assessment and to put in place a nutritional care plan to ensure that the patient's nutritional needs are met. Generally nutrition screening tools follow the basic principles of measuring weight/height and/or Body Mass Index (BMI), weight loss over a prior period of time and recent appetite/food intake and are thus **easy to implement**.

Validated tools provide a **reliable** way for healthcare professionals to identify patients who are malnourished or at risk of malnutrition. It is important that the validity of a nutritional risk screening tool is considered when selecting a tool, along with other considerations such as the intended purpose of the tool, reliability and practical aspects of implementation. ESPEN recommends the following tools for use in specific healthcare settings: the 'Malnutrition Universal Screening Tool' ('MUST') in the community, Nutrition Risk Screening (NRS-2002) for use in hospitals and the Mini Nutritional Assessment (MNA) in older people. In some countries national approaches have been developed, for example in the UK 'MUST' is often used in hospital and community settings to aid continuity of care. In practice the selection of a screening tool may vary from guidelines due to practical issues or local preferences. A number of tools have been developed for use in children and work is underway to assess the most suitable tool.

Different measurement approaches explain at least in part large differences in reported values for prevalence of malnutrition and risk of malnutrition. Nevertheless, all evaluations of prevalence point in the same direction and highlight the enormous dimension of the issue.

Malnutrition is more than just weight loss. Deficiencies of specific micronutrients (vitamins, minerals and trace elements) are common and should be considered part of malnutrition. However, micronutrient deficiencies will not be identified when screening for nutritional risk, but should be taken into consideration during nutritional assessment and when planning nutritional care.

Despite the availability of screening tools, **malnutrition still often goes undetected and thus untreated** in hospitals, care homes and in people living in their own homes all across Europe and other parts of the world. Often less than 50% of patients identified as malnourished receive nutritional intervention.

Conclusion

Although a variety of practical, validated screening tools are available for the identification of malnutrition and risk of malnutrition in children, adults and older people they are not universally employed across healthcare systems. This means that malnutrition continues to go undetected in patients in hospital, in care homes and in patients living independently. The opportunity for early identification and appropriate management of malnutrition or risk of malnutrition is therefore often missed.

Recommendations

The MNI is committed to supporting efforts to raise awareness of malnutrition and to fight malnutrition.

On the issue of **identification of malnutrition** the MNI makes the following recommendations:

Recommendation	Issues to consider
National nutrition policy should be in place that addresses undernutrition as well as obesity and overweight	• Nutrition policy should cover all age groups across all healthcare settings and provide a framework for a consistent approach to standards and quality improvement in nutritional care
Routine screening for vulnerable groups should be built into national nutrition policies and quality standards with audit and quality control measures included	• Vulnerable groups include patients admitted to hospitals, care homes, and under the care of community/general practitioners • A programme of regular audit and quality control should be implemented to ensure that screening is undertaken
Validated screening tools should be used to identify patients with malnutrition or risk of malnutrition	• Selection of appropriate screening tools should take account of factors including the patient group, the setting, practical implementation and validity of the tool • Guidance from professional societies and national authorities should be taken into account when selecting a suitable tool. In addition the possibility that the use of one tool across healthcare settings may facilitate continuity of care and comparisons across patient groups and care settings should also be considered
Appropriate equipment (weighing scales, stadiometers) should be made available to enable screening to take place	• The equipment used for screening should comply with relevant national guidance • Equipment should be regularly calibrated in line with national guidance
Agreement should be made about who is responsible for performing screening for malnutrition or risk of malnutrition	• A healthcare worker with the right knowledge and skills is well placed to undertake screening, but agreement is needed on exact roles and responsibilities. Health-care workers need to know what is expected of them • **Training** is a critical component of ensuring that healthcare workers have the knowledge and skills to undertake screening, and when and how to act upon the results of screening • **Appropriate documentation** of the results of screening and action planned and taken is critical for continuity of care and for audit and quality control activities.

1.1 What is malnutrition and how is it measured?

In adults and older people

Malnutrition in adults can be defined as 'a state of nutrition in which a deficiency, excess or imbalance of energy, protein and other nutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function, and clinical outcome'.[12] This definition encompasses overweight and obesity as well as under-nutrition. Malnutrition is not just a matter of underweight or wasting; it can include deficiencies of micronutrients such as vitamins and minerals as well.

The presence and degree of malnutrition is established using 'nutritional assessment', a detailed, specific and in-depth evaluation undertaken by a competent health professional, which should be undertaken using a variety of measures and repeated at regular intervals to identify trends for an individual over time. A variety of methods of assessment are commonly used, ranging from simple 'eyeball assessment' to more complex measures, e.g. anthropometric or biochemical measures. No single measure should be used in isolation, and a number of important factors should be considered during nutritional assessment (see Table 1.1).[19]

Table 1.1 **Factors that should be considered during nutritional assessment** (adapted from Thomas 2007)[19]

Clinical considerations	Impact of acute or chronic illness, surgery or treatment, e.g. medication
Physical state	Physical appearance (thin, pale, loose clothing), mobility, mood, breathlessness, poor wound healing, oedema, physical and psychosocial conditions, weight loss
Dietary aspects	Current intake, recent changes in intake, identifying factors which may affect food and fluid intake, nutritional requirements
Anthropometric measures	Body weight, height, adiposity (waist circumference, body mass index [BMI], skinfold thickness), muscle mass (mid-arm muscle circumference [MAMC], grip strength), estimates of water content and body composition
Biochemical and haematological markers	Detailed knowledge is essential as some markers are dynamic, changing on a daily basis, and influenced by disease and age. Useful for specific nutrients, e.g. vitamin B_{12} or iron deficiency in anaemia

In children

Inadequate growth in early childhood has been described as failure to thrive,[20] and more recently as faltering growth.[8] Under-nutrition is accepted as the primary cause of poor growth in infancy. Although no agreed consensus exists for the definition of faltering growth,[7] in practice, abnormal growth patterns such as a fall across centiles, plateauing or fluctuating weight should trigger further assessment.[8] Prompt identification of faltering growth is a prerequisite for effective management; infants and children who have faltering growth should receive immediate nutritional evaluation and intervention.[20] See footnote to Table A1.8, Appendix I for details of criteria for classification of malnutrition in children.

The general principles for nutritional assessment described in Table 1.1 also relate to children; however, extra factors to consider include feeding behaviour and feeding skill development, growth evaluation, including the determination of target height, family viewpoint regarding

nutrition and feeding, and maternal nutritional status if feeding an infant.[19] UK and international charts are available for height, weight, head circumference, BMI and waist circumference. As growth is an important measure of health and well-being, the World Health Organization (WHO) published Child Growth Standards for infants and children up to the age of 5 years in 2006 and for 5-19 year olds in 2007. Based on the growth of healthy breastfed children in optimal conditions in 6 countries, these standards describe optimum growth rather than average growth. The standards have been implemented in a number of countries, including the UK in 2009.[21]

1.2 What is nutritional risk and how is it measured?

In adults and older people

Due to lack of adequate nutrition, acute or chronic disease and/or treatment, an individual may move from a good nutritional status to frank malnutrition in a matter of weeks, months or years. Severe malnutrition/emaciation may be clinically obvious, but as uncertainty exists in detecting lesser degrees of malnutrition (due to the lack of universally agreed criteria), the concept of 'risk' is useful.[13] Risk is defined as 'a measure of the likelihood that malnutrition is present or likely to develop',[13] thereby aiming to identify those individuals who are at risk of adverse outcomes and who might benefit clinically from nutritional support.[14]

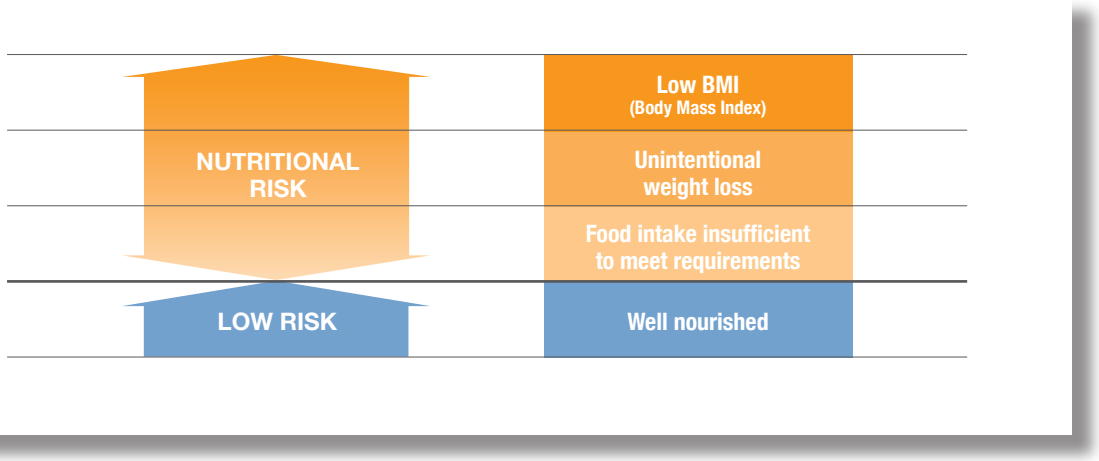

Figure 1.1 The concept of nutritional risk

Reflecting common practice, in this report the term 'malnutrition' is used synonymously with under-nutrition and nutritional risk.

Nutritional risk is of relevance because:

- it is widespread, particularly in patients admitted to hospital, residents in care homes, and people receiving community care;
- it has severe clinical consequences: weight loss, functional impairments, impaired quality of life, increased complications, and higher mortality;
- it results in economic consequences from increased consumption of healthcare resources due to management of complications, prolonged length of stay in hospital, increased readmission to hospital, need for community care, and thereby increased costs;

- it is frequently under-recognised and therefore under-treated;
- it is particularly common in the older person. Given that the population is aging (the number of older people in Europe aged 65–79 years will increase by 37.4% by 2030)[22] and that the problem is often unrecognised, this means that the costs to healthcare systems are likely to escalate at an unprecedented rate due to adverse clinical consequences.

Screening can be defined as 'an initial brief evaluation, which often precedes an in-depth and more accurate evaluation, of those considered to be at risk of a particular disease or condition'.[13] Table 1.2 summarises the main differences between nutritional screening and nutritional assessment.

Table 1.2 **Summary of the main differences between nutritional screening and nutritional assessment** (adapted from Elia 2003)[13]

Nutritional screening	Nutritional assessment
• Simple, quick, reliable, sensitive, reproducible	• Detailed evaluation of nutritional status and nutritional needs
• Identifies those likely to have or develop nutritional problems and classifies them, e.g. as medium- or high-risk	• Ideally performed in patients identified as medium- or high-risk through screening
• Typically based on current weight, history of weight loss and/or food intake/appetite/acute disease effect (i.e. severity of disease)	• Ideally performed by a dietitian/nutritionist or other trained healthcare professionals
• Able to be performed by other healthcare workers who have received appropriate training	• The results of nutritional assessment are used by healthcare professionals to establish the presence of and degree of malnutrition and to plan appropriate nutritional intervention
• Able to guide other healthcare workers who have received appropriate training to an appropriate course of action	

The act of regular nutritional screening applies a test to a whole population (e.g. on admission to hospital or a nursing home) to identify individuals who are 'at risk' of malnutrition to ensure that timely and appropriate nutritional care is provided. Figure 1.2 illustrates that nutritional screening is intended to identify individuals who are 'at risk' of malnutrition across the spectrum of nutritional status. An 'at risk' status may result from the effects of disease or treatment, or it may arise in a well-nourished individual due to an acute event such as sustaining an injury or undergoing emergency surgery that will result in no nutritional intake for a period of time. Individuals identified as high-risk are likely to be, but are not necessarily, frankly malnourished, although a more detailed nutritional assessment should be undertaken for 'at risk' individuals to establish the degree of malnutrition present, its causes, and the best course of action.

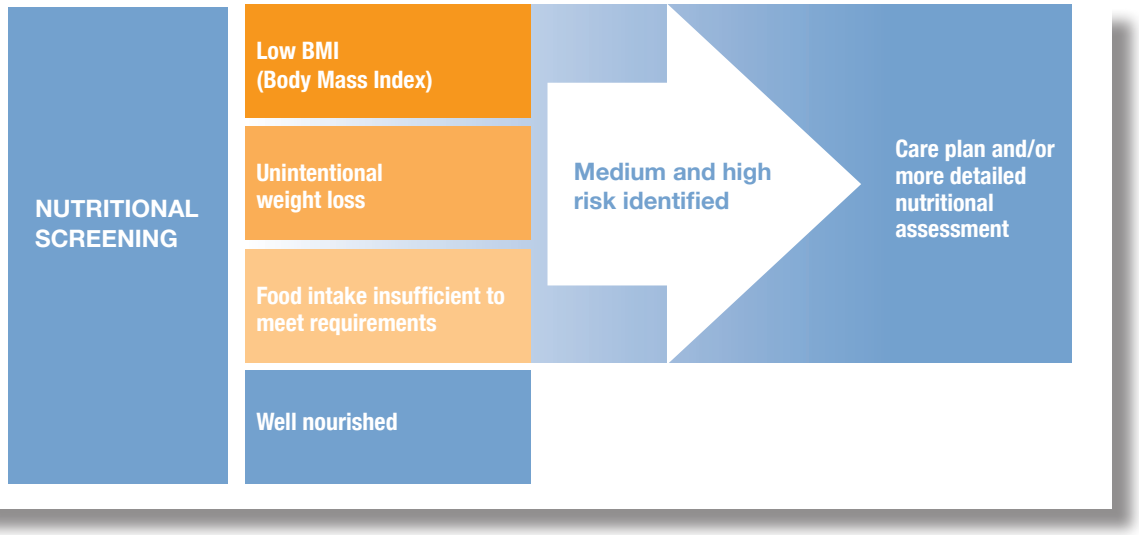

Figure 1.2 **Individuals identified as 'at-risk' of malnutrition through nutritional screening may have different degrees of malnutrition**

Different screening tests or tools use different criteria and/or cut-off points and/or weightings to detect nutritional risk. Furthermore, some tools have been developed for specific purposes or settings, or for use by specific healthcare workers.[13;23] This means that not all individuals identified as 'at risk' are at the same point on the malnutrition spectrum (this is true even if a single tool is used). Table 1.3 shows some examples of commonly used screening tools designed for use in adults or older people and summarises their main components.

Table 1.3 **Summary of components included in nutritional risk screening tools specifically designed for use in adults or older people**

Reference	Tool	Age group & healthcare setting	Anthropo-metric measures	Weight loss	Nutritional intake	Other	Linked to action plan
Elia 2003[13]	'MUST'*	Adults Multiple care settings	✔ (BMI**)	✔	✔	Acute disease effect	Yes
Kondrup et al. 2003[24]	NRS-2002	Adults + option for ≥ 70 yrs Hospital	✔ (BMI)	✔	✔	Severity of illness, age	Prompts user to initiate a care plan
Rubenstein et al. 2001[25]	MNA-SF†	Older people Multiple care settings	✔ (BMI or calf circumference)	✔	✔	Mobility, acute disease/physical stress, neuropsyc-hological problems	Yes
Kruizenga et al. 2005[26]	SNAQ¥	Adults Hospital	-	✔	✔	Use of ONS or tube feeding	Prompts nutritional intervention
Ferguson et al. 1999[27]	MST	Adults Hospital	-	✔	✔	-	Yes
Jeejeebhoy et al. 1990[28]	SGA***	Adults Hospital	-	✔	✔	GI symptoms, functional capacity, underlying disease state, physical exam	No

*'Malnutrition Universal Screening Tool' ('MUST') – suitable for use across healthcare settings, see **http://www.bapen.org.uk/musttoolkit.html** for more information. **Alternative measures and subjective criteria can be used if unable to measure height/weight. †Mini Nutritional Assessment Short-form. MNA fulfils the function of both nutritional screening and assessment. See **www.mna-elderly.com** for more information. ¥SNAQ^{RC} available for use in older people in care homes or residential care and SNAQ^{65+} for patients in the community aged ≥ 65 years, see **http://www.fightmalnutrition.eu/malnutrition/screening-tools/** for more information. ***Subjective Global Assessment.

Use of specific screening tools varies by country, and the NutritionDay survey showed that screening was most often performed using locally-developed tools.[29] Results from the 2010 British Association for Parenteral and Enteral Nutrition (BAPEN) Nutrition Screening Week in the UK showed that among care homes and hospitals using screening tools, 'MUST' was the most common tool used to screen for risk of malnutrition, potentially facilitating continuity of care within and between care settings and the comparison of prevalence rates across countries and settings.[30] It is important that the validity of a nutritional risk screening tool is considered when selecting a tool, along with other considerations such as the intended purpose of the tool, reliability and practical aspects of implementation.[14;23]

In children

Growth in infancy and childhood is most commonly assessed by measuring weight-for-height (WFH) and height-for-age (HFA).[31] Anthropometric measures are rapid, inexpensive and non-invasive. Malnutrition can also be assessed as thinness (low BMI for age), as described by Cole et al. in 2007, where the thinness cut-off linked to 17 kg/m^2 is close to the wasting cut-off based on -2 z-scores.[32] However, no single anthropometric measure provides enough information to make a full assessment of nutritional status.[31] The use of anthropometric measures alone may underestimate the problem of malnutrition in hospitalised children or children with specific underlying diseases. Anthropometric measures will identify patients who are malnourished but not those who are 'at risk' of developing malnutrition.[33] On the other hand, clinician evaluation alone has also been shown to be inadequate for accurate assessment of nutritional status and for identification of severe malnutrition.[34]

In an effort to overcome these issues, multi-component screening tools have been developed to identify children at risk of malnutrition, who should then undergo further assessment.

Tools to screen for risk of malnutrition specifically developed for use in children are available (see Table 1.4), and they usually take account of nutritional intake, presence and severity of disease and weight loss, and in some cases they include anthropometric measures. In most cases, the results of screening are linked to a care plan, management pathway or recommendations for nutritional intervention.[35-38]

Table 1.4 Summary of components included in nutritional risk screening tools specifically designed for use in children

Reference	Tool	Age group	Anthropo-metric measures	Weight loss	Nutritional intake	Other	Linked to action plan
Gerasimidis et al. 2010[37]	Paediatric Yorkhill Malnutrition Score (PYMS)	1–16 years	✔ (BMI)	✔	✔	Acute admission or condition effect on nutrition	Yes
Hulst et al. 2010[38]	STRONGkids Screening Tool Risk of Nutritional Status and Growth	> 1 month	-	✔	✔	Subjective clinical assessment High-risk disease	Yes
McCarthy et al. 2009[35]	Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP)	2–17 years	✔ (Height, weight)	Compare with growth charts	✔	Diagnosis	Yes
Secker and Jeejeebhoy 2007[39]	Subjective Global Nutritional Assessment (SGNA) for children	31 days –17.9 years	History from parents	History from parents	History from parents	History of GI symptoms, and functional capacity	Not specified
Sermet-Gaudelus et al. 2000[36]	Paediatric Nutritional Risk Score	> 1 month	-	-	✔	Pain Pathological condition	Yes

Assessing nutritional status and nutritional risk in children with specific diseases

Specific growth charts have been developed to take account of the differences in expected growth in children with a variety of underlying diseases (e.g. cerebral palsy, Down's syndrome, Duchenne muscular dystrophy).[31] These growth charts can be used in some cases to ensure that a more appropriate assessment of nutritional status is undertaken; however, in cerebral palsy for example, the growth charts are used to plot current growth rather than optimal growth. Screening tools for use in children with specific conditions have been developed, e.g. cystic fibrosis.[40]

Different measurement approaches explain at least in part large differences in reported values for malnutrition

- As described above, measuring frank malnutrition using nutritional assessment techniques and screening for nutritional risk are different; however, in the published literature, prevalence rates reported for 'malnutrition' are not always clearly separated in this way.

- The use of anthropometric measures alone may underestimate the extent of nutritional risk. Anthropometric measures will identify patients who are malnourished but not those who are 'at risk' of developing malnutrition.

- In a study of the prevalence of malnutrition in children on admission to hospital (n = 1571) using the PYMS tool, 46% of the patients at high risk of malnutrition had a normal BMI, illustrating the importance of using a malnutrition screening tool rather than BMI alone to assess malnutrition risk.[41] In the Dutch national survey among 424 hospitalised children the same message can be drawn: 8% of the children were scored as high risk, but of these children 47% were malnourished based on assessment of WFH and HFA.[38] In the Australasian Nutrition Care Day Survey undertaken in 2010 (acute care hospitals in Australia and New Zealand, n = 3122), 18% of the overweight/obese patients in the study (n = 299) (BMI > 25 kg/m^2) were assessed as malnourished (Subjective Global Assessment [SGA] B+C categories).[42]

- In children, although most reports include moderate and severe malnutrition when reporting prevalence figures, some reports include severe malnutrition alone, whilst others include mild malnutrition as well as moderate and severe malnutrition, leading to much higher figures. In other cases, details of the severity of malnutrition are not provided, making comparisons difficult (see Appendix I, Table A1.8).

- Some studies report either acute or chronic malnutrition or an overall figure which is either a simple addition of the two or reflects the use of a different method of screening or assessment which does not distinguish between acute and chronic malnutrition (see Appendix I, Table A1.8).

- It is interesting to note that some studies excluded patients who are likely to be at high risk of malnutrition, in particular studies in children:

  ~ Rocha et al. (2006) reported prevalence rates of between 6.9% and 18.7% (see Appendix I, Table A1.8 for details of classification) in children within 48 hours of admission to hospital. However, they excluded children with chronic liver or renal disease, surgical pathologies or cerebral palsy and children who were admitted to intensive care or oncology units during the study period;[43]

~ Hankard et al. (2001) reported a prevalence rate of 20% (BMI z-score below -2 SD, 12% when patients with anorexia nervosa were excluded) in children admitted to medical, psychiatric or surgical wards. The study design excluded patients receiving nutritional support, who represented 19% of the total number of patients admitted on the day of the survey. As these patients were receiving nutritional support, their nutritional status would be expected to be good if the treatment was adequate and effective; however, they would also most likely reflect the patients with a diagnosis which would place them most at risk of malnutrition.[44] Gerasimids et al. excluded paediatric patients from cardiology, renal, orthopaedics and critical care;[37]

~ An Italian study of all children aged 1 month to 16 years admitted to a medical paediatric ward with Grade 1 conditions involving mild stress factors, such as admissions for diagnostic procedures, minor infection or minor surgery, reported a prevalence rate of 10.2% (BMI z-score below -2 SD). The study provides valuable data in this group of patients, but it should be used with care as patients with a hospital stay of > 72 hours and patients with chronic conditions were excluded.[45]

- Studies using nutritional risk screening tools specifically designed for adults and children or SGA report higher prevalence rates for malnutrition compared to studies that use anthropometric measures alone (see Section 2 – Prevalence of Malnutrition and Tables A1.1–A1.8 in Appendix I).

Where possible in this report, the term malnutrition is defined in relation to specific studies

Stratton et al. recommend that wherever the terms 'malnutrition' or 'at risk' of malnutrition are used, they should be defined or explained.[46] In practice, these terms and nutritional risk are often used interchangeably.

Where available, this report includes information on the type of screening test used, the criteria used to define nutritional risk/malnutrition, the patient groups and the clinical setting as reported in original texts to help to avoid confusion. In many cases, this information is included in the detailed tables in the Appendices.

Malnutrition is more than just weight loss

- Deficiencies of specific micronutrients (vitamins and minerals) are common and should be considered part of malnutrition.[47] However, micronutrient deficiencies will not be identified when screening for nutritional risk, but should be taken into consideration during nutritional assessment and when planning nutritional care.

- Vitamin D deficiency is one of the most common nutrient deficiencies among older people.[48;49] Low vitamin D levels (< 20 ng/ml) have been found in nearly 50% of independent community-dwelling older men and women.[50]

- Research findings in targeted population groups indicate that vitamin D deficiency is prevalent in 57% of medical inpatients, 49% of patients admitted to sub-acute rehabilitation facilities, and 23% (12% deficient, 11% severely deficient) of patients with gastrointestinal (GI) disease.[51-53]

- Poor status of a range of micronutrients has been reported in the UK National Diet and Nutrition Survey (people aged 65 years and over), for example:[54]

  ~ 40% of older people (both free-living and institutionalised) had low biochemical status of riboflavin;

~ 40% of older people living in institutions and 15% of free-living older people had low status of vitamin C and folate;

~ 52% of older men and 39% of older women living in institutions had haemoglobin levels below the WHO cut-off for anaemia (13.0 g/dl for men and 12.0 g/dl for women);

~ 15% of older men and 7% of older women living in institutions had plasma zinc concentrations below 10 µmol/l indicating zinc deficiency.

- Plasma zinc and selenium levels below reference levels have been observed in hospitalised older patients with hip fractures and older people attending day care centres in the UK.[55]

Malnutrition still goes undetected and untreated across healthcare settings

Hospital inpatients

- As many as 40% of patients found to be at risk of malnutrition in a Danish hospital had not been screened for nutritional problems.[56]

- Rasmussen et al. (2004) found that nearly 40% of patients in Danish internal medicine, GI and orthopaedic surgery departments were at nutritional risk, and that two-thirds did not have a nutrition care plan or monitoring of dietary intake.[57]

- A prospective study of 395 newly admitted patients to general medical wards in a Dutch hospital revealed that nutritional assessment and intervention were not sufficiently applied by any professional (doctor, medical student, nurse) at any stage of the pre-, actual- and post-hospitalisation period.[58]

- A study in a major tertiary teaching hospital in Australia found that despite 30% of patients being identified as malnourished and 61% at risk, there was poor documentation by staff of two key risk factors (recent weight loss in 19% and appetite in 53% of cases), and even poorer evidence of referral for dietetic assessment in these cases (7% and 9% respectively).[59]

- A cross-sectional survey of 2,094 patients in 140 Belgian hospital wards for older people found a suboptimal implementation of nutritional care practices, such as:[60]

  ~ 56% of wards did not undertake nutritional screening or assessment at admission;
  ~ 86% of wards did not have a nutrition protocol;
  ~ only 31% of wards used a standardised nutritional screening tool.

- In one UK hospital, only 69% of patients were screened for malnutrition on admission, with only 45.2% of high-risk patients appropriately referred to dietetic services. In almost 40% of high-risk cases, no action was taken.[61]

- In the 2011 UK Nutrition Screening Week Survey, most hospitals reported that in spite of a screening policy being in place (99%), weighing (assessment of body weight on admission) on all wards was carried out in only 67% of the hospitals surveyed, although this has improved from 49% in 2007 (Figure 1.3).[62]

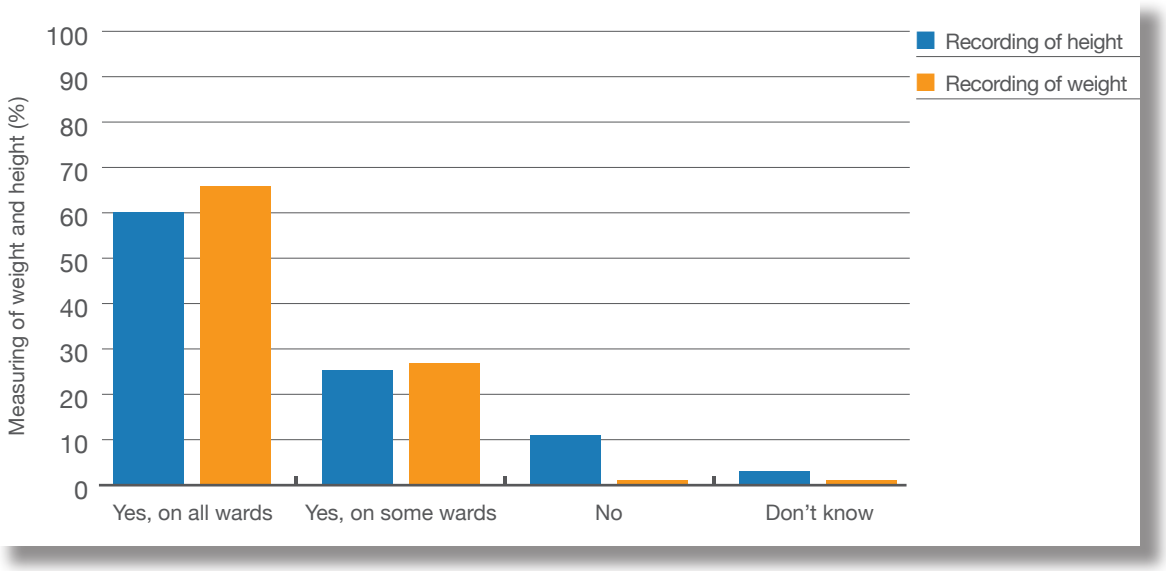

Figure 1.3 **Measurement of height and weight in UK hospitals participating in the National Nutrition Screening Week Survey in 2011** (adapted from Russell & Elia 2012)[62]

- A prospective cohort study of newly admitted adult patients (18–74 years of age) to an acute tertiary hospital in Singapore found that only 3 of the 235 malnourished patients (SGA B+C) were coded as such, illustrating that the majority of malnourished patients are either not recognised or that the presence of malnutrition is not documented.[63]

- An analysis of over 1.5 million patients from the Minimum Basic Data Set from Spanish hospitals identified only 1.4% with malnutrition, a much lower prevalence than in published studies within Spanish hospitals and hospitals in other countries across the world (see Table A1.1, Figure 2.1); the authors suggested that this low number was due to low communication of malnutrition in discharge reports.[64]

The community

- In a multi-centre survey of hospital outpatients in the Netherlands (*n* = 2288; 9 hospitals), only 17% of severely malnourished patients and 4% of moderately malnourished patients were referred to a dietitian.[65]

- In a Dutch study, nutritional interventions were applied in fewer than half of the malnourished patients identified across hospitals, nursing homes and patients receiving care in their own home. In fact, only 20% of patients in their own home received appropriate nutritional care.[66]

- In a large international multi-centre study (*n* = 3248; 49 care homes), despite screening on admission (undertaken more frequently in German [94%] than Dutch [88%] and Austrian [86%] care homes), fewer than 50% of all of the residents identified as malnourished received nutritional interventions (Germany 46%, Austria 40% and the Netherlands 46%).[67]

- An audit of the use of ONS in care homes in the south of England (*n* = 1176, 43 care homes) found that most residents identified as at risk of malnutrition did not receive ONS in the 4 weeks prior to the audit and none were under the care of a dietitian (39% of residents malnourished [medium and high risk], 8.2% of all residents received ONS). Further work is needed to establish whether other forms of nutritional support are used.[68]

- A cross sectional study of nutritional care in 19 care homes (*n* = 703; mean age 84 [range 27-104 years]) in Peterborough in the UK showed that although 32% were found to be at risk of malnutrition ('MUST' 13% medium + 19% high risk) the majority (64%) of patients at high risk were not receiving any form of nutritional support including food fortification, ONS or dietetic care.[69]

- In a community hospital in Germany, 75% of patients who were judged by the attending physician to be malnourished did not receive nutritional support.[70]

- The medical records of malnourished patients in The Health Improvement Network (THIN) database (actual health record data from a representative range of National Health Service [NHS] General Practitioner [GP] practices across the UK) showed that only 35.5% of malnourished patients received some form of nutritional intervention (meaning that two–thirds received no intervention despite having been identified as malnourished).[71]

Malnutrition is often undetected and untreated in children

- Pawellek et al. (2008) found that almost 25% of children admitted to a paediatric hospital in Germany did not have combined height and weight data recorded, hampering efforts to identify children at risk of malnutrition.[72]

- A pilot study for The Children's Nutrition Survey examined the current nutrition and dietetic practices in paediatric centres across the UK and Ireland (*n* = 27; 7 specialist paediatric hospitals and 20 district general/single wards) and found that:[73]

  ~ most centres reported that they were not using a nutrition screening tool;

  ~ although the majority of centres measured weight on admission (> 85%), measurement of height was infrequently undertaken in hospitals with a nutrition support team/nutrition steering committee, and it appeared that it was not measured in hospitals without such a team (31% vs 0%) (see Figure 1.4).

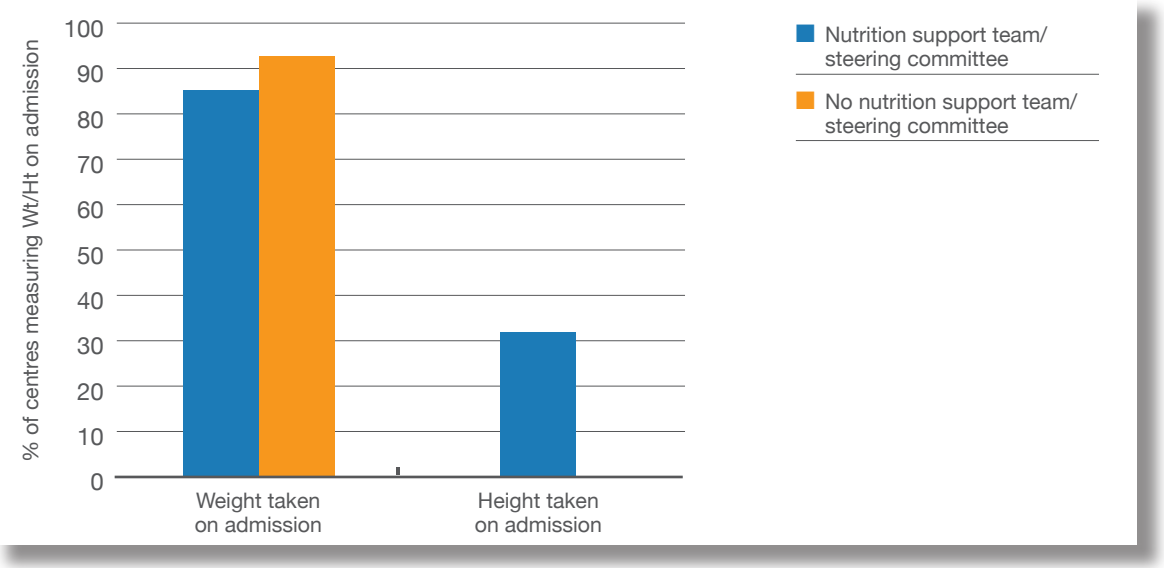

Figure 1.4 **Current nutrition-related practices in paediatrics throughout the UK and Ireland: results for measurement of weight and height on admission** (adapted from Carey et al. 2010)[73]

- In France, a study of the prevalence of malnutrition in hospitalised children aged between 2 months and 16 years (*n* = 280) showed that only 30% of malnourished children were identified.[74]

- Only 50% of children identified as malnourished in a cross-sectional survey in France had been referred to a dietitian on the day of the study.[44]

- A cross-sectional analysis undertaken at the time of enrolment of children and adolescents with Crohn's disease in a trial of initiating therapy with either thiopurine or infliximab established that 36% of severely underweight patients did not receive a multi-vitamin

Inconsistent nutrition-related practices are widespread in centres that care for children

- A pilot study for The Children's Nutrition Survey examined the current nutrition and dietetic practices in paediatric centres across the UK and Ireland (*n* = 27; 7 specialist paediatric hospitals and 20 district general/single wards) and found that:[73]

  ~ less than half (48%) had a nutrition support team or nutrition steering committee;

  ~ only 6 centres (22%) routinely included nutrition-related information in the discharge plan;

  ~ audits of nutrition practices, implementation of referral criteria, and staff training on nutrition topics were not consistently undertaken across centres (see Figure 1.5).

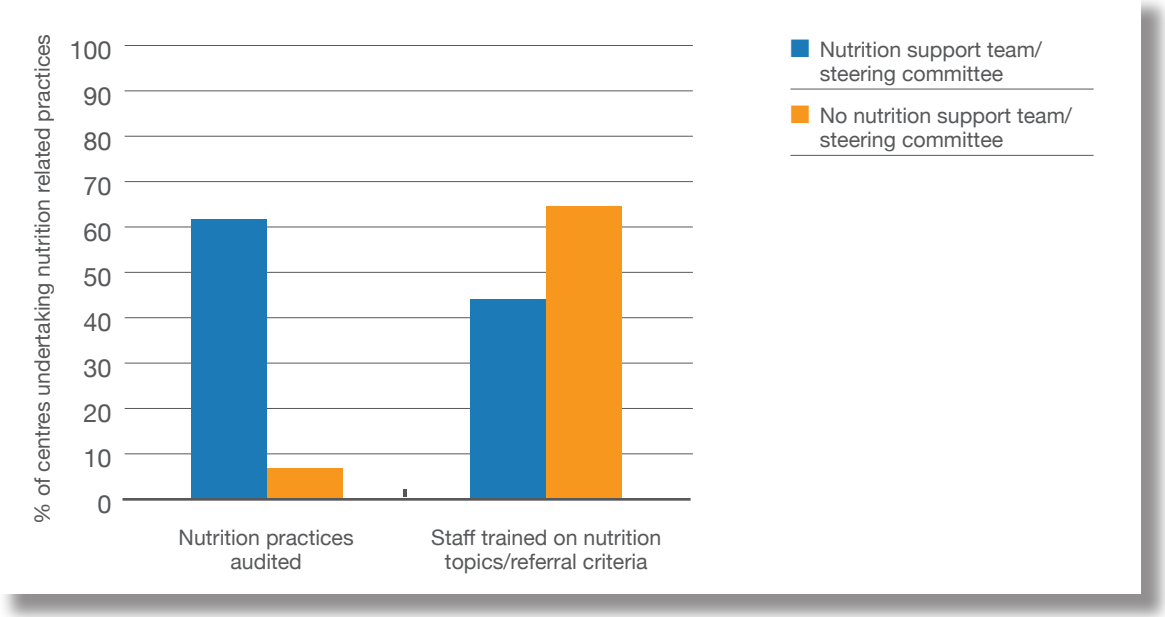

Figure 1.5 **Current nutrition-related practices in paediatrics throughout the UK and Ireland** (adapted from Carey et al. 2010)[73]

- A nationwide survey (USA) of 125 institutions (54% response rate) found no consistency in the provision of nutritional services in paediatric oncology, a group of patients at high risk of malnutrition. Many institutions fail to undertake nutritional assessments at critical time points during care, do not use screening tools to identify patients at risk of malnutrition, and have no criteria for intervention (see Figure 1.6).[76]

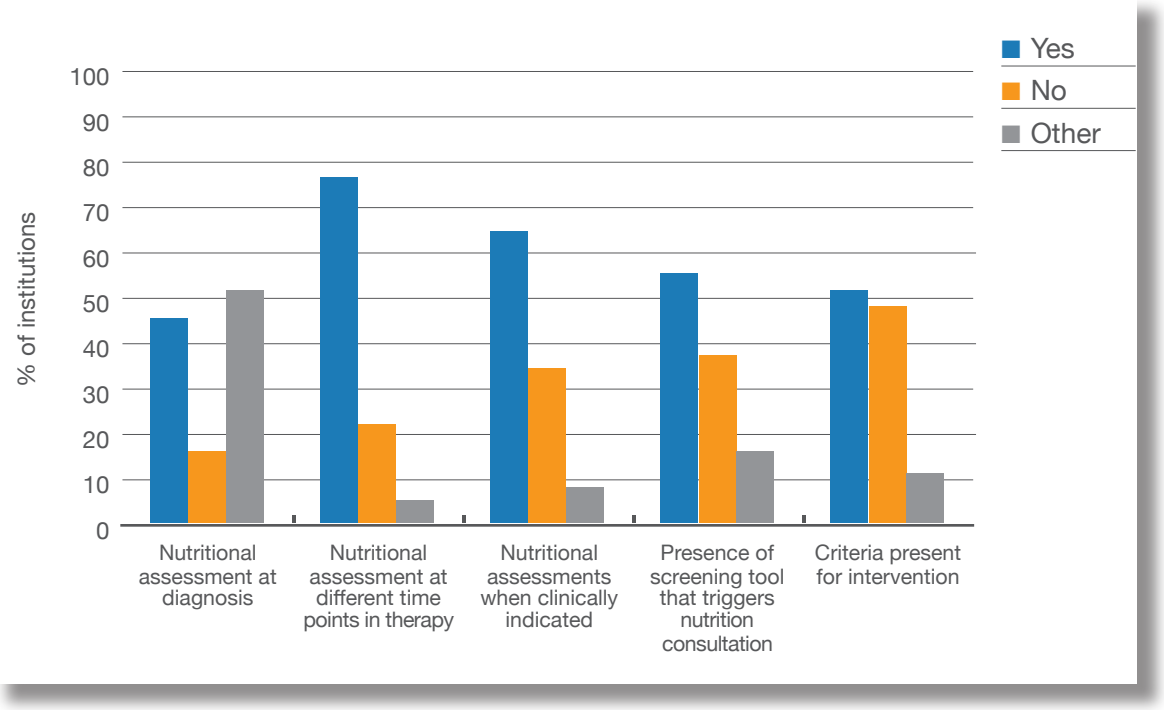

Figure 1.6 **Standards of nutritional care in paediatric oncology: results from a nationwide survey** (adapted from Ladas et al. 2006)[76]

Continuity of care

- The UK Nutrition Week Survey undertaken in winter 2010 also highlighted that although the results of screening were linked to a care plan in 9 out of 10 hospitals surveyed, less than half always or usually included nutritional information in discharge letters, potentially affecting continuity of nutritional care.[77]

2 PREVALENCE OF MALNUTRITION

Summary

Malnutrition is not a new problem and with an ageing population it continues to be a **major public health concern**. It is not confined to developing countries, but is **highly prevalent in the European healthcare system and in other developed regions**.

Based on work done in the UK (showing > 3 million adults are at risk of malnutrition) and extrapolated to the rest of Europe, an estimated **20 million adults are at risk of malnutrition in the European Union (EU) and 33 million adults are at risk across Europe**.

Malnutrition is prevalent across **all healthcare settings** particularly in patients in hospital and in institutions:

- Large-scale studies show that **about 1 in 4 adult patients in hospital** are at risk of malnutrition or are already malnourished.
- **More than 1 in 3 patients in care homes** are malnourished or at risk of malnutrition.
- As many as **1 in 3 older people living independently** are at risk.

Whereas many studies have addressed the prevalence of malnutrition in hospitals, the prevalence in the community setting has received less attention. Data from 2009 reveals that in the UK, 93% of the estimated 3 million people who are malnourished or at risk of malnutrition live in the community.

Malnutrition is prevalent **across all age groups**:

- In adults it is **particularly a problem in older people**. In the UK Nutrition Screening Week Survey in 2011, the risk was 30% greater in hospital patients aged 65 years and over than in those aged under 65 years (28% vs 21%, $p < 0.001$).
- **Almost 1 in 5 children** admitted to Dutch hospitals have acute or chronic malnutrition.

Malnutrition is common across a variety of **patient groups** e.g. **in patients with gastrointestinal, respiratory and neurological disease**. It is particularly prevalent in **people with cancer**, where rates of malnutrition have been found to be **twice as high** when compared with patients without cancer.

Conclusion

Many studies have been published in many different parts of the world using a variety of screening tools and techniques designed to estimate the prevalence of malnutrition and risk of malnutrition. The diverse methods that have been used at least partly explain the wide variability in reported prevalence rates. However, it is clear that all studies point to the same conclusion that malnutrition and the risk of malnutrition is very common in patients across the age range and across healthcare settings, and that it is of particular concern in older people.

Recommendations

On the issue of **prevalence of malnutrition** the MNI makes the following recommendations:

Action	Issues to consider
A commitment should be made to systematically measure the prevalence of malnutrition and risk of malnutrition and the results widely disseminated	• Measuring prevalence of malnutrition and risk of malnutrition is a key way of driving awareness of this of subject and calling for action, and should be considered in countries where this has so far not been done. The UK Nutrition Screening Week is an excellent example for such countries to refer to
A common approach should ideally be taken to measuring and documenting malnutrition and risk of malnutrition	• A common approach would be of great value to enable comparison of prevalence rates across healthcare settings and countries

Malnutrition is not a new problem

- A systematic analysis of a large number of studies reporting on malnutrition according to healthcare setting and clinical condition from as early as the 1970s revealed a prevalence of adult patients with a BMI of < 20 kg/m^2 of up to 60% in hospital and community settings across countries.[46]

- The analysis also showed that over 10% and up to 40% of children were at risk of malnutrition if WFH < 90% and HFA < 95% were used as the criteria.[46]

2.1 Hospital

One in four adult hospital patients is malnourished or at risk of malnutrition

- Despite differences in the age of subjects, there is consistent and overwhelming evidence that malnutrition is a widespread problem in hospitals across the world and that it is highly prevalent in affluent and developed societies (see Table A1.1 in the Appendix) (see Figure 2.1). Variation in prevalence figures may in part reflect the different methods that exist to detect malnutrition risk.

- Recent large-scale multi-centre surveys (n > 5000 in each study; undertaken in the last 5 years) show that about 1 in 4 (18–34%) adult hospital patients are malnourished or at risk of malnutrition[29;62;77-81] (see Table 2.1). In the winter 2010 UK Nutrition Screening Week Survey a prevalence of 34% was found in adult patients admitted to hospital; this higher figure may be related to a number of reasons, including a higher prevalence of malnutrition in patients with respiratory disease.[77]

- The NutritionDay Survey undertaken by 1,217 units from 325 hospitals in 25 countries (Europe and Israel; data collected on a single day in 2007 and 2008) included 21,007 adult patients and found that 27% of patients were classified as being at risk of malnutrition.[29] Similar results were found in the Australasian Nutrition Care Day Survey undertaken in 2010 (acute care hospitals in Australia and New Zealand, n = 3122), where 32% of adult hospital patients were found to be malnourished (combined number of malnourished patients identified by SGA [B+C categories] and BMI < 18.5 kg/m^2).[42]

- In smaller studies, rates of malnutrition and risk of malnutrition of up to 90% have been reported in adult hospital patients (see Table A1.1 in the Appendix) (see Figure 2.1).

Table 2.1 **Summary of recent large-scale studies of the prevalence of malnutrition and the risk of malnutrition in adult hospital patients** (*n* > 5000; undertaken in the last 5 years)

Country/ Region	Author (year)	Patients (*n*)	Timing of nutritional assessment/screening (data collection)	Prevalence %	Method of assessment/ screening
Europe and Israel	Schindler et al. (2010)[29]	21007	One day, cross-sectional (single day in 2007 & 2008)	**27**	Variety of tools used, including NRS-2002, 'MUST', national or local tools
Switzerland	Imoberdorf et al. (2010)[79]	32837	On day of admission	**18.2**	NRS-2002
The Netherlands	Meijers et al. (2009)[78]	8028	Cross-sectional, point prevalence on specified day	**23.8**	Based on BMI, weight loss and food intake*
UK	Russell & Elia (2012)[62]	7657	Within 72 hours of admission (spring 2011)	**25**	'MUST'
UK	Russell & Elia (2011)[77]	9669	Within 72 hours of admission (winter 2010)	**34**	'MUST'
UK	Russell & Elia (2009)[81]	5089	Within 72 hours of admission (summer 2008)	**28**	'MUST'
UK	Russell & Elia (2008)[80]	9336	Within 72 hours of admission (autumn 2007)	**28**	'MUST'

*See Table A1.1, Appendix I for further details of method

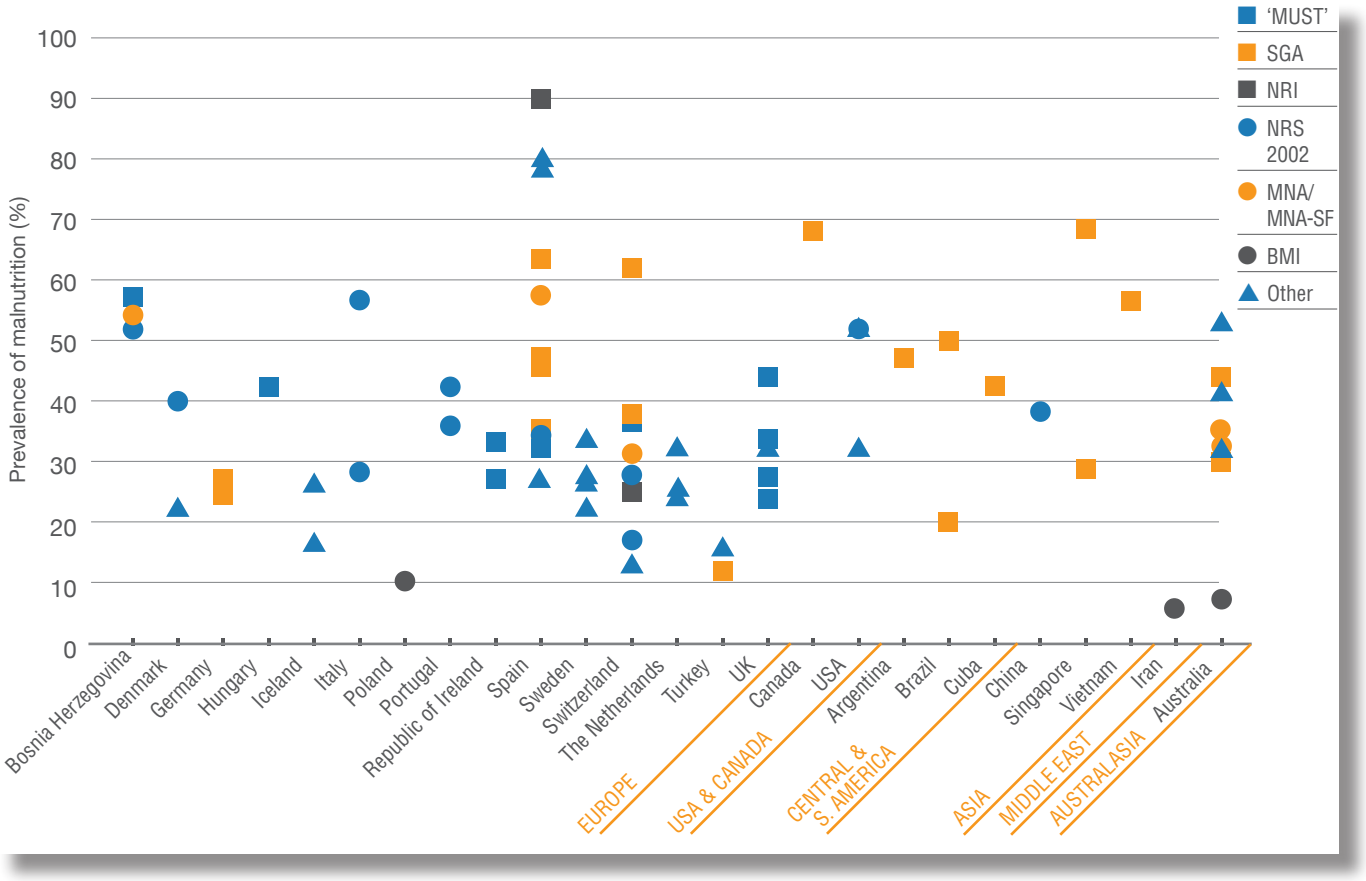

Figure 2.1 **Prevalence of malnutrition risk in adult hospital patients using different screening methods by country and world region**
(see Appendix I, Table A1.1 for full details)

Older people are at significantly higher risk of malnutrition

- Malnutrition affects all age groups but increasing age is associated with an increased risk of malnutrition.[62;77;79-90] Older people are vulnerable to malnutrition as they often have several co-morbidities that are often chronic and progressive.[91] In the UK Nutrition Screening Week Survey in 2011, the risk was 30% greater in patients aged 65 years and over than in those aged under 65 years (28% vs 21%, $p < 0.001$).[62]

One in three older people in hospital are malnourished or are at risk of malnutrition

- The prevalence of malnutrition and risk of malnutrition is high in older people in hospital (see Table A1.2 in the Appendix, Figure 2.2). In some studies, depending on the ward or method used, over 90% of older people were found to be malnourished or at risk of malnutrition.[59;60;70;92]

- Recent large-scale surveys ($n > 1000$) show that about 1 in 3 older people in hospital are malnourished (38.7%)[93] or are at risk of malnutrition (22–47.3%)[60;62;77;79-81;93] (see Table 2.2).

- In an Italian study, older hospital patients with mild cognitive impairment (MCI) ($n = 65$) and dementia ($n = 84$) were more likely to be malnourished than those with no cognitive impairment (NoCI) ($n = 439$) (dementia 59.5% vs NoCI 15%, $p < 0.001$ and MCI 44% vs NoCI 15%, $p < 0.001$).[94]

Table 2.2 **Summary of recent, large-scale studies of the prevalence of malnutrition and risk of malnutrition in older people in hospital** ($n > 1000$; undertaken in the last 5 years; using a validated screening tool)

Country/ Region	Author (year)	Patients (*n*)	Timing of nutritional assessment/screening (data collection)	Prevalence %	Method of assessment/ screening
Europe†	Kaiser et al. (2010)[93]	1384	Not available	86 (47.3 at risk, 38.7 malnourished)	MNA
Belgium	Vanderwee et al. (2011)[60]	2094	Cross-sectional (between 16th May and 15th June 2007)	31.9	MNA-SF
Switzerland	Imoberdorf et al. (2010)[79]	See Table A1.2, Appendix I	On day of admission	22 (65–84 years) 28 (> 85 years)	NRS-2002
UK	Russell & Elia (2012)[62]	See Table A1.2, Appendix I	Within 72 hours of admission (spring 2011)	28	'MUST'
UK	Russell & Elia (2011)[77]	See Table A1.2, Appendix I	Within 72 hours of admission (winter 2010)	39	'MUST'
UK	Russell & Elia (2009)[81]	See Table A1.2 Appendix I	Within 72 hours of admission (summer 2008)	32	'MUST'
UK	Russell & Elia (2008)[80]	See Table A1.2, Appendix I	Within 72 hours of admission (autumn 2007)	30	'MUST'

†Retrospective pooled analysis of data from studies in older people in hospitals in Belgium, Switzerland, Germany, Italy and Sweden

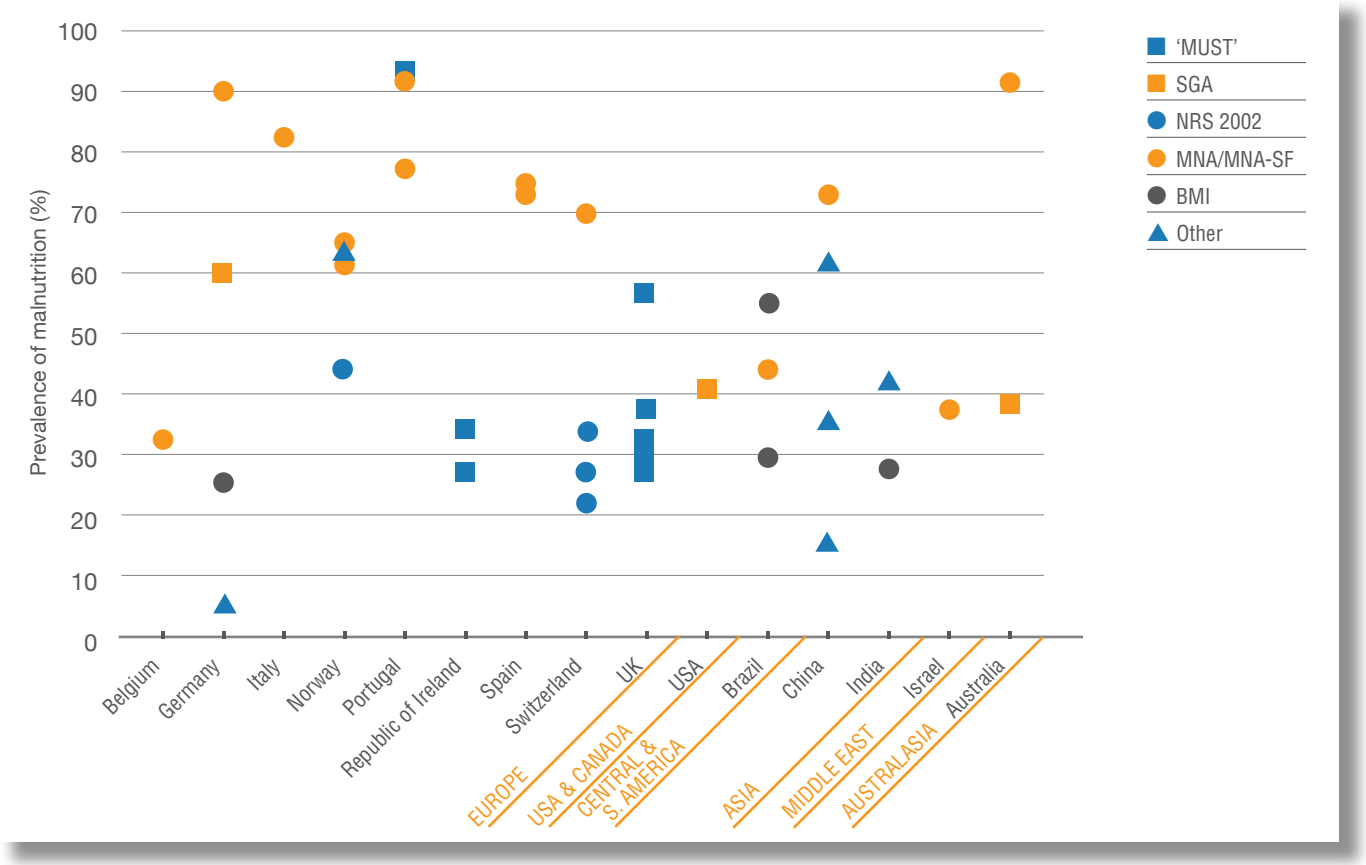

Figure 2.2 **Prevalence of malnutrition risk in older people in hospital using different screening methods by country and world region**

(see Appendix I, Table A1.2 for full details)

Malnutrition in children in developed countries

- Whilst childhood malnutrition is internationally recognised as a major public health problem in developing countries, especially those afflicted by poverty, war and famine, it is often assumed to be absent in affluent developed countries. Worldwide, under-nutrition is an underlying cause of 53% of all deaths in children younger than 5 years.[95] Underweight does exist in developed countries and it is projected to decrease from 1.6% in 1990 to 0.9% in 2015, a change of -41%.[96] However, although these figures appear low in comparison to developing countries, malnutrition and underweight is a significant problem in developed countries, particularly in children with underlying disease-related malnutrition, as illustrated by the high prevalence of malnutrition on admission to hospital.

Malnutrition and risk of malnutrition is common in children in hospital

- Malnutrition and risk of malnutrition has been reported in 2–85% of children in hospital (see Figure 2.3 and Table A1.8, Appendix I). The prevalence reported in the literature varies due to the different methods used for either screening for malnutrition risk or assessment of nutritional status, the criteria used to define malnutrition, how the results have been reported (whether they include mild, moderate and severe malnutrition or acute and/or chronic malnutrition), the type of population studied, and the disease spectrum of the subjects included or excluded from individual studies.

- Studies using nutritional risk screening tools specifically designed for paediatric populations or SGA report higher prevalence rates for malnutrition in children (18–85%)[35-37;39;97-99] compared to studies that use anthropometric measures alone, such as WFH, weight-for-age (WFA), % ideal body weight (IBW), BMI, TSFT and MUAC (2.5–52%)[43-45;72;74;99-108] (see Figure 2.3 and Table A1.8, Appendix I).

Data from large-scale national or regional surveys describing the prevalence of malnutrition risk in children on admission to hospital is emerging

- A large cross-sectional study (The Children's Nutrition Survey) undertaken in the UK and Ireland found a prevalence of malnutrition in children (mean age 5.7 years) of 11% (in terms of WFA ≤ 2 SD; timing of assessment not specified) (n = 1003). Thirty-one hospitals participated, 20 of which had nutrition support teams.[109]

- A prospective multi-centre cohort study investigating the prevalence of malnutrition risk in children on admission to hospital and the impact on outcomes is currently underway in 14 centres across 12 different European countries and it is being funded by ESPEN. The study also aims to arrive at an agreement on the preferred screening tool for identifying nutritional risk in children.

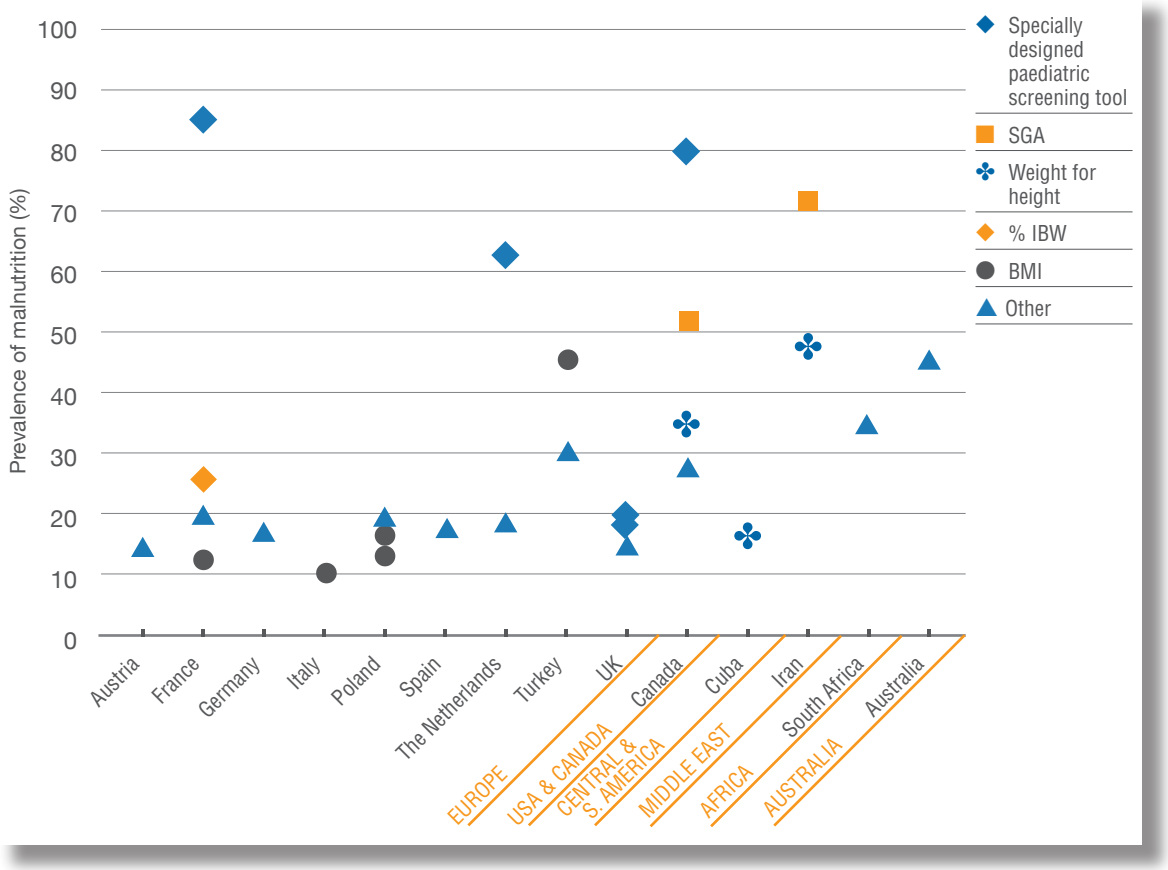

Figure 2.3 **Prevalence of malnutrition and risk of malnutrition in children in hospitals using different screening and/or assessment methods by country and region.**

(see Appendix I, Table A1.8 for full details)

Malnutrition and risk of malnutrition are common across a variety of hospital wards

- Malnutrition and risk of malnutrition are common across a variety of hospital ward types, with a particularly high prevalence in care of the elderly, oncology, respiratory, endocrine and gastroenterology wards/specialities (see Figure 2.4).[42;62;63;78;83]

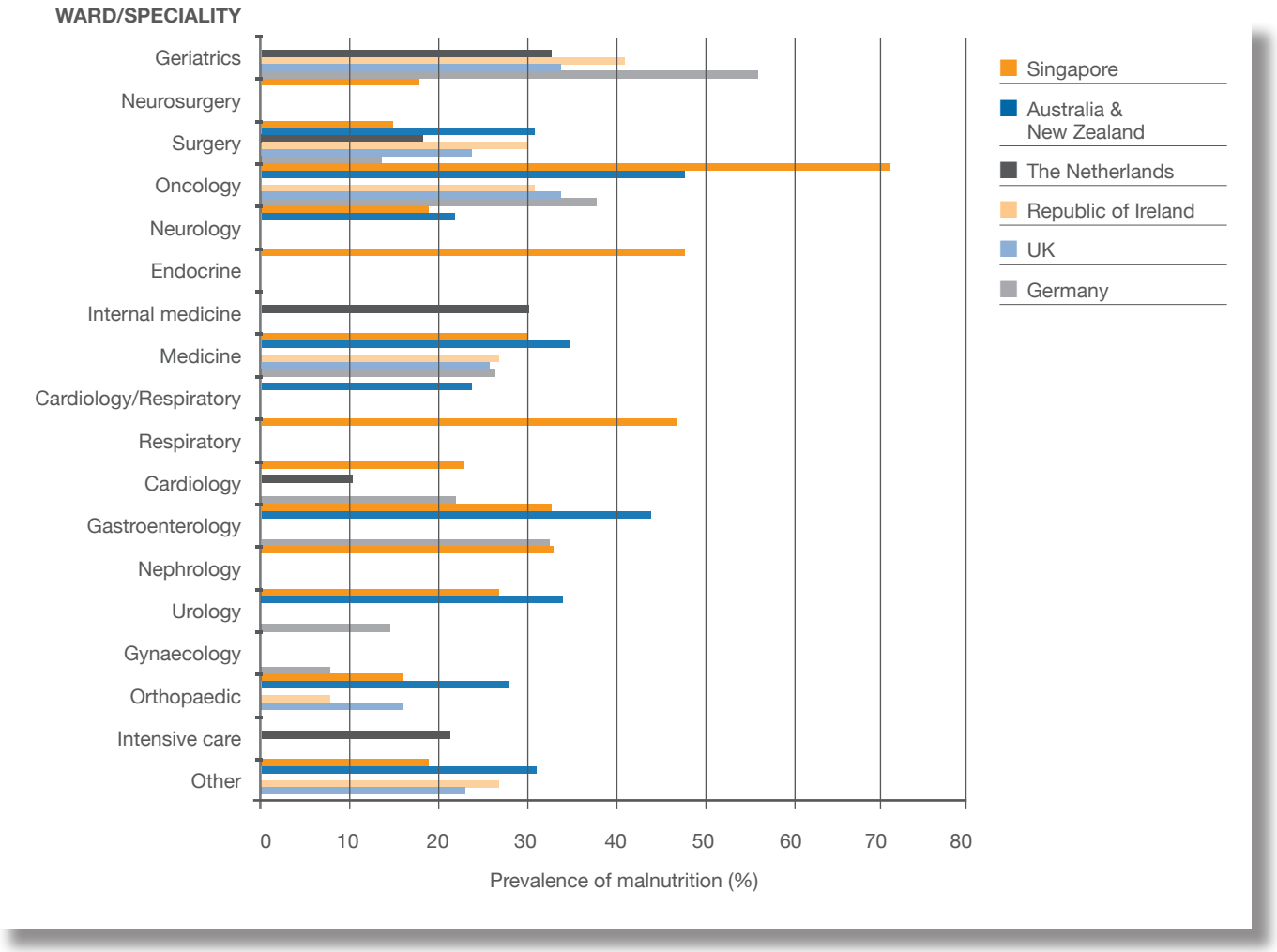

Figure 2.4 **Prevalence of malnutrition and risk of malnutrition according to hospital ward/primary admitting speciality**

(Singapore *n* = 818 [SGA B+C], Australia & New Zealand *n* = 3080 [SGA B+C & BMI], the Netherlands *n* = 8028 [defined by BMI, undesired weight loss, nutritional intake*], UK *n* = 7408 ['MUST' medium + high risk], Republic of Ireland *n* = 1090 ['MUST' medium + high risk], Germany *n* = 1886 [SGA B+C])[42;62;63;78;83]

(*see details in Table A1.1)

Malnutrition in children is more common in specialist wards and hospitals than in general units

- In hospitals in the Netherlands, a significantly higher rate of chronic malnutrition (HFA < - 2 SD) was found in children admitted to academic hospitals (14%) compared to general hospitals (6%), $p = 0.013$. This may reflect the nature of the cases seen at academic hospitals, where possibly more complex cases are managed.[101] Hulst et al. (2010) found that the distribution of risk categories differed between general and academic hospitals i.e.15% of children in academic hospitals were at high risk vs 5% in general hospitals ($p = -0.014$ for low vs high risk and $p < 0.001$ for moderate vs high risk).[38]

- Gerasimidis et al. (2011) found that a high risk of malnutrition was more prevalent in the specialist wards than the acute receiving wards of a tertiary paediatric hospital (18% in specialist vs 8.3% in acute receiving).[41]

Malnutrition and risk of malnutrition is prevalent in a wide variety of diseases in adults

- Recent large-scale multi-centre surveys consistently show that malnutrition risk is common across many diagnostic groups in hospitals, with a particularly high prevalence in patients with GI, respiratory and haematological disease and cancer (see Figure 2.5).[62;78]

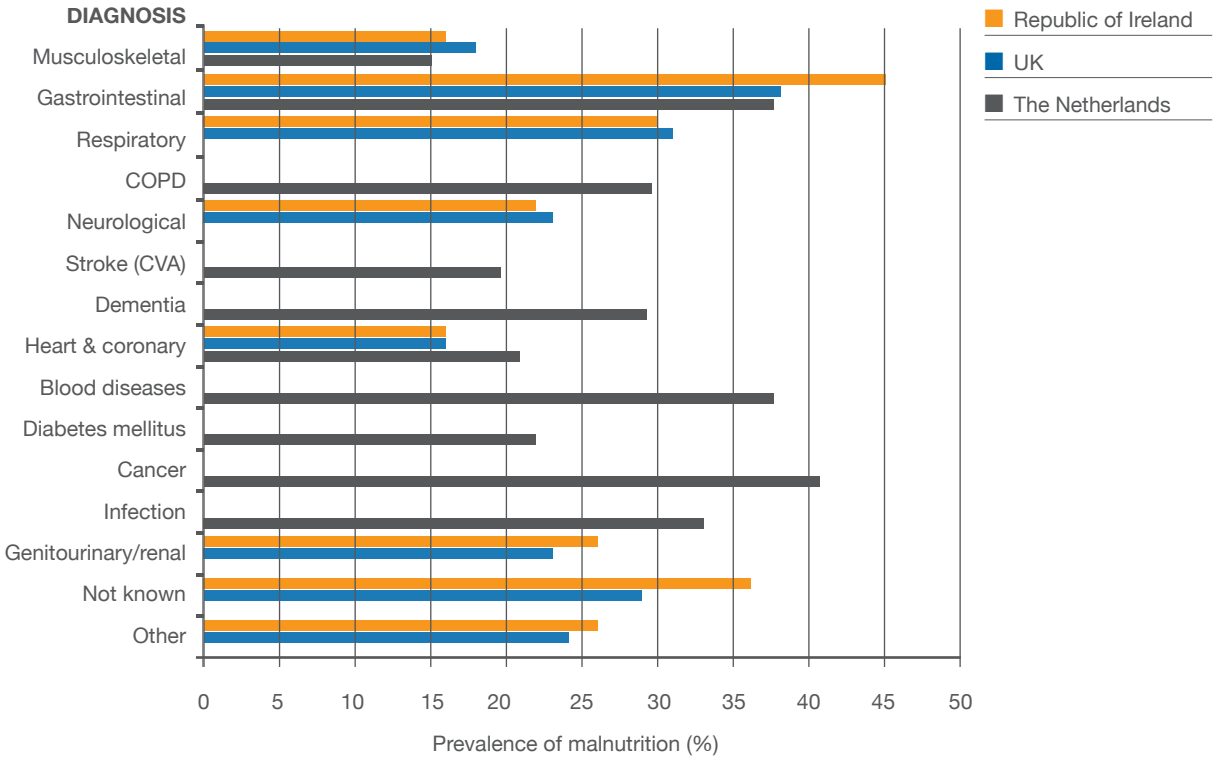

Figure 2.5 **Prevalence of malnutrition risk in hospital by diagnosis**
(Republic of Ireland *n* = 1102 ['MUST' medium + high risk], UK *n* = 7521 ['MUST' medium + high risk], the Netherlands *n* = 8028 [defined by BMI, undesired weight loss, nutritional intake*]).[62;78]
(*see details in Table A1.1)

Malnutrition is prevalent in a wide variety of diseases in children

- In a study of children (*n* = 475) on admission to a large tertiary care children's hospital in Germany, the greatest prevalence of malnutrition was found in patients with multiple diagnoses (42.8%), children with learning disabilities (40.0%), children with infectious diseases (34.5%), and children with cystic fibrosis (33.3%) (see Figure 2.6).[72] Note that the overall figures include mild, moderate and severe malnutrition.

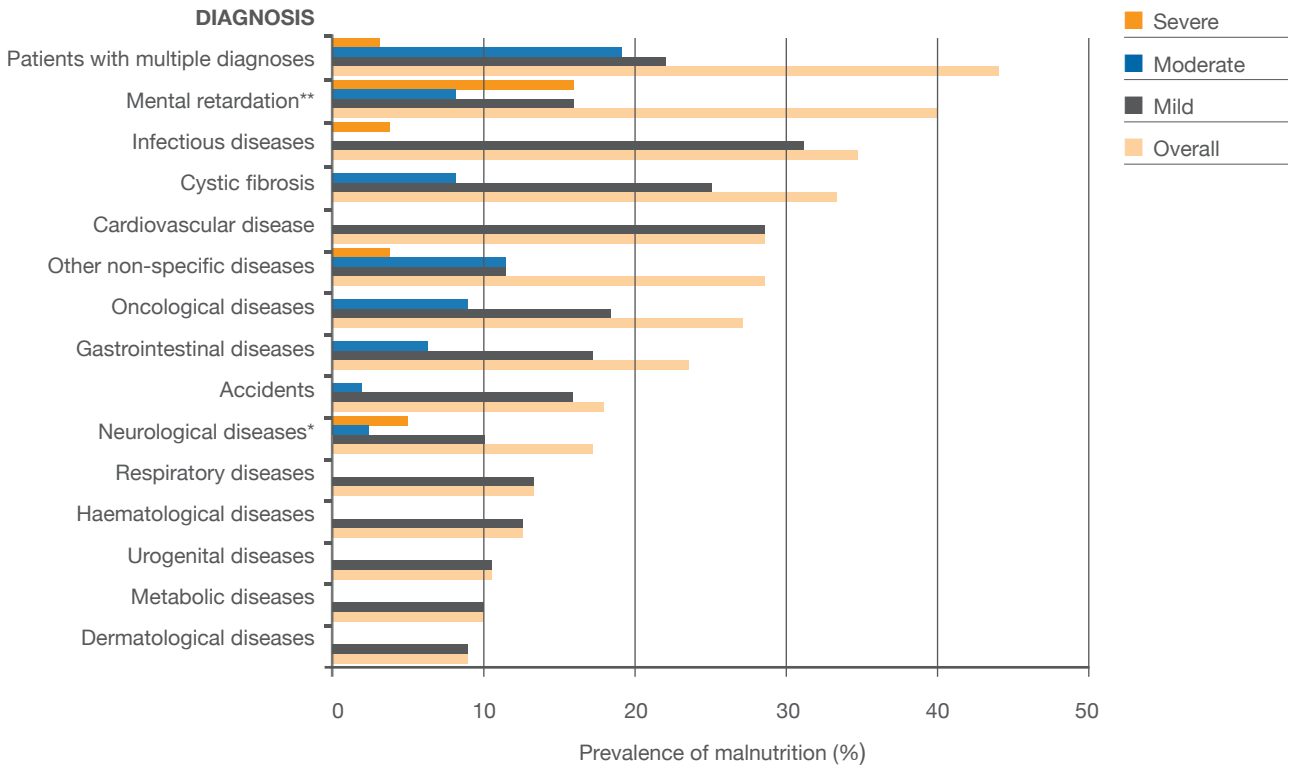

Figure 2.6 **Prevalence of malnutrition in children on admission to hospital in Germany by diagnosis and degree of malnutrition**

(*Includes mental retardation, **subgroup of patients with neurological diseases)[72]

- A nationwide prospective observational study of all newly admitted children to hospitals in the Netherlands (n = 424) found that children with an underlying disease had a significantly higher overall prevalence of malnutrition and chronic malnutrition compared to children without an underlying disease (28% vs 15% and 18% vs 5% respectively [p = 0.004 and p < 0.001]).[101]

- The highest prevalence of acute malnutrition was found in children with GI disease (18%), and the highest prevalence of chronic malnutrition was seen in children with neurological disease (31%); the overall prevalence was around 19% (see Figure 2.7).[101]

- Using multiple logistic regression analysis that allowed for age, underlying disease, ethnicity and surgery, Joosten et al. (2010) showed that a significant relationship existed between the presence of malnutrition on admission and underlying disease (odds ratio [OR] 2.2, confidence interval [CI] 1.3–3.9; p = 0.005). For chronic malnutrition, both underlying disease and non-white ethnicity were significantly related to a higher prevalence of malnutrition (OR 3.7, CI 1.7–7.8; p = 0.001 and OR 2.8, CI 1.2–6.6; p = 0.016 respectively), but this was not the case for acute malnutriton.[101]

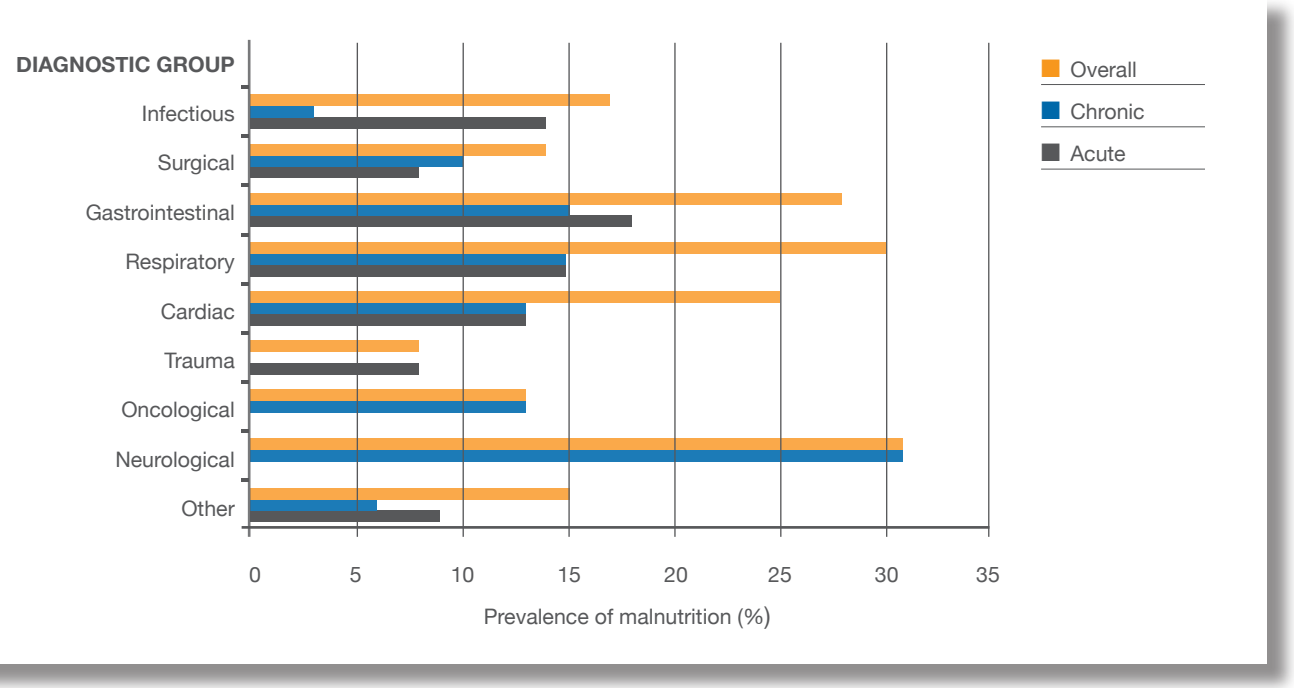

Figure 2.7 **Prevalence rates of malnutrition in children on admission to hospital in the Netherlands by diagnostic group and type of malnutrition**[101]

Deterioration in nutritional status during hospital stay can occur in both malnourished and well-nourished patients

- In a review by Stratton et al. (2003), deterioration in nutritional status during hospital stay was identified in a variety of patient groups e.g. general hospital/mixed diagnoses, paediatrics, stroke and surgical patients, with over 80% of patients in some studies losing weight during hospitalisation.[46]

- Table 2.3 shows the change in malnutrition risk (assessed using MNA) during hospital stay for older people admitted to medical and surgical wards in a non-teaching hospital in Portugal. A higher proportion of patients were at risk of malnutrition on discharge than on admission.[92]

Table 2.3 **Prevalence of malnutrition and risk of malnutrition in older people on hospital admission and discharge** (adapted from Cansado et al. 2009)[92]

	Surgical patients (*n* = 341)			Medical patients (*n* = 190)		
MNA Category	**Admission (%)**	**Discharge (%)**	***p****	**Admission (%)**	**Discharge (%)**	***p*****
Normal	21.9	22.8	NS***	8.4	4.2	0.05
Risk of malnutrition	51.3	43.4	0.05	48.9	44.7	0.07***
Malnourished	26.6	33.7	0.003	42.6	51.0	0.002

*p** indicates statistical differences for surgical patients on admission vs discharge
*p*** indicates statistical differences for medical patients on admission vs discharge
***NS: Not Significant

Weight loss can occur in children during hospital stay even when well-nourished on admission

- A study in Sao Paolo, Brazil of 203 children (average age 21.6±15.4 months; majority aged less than 24 months, *n* = 126, 62.2%) whose nutritional status was assessed within 48 hours of admission to hospital and again a maximum of 24 hours before discharge found that:[43]
  - 51.6% of children lost weight during their hospital stay;
  - malnourished children on admission remained malnourished on discharge;
  - 9.2% of well-nourished children on admission developed mild malnutrition during their hospital stay.
- In a prospective study in France, Sermet-Gaudelus et al. (2000) found that 65% of children lost weight during their hospital stay and that weight loss was > 2% of admission weight in 45% of these children.[36]
- In a national screening survey in The Netherlands, 65% of children in hospital neither gained nor lost weight, but 3% of children experienced weight loss of more than 5% during their hospital stay.[101]

2.2 Community

Malnutrition is common in outpatients

- Between 7% and 16% of patients across hospital general outpatient departments have been found to be malnourished or at risk of malnutrition (see Table A1.3, Appendix 1).[65;110;111]
- The prevalence varies considerably depending on the department:
  - a large multi-centre study in the Netherlands (*n* = 2288, 9 hospitals) found the highest prevalence of malnutrition in oral maxillofacial surgery outpatients (17%), although this could be an underestimate as no patients with head and neck cancer were present on the day of the survey (see Figure 2.8);[65]
  - in a study of 1,000 outpatients with cancer in Italy, 39.7% were found to have experienced significant weight loss (≥ 10%) and 33.8% were found to be at nutritional risk.[112] A small study (*n* = 207) of medical oncology outpatients in a UK hospital found that the prevalence of risk of malnutrition ranged from 45% to 83% depending on the tumour site[113] (see Table A1.3, Appendix 1 for details);
  - depending on the severity of disease, as many as 1 in 4 outpatients with Chronic Obstructive Pulmonary Disease (COPD) are malnourished or at risk of malnutrition;[114;115]
  - about 1 in 3 adult gastroenterology outpatients have been identified as at risk of malnutrition;[116]
  - a study of older people attending a geriatric medical outpatient clinic in Turkey found that 28% were at risk of malnutrition (using MNA).[117]

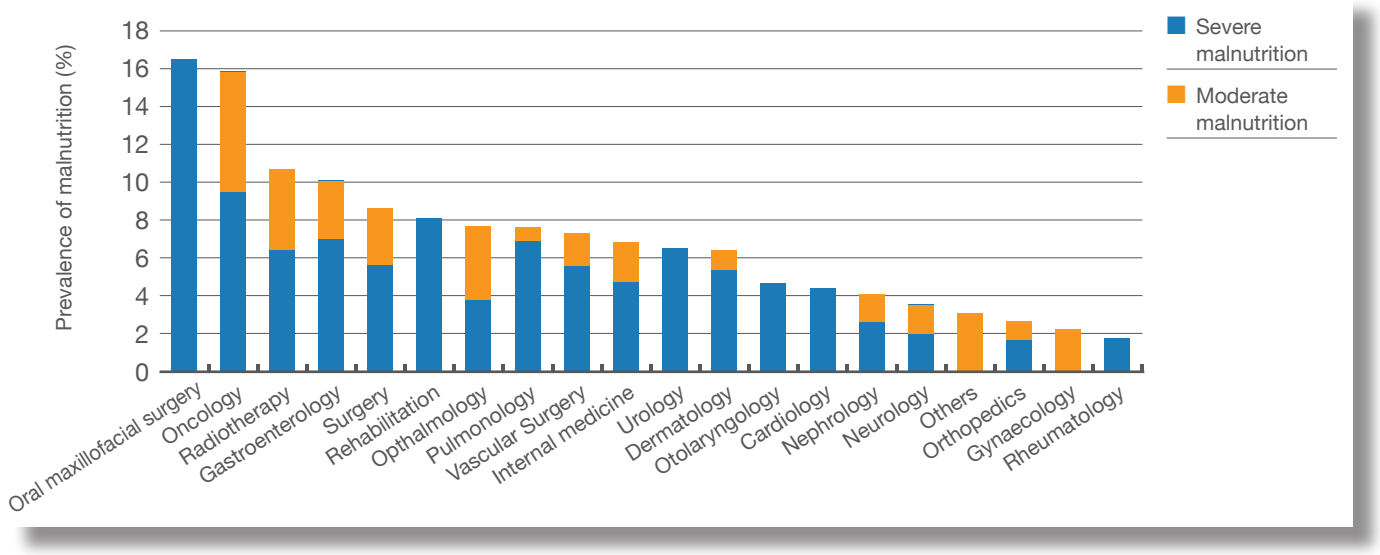

Figure 2.8 **Prevalence of malnutrition in outpatient departments in the Netherlands** (n = 2288).[65]
Others: psychiatry, radiology, geriatrics and physiotherapy (see Table A1.3, Appendix 1 for details)

Malnutrition is found to be common in people with intellectual disability and mental health problems

- In UK adults aged 20 years and over with intellectual disability, the prevalence of under weight (BMI ≤ 20 kg/m^2) has been shown to be 18.6%.[118]
- The UK Nutrition Screening Week Survey 2011 found a prevalence of malnutrition risk in patients in mental health units (n = 543) of 19% (Table A1.7, Appendix 1).[62]
- In Taiwan, a study by Tsai et al. found that the prevalence of malnutrition and malnutrition risk (using MNA-Taiwan version) in patients in mental health units differed with different diagnoses as follows:[119]
  - 12.5% in patients with bipolar disorder;
  - 21.1% in patients with schizophrenia;
  - 55.6% in patients with major depression.

More than 1 in 3 patients in care homes are malnourished or at risk of malnutrition

- Estimates using a variety of methods in different types of care homes (majority of participants were older people) suggest that between 9% and 97% of residents in long-term care facilities are at risk of malnutrition or already malnourished (see Figure 2.9) (Table A1.4, Appendix 1). Figures at the lower end of this prevalence range are reported in studies where prevalence of malnutrition or malnutrition risk was assessed either by using a healthcare professional's subjective assessment or BMI;[120-122] both of these methods are known to underestimate the prevalence of malnutrition risk. An exception was residential homes in the Republic of Ireland which reported a prevalence of malnutrition risk using 'MUST' of 9% and 0% in 2010 and 2011, which contrasts starkly with the results for the UK for the same years (30% and 41% respectively).[62;77] There may be differences between the two countries in the type of residents cared for in these facilities; however, it must also be noted that in the Republic of Ireland the sample sizes were small, with very low numbers of patients participating per care home (2010: n = 143 [17 care homes], 2011: n = 29 [6 care homes]), meaning that the results may not be representative of the actual level of malnutrition risk in residential homes in the Republic of Ireland.

Prevalence figures at the upper end of the range are reported in studies where MNA or MNA-SF was used.[120;123-130] In many of these studies, the subjects differed in terms of age, type of care home, and underlying condition, and some included small sample sizes (see Table A1.4, Appendix I).

- Based on recent large studies (n > 1000) using a validated screening tool (MNA or 'MUST'), more than 1 in 3 patients (30–53.4%) living in care homes are at risk of malnutrition[68;80;93;120;131] (see Table 2.4).

Table 2.4 **Summary of recent large-scale studies of the prevalence of malnutrition and risk of malnutrition in patients in care homes** (n > 1000; undertaken in the last 5 years; using a validated screening tool; majority of participants were older people)

Country/ Region	Author (year)	Patients (n)	Timing of nutritional assessment/screening (data collection)	Prevalence %	Method of assessment/ screening
International†	Kaiser et al. (2010)[93]	1586	Not available	67.2 (53.4 at risk, 13.8 malnourished)	MNA
Finland	Suominen et al. (2009)[120]	1043	All patients during 2 weeks in September 2003	97.4 (40.7 at risk, 56.7 malnourished)	MNA
Hungary	Lelovics et al. (2009)[131]	1381	Timing of assessment not clear	38.1	'MUST'
UK	Parsons et al. (2010)[68]	1176	Timing of assessment not specified	39	'MUST'
UK	Russell et al. (2008)[80]	1610	Restricted to adults admitted within the previous 6 months	30	'MUST'

†Retrospective pooled analysis of data from studies in older people in nursing homes in Switzerland, Germany, Spain, France, The Netherlands, the United States and South Africa

- Studies in the UK using 'MUST' show that the risk appears to increase with increasing dependency (35–46% in nursing homes vs 22–36% in residential homes) (see Table A1.4, Appendix 1). In a study of the prevalence of risk of malnutrition in a Primary Care Trust in England (n = 703), a significantly higher prevalence was found in nursing care compared with residential care (38% vs 25%, p = 0.001).[69] The prevalence of malnutrition (using SGA) was found to be higher in residents receiving a higher level of care in aged care facilities in Australia (OR 2.9 [95% CI 1.7–5.2; p < 0.001]).[132]

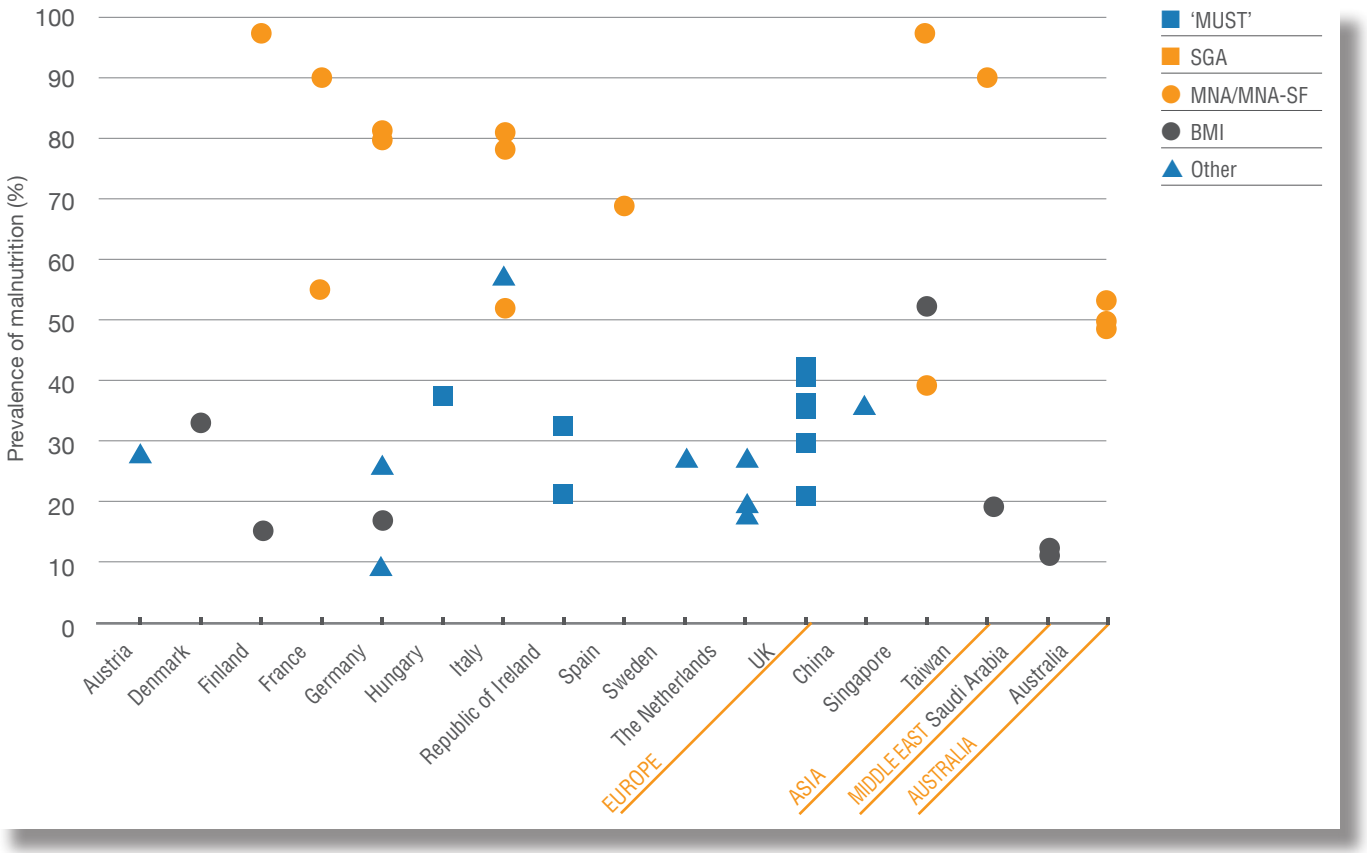

Figure 2.9 **Prevalence of malnutrition risk in care homes using different screening methods by country and world region**

(see Appendix I, Table A1.4 for full details)

As many as 1 in 3 older people living independently face the same risk

- Malnutrition is not just found in older people (the age of subjects differs in different studies but in general, people aged over 60 years or 65 years are included) in hospitals and care homes; free-living older people are also at risk of malnutrition. As with other settings, the prevalence varies depending on the method used (2–52%) (see Table A1.6, Appendix 1) and the type of subjects studied, including disease status. Special efforts should be made to identify these people since they may not all be in regular contact with health or social care professionals, meaning that malnutrition could easily be missed.

- A large pooled analysis of previously published datasets of community-dwelling older people (n = 964, > 65 years of age) from 5 different countries (Switzerland, France, Japan, Sweden and South Africa) using MNA found that 31.9% of participants were at risk of malnutrition and 5.8% were malnourished.[93]

- Prevalence of risk of malnutrition of 12–14% (using 'MUST') has been found in residents in sheltered accommodation in the UK (see Table A1.5, Appendix 1) and 31–37% in recipients of meals on wheels in the UK and Ireland (using 'MUST' and MNA) (see Table A1.6, Appendix 1).[133-135] Prevalence of malnutrition or risk of malnutrition of up to 90% using MNA has been found in older people resident in serviced flats in Sweden and Finland.[136-138]

- There are few studies to date on the risk of malnutrition in patients attending general practices (family doctors), although emerging data indicates that the prevalence of malnutrition risk in older community-dwelling Dutch people attending general practices for influenza vaccination (identified using SNAQ) is 12%, and 10.8% in adults (mean age 41.8, SD±18.3) attending GP practices in areas with a high Multiple Deprivation Score in the UK (identified using 'MUST').[139;140]

Malnutrition is common in patients with cancer

- When considering the issue of malnutrition in cancer, it is important to note that the terms malnutrition and cachexia are often used interchangeably due to differing definitions of cancer cachexia.[141] In addition, it can be difficult to separate the effects of cachexia and the effects of cancer treatment as a cause of malnutrition.[141] The approach used in a recent review of the effect of malnutrition on cancer patients by Henry (2011) will be employed here, i.e. 'the term "malnutrition" is used to describe the changes in nutritional status observed in cancer patients'.[141]

- A number of definitions of cancer cachexia have been proposed[1-3] and a practical, easy-to-use classification of cancer cachexia has been developed (defined as ≥ 10% weight loss associated or not with anorexia, early satiation and fatigue; weight loss of < 10% is defined as pre-cachectic).[4]

- Cancer is a chronic condition often identified late and it involves complex treatment regimens. Nutrition and malnutrition are often not seen as important by healthcare professionals and weight loss is incorrectly viewed as inevitable by patients and their families.

- In practice, the need to identify patients who are at nutritional risk or who are malnourished is an important aspect of good patient care, since cancer-related weight loss affects patients' physical activity, morbidity, response and tolerance to treatment, survival, and quality of life.[142]

More than 1 in 3 patients with cancer are malnourished and they are at higher risk of malnutrition than other patient groups

- In a prospective observational multi-centre study conducted in French cancer centres (n = 1545 inpatients and patients admitted for 1 day [outpatients], median age 59.3±13.8 years, 23.4% aged ≥ 70 years), the overall prevalence of malnutrition was reported to be 30.9% (with 18.6% of cases classed as moderate malnutrition and 12.2% as severe).[143] Table 2.5 shows the prevalence of malnutrition according to tumour type.

- In a study of 1,000 outpatients with cancer in Italy, 39.7% were found to have experienced significant weight loss (≥ 10%) and 33.8% were found to be at nutritional risk.[112] A small study (n = 207) of medical oncology outpatients in a UK hospital found that the prevalence of risk of malnutrition ranged from 45% to 83% depending on the tumour site[113] (see Table A1.3, Appendix 1).

- Not unexpectedly, the rate of malnutrition is more than twice as high in patients with malignant disease (n = 54) than in patients with non-malignant disease (n = 448) (50.9% vs 21.0%, $p < 0.0001$, assessed using SGA).[144] The 2010 UK Nutrition Screening Week Survey similarly demonstrated a significantly increased risk of malnutrition in those with a cancer diagnosis (44% vs 32% without cancer, $p < 0.001$).[77]

Table 2.5 **Prevalence of malnutrition in expert cancer centes in France by tumour type** (adapted from Pressoir 2010)[36]

Tumour type	Overall prevalence of malnutrition %	Moderate malnutrition %	Severe malnutrition %
Breast	18.3	11.2	7.1
Head and neck	45.6	22.5	23.1
Colorectal	31.2	22	9.2
Haematological	34.2	26.3	7.9
Upper digestive	49.5	26.3	23.2
Gynaecological	32	16.4	15.6
Lung	40.2	21.9	18.3
Other*	27	18	9

*Prostate, urinary, brain, thyroid, testicular and kidney cancers; trunk and limb sarcomas; melanoma; other thoracic or abdominal cancers; unclassified tumour.

Definitions of malnutrition used

	Age ≤ 70 years of age	Age > 70 years of age
Moderate malnutrition	Weight loss over last 6 months ≥ 10% or BMI < 18.5 kg/m²	Weight loss over last 6 months ≥ 10% or BMI < 21 kg/m²
Severe malnutrition	Weight loss over last 6 months ≥ 15% or BMI < 16 kg/m²	Weight loss over last 6 months ≥ 15% or BMI < 18 kg/m²

Patients with advanced cancer have a higher prevalence of weight loss and malnutrition

- As may be expected, studies confirm a higher prevalence of patients with weight loss and malnutrition with more advanced stages of disease. A Brazilian study showed prevalence of malnutrition across different cancer types according to stage, with 23% in Stages I–II, 21.9% in Stage III, rising to 62% in Stage IV cancers.[145]
- In a study of patients with locally advanced or metastatic cancer in Spain (n = 781, median age 62 years [range 19–92]) using a Patient-Generated Subjective Global Assessment (PG-SGA), more than 50% of patients with cancer were found to have moderate or severe malnutrition.[146]
- Sixty-eight percent of patients receiving palliative home care services in the Stockholm region were found to be at risk of malnutrition (based on modified NRS-2002), with prevalence ranging from 52% to 76% depending on the tumour site.[147]
- A study describing a retrospective review of presenting symptoms in 1,539 lung cancer patients also showed prevalence of weight loss at presentation (see Table 2.6).[148]

Table 2.6 **Prevalence of malnutrition in lung cancer patients according to cancer type and stage** (adapted from Chute et al. 1985)[148]

Cancer type	Stage	Prevalence of malnutrition % (assessed by weight loss)
Small-cell lung cancer	Limited disease	35
	Extensive disease	52
Squamous cell lung cancer	Stage I	36
	Stage II	44
	Stage III	52
Adenocarcinoma lung cancer	Stage I	14
	Stage II	33
	Stage III	49
Large-cell lung cancer	Stage I	13
	Stage II	52
	Stage III	45

3 CAUSES OF MALNUTRITION

Summary

Poor food and nutrient intake due to disability and disease are at the heart of the cause of malnutrition; here are some examples:

- patients with **cancer** may have altered taste, nausea and anorexia due to their medical treatment
- patients with **stroke or other neurological conditions** may have swallowing difficulties or problems with self-feeding for example, poor oral-motor function in cerebral palsy
- breathlessness in **severe respiratory disease** can make eating difficult
- patients with **severe dementia** may forget to eat or even forget how to eat
- poor dentition and swallowing problems are a particular problem in **older people**

Inadequate food intake is common in patients in hospital including in children and older people and in patients in the community. More than 50% of patients in hospital don't eat the full meal they are given and 30% of nursing home residents eat less than half their lunch.

As a result energy, protein and micronutrient intake (vitamins, minerals and trace elements) is compromised and often fails to meet recommendations or estimated requirements, which may be increased in disease. Identification of and addressing where possible the underlying causes of malnutrition will help ensure maximal effectiveness of nutritional support.

Many other factors at organisational or institutional level exacerbate the problem of malnutrition such as:

- **lack of nutritional policies and equipment** for screening
- **lack of a clear description of responsibilities** for health authorities, institutions and healthcare workers
- **lack of nutritional knowledge** due to inadequate training
- **poor documentation of nutrition related information**
- **lack of adequate nutrition care planning and lack of monitoring**

Conclusion

The causes of inadequate food intake to meet nutritional requirements in disease and disability are multi-factorial. They include patient-related factors as well as organisational and institutional factors. Therefore a multi-disciplinary approach is needed to identify and implement appropriate and effective solutions. All stakeholders need to be involved from national and professional bodies (to set national nutritional policy/quality standards) to the patient and carer. Awareness of the issue of malnutrition and education on how to manage it are vital components in achieving success in the fight against malnutrition.

Recommendations

On the issue of **causes of malnutrition** the MNI makes the following recommendation:

Action	Issues to consider
Evidence based approaches for nutritional care plans should be used, taking into account the causes of malnutrition, the objectives of intervention and also environmental and practical constraints	• Identification of and addressing where possible the underlying causes of malnutrition will help ensure maximal effectiveness of nutritional support • The actions taken to address a patient's nutritional needs should be evidence based but should also be tailored to each individual patient taking account of their individual circumstances and wishes

The effects of disease and treatment on food and thus energy and nutrient intake are key factors in the development of malnutrition in adults and children

- Table 3.1 summarises the causes of nutritional inadequacy in various diseases.
- For children with faltering growth, contributing factors include not only underlying medical conditions, but also factors such as parental attitude and cultural beliefs, child management/coercive behaviour, maternal influences/family difficulties, poverty, neglect, and abuse. Progression through weaning, appetite, feeding difficulties, excess fluid, and dental caries are also important considerations.[8]

Table 3.1 **Diseases associated with malnutrition and causes of nutritional inadequacy** (adapted from Gibbons and Fuchs 2009)[149]

Disease or risk factor	Cause of inadequacy
Short bowel syndrome	• Nutrient loss from malabsorption
Cystic fibrosis	• Nutrient loss from malabsorption caused by pancreatic insufficiency • Increased energy expenditure from chronic lung disease • Decreased oral intake as a result of recurrent respiratory infections and altered taste
Inflammatory bowel disease	• Increased energy expenditure from chronic inflammatory process/ cachexia • Nutrient loss from malabsorption • Decreased oral intake as a result of abdominal pain, diarrhoea, anorexia and cachexia
Chronic liver disease	• Nutrient loss from malabsorption • Inappropriate substrate use • Increased metabolic needs • Decreased oral intake as a result of abdominal pain, altered taste, cachexia (if prominent underlying inflammatory component)
Chronic kidney disease	• Decreased oral intake as a result of altered taste, anorexia, nausea, cachexia (if underlying inflammatory component) & dietary restrictions • Altered energy expenditure resulting from metabolic disturbances (uraemia, acidosis)
Heart disease	• Decreased oral intake caused by fatigue and shortness of breath
Cancer	• Increased energy expenditure from cachexia • Decreased oral intake as a result of gut mucosal injury, altered taste and cachexia • Nutrient loss from malabsorption caused by gut mucosal injury
Neurological diseases	• Feeding difficulties related to oral dysfunction, abnormal movement and reflexes, sensory and perceptual difficulties, posture, and communication. Swallowing problems/dysphagia
Acute metabolic stress, e.g. burns, trauma, surgery	• Inability to eat and drink (e.g. ventilated, nil by mouth) • Increased metabolic needs • Increased losses e.g. exudate, fistula
Unknown causes	• Fussy eating/swallowing difficulties • Non-organic faltering growth

Poor food intake due to disease or disability leads to inadequate energy and nutrient intake

- Poor food intake may occur for a variety of reasons associated with disease and disability in adults and children, and it may be physical or psychological in origin (see Figure 3.1). Patients with cancer may have altered taste, nausea and anorexia due to treatment, whilst patients with stroke or other neurological conditions may have swallowing difficulties or problems with self-feeding, for example, poor oral-motor function in cerebral palsy. Breathlessness in severe respiratory disease can make eating difficult. Patients with severe dementia may forget to eat or even forget how to eat.

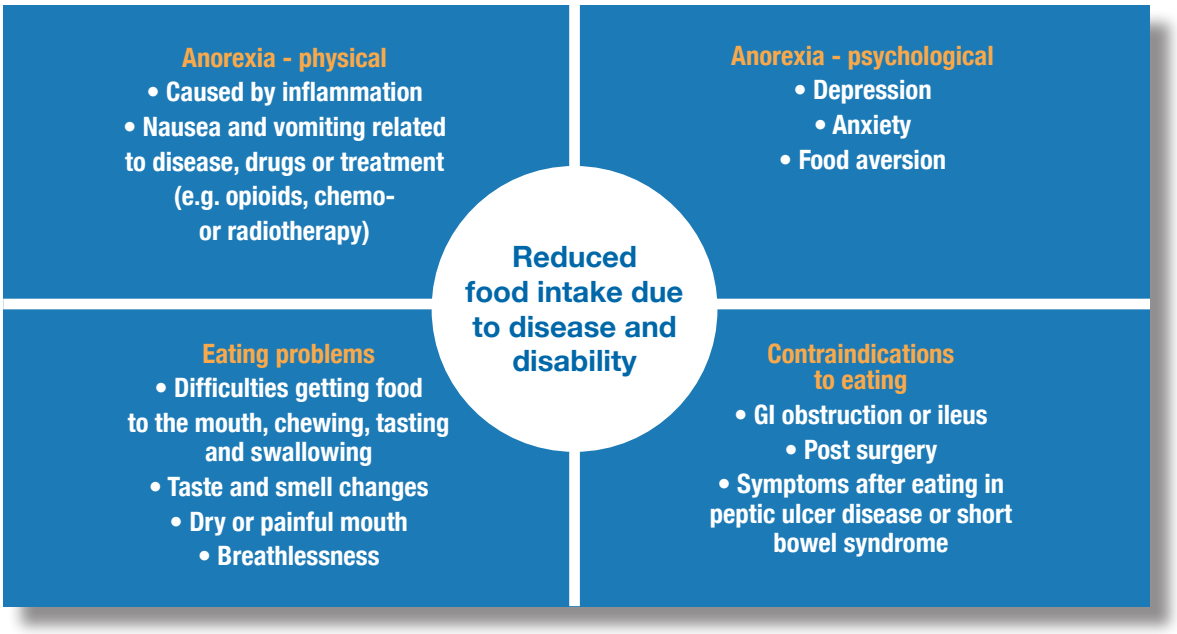

Figure 3.1 Causes of reduced food intake associated with disease and disability[46]

3.1 Hospital

Inadequate food intake is common in adult and older patients in hospital

- Inadequate food intake is common in hospitals despite adequate food provision.[150-152]

- The NutritionDay Survey conducted in European hospitals in 2006 (748 wards from 256 hospitals in 25 countries, total *n* = 16455) showed that less than half of all patients finished their meals. The most frequent reason cited by patients for eating less or nothing was 'not being hungry' (43%).[153] In the Australasian Nutrition Care Day Survey undertaken in 2010 (acute care hospitals in Australia and New Zealand, *n* = 3122), on average 1 in 2 malnourished patients (55%) ate ≤ 50% of the food offered and 1 in 3 well-nourished patients (33%) consumed ≤ 50% of the food offered during the survey.[42]

- In a longitudinal observational study of 100 older (mean age 81.7 years [SD ± 7.2]) inpatients in an inner-city hospital elderly care unit in the UK, patients were judged to be eating inadequately in 67% of assessments (285 out of 425) carried out during the study period of 4 weeks.[154]

- A cross-sectional observational study in Sweden found eating difficulties to be common in hospital patients (49%). Patients with a low BMI had significantly more eating difficulties than patients with a normal or high BMI.[155]

Inadequate food intake is also of concern in children in hospital

- A small Swedish survey of 21 children (median age 14.5 years [range 11–17]) receiving chemotherapy for cancer reported that the causes of poor food intake in children with cancer range from primary changes in taste to the effects of the disease itself, treatment or the environment. The frequency of eating problems is presented in Figure 3.2, with responses shown separately for children, their parents and nurses. Whilst the results show that significant eating problems occur, it is interesting to note that parents generally report these problems more frequently than the children themselves.[156]

- Access to food may also pose a challenge in meeting the nutritional needs of children in hospital. A survey of current practice in children's cancer care in the UK found variable facilities for preparation and storage of food and drink for patients. Kitchen facilities were available at 90% of centres; however, there were restrictions in some centres, e.g. no microwave, only a toaster and kettle, no raw food allowed. Two centres had a chef available to cook on demand for children. Most centres (90%) had storage facilities for snacks and over 80% allowed food to be brought in from home.[157]

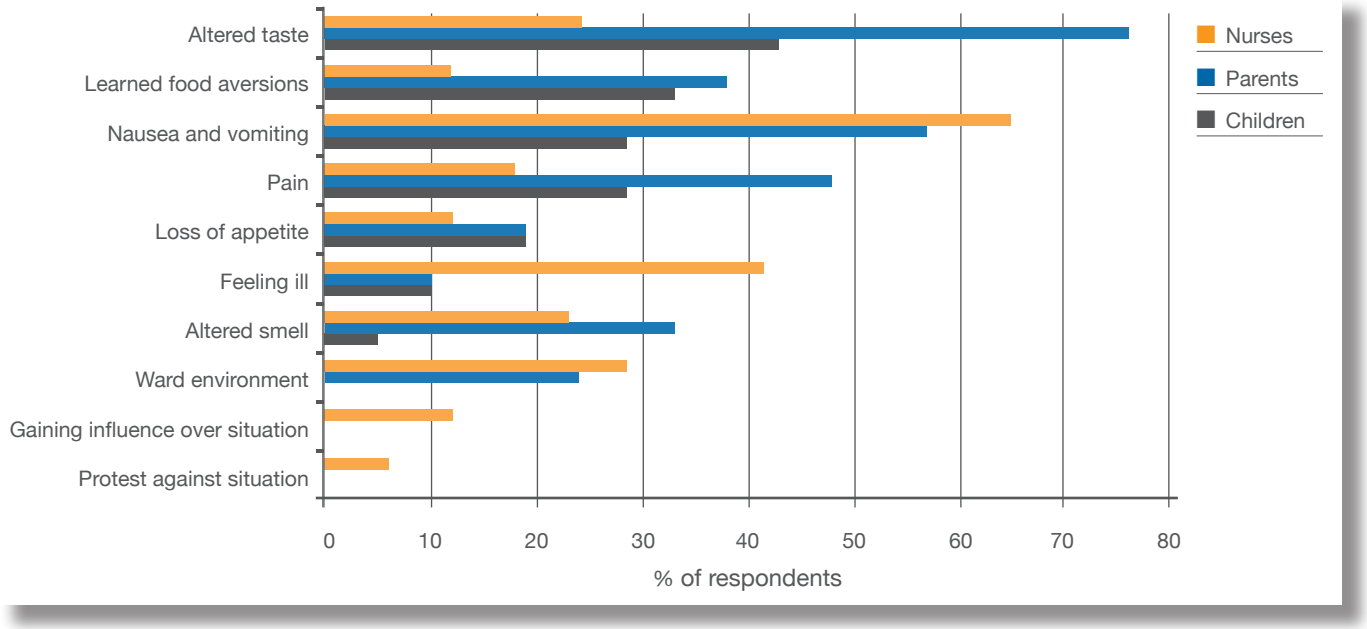

Figure 3.2 **Causes and frequency of eating problems among 21 children undergoing chemotherapy for cancer: responses of children, parents and nurses.[156]**
(Note that an individual may contribute to more than 1 category)

Energy intake is compromised and fails to meet recommended intake levels in adult hospital patients

- Stratton et al. (2003) collated studies that measured food intake in a variety of patient groups and demonstrated that in hospital patients, energy intakes fell consistently short of requirements across a spectrum of diseases.[46]

- In the European NutritionDay Survey (data collected during the 1-day cross-sectional Nutrition Days in 2007 and 2008), data on energy goal and intake was available for 12,398 patients, 47% of whom consumed less energy than their estimated requirements (defined as ≥ 1500 kcal/day for most patients).[29]

- In a prospective cohort study of older medical hospital patients (n = 134) in a large teaching hospital in Australia, almost two-thirds of patients (59%) did not consume enough dietary intake to meet estimated resting energy requirements, and only 8% of patients had sufficient energy intake for estimated total energy expenditure.[158]

Energy intake may be compromised in children in hospital

- A study of children aged > 6 months admitted to medical or surgical wards for > 48 hours in France (*n* = 183) found that 67% of malnourished and 70% of non-malnourished patients had an energy intake of less than 75% of the recommended daily allowance.[44]

- Campanozzi et al. (2009) found that of 496 children aged 1 month to 16 years admitted to medical paediatric wards with mild clinical conditions, 50.4% had a food intake of < 50% of the recommended dietary allowance.[45]

Protein intake is compromised in hospital patients, particularly in older people

- Older people and people with compromised health have difficulty meeting recommended intakes for protein, particularly hospitalised older people and orthopaedic patients.[46;55;150;159] When compared with typical daily intakes in the healthy population, it is clear that protein intake in a variety of patient groups is severely compromised.[46]

- Data on dietary intake retrospectively extracted from dietetic records of 610 undernourished adult patients (identified using SNAQ) admitted to a general hospital for > 4 days in The Netherlands in 2008 showed that more than half of the patients (58.4%) did not meet predefined requirements for either protein or energy.[160]

Micronutrient intake is compromised in adult hospital patients

- Hospital patients, particularly older hospital patients, have lower than recommended intakes of a range of vitamins and minerals. In female orthopaedic inpatients, median intakes of vitamin D, magnesium, potassium and selenium were found to be even below the lower reference nutrient intake.[iii,159] Compared with day centre visitors, hospitalised hip fracture patients had significantly lower micronutrient intakes, e.g. 29% lower vitamin B_6, 23% lower selenium, 21% lower iron, 20% lower calcium and 20% lower magnesium.[55]

3.2 Community

Inadequate food intake is common in patients in the community

- A cross-sectional observational study in Sweden found eating difficulties to be common in special accommodation residents, i.e. nursing home-type care (56%). Patients with a low BMI had significantly more eating difficulties than patients with a normal or high BMI.[155]

- In a recent large survey (NutritionDay in 2007) of Austrian and German nursing home residents (*n* = 1922), 1 in 3 residents ate ≤ 50% of their lunch on the day of the assessment.[121]

Energy intake is compromised and fails to meet recommended intake levels in community patients

- Stratton et al. (2003) collated studies that measured food intake in a variety of patient groups; in community patients, energy intake was better than in hospital patients but still of concern in a number of patient groups.[46]

- In community-based older people with medium and high risk of malnutrition (identified using 'MUST'), total daily energy intake was found to be significantly lower than the national average for older people (1368 [SD 513] kcal vs 1628 [SD 464] kcal, z-score $p < 0.004$).[161]

- A cross-sectional study of nutrient intake in older serviced house residents in Finland (*n* = 375) found that 46% consumed less energy than recommended, with 13% receiving less than 1,200 kcal/day.[136]

[iii]Lower reference nutrient intake (LRNI): an amount of a nutrient sufficient for only the few people in a group who have low needs

Protein intake is compromised in patients in the community

- In a study of the nutritional status of older people in low-level care facilities in Australia (semi-independent ambulatory residents; similar to residential care homes in the UK) (n = 95, mean age 85.8±6.6 years), 3-day weighed food intake showed that 30% of residents consumed less than the estimated average requirement (EAR) for protein (i.e. 46 g/day). However, when intake was compared with a requirement of 1 g/kg/day of protein, 77% of residents were found to have an inadequate intake.[162]

- A cross-sectional study of nutrient intake in older serviced house residents in Finland (n = 375) found that 47% received less than 60 g of protein/day and 11% received less than 40 g/day.[136]

Micronutrient intake is compromised in patients in the community

- Low intakes (below reference values) of some but not all micronutrients are evident in a substantial proportion of free-living and institutionalised older adults and in those at risk of malnutrition.[47;163] Over 80% of older adults have intakes below the reference nutrient intake (RNI) for potassium, magnesium, copper and vitamin D (see Figures 3.3 and 3.4).

- Even in well-nourished, apparently healthy free-living older people consuming adequate macronutrients, lower than recommended micronutrient intake is prevalent and this increases significantly with age.[164]

- Assessment of energy and nutrient intakes in 52 Swedish nursing home residents showed that of 16 micronutrients considered, males had a mean intake below the Swedish Nutrition Recommendations (SNR) for 9 nutrients and females for 8 nutrients. Intakes of vitamin D, vitamin E, folic acid and selenium were very low, reaching only 40–60% of the SNR.[165]

- Lower than recommended intakes of fibre, vitamin E, vitamin D and folic acid were found to be particularly common in all age groups of residents in serviced housing in Finland. The proportions of residents failing to meet these nutrient requirements were 98%, 98%, 83% and 86% respectively.[136]

- In community-based older people with medium and high risk of malnutrition (identified using 'MUST'), mean total daily intake for micronutrients such as magnesium, iron, zinc, selenium, iodine, vitamin A and folate was found to be below the RNI and the national average daily intake in older people.[161]

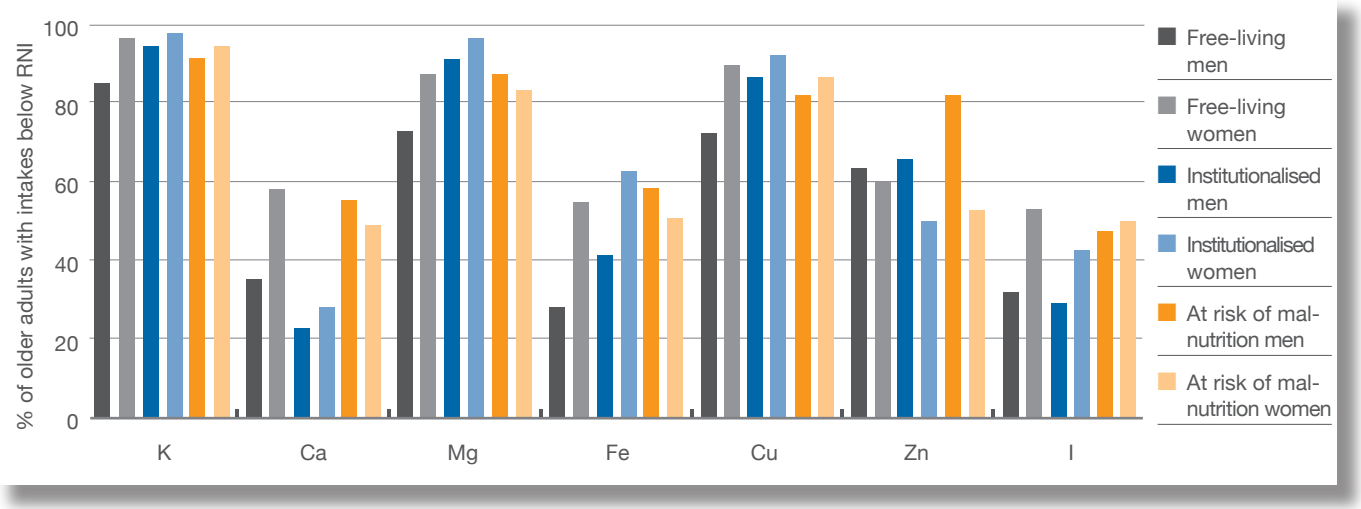

Figure 3.3 **Percentage of older adults in the UK with mineral intakes below the RNI** (adapted from Stratton 2007).[47]

RNI for men and women aged ≥ 50 years. Number of patients varies according to micronutrient and group (male and female): free-living (n = 540–735), institutions (n = 93–319), at risk of malnutrition (all settings n = 55–80)

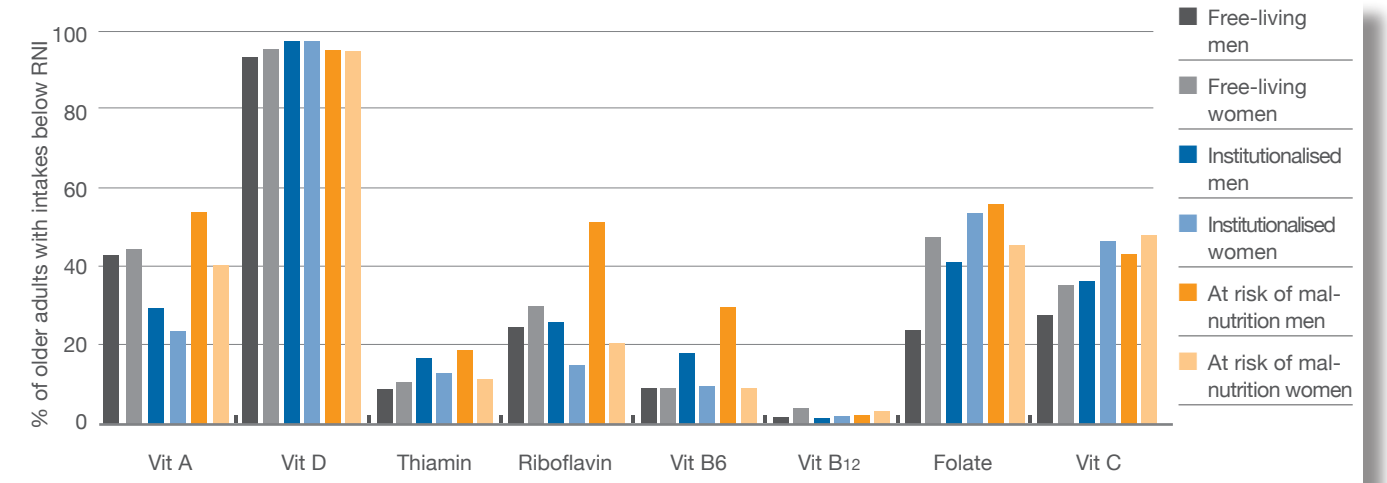

Figure 3.4 **Percentage of older adults in the UK with vitamin intakes below the RNI** (adapted from Stratton 2007).[47]

RNI for men and women aged ≥ 50 years. Number of patients varies according to micronutrient and group (male and female): free-living (*n* = 540–735), institutions (*n* = 93–319), at risk of malnutrition (all settings *n* = 55–80)

Energy and nutrient intake is compromised in children with a variety of conditions

- Two recent reviews of growth, nutritional issues and management in children with neurological impairment and cerebral palsy both identified poor food intake and inadequate energy intake as factors in the development of malnutrition and poor growth in this patient group.[166;167] Poor oral-motor function impairs the ability to consume sufficient energy and nutrients to sustain adequate growth.[167]

- Eating problems are commonly reported in children with motor disability (20%), with an adverse impact on intake of some but not all nutrients:[168]

  ~ energy intake 76% of recommendations;
  ~ vitamin D intake 76% of recommendations;
  ~ iron intake 87% of recommendations;
  ~ fibre 52% of recommendations.

- Sullivan et al. (2002) assessed the macro- and micronutrient intake (using a 24-hour recall and a 3-day diet diary) of a group of neurologically-impaired children with motor and feeding problems and found that:[169]

  ~ 59% of the group with severe disabilities consumed below 80% of the EAR vs 16% of the group with moderate disabilities;
  ~ generally, children met their protein requirements;
  ~ nearly half of the children did not meet the RNI for iron;
  ~ half of the children with severe disabilities failed to meet at least 81% of the RNI for potassium, iron, copper, magnesium and zinc;
  ~ low intakes of selenium, vitamin A, niacin and folate were also seen in the groups with moderate and mild disabilities.

- A review of nutrition in children with chronic renal failure (CRF) and on dialysis by Rees and Shaw (2007) described energy intakes below recommended intakes, deteriorating intake with severity of CRF, and decreased intake over time. Low intakes of calcium, zinc and vitamins were also reported.[170]

- Children (10–16 years of age) with active Crohn's disease (CD) and children with CD in remission have been shown to have energy intakes significantly lower than estimated energy requirements ($p = 0.001$ and $p = 0.03$ respectively) and lower than recommended intakes of calcium and iron.[171]

There are multiple inter-related causes of malnutrition in cancer

- The possible causes of malnutrition in cancer patients are summarised in Table 3.2, but many of the factors listed in Figures 3.1 and 3.5 are also involved in the development of malnutrition in cancer patients. The causes are multi-factorial and they can be related to the effects of the tumour and/or treatment and the psychological effects of living with cancer.[141]

Table 3.2 **Possible causes of weight loss and malnutrition in cancer patients** (adapted from Henry 2011)[141]

CAUSES
• Catabolic effects of the tumour/abnormal metabolism of nutrients
• Inadequate intake due to tumour-induced anorexia
• Reduced food intake secondary to treatment side effects such as nausea, vomiting, stomatitis, constipation and malabsorption
• Obstruction from tumour or as a consequence of treatment, e.g. dysphagia secondary to cancer of the oesophagus, bowel obstruction secondary to disease, and dysphagia as a consequence of radiotherapy to the pharynx
• Pain, anxiety and depression

There are numerous reasons why food and thus energy and nutrient intake are poor in disease

- Energy and nutrient intake are affected by factors arising from the patient's condition and situation, healthcare workers' knowledge and action, institutional organisation, eating difficulties, inadequate provision of energy and nutrients, lack of guidance for staff, poor knowledge of nutrition, and failure to follow nutritional policies (see Figure 3.5).[46;56;57;73;76;146;154;155;158;172-177]

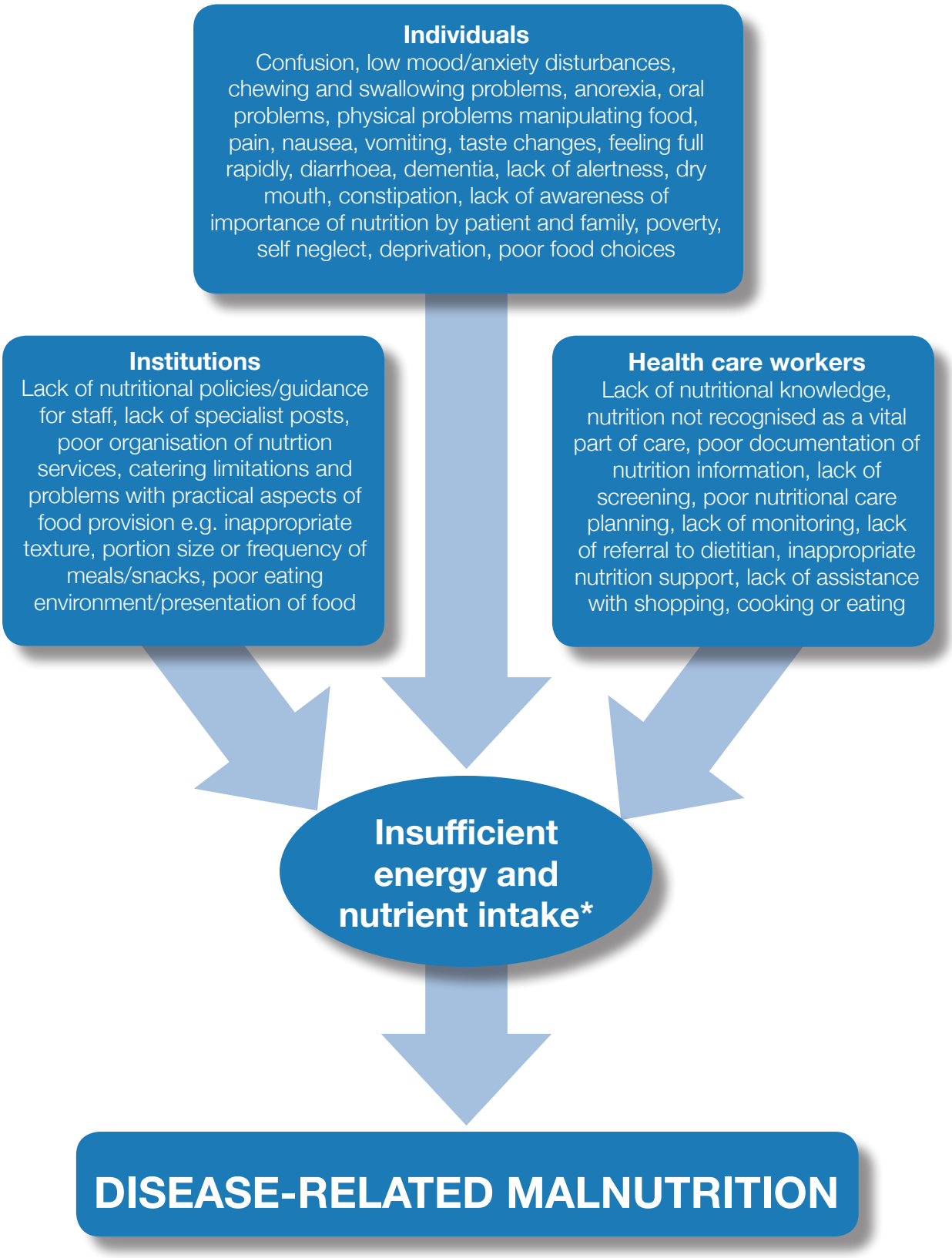

Figure 3.5 **Factors leading to insufficient energy and nutrient intake in adults as a cause of disease-related malnutrition** (adapted from Stratton et al. 2003)[46]

*Requirements for some nutrients may be increased due to malabsorption, altered metabolism and excess losses

4 CONSEQUENCES OF MALNUTRITION

Summary

Malnutrition leads to **far-reaching physical and psycho-social consequences** such as impaired immune response, impaired wound healing, reduced muscle strength and fatigue, inactivity, apathy, depression and self-neglect. **Malnutrition is also associated with poorer quality of life**. In children, growth and development is adversely impacted by malnutrition. Malnutrition has a particularly high adverse impact in the older person impairing function, mobility and independence.

These effects in turn contribute to increased morbidity and mortality. Malnourished hospital patients experience significantly higher complication rates than well-nourished patients (30.6% vs 11.3%) and the risk of infection is more than three times greater. Significantly higher mortality rates have been found in 'at-risk' hospital patients compared with 'not-at-risk' patients (12% vs 1%).

It is thus unsurprising that malnutrition is associated with increased healthcare resource use such as increases in length of hospital stay and increased readmissions. Average length of hospital stay may be increased by 30% in malnourished patients. In community patients malnourished patients visit family doctors more often and have more frequent hospital admissions than well-nourished patients.

As a result of increased morbidity and healthcare resource use malnutrition is costly to the individual, to society and to the economy. The estimated cost of managing patients at risk of malnutrition in the EU is €120 billion and €170 billion across Europe. This estimate is based on economic evidence from the UK showing costs for managing patients at risk of malnutrition exceed €15 billion.

Conclusion

The adverse consequences of malnutrition arising as a result of disease and disability are far-reaching at both the individual and the societal level. Failure to address malnutrition risk appropriately puts unnecessary additional pressure on already constrained healthcare systems and leads to sub-optimal quality of care. The application of evidence-based nutritional screening programmes should help to address this.

Recommendations

On the issue of **consequences of malnutrition** the MNI makes the following recommendation:

Action	Issues to consider
Awareness should be raised about the wide ranging negative consequences of malnutrition for patients, for healthcare providers and for society in general.	• Education and training activities can be used to ensure that healthcare workers are fully aware of the negative consequences of malnutrition and what action to take to avoid these. However extra efforts need to be made to ensure that this message is heard and understood by all stakeholders including policy makers, healthcare providers, patients and carers. Malnutrition should not be accepted as an inevitable consequence of disease or ageing
Evidence based screening programmes should be used to ensure that malnutrition and risk of malnutrition is identified early and appropriate action is taken to minimise its consequences	

Malnutrition adversely impacts on every organ system in the body, with potentially serious consequences (see Table 4.1).[91]

- Restricted recent dietary intake has been shown to affect metabolic, psychological and physical function in the presence and absence of disease, and in surgical patients to reduce collagen deposition, with implications for effective wound healing.[46]

Table 4.1 **Key physical and psychosocial effects of malnutrition** (adapted from Elia and Russell 2009)[91]

Effect	Consequences
Impaired immune response	Impaired ability to fight infection
Reduced muscle strength and fatigue	Inactivity, and reduced ability to work, shop, cook and self-care. Poor muscle function may result in falls, and poor respiratory muscle function may result in poor cough pressure - delaying expectoration and recovery from chest infection
Inactivity	In bed-bound patients, this may result in pressure ulcers and venous blood clots, which can break loose and embolise
Impaired temperature regulation	Hypothermia
Impaired wound healing	Increased wound-related complications, such as infections and un-united fractures
Impaired ability to regulate salt and fluid	Predisposes to over-hydration or dehydration
Impaired psycho-social function	Apathy, depression, introversion, self-neglect, hypochondriasis, loss of libido and deterioration in social interactions

4.1 Functional consequences

Malnutrition has functional consequences in adults and older people

- Malnutrition is associated with decreased muscle function and impaired functional status. In adult hospital patients, decreased hand-grip strength is a predictor of loss of functional status.[178] Reduced muscle strength and fatigue can lead to falls, reduced ability to self-care, and poor recovery from chest infection.[91]

- Low plasma vitamin D levels (< 20 ng/ml) have been associated with poorer physical performance and a greater decline in physical performance than with plasma vitamin D levels of at least 30 ng/ml.[50] In addition, low plasma vitamin D concentrations have been associated with a greater risk of future nursing home admission, and they are independently associated with an increased risk of falling in older people, particularly in those aged 65–75 years.[179;180]

- The clinical criteria for frailty ('shrinking' [i.e. unintentional weight loss/sarcopenia], weakness, poor endurance and low activity) are associated with chronic under-nutrition resulting in loss of weight and muscle mass and poor muscle function.[181] Without appropriate intervention, frail older people are likely to experience functional limitations and disability, increased morbidity and use of healthcare resources, and mortality.[144]

- A recent review of the links between nutrition and frailty suggested that loss of appetite, weight loss, sarcopenia, low energy and protein intake, low intake and blood levels of vitamins (B,C,D,E, folate), antioxidants (carotenoids) and trace elements (selenium and zinc) influence the development or aggravation of frailty.[182]

- Maintaining function in older people is considered a high priority by the WHO to help to prevent decline and institutionalisation (see Figure 4.1).

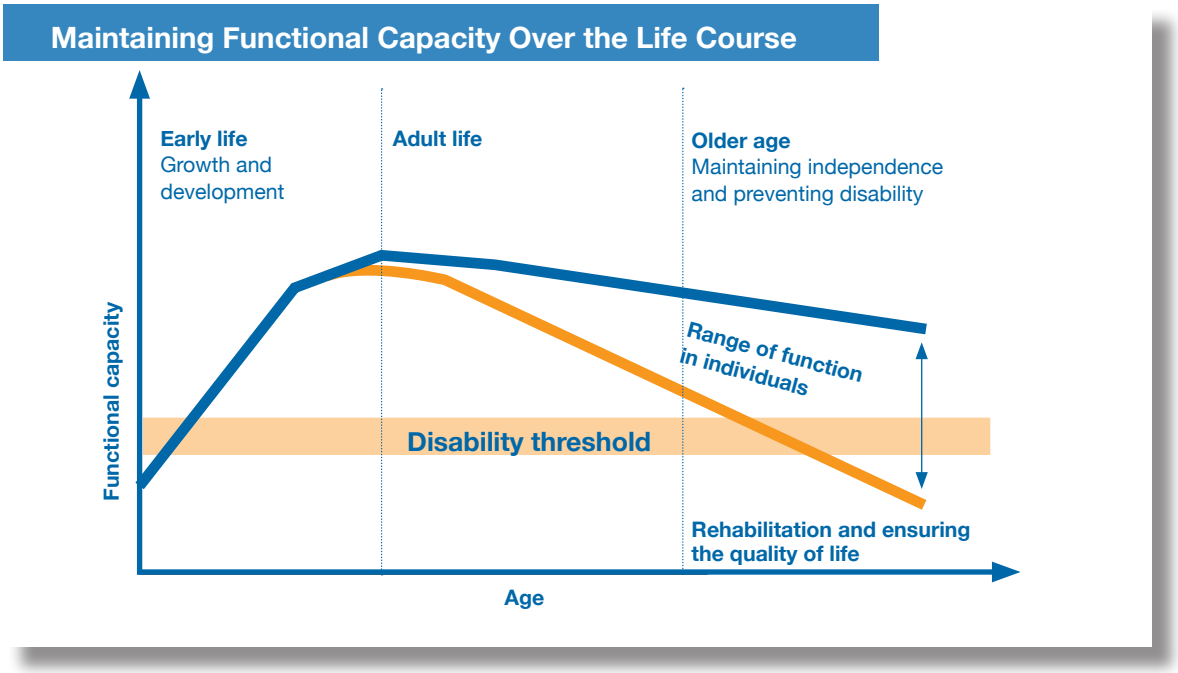

Figure 4.1 Maintaining functionality and independence

Malnutrition is associated with impaired function in children and adults with cystic fibrosis

- Using the German Cystic Fibrosis Quality Assurance (CFQA) patient registry, cross-sectional and longitudinal analyses were undertaken in 3,298 patients aged > 2 years to investigate the relationship between malnutrition (stunting and/or wasting in children, BMI < 19 kg/m^2, weight < 80% or height < 90% of the median normal value for sex and age in adults) and lung function. The study found that:[183]

  ~ patients with malnutrition had significantly worse lung function;
  ~ malnourished adolescents had a serious decline in lung function compared with their well-nourished counterparts;
  ~ a fall in weight or height of ≥ 5% predicted within 1 year was associated with decrease in lung function; patients with improved nutrition showed constant or improved lung function.

Malnutrition is associated with impaired quality of life

- Malnutrition has been shown to impair quality of life (QOL) in free-living older people and in patients with cancer, hip fracture and COPD. Poor QOL is also reported in malnourished surgical patients, patients with end-stage renal disease undergoing haemodialysis and in general admissions to the acute hospital setting.[46]

4.2 Clinical consequences

4.2.1 MORTALITY

Malnutrition is associated with increased mortality in adults and older people

- A comprehensive review of studies addressing the associations between malnutrition and mortality showed that malnourished patients have a higher mortality rate than well-nourished patients. This effect was seen in a wide variety of patient groups and in younger patients:[46]
  - ~ general hospital admissions, medical and surgical patients;
  - ~ older people in a variety of care settings, e.g. hospital, intensive care, medical units, rehabilitation and long-term care;
  - ~ patients with stable COPD or acute exacerbations;
  - ~ patients with Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS);
  - ~ patients with cancer;
  - ~ patients with renal failure prior to dialysis or receiving dialysis;
  - ~ patients following stroke;
  - ~ patients in the community with chronic respiratory, GI, neurological or cardiovascular disease or cancer.

- In a large (n = 5051, mean age 59.8 years [±0.3 SEM]) multi-region (12 countries; Western Europe = 4, Eastern Europe = 5 and Middle East = 3), multi-centre (26 hospital departments; surgery, internal medicine, oncology, intensive care, gastroenterology and geriatrics) study, death was more frequent in 'at risk' patients than 'not at risk' patients (12% vs 1%, $p <$ 0.001), i.e. mortality was 12 times higher in 'at risk' patients (see Figure 4.2).[184]

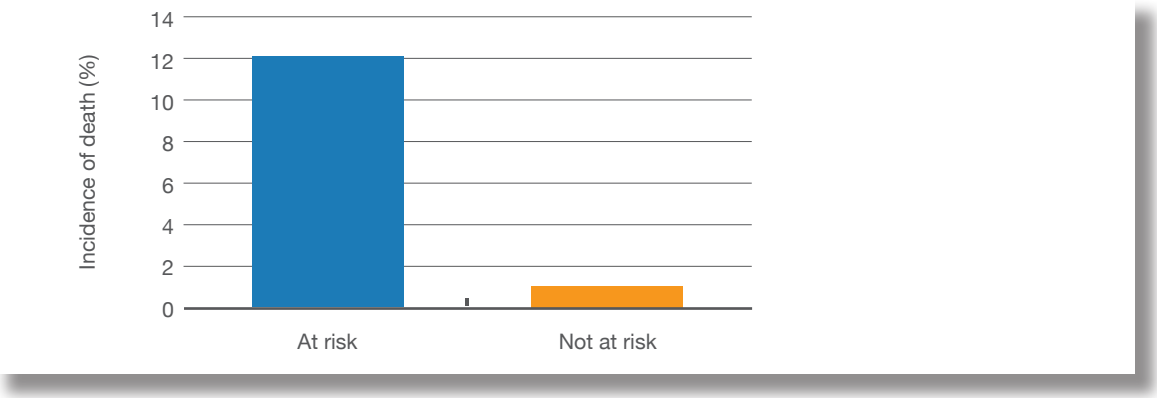

Figure 4.2 **Increased frequency of death in at risk patients vs not at risk patients ($p < 0.001$)** (adapted from Sorensen et al. 2008)[184]

- A prospective cohort study of newly admitted adult patients (18–74 years of age) to an acute tertiary hospital found that the mortality rate was higher in malnourished patients (SGA B+C) than in well-nourished patients at 1 year (34.0% vs 4.1%), 2 years (42.6% vs 6.7%) and 3 years (48.5% vs 9.9%, $p < 0.001$ for all). Malnutrition was a significant predictor of mortality (adjusted hazard ratio [HR] of 4.4 [95% CI 3.3–6.0], $p < 0.001$) (see Figure 4.3).[63]

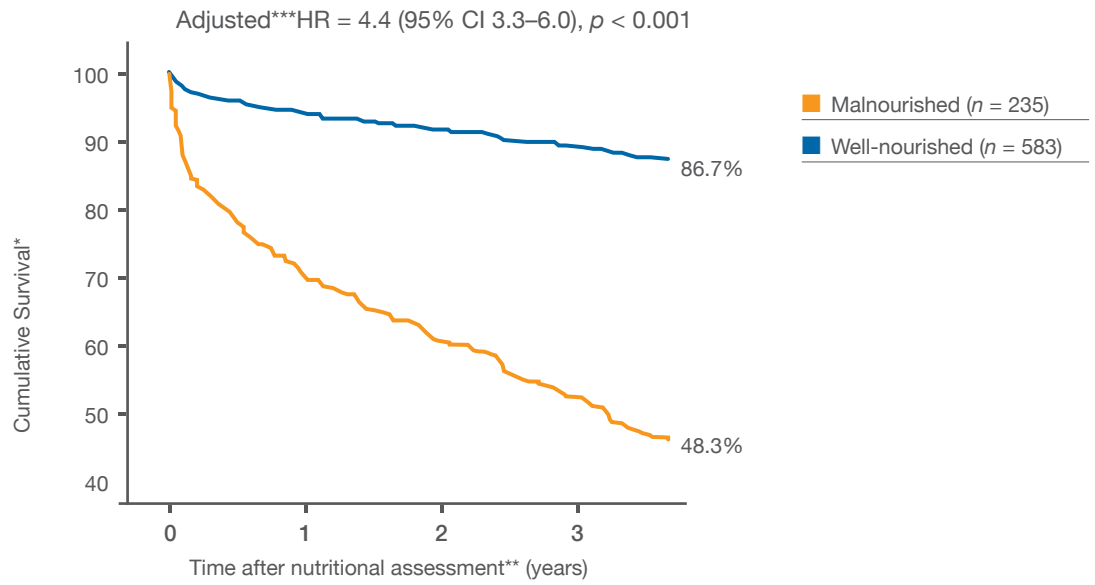

Figure 4.3 **Cumulative survival in well-nourished and malnourished patients (*n* = 818).** (adapted from Lim et al. 2011)[63]

HR: Hazard Ratio.
*Survival and mortality data from Singapore Death Registry.
**Assessment with Subjective Global Assessment within 48 h of hospital admission.
***Adjusted for ethnicity, age and gender.

- A survey of outpatients with COPD found that those at risk of malnutrition (medium and high risk using 'MUST') were more likely to die within 6 months than patients not at risk (6-month mortality rate 16.3% vs 5.8%, $p = 0.023$).[185]
- In a study that analysed the medical records of randomly selected malnourished patients with 996 matched (for age, gender and GP practice) non-malnourished patients in the UK, malnutrition remained an independent predictor of mortality after adjustment for age and co-morbidity.[71]
- Two-year mortality in nursing home residents in Sweden was found to be 52%. Male gender and low body weight were associated with increased risk of mortality.[165]
- DRM has been found to double the risk of mortality in hospital patients and to triple mortality in older patients in hospital and after discharge (see Figure 4.4).[186;187]

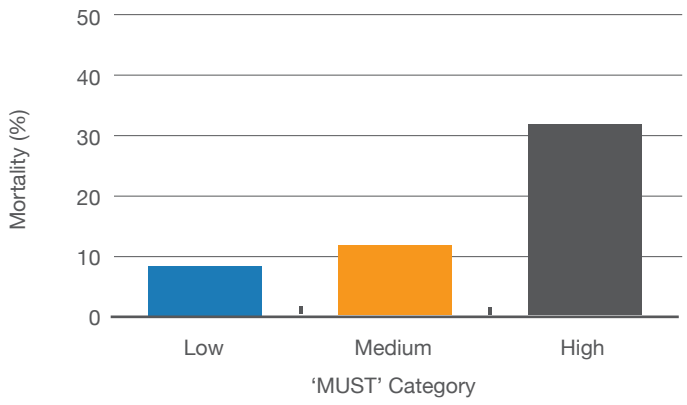

Figure 4.4 **Significant increase in in-hospital mortality with increasing malnutrition risk category (*p* = 0.01)** (adapted from Stratton et al. 2006)[186]

Malnutrition is associated with increased mortality in children

- Although data demonstrating that malnutrition has an adverse impact on morbidity and mortality in paediatrics is limited, it is clear from extrapolation of studies in adults and from studies in children in developing countries that malnutrition is associated with a greater risk.[188]

- A study of children operated on for congenital heart defects who died > 30 days after surgery showed that a decrease in WFA during the first months after surgery was strongly related to late mortality.[189]

- A prospective study of children aged 1–18 years newly diagnosed with cancer in low income countries in Central America showed that significantly higher mortality rates were related to degree of malnutrition (using percentile BMI for age, MUAC, TSFT and albumin) (14.0% vs 16.8% vs 20.5% for adequately nourished, moderately depleted and severely depleted children respectively [total 18.4%, $p = 0.006$]). Event-free survival at 2 years from diagnosis was significantly different in the 3 groups (65% vs 57.3% vs 48.4%, $p < 0.001$).[190]

4.2.2 COMPLICATIONS

Malnutrition is associated with increased morbidity in adults and older people

- The risk of infection is more than three times greater among hospitalised malnourished patients than well-nourished patients.[191]

- In a large ($n = 5051$, mean age 59.8 years [±0.3 SEM]) multi-region (12 countries; Western Europe = 4, Eastern Europe = 5 and Middle East = 3), multi-centre (26 hospital departments; surgery, internal medicine, oncology, intensive care, gastroenterology and geriatrics) study, the rate of complications was more frequent in at risk patients than not at risk patients (30.6% vs 11.3%, $p < 0.001$) (see Figure 4.5).[184]

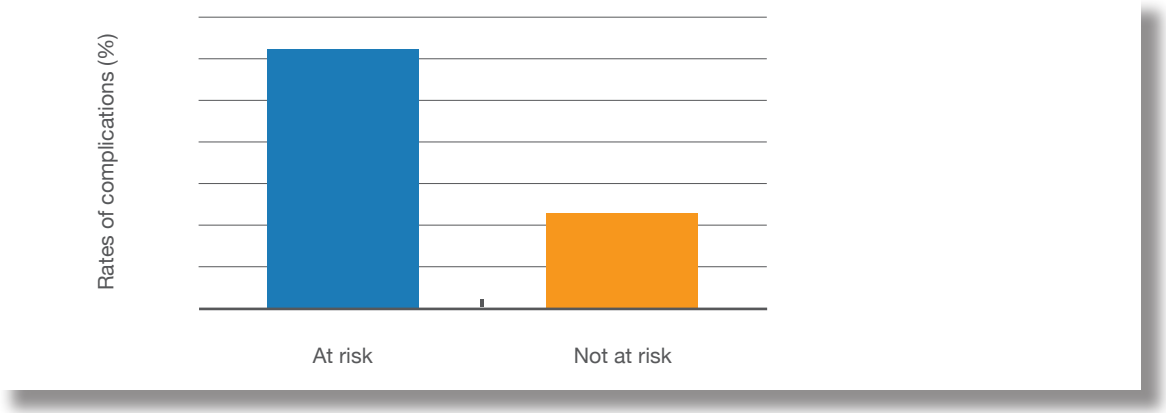

Figure 4.5 **Increased rate of complications in at risk patients vs not at risk patients ($p < 0.001$)** (adapted from Sorensen et al. 2008)[184]

- Older women with weight loss have increased rates of hip bone loss and the risk of subsequent hip fracture is twice greater.[192]

Malnutrition is associated with increased morbidity in children

- In a study of children aged 31 days to 17.9 years (n = 175) who required major abdominal or non-cardiac thoracic surgery on a non-emergency basis, malnourished children had a higher rate of infectious complications compared to well-nourished children (p = 0.042).[39]

- A prospective cohort study of 385 children admitted to a tertiary paediatric intensive care unit at a teaching hospital in Brazil found that malnutrition on admission (using z-score of WFA in infants < 2 years of age and z-score of BMI in children aged ≥ 2 years based on WHO child growth standard curves) was associated with greater length of mechanical ventilation in a multiple logistic regression model (OR 1.76, 95%; CI 1.08–2.88, p = 0.024).[193]

- A prospective study of children aged 1–18 years newly diagnosed with cancer in low income countries in Central America showed that frequency of abandonment of therapy was related to degree of malnutrition (using percentile BMI for age, MUAC, TSFT and albumin) (6.1% vs 12.5% vs 14.0% for adequately nourished, moderately depleted and severely depleted children respectively [total 11.9%, p < 0.001]).[190]

Malnutrition has an adverse impact on growth and development in children

- Poor weight gain or weight loss is one of the first indicators of malnutrition in children with acute malnutrition presenting with decreased WFH but normal HFA.[194]

- Nutritional imbalances that are sustained for any appreciable length of time adversely affect growth in terms of height.[194]

- Development is rapid in childhood, particularly in early childhood, and adverse effects of malnutrition on learning, behaviour and cognition in children have been described.[46]

- A review and meta-analysis showed that failure to thrive in infancy is associated with adverse cognitive outcomes in children identified in primary care (pooled effect size weighted standardised mean difference -0.30; 95% CI -0.18 to -0.42) and in children identified in hospital or specialist clinics (-0.85; 95% CI -0.41 to -1.30). The large difference in effect size may be related to the fact that cases with more developmental delay are more likely to be referred to hospitals or specialist clinics.[195]

- A small-scale study (n = 20, age groups 5–7 years and 8–10 years) from India designed to investigate the effect of stunting and/or wasting (as a result of chronic protein-energy malnutrition) on the nature of cognitive development and the rate of cognitive development found that malnourished children performed poorly compared with well-nourished children in tests of cognitive flexibility, attention, working memory, visual perception, verbal comprehension and memory. Stunting in particular may be responsible for the lack of age-related improvement in malnourished children for tests of design fluency, working memory, visual construction, learning or memory.[196]

- Early infancy may be a critical period for the effect of under-nutrition on cognitive development. The Avon Longitudinal Study of Parents and Children (ALSPAC) in the UK (n = 5771) found that early growth faltering (defined as < 5th percentile for weight gain in the first 8 weeks) was associated with a total intelligence quotient (IQ) that was significantly lower by an average of -2.71 points at 8 years of age.[197]

- Infants (n = 130) with faltering growth (defined as sustained WFA < 5th percentile or weight-for-length < 10th percentile) recruited from primary care clinics in low-income urban areas in the US were compared with infants with adequate growth and were shown to be more vulnerable to short stature, poor arithmetic performance and poor work habits at 8 years of age, illustrating the possible longer-term effects of early failure to thrive, although other factors could be involved.[198]

Malnutrition may affect the ability to withstand cancer treatment

- Nutritional risk (using NRS-2002) has been shown to be an independent predictor of postoperative complications in colorectal cancer patients.[199]
- Malnutrition has similar effects on patients with cancer as it has on patients without cancer, such as effects on GI integrity, adverse impact on respiratory and cardiac muscle function, recovery from surgery, wound healing, psychological and immune function.
- Treatment effects may also contribute, including the use of chemotherapy agents, irradiation and immunosuppressive medications, and surgery. Studies have demonstrated that malnourished patients receiving chemotherapy have more pronounced treatment-related side effects and breaks from treatment to manage these, e.g. stomatitis.[200]
- Malnutrition in cancer is associated with poor response to therapy, increased susceptibility to treatment-related adverse events, as well as poor outcome and QOL.[201]

4.3 Economic consequences

4.3.1 HEALTHCARE RESOURCE USE

- Malnutrition is associated with increased morbidity in both acute and chronic disease, e.g. poor wound healing and postoperative complications such as acute renal failure, pneumonia and respiratory failure. The increased morbidity results in increased health care needs, resulting in increased costs (see Figure 4.6).[202]

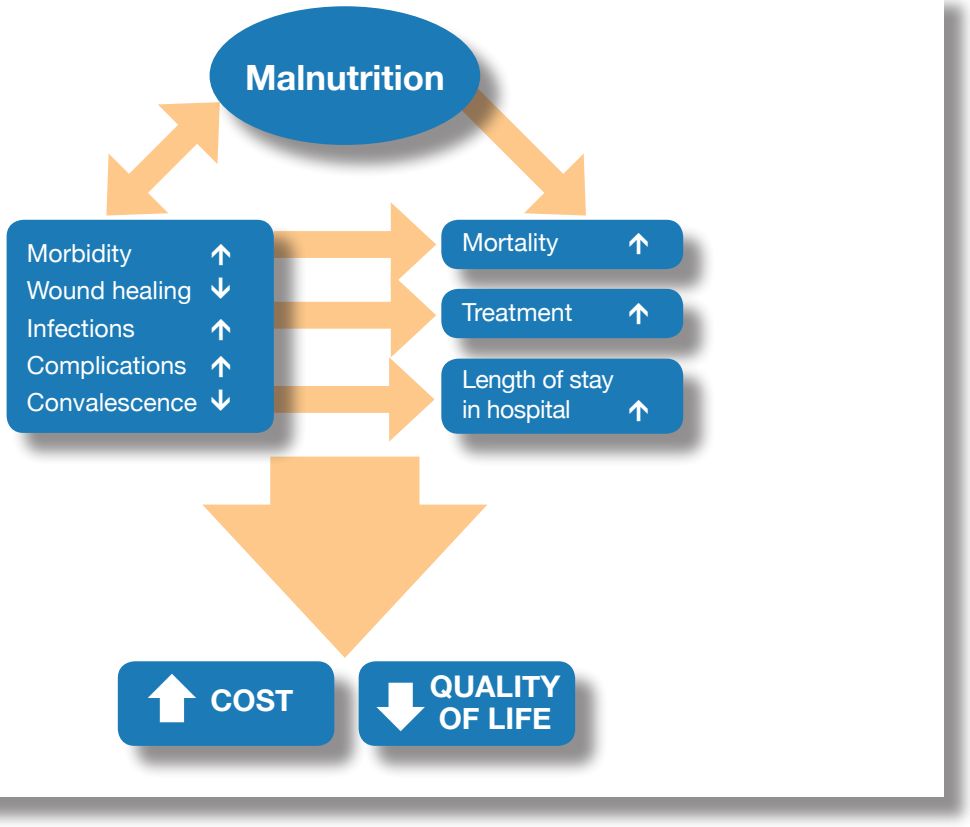

Figure 4.6 **Prognostic impact of malnutrition** (adapted from Norman et al. 2008)[202]

Malnutrition increases use of healthcare resources by adult and older hospital patients

- In prospective and 2 large retrospective evaluations, studies demonstrate that adults and older patients in hospital (with a variety of conditions) use significantly more healthcare resources than well-nourished patients in terms of (see Table 4.2):

  ~ increases in length of hospital stay;
  ~ increases in readmission rates;
  ~ delays in returning home.

Malnutrition increases use of healthcare resources by adults and older people in the community

- Similarly, in prospective evaluations and 1 large retrospective evaluation, studies demonstrate that adults and older patients (with a variety of conditions) use significantly more healthcare resources than well-nourished patients in terms of (see Table 4.3):

  ~ increases in the number of diagnosed diseases;
  ~ increases in the number of visits to family doctors;
  ~ increases in hospital admissions and readmissions;
  ~ increases in length of hospital stay.

Malnutrition in children is associated with an increased length of hospital stay

- A number of studies have demonstrated that malnourished children have a longer hospital stay compared with well-nourished children (see Table 4.4). This increase in use of healthcare resources is likely to increase the cost of care of malnourished children.

Table 4.2 **Examples of significantly increased use of healthcare resources by patients identified as malnourished or at risk of malnutrition compared with non-malnourished patients – hospital**

Country/Region	Study	Population (*n*) Study design	Method	Malnutrition/risk	Outcome
Brazil	Leandro-Merhi et al. (2011)[203]	Adults and elderly, surgical (*n* = 350) Prospective evaluation	SGA for adults, MNA for elderly	Adults: 19.3% slightly malnourished, 0.8% at risk Elderly: 11% malnourished, 32.9% at risk	• ↑LOS (malnourished 10.1±8.7 vs at risk of malnutrition 7.5±6.5 vs well-nourished 5.7±5.8 moderate days, $p = 0.0005$)
Europe	Pernicka et al. (2010)[204]	Adults, hospital (*n* = 1,346 pairs case/controls) Retrospective evaluation	BMI + weight loss	7% malnourished	• ↑LOS (mean LOS 15.1 [95% CI 14.1–16.0] in malnourished cases vs 12.2 [95% CI 11.4–13.0] in non-malnourished controls)
France	Nitenberg et al. (2011)[205]	Adults, post-surgical colorectal cancer (*n* = 762) Post-hoc analysis of prospective data	See details*	No details	• ↑LOS (mean LOS was 3.1 days longer in malnourished patients than in well-nourished patients, $p = 0.004$) • delays returning home (69.6% of malnourished patients referred to another facility compared with 54.2% of well-nourished patients, $p = 0.027$)
France	Grigioni et al. (2010)[206]	Adults, hospital (*n* = 354) Prospective evaluation	BMI/weight change/albumin	29.5% moderate/severe malnutrition	• ↑LOS (11.7 days vs 7.9 days, $p < 0.001$)
France	Pressoir et al. (2010)[143]	Adults, cancer hospital (*n* = 879) Prospective evaluation	See details**	30.9% malnourished (12.2% severe)	• ↑LOS (median 19.3±19.4 days vs 13.3±19.4 days, $p < 0.0001$)
Germany	Pirlich et al. (2006)[83]	Adults, hospital (*n* = 1,886) Prospective evaluation	SGA	27.4% malnourished (17.6% moderate and 9.8% severe)	• ↑LOS (average difference 4.6 days or 42%, $p < 0.001$)
Singapore	Lim et al. (2011)[63]	Adults, hospital (*n* = 818; 530 matched for DRG group) Prospective evaluation	SGA	29% malnourished (25% moderate and 4% severe)	• ↑LOS (mean 6.9±7.3 days vs 4.6±5.6 days, $p = 0.001$, DRG matched, adjusted) • readmission within 15 days of index admission (RR 1.9; CI 1.1–3.2)
Spain	Marco et al. (2011)[64]	Hospital, internal medicine (*n* = 1,567,659) Retrospective evaluation	Diagnostic codes for malnutrition	1.4%†	• ↑LOS (18.1 vs 9.8 days, $p < 0.001$)

Table 4.2 Continued

Country/Region	Study	Population (*n*) Study design	Method	Malnutrition/risk	Outcome
Spain	de Luis & Lopez Guzman (2006)[207]	Adults, hospital internal medicine (*n* = 213) Prospective evaluation	MNA	23.9% (MNA < 17) 50.2% at risk (MNA 17–24)	• ↑LOS (increase of 2.6 days for each decrease of 1 kg of body weight, decrease of 3.2 days for each 1 point increase in MNA score)
Spain	Planas et al. (2004)[208]	Adults, hospital (*n* = 400) Prospective evaluation	SGA	46% malnourished	• ↑LOS (overall population 7.5±5.4 days vs 5.0±5.1 days; scheduled admissions 7.1±6.2 days vs 4.8±4.4 days, both $p < 0.05$) • ↑readmission rate (total – overall 30.1% vs 15.1%, scheduled 32.8% vs 15.9%, cancer 39.7% vs 21.4%, all $p < 0.05$; non-elective – overall 20.7% vs 13.2%, scheduled 21.4% vs 12.8%, cancer 29.3% vs 17.2%, all $p < 0.05$)

*Weight loss > 10% in the 6 months pre-surgery and/or BMI < 18.5 kg/m^2 (points < 70 years) or < 21 kg/m^2 (points ≥ 70 years)
**See table 1.2 for definitions of malnutrition used by Pressoir et al. (2010)
†Low due to low communication of malnutrition in discharge reports

Table 4.3 **Examples of significantly increased use of healthcare resources by patients identified as malnourished or at risk of malnutrition compared with non-malnourished patients – community**

Country/Region	Study	Population (*n*) Study Design	Method	Malnutrition/risk	Outcome
Israel	Feldblum et al. (2009)[209]	Older people, community (*n* =204) Prospective evaluation	MNA	38.7% at risk (MNA < 24)	Healthcare use before index hospital admission: • ↑no. diagnosed diseases (mean 7.4±0.21 vs 5.9±0.16, $p = 0.001$) • ↑no. family physician visits (mean 7.7±0.95 vs 3.7±0.75, $p = 0.001$) • ↑no. hospital admissions before current admission (mean 1.7±0.19 vs 1.1±0.15, $p = 0.02$) Healthcare use after index hospital admission: • ↑LOS (current event) (mean 7.14±0.8 days vs 5.0±0.4 days, $p = 0.01$) • ↑LOS (in following 3 months) (mean 2.8±0.54 days vs 1.4±0.29 days, $p = 0.03$)
UK	Guest et al. (2011)[71]	Adult malnourished community patients (*n* = 1,000) Retrospective analysis	BMI < 18.5 kg/m^2 + clinical indicators		• ↑no. GP visits in 6 months (mean 18.9 in malnourished cases vs 9.12 in non-malnourished controls, $p < 0.001$) • ↑no. hospital admissions in 6 months (13% vs 5%, $p < 0.05$) • ↑LOS (6.24 days vs 3.26 days, $p < 0.001$)
UK	Cawood et al. (2010)[210]	Adult outpatients (*n* = 194) Prospective evaluation	'MUST'	18% at risk (12% medium, 6% high)	• ↑LOS (all hospital admissions: low risk 0.90±3.9 days vs medium risk 2.04±4.9 days vs high risk 4.92±8.1 days, $p = 0.007$) • ↑no. hospital admissions in 6 months (12.6% vs 26.1% vs 66.7%, $p = 0.000$) • ↑no. emergency admissions in 6 months (5.0% vs 8.7% vs 41.7%, $p = 0.000$) • ↑no. planned admissions in 6 months (7.5% vs 21.7% vs 25.0%, $p = 0.025$)
UK	Collins et al. (2010)[185]	Adult COPD outpatients (*n* = 205) Prospective evaluation	'MUST'	23.9% at risk (medium + high)	• ↑no. emergency and elective admissions per patient in 6 months (low risk 0.65±1.1 vs medium + high risk 1.10±2.0, $p = 0.043$) • ↑no. emergency admissions per patient in 6 months (low risk 0.48±0.9 vs medium + high risk 0.92±1.8, $p = 0.023$)

Table 4.4 Summary of studies showing increased length of hospital stay in malnourished children or children at risk of malnutrition*

Country/ Region	Study	Population (*n*)	Method of assessment/screening	Outcome
Brazil	Fernandez et al. (2008)[107]	Children aged < 3 years (*n* = 67)	Gomez score (WFA)	Linear regression analysis showed an association between longer hospital stay and no weight gain (r^2 = 0.11; p = 0.005)
Canada	Groleau & Babakissa (2008)[98]	Children aged 0–18 years (*n* = 173)	A variety of methods (see Table A1.8, Appendix I)	Length of stay was significantly correlated to nutritional status (r = -0.268; $p < 0.05$)
Canada	Secker & Jeejeebhoy (2007)[39]	Children aged 31 days–17.9 years scheduled for surgery (*n* = 175)	Subjective Global Nutritional Assessment (SGNA)	Postoperative stay was more than twice as long for severely malnourished (19.0±58.8 days) vs well-nourished children (5.3±5.4 days) and moderately malnourished children (8.4±11.1 days) (p = 0.002) (remained significant when extreme outlier removed from the analysis) When taken together, moderately and severely malnourished children had a 55% longer hospital stay than well-nourished children
The Netherlands	Hulst et al. (2010)[38]	Children aged > 1 month, admission to paediatric ward and expected stay at least 1 day (*n* = 424)	$STRONG_{kids}$	After adjustment for a variety of clinical factors including younger age, presence of underlying disease, non-surgical reason for admission and non-Caucasian ethnicity, increase in nutritional risk category was significantly related to a longer length of hospital stay (p = 0.017)
The Netherlands	Joosten et al. (2010)[101]	Children aged > 1 month, admission to medium care unit and expected stay at least 1 day (*n* = 424)	Acute malnutrition = WFH < -2 SD Chronic malnutrition = HFA < -2 SD	Median duration of hospital stay of children with acute malnutrition was significantly longer vs non-malnourished children (median 4 [range 1–44] days vs 2 [1–24] days, p = 0.001)

*See Table A1.8, Appendix 1 for details of prevalence of malnutrition and risk of malnutrition

4.3.2 FINANCIAL COSTS

Malnutrition increases healthcare costs

- Increasing efforts are being made to establish the cost of malnutrition in Europe and in different countries, including the UK, The Netherlands, Germany, Belgium, Republic of Ireland, France, Spain and Australia.

United Kingdom

- Malnourished patients have more GP visits, more hospital admissions (e.g. 56% and 82% more respectively for those ≥ 65 years of age), > 30% longer hospital stays, and greater likelihood of admission to care homes than well-nourished individuals.[211] These factors were used to help to calculate the overall cost of malnutrition in the UK.

- The annual healthcare cost of malnutrition and any associated disease in the UK in 2003 was estimated to be in excess of €8.6 billion (£7.3 billion[iv]) per year (see Figure 4.7, Actual costs).[211] The costs were split approximately as:

  - €4.5 billion (£3.8 billion[iv]) due to the treatment of malnourished patients in hospital;
  - €3.1 billion (£2.6 billion[iv]) due to the treatment of malnourished patients in long-term care facilities;
  - €0.58 billion (£0.49 billion[iv]) from GP visits;
  - €0.21 billion (£0.18 billion[iv]) from hospital outpatient visits;
  - €0.06 billion (£0.05 billion[iv]) from artificial nutrition support in hospital;
  - €0.18 billion (£0.15 billion[iv]) from artificial nutrition support in the community (artificial nutrition support includes PN, enteral tube feeding and ONS).

- Figure 4.7 also shows the extra cost of treating all patients in the general population with medium and high risk of malnutrition and associated disease compared with treating the same number of patients with low risk of malnutrition and associated disease. This is referred to as the annual additional healthcare cost (or incremental cost) and it was estimated to be over €6.3 billion (£5.3 billion[iv]). Most of this cost was due to more frequent and more expensive hospital inpatient spells and greater need for long-term care in those with medium and high risk of malnutrition than those with low risk of malnutrition.[211]

- It was estimated that more than half of the expenditure on DRM goes to people aged ≥ 65 years of age, who account for only about 15% of the population.[211]

[iv]Calculated based on an exchange rate of €1.17993 (Source: Interbank 29/02/12)

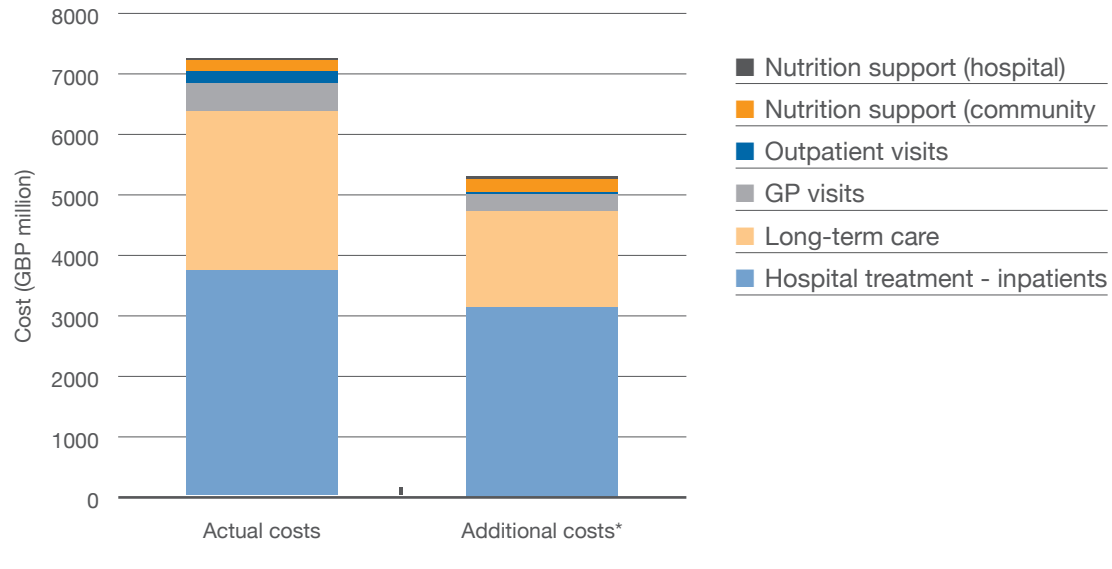

Figure 4.7 **Estimated annual public health expenditure in medium and high risk of malnutrition** (adapted from Elia et al. 2005)[211]

*Additional annual costs for treating community patients with medium and high risk of malnutrition compared with the same number with low risk of malnutrition

- In 2007 an update of this calculation was performed to account for the rising public expenditure on health and to include the cost of services providing support to malnourished patients, such as care at home and GP visits to people aged 65 years and over, that were not included in the 2003 estimate. Public expenditure on DRM in the UK in 2007 was estimated to be in excess of €15 billion (£13 billion[iv]) per annum, corresponding to ≥ 10% of the total expenditure on health and social care.[212] Healthcare costs (UK) include cost of hospital inpatients, hospital outpatients and primary care (prescriptions and general medical services). Social care costs include costs of adult nursing, residential care, home care, assessment and management and other, and children and family services. Estimates are based on the mean proportion of malnourished patients (see Figure 4.8).

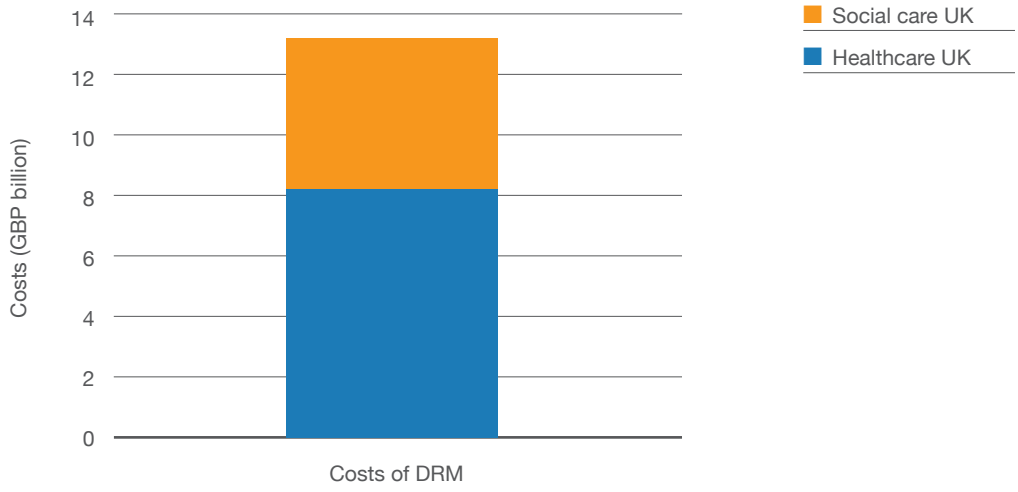

Figure 4.8 **The cost of disease-related malnutrition in the UK in 2007** (adapted from Elia 2009)[212]

- In comparison, the economic costs of obesity are estimated at €3.9–4.4 billion (£3.3–3.7 billion[iv]) per year, and even if the estimate includes obesity plus overweight (€7.8–8.7 billion [£6.6–7.4 billion[iv]]),[213] the figure is still approximately half the cost of DRM.

[iv]Calculated based on an exchange rate of €1.17993 (Source: Interbank 29/02/12)

- A very recent analysis of 1,000 medical records of randomly selected malnourished patients with 996 matched (for age, gender, GP practice) non-malnourished patients in the UK found that malnourished patients consumed significantly more healthcare resources over 6 months than their well-nourished counterparts. As a result, a malnourished patient costs the NHS on average an additional €1,183 (£1,003[iv]) over 6 months compared to a similar non-malnourished patient. The additional cost of malnutrition comprised:[71]

  - 34% GP consultations;
  - 19% hospital admissions;
  - 15% nutritional interventions;
  - 8% drug prescriptions.

- The study hypothesised that if malnutrition in the community occurred in 6% of the population, the cost to the NHS in the first 6 months after diagnosis would be €4.4 billion (£3.7 billion[iv]).[71]

- An economic analysis of the costs associated with weight status of patients with COPD (n = 424) suggested that the lowest costs were associated with a BMI of 30–35 kg/m² (obesity range) and the highest with BMI < 20 kg/m² (underweight) (see Figure 4.9).[214]

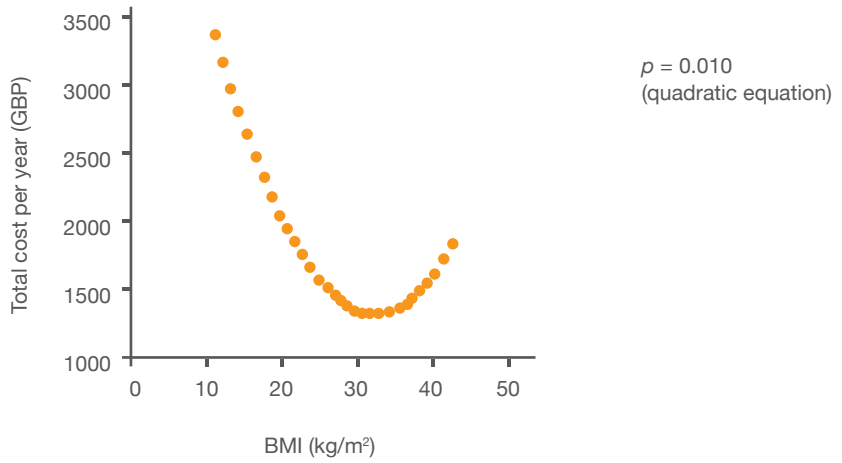

Figure 4.9 **Total secondary healthcare use costs per patient per year according to BMI** (adapted from Collins et al. 2011).[214]

Adjusted for age, gender and COPD disease-severity (GOLD 2009), using univariate analysis.

[iv]Calculated based on an exchange rate of €1.17993 (Source: Interbank 29/02/12)

The Netherlands

- An economic evaluation of the cost of disease-related malnutrition (DRM) in The Netherlands showed that the total additional costs in 2011 were €1.9 billion which equals 2.1% of the total Dutch national health expenditure and 4.9% of the total costs of the health care sectors analysed in this study (hospital, nursing- and residential home and home care setting). Total additional costs of disease-related malnutrition were about 4 times higher for patients of at least 60 years of age (€1.5 billion) than for patients in the age category of > 18 and < 60 years (€403 million). Also 66% of the total expenditure on DRM was attributable to the hospital setting (€1.2 billion). The proportion of the nursing home and residential home setting accounted for 24% (€453 million) and home care setting for 10% (€185 million) of the total expenditure on DRM.[215]

- The cost of malnutrition in Dutch nursing homes was calculated from data generated by a survey of 30 dietitians working in 110 nursing homes using national data on the number of nursing home residents, which was extrapolated to the entire nursing home population. Data on staff time involved in aspects of nutritional care and cost of treatment was collected. The key findings included:[216]

  - the total additional cost of managing malnutrition for the Dutch care home sector is €279 million per year, which represents 3% of the annual care home budget and 0.7% of the annual healthcare budget;
  - the additional cost of managing care home residents with malnutrition is €10,000 per patient per year;
  - the additional cost of managing care home residents at risk of malnutrition is €8,000 per patient per year.

Germany

- In Germany, the total additional costs of malnutrition were calculated in the Cepton Report by considering the additional costs that arise due to malnutrition from patients in hospital (e.g. longer hospital stay, more hospitalisations, higher rates of complications), in home care (higher complexity and decreased mobility), and in ambulant physician care (increased visits, cost of clinical nutrition). Figure 4.10 shows the costs of malnutrition in hospital and the additional costs caused by extended length of stay of malnourished patients.[217]

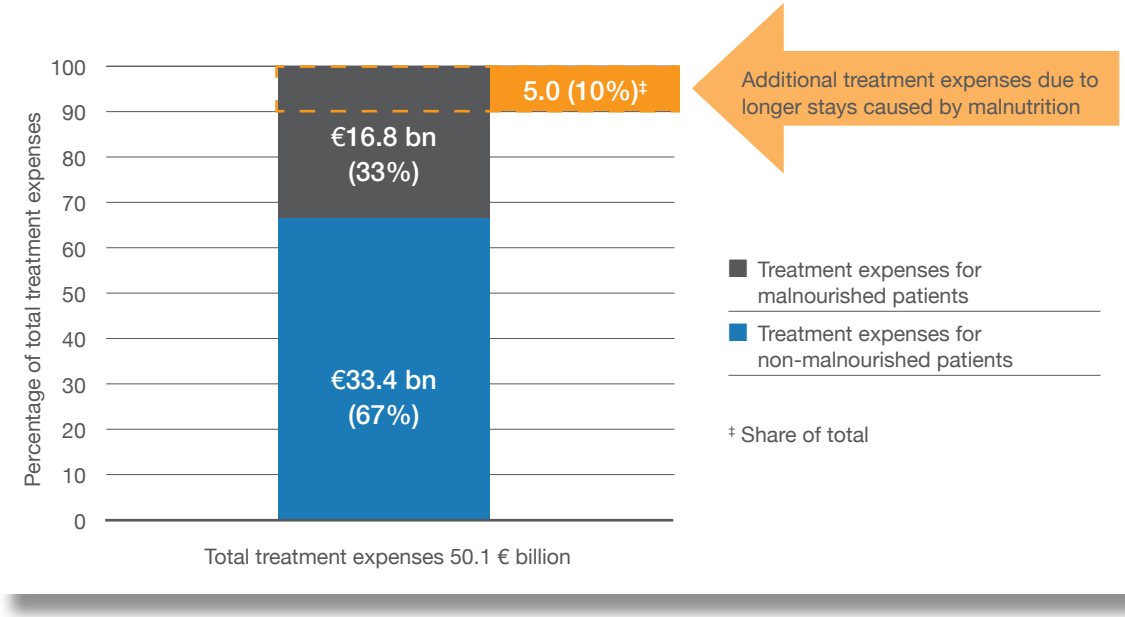

Figure 4.10 **Costs of malnutrition in hospitals in Germany** (adapted from Cepton 2007)[217]

- In total, across all care settings the additional costs of malnutrition in Germany accumulate to €9 billion and they are expected to rise to €11 billion by 2020, with the highest increase expected in the home care sector (see Figure 4.11).[217]

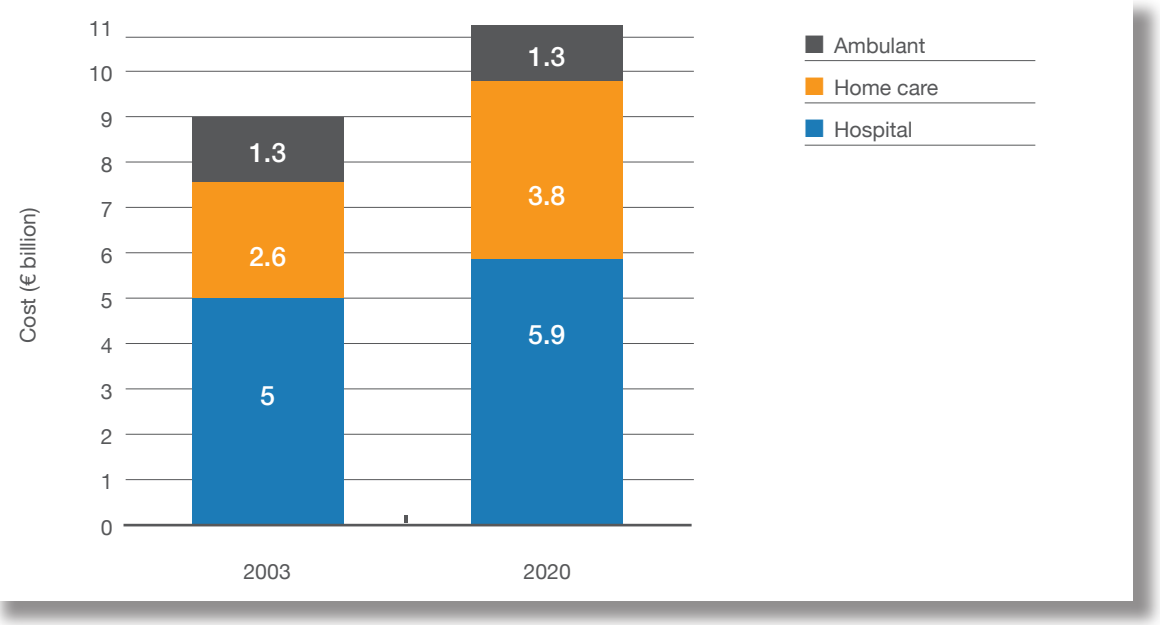

Figure 4.11 **Additional costs due to malnutrition in Germany calculated for 2020** (adapted from Cepton 2007)[217]

All care sectors, 2003 vs 2020

- Data from a German population-based cohort of 1,999 patients showed that low Geriatric Nutritional Risk Index (GNRI) is associated with increased healthcare costs and risk of hospitalisation at baseline and at 10-year follow-up. After adjustment for socioeconomic characteristics, lifestyle factors and co-morbidity, subjects with low GNRI at baseline were compared with subjects with normal GNRI values, and at 10-year follow up they were found to have:[218]

  ~ 47% higher total healthcare costs;
  ~ 50% higher risk of hospitalisation;
  ~ 62% higher inpatient costs;
  ~ 27% higher pharmaceutical costs.

Belgium

- Using information from a large observational database from 26 hospitals in Belgium, an analysis was conducted to compare inpatient pharmaceutical costs, procedure costs, hotel costs and overall costs of malnourished patients (coded within the database as having a secondary diagnosis of 'underweight' and 'severe weight loss', n = 927) and normally nourished patients (matched controls, n = 26067).[219] The analysis showed that:

  ~ the overall mean cost difference per stay between malnourished and normally nourished patients averaged €1,152 (95% CI €870; €1,433);

  ~ the average differences for specific costs were:
  - pharmaceuticals €264 (€192; €336);
  - procedures €137 (€113; €161);
  - hotel costs €754 (€508; €1,000).

Republic of Ireland

- An economic evaluation of the cost of DRM in the Republic of Ireland using methodology adapted from Elia and Stratton (2009)[212] found that malnutrition is estimated to have cost over €1.4 billion in 2007, representing over 10% of the public expenditure on health and social care.[220]

France

- A post-hoc analysis of the data collected in a prospective study was used to assess the clinical and economic impact of malnutrition in post-surgery colorectal cancer patients. Malnutrition was found to impact the cost per hospital stay by over €3,000 per patient, with an annual impact of over €9 million for French public hospitals.[205]

Spain

- An analysis of over 1.5 million patients from the Minimum Basic Data Set from Spanish Hospitals identified 1.4% with malnutrition (low due to low communication of malnutrition in discharge reports); nevertheless, the length of stay was found to be twice as long for malnourished patients with a recorded malnutrition code than for the general population admitted to internal medicine wards, resulting in significantly higher hospital admission costs for malnourished patients (€5,228 vs €3,538, $p < 0.001$).[64]

- Updated data of Spanish costs related to malnutrition from the PREDyCES Study are available at http://www.nutricionhospitalaria.com/pdf/5986.pdf

Europe and the European Union

- The estimated cost of DRM in Europe is €170 billion[221] or €120 billion in the EU.[222] This estimate is based on health economic evidence from the UK showing that costs for managing patients at risk of malnutrition exceed €15 billion.[212]

Australia

- The costs arising from pressure ulcers attributable to malnutrition have been estimated to be €7 million for 2002/2003 in public hospitals in Queensland, Australia. The estimate is based on approximately one-third of pressure ulcers being attributable to malnutrition, and it only includes the costs of increased length of stay associated with pressure ulcers; nevertheless, a cost of €7 million is considered substantial.[223]

- In a study designed to estimate the cost of inpatient malnutrition in hospitals in Victoria, Australia, which controlled for underlying condition and any treatment administered, malnutrition was estimated to add €1,398 (AU$1,745[v]) per admission. The total cost of malnutrition to the Victoria Public Hospital system in 2003–2004 was estimated to be at least €8.6 million (AU$10.7 million[v]). Malnutrition was under-reported in the study, so this represents the lower boundary of the true cost of malnutrition.[224]

- A prospective cohort study of newly admitted adult patients (18–74 years of age) to an acute tertiary hospital in Singapore found that the mean difference between the actual cost and the average cost of hospitalisation for malnourished patients (SGA B+C) was greater than for well-nourished patients €290±2,075 [S$488±3494[vi]] vs €827±3,653 [S$1392±6150[vi]], $p = 0.014$).[63]

[v]AU$ 1:0.80124 €, [vi]S$ 1:0.59393 €. Source: Interbank 29/02/2012

Costs of malnutrition in children

- There are a lack of data on the financial costs of malnutrition in children specifically. However, in recent years there has been increasing interest in the costs of malnutrition due to the increasing pressure on health and social care budgets, and data is now available (mainly for adults) in a number of countries (see pages 75-80).

- Studies in adult patients clearly show that malnutrition increases length of hospital stay, readmissions to hospital, and complications, which contribute to increases in healthcare resource use. Studies show that LOS for malnourished children has also increased compared to well-nourished children (see Table 4.4); therefore, it is highly likely that this will result in increased healthcare costs, although these calculations have not yet been undertaken for DRM in children.

5 BENEFITS OF ONS

Summary

Good nutritional care is a vital part of patient management and includes nutritional screening, provision of appetising and nutritious food, nutritional support and monitoring. ONS are one of a spectrum of nutritional support strategies that can be used to tackle malnutrition, which also include dietary counselling, tube feeding and parenteral nutrition. ONS are an effective and non-invasive solution to malnutrition in patients who are able to consume some normal food but not enough to meet nutritional requirements.

ONS have proven nutritional, functional, clinical and economic benefits in both the hospital and community setting in a wide variety of patient groups. Studies show that ONS increase energy and protein intakes in both hospital and community patients without reducing spontaneous intake from food; indeed ONS may help to **stimulate appetite** e.g. in post-surgical patients and in older people.

Improvements in clinical outcome and healthcare resource use have been consistently demonstrated in a number of trials and meta-analyses:

- Meta-analyses show that ONS lead to **weight gain** in patients in hospital and in those transferred to the community including older people e.g. average weight change between supplemented and control group +3%.
- Meta-analyses consistently show a **reduction in mortality** in patients given ONS compared with standard care (e.g. 24% reduction), particularly in undernourished older people.
- **Reductions in complication rates** of between 25% and over 50% are seen in meta-analyses of ONS compared with routine care.
- Meta-analysis shows that use of ONS significantly **reduces the proportion of patients (variety of conditions) admitted or readmitted to hospital** compared with routine care (24% vs 33%).
- Intervention with high-protein ONS has been shown to **reduce overall readmissions by 30%**.

Improvement in quality of life, activities of daily living, muscle strength, respiratory muscle function and sleep scores have been demonstrated in patients receiving ONS.

ONS have been demonstrated to be more effective than dietary advice and snacks; **greater intakes of energy, protein and vitamins and fewer complications** have been shown in patients with fractured neck of femur when compared with snacks (with equal energy content). **Significantly greater energy and protein intakes** with ONS have been reported in a randomised controlled trial of ONS versus dietary advice in care home residents. Data on the benefits of dietary counselling and food fortification in the management of malnutrition are lacking or are of variable quality.

Potential cost savings as a result of reduced healthcare use have been demonstrated in patients supplemented with ONS and can be realised in both the hospital and the community setting. Economic modelling undertaken by NICE (2006) showed ONS to be cost-effective as part of a screening programme.

A holistic approach must be taken when considering the investment needed to manage malnutrition; the cost may be incurred in one setting whilst the benefit appears to occur in another. However, taken as a whole, effective prevention and management of malnutrition will realise cost savings across the social and healthcare system.

Conclusion

ONS are one of a spectrum of nutritional support strategies that can be used to tackle malnutrition. There is consistent, good quality evidence from multiple individual trials and meta-analyses demonstrating the beneficial nutritional, functional and clinical effects of ONS in malnourished patients. Besides improving the well-being of patients, fighting malnutrition with ONS is an opportunity for healthcare providers to control costs. This is especially relevant in light of the ageing population and the high prevalence of chronic disease that adversely impacts nutritional status, which in turn contributes to increased cost burden. Controlling and managing malnutrition is an effective solution.

Recommendations

On the issue of **benefits of ONS** the MNI makes the following recommendation:

Action	Issues to consider
A wealth of evidence is available that demonstrates the benefits of ONS. This should be translated into practice to ensure that patients who need nutritional intervention receive it in a timely and appropriate manner	• Information about the benefits of ONS and how they should be used in practice should be included as part of education and training on the management of malnutrition • Patients' progress should be regularly monitored and their nutritional care plan, including all types of nutritional intervention, should be adjusted accordingly • Appropriate forms of nutritional intervention, including ONS, should be available to all patients when needed and access or ability to pay should not be a constraint

Good nutritional care

The central factor in the development of malnutrition is nutritional intake that is insufficient to meet requirements. This can arise due to a number of different reasons related to disease and disability, impacting on food intake, losses of nutrients and/or increased requirements. Although in some cases improvement of the quality or quantity of food supplied can ameliorate the problem, in many cases, the person concerned is simply unable to consume sufficient normal food to meet his or her requirements and maintain a healthy nutritional status. In this case, it is vital to consider other options to improve nutritional intake (see Figure 5.1). Dietary counselling, conventional food, and oral nutritional supplements (ONS) are all considered as strategies for improving nutritional intake. When patients are unable to consume sufficient nutrition via the oral route, tube feeding may be required. In cases of severe gut dysfunction, nutrition given orally or via tube feeding is not an option, and intravenous (parenteral) nutrition will be needed.

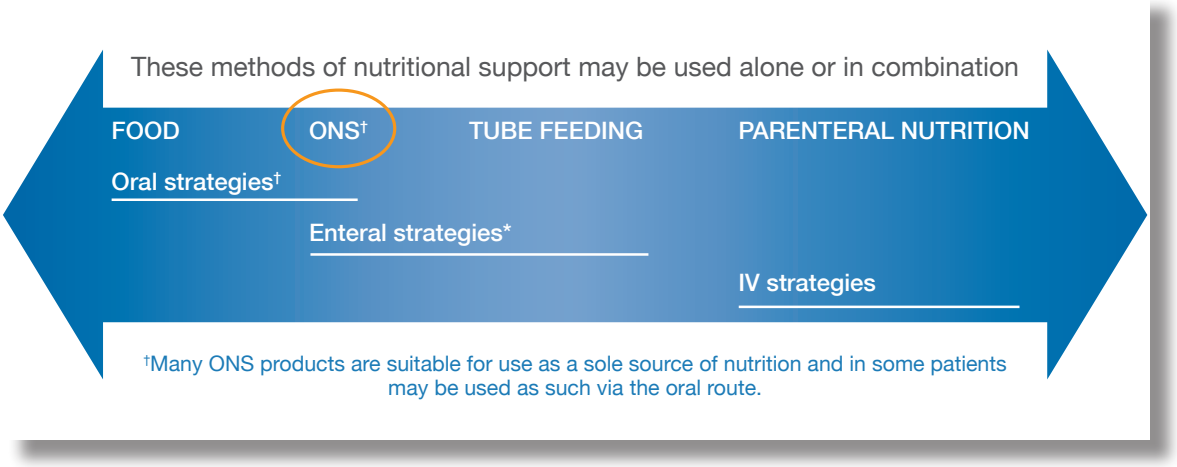

Figure 5.1 The spectrum of nutritional support
(*ESPEN definition of Enteral Nutrition includes ONS)

Good nutrition is an essential part of care, and it includes ensuring that the right people receive the right nutritional support at the right time during their care, regardless of whether that care is delivered in hospital, in an institution or in the person's own home. Good nutritional care starts with ensuring that people have access to appetising and nutritious food that meets their preferences and nutritional, cultural and religious needs, and that they are supported to either provide this for themselves or to be able to avail themselves of it when it is provided by others, e.g. through assistance with shopping or cooking, lunch clubs, meals on wheels or assistance with eating and drinking.

Good nutritional care also includes ensuring that people who are malnourished or at risk of malnutrition are identified through screening programmes, and that action is taken to ensure that they receive appropriate and timely nutritional support. As outlined in Figure 5.1 nutritional support may take many forms, e.g. dietary counselling, food fortification, ONS, tube feeding and PN. Healthcare professionals should look to evidence-based guidelines to assist them in selecting the most appropriate method of nutritional support for their patient, taking account of the goals of care, the patient's nutritional needs, ability to eat, diagnosis and prognosis, and ability to adhere to the intervention. It is essential that healthcare professionals combine their clinical experience with a sound knowledge of the evidence base and practical common sense in the provision of nutritional support, e.g. a patient with a poor appetite may not be able or willing to consume extra food or may lack the energy or ability to prepare it. ONS were conceived specifically to meet this medical need, providing energy and nutrient-dense solutions in easily consumed aliquots.

Infants and children with faltering growth may need an enhanced intake of energy and nutrients, which can be achieved by increasing the energy density of the diet using a number of methods which include ONS. Koletzko and Dokoupil (2008) suggested the following elements in a stepwise approach to increasing energy and nutrient supply,[225] however it should be noted that this stepwise approach is not necessarily evidenced-based:

- analysis of needs, diet and feeding situation;
- individual professional counselling on dietary choices and feeding practice;
- offer meals and snacks more frequently;
- preferential choice of energy-dense foods, drinks and snacks;
- enrichment of formula and home foods with glucose polymers and/or oils;
- **use of drinkable supplements (sip feeds) (ONS);**
- tube feeding (nocturnal/continuous);
- parenteral Nutrition.

It is well accepted that good nutrition is essential for adequate growth and development in children. For this reason, undertaking research to demonstrate the benefits of nutritional support in children is difficult, since it would be unethical to randomise malnourished children or children in need of nutritional support to receive no treatment. This may help to explain the lack of randomised controlled trials (RCTs) investigating the effect of ONS in children. ONS can be used as part of the spectrum of nutritional support strategies to tackle malnutrition. This will be the focus in the next sections.

5.1 Nutritional benefits of ONS

5.1.1 NUTRITIONAL INTAKE

ONS increase total energy intake in adult hospital patients

- A comprehensive systematic review of trials in the hospital setting (58 trials, 34 RCTs, 25 [74% of the total RCTs] assessed intake with ONS) indicated the efficacy of ONS in increasing total energy intake in a variety of patient groups: patients with COPD, older people, post-surgical patients, orthopaedic patients, patients with liver disease, and patients with cancer.[46]

- The effect was observed regardless of whether the mean BMI of the group was < 20 kg/m^2 or > 20 kg/m^2.[46]

- In hospital patients, ONS have been shown not to substantially reduce food intake, and in some patient groups (e.g. post-surgical patients), ONS even appear to stimulate appetite and food intake (see Figure 5.2).[226] During acute illness, the effectiveness of ONS in increasing total energy intake may be limited.[46]

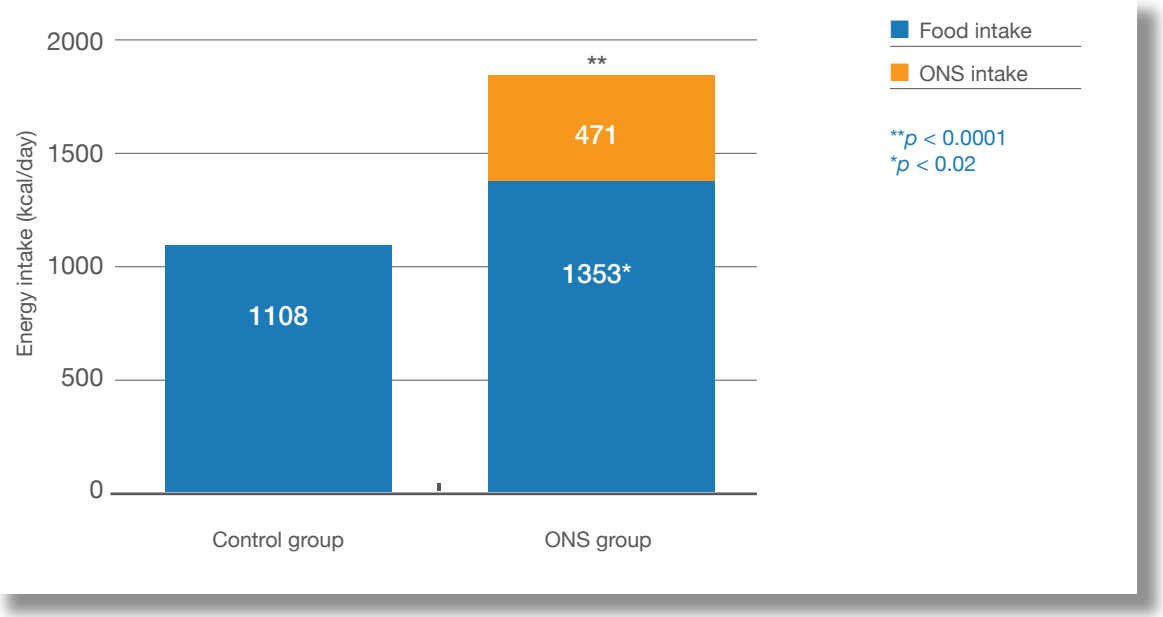

Figure 5.2 **Higher total food and energy intake in hospitalised post-surgical patients with ONS** (adapted from Rana et al. 1992).[226]

Significant increase in total energy intake, p < 0.0001; significant increase in intake from ward diet, p < 0.02

ONS increase total energy intake in adult patients in the community

- In a systematic review of patients in the community setting (108 trials, 44 RCTs, *n* = 3747, the effect of ONS on energy intake was assessed in 32 RCTs), ONS increased total energy intake across a variety of patient groups: patients with COPD, older people, patients with cystic fibrosis, patients with CD, patients with HIV, surgical patients and patients with liver disease.[46] In the RCTs assessing energy intake (*n* = 29), 91% showed improvements, of which > 70% were significant. The mean increase in total energy intake was equivalent to 69% of the ONS energy, although there was wide variation across the studies. The increase was greater in studies of patients with a mean BMI of < 20 kg/m^2 than > 20 kg/m^2.[46]

- A systematic review of the effects of oral nutritional intervention in care homes using ONS (3 RCTs [*n* = 196]) showed improvements in energy intake (mean difference 123 kcal [95% CI 92–154 kcal], $p < 0.0001$).[227]

- Cawood et al. undertook a subgroup analysis of 11 RCTs in community patients (*n* = 672) (in 2 RCTs, ONS commenced in hospital and continued after discharge), which showed significant improvements in total energy intake in patients who received oral nutritional intervention with high-protein ONS versus controls (349 kcal [95% CI 210–488], $p < 0.001$ random effects model).[228]

ONS are effective in increasing energy intake in older people in hospital

- Normally nourished or mildly undernourished older hip fracture patients (*n* = 60) supplemented with high-protein ONS during hospital admission had significantly higher total energy intake compared with controls (standard or texture modified diet) ($p < 0.05$).[229]

- An RCT of nutritional support in an acute hospital trauma ward found that patients supported by a dietetic assistant had a mean energy intake of 349 kcal/d greater than the 756 kcal/d achieved by patients receiving conventional nursing care. Of the additional 349 kcal/d, 286 kcal/d (82%) came from ONS.[230]

ONS are effective in increasing energy intake in older people across healthcare settings

- In a large systematic review of protein and energy supplementation (ONS) specifically in older people (62 trials, *n* = 10187 randomised participants), a significant increase in total daily energy intake was reported in the majority of studies (variety of inpatient and community settings).[231]

- In a prospective RCT in older patients (> 75 years of age, at risk of malnutrition) investigating the effect of supplementation (*n* = 35) versus no supplementation (*n* = 35) throughout hospitalisation and convalescence, spontaneous intake was maintained despite supplementation, i.e. ONS may have stimulated appetite. The spontaneous energy intake (excluding supplements) was calculated for 10 control and 16 supplemented patients, and it was found to be significantly higher in the supplemented group ($p < 0.01$) (see Figure 5.3).[232]

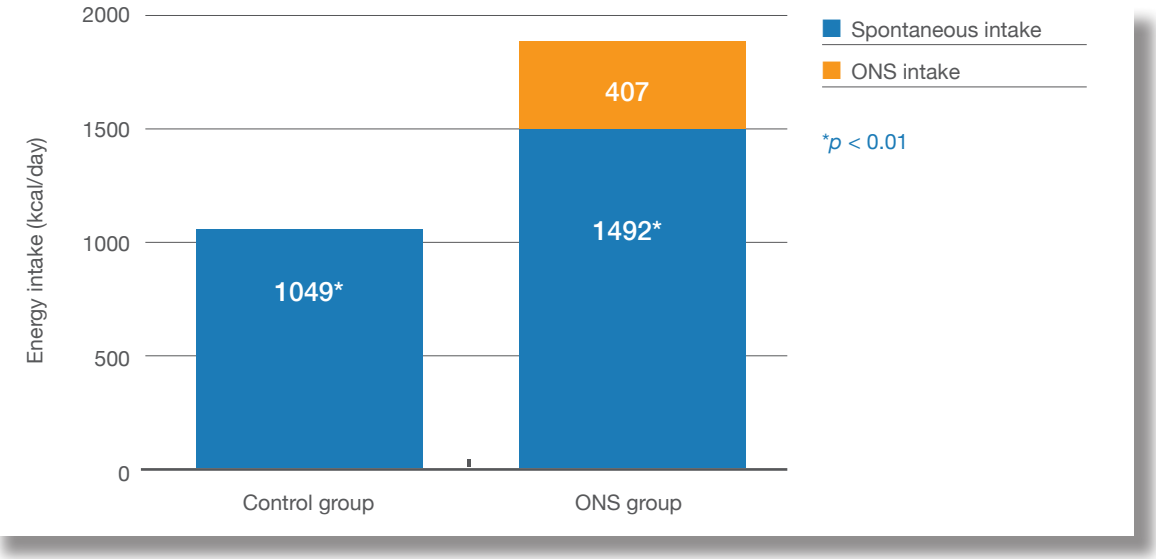

Figure 5.3 **Greater total energy intake with ONS in supplemented group vs control group** (adapted from Gazzotti et al. 2003).[232]

ONS started in hospital and continued in the community; spontaneous intake maintained despite supplementation with ONS (60 days after inclusion in the study; *p < 0.01)

- Significant improvements in energy intake with ONS versus usual care have been observed in older patients with Alzheimer's disease at risk of malnutrition in hospital and day care centres (total energy intake at 3 months was 291 kcal/d greater than at baseline) and in older malnourished patients (≥ 75 years of age) discharged from hospital into the community (significantly greater energy intake in ONS group vs control group, $p = 0.022$).[233;234]

- An RCT comparing the effectiveness of ONS with dietary advice in care home residents ($n = 104$) at risk of malnutrition (using 'MUST' [medium and high risk]) showed that energy intakes were significantly higher in residents randomised to receive ONS than in residents who received dietary advice (1655±502 kcal vs 1253±469 kcal, $p = 0.001$). Appetite sensations were not significantly different between the 2 groups.[235]

High-protein ONS increase total energy intake in adult patients across healthcare settings

- A systematic review and meta-analysis of 12 RCTs in patients across healthcare settings ($n = 1242$) (2 RCTs in hospitals, 10 RCTs in the community, and 3 RCTs across hospital and community) showed improvements in total energy intake in patients who received oral nutritional intervention with high-protein ONS versus controls in all but 1 trial (see Figure 5.4), and significantly so on meta-analysis (314 kcal [95% CI 146–482 kcal], $p < 0.001$ random effects model).[228]

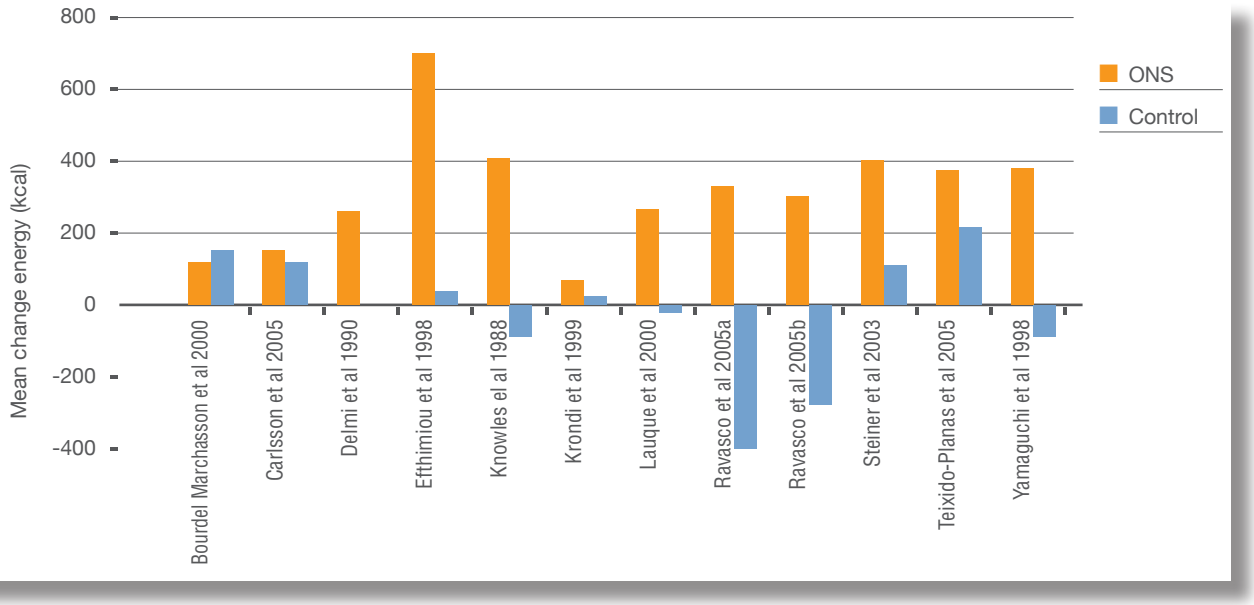

Figure 5.4 **Effect of high-protein ONS vs control on intake of energy** adapted from Cawood et al. 2012).[228]

Mean change in intake during intervention period (baseline to end of intervention)

ONS increase energy intake in a variety of diseases in adults and children

- A systematic review of the effect of ONS in community patients including children by Stratton et al. (2003) concluded that:[46]

  - nutritionally complete ONS can be used as a sole source of nutrition in both adults and children with acute exacerbations of CD. The review also suggested that ONS may increase total energy intake without substantially reducing food intake;

  - in undernourished cystic fibrosis patients (adults and children), ONS can increase total energy intake without substantially reducing food intake. The increase in total intake may be equivalent to more than 80% of ONS energy, although large volumes of unpalatable formulations may reduce appetite.

ONS are effective in increasing protein intake in adult patients across healthcare settings

- In a review of trials of ONS versus standard care (hospital and community, malnourished or at risk of malnutrition), NICE (National Institute for Health and Clinical Excellence) (2006) reported higher protein intakes in the supplemented groups, and that ONS may be more effective in increasing intake than dietary advice.[236] Stratton et al. (2003) also reported significant increases in protein intake in patients receiving ONS.[46]

- A systematic review and meta-analysis in 10 RCTs of patients across healthcare settings (n = 1152) showed improvements in total protein intake in patients who received oral nutritional intervention with high-protein ONS versus controls in all but 1 trial (see Figure 5.5), and significantly so on meta-analysis (22 g [95% CI 10–34 g], $p < 0.001$ random effects model).[228]

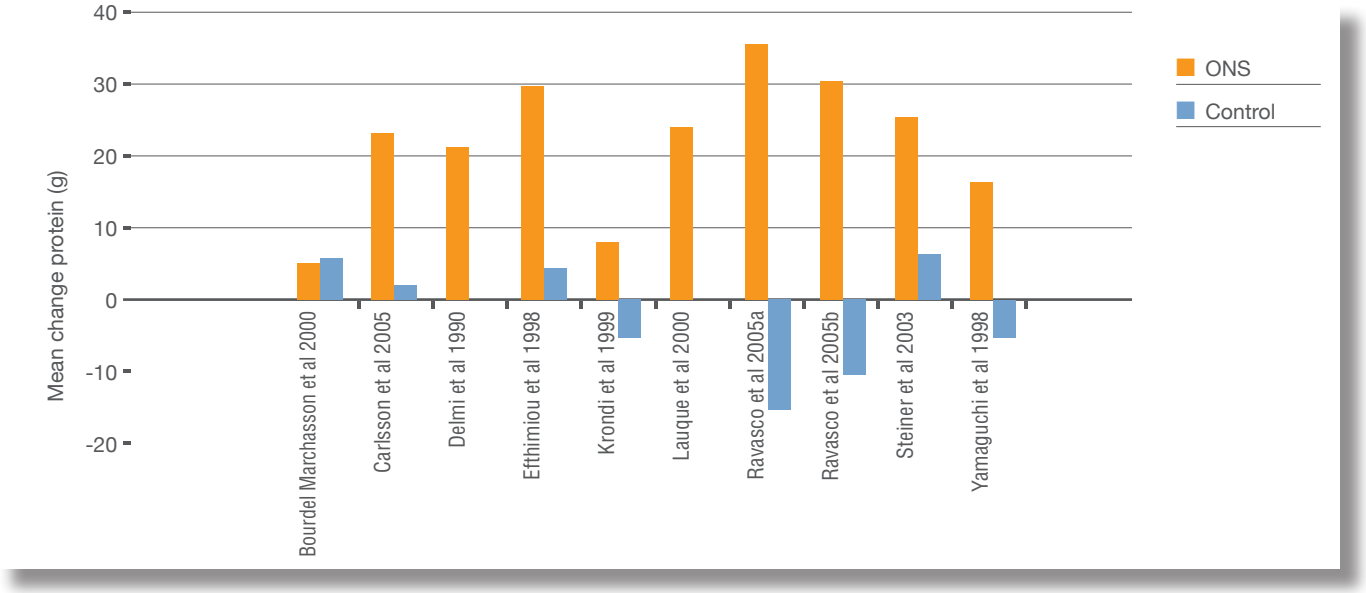

Figure 5.5 **Effect of high-protein ONS vs control on intake of energy** (adapted from Cawood et al.)[228]
Mean change in intake during intervention period (baseline to end of intervention)

- Malnourished adult community patients with benign GI disease randomised to receive high-protein ONS plus dietary counselling for 3 months achieved a significantly higher total protein intake than patients randomised to receive dietary counselling alone (117.1±34.7 g protein/day vs 74.6±44.6 g protein/day, $p < 0.0001$).[237]

ONS are effective in increasing protein intake in older people across healthcare settings

- In a large systematic review of protein and energy supplementation specifically in older people (62 trials, n = 10187 randomised participants), a significant increase in total daily protein intake was reported in the majority of studies (variety of inpatient and community settings).[231]

- Normally nourished or mildly undernourished older hip fracture patients (n = 60) supplemented with high-protein ONS during hospital admission had significantly higher total protein intake compared with controls (standard or texture modified diet) ($p < 0.05$).[229]

- Use of ONS has been demonstrated in clinical trials to increase protein intake in:

  ~ older patients recently discharged home (see Figure 5.6);[232]
  ~ malnourished older patients in hospital (n = 17) compared with controls (n = 6) who received no ONS but careful attention from nursing staff to finish meals (+65% protein intake vs +32%, $p < 0.0001$);[238]

- ~ older patients recovering from hip fracture in a rehabilitation hospital given high-protein supplements (vs standard supplements [63 g vs 50 g protein/d, $p < 0.048$]);[239]

- ~ older patients with Alzheimer's disease at risk of malnutrition in hospital and day care centres (total protein intake at 3 months was 16 g/d greater than at baseline $p < 0.001$).[233]

- An RCT comparing the effectiveness of ONS with dietary advice in care home residents ($n = 104$) at risk of malnutrition (using 'MUST' [medium and high risk]) showed that protein intakes were significantly higher in residents randomised to receive ONS than in residents who received dietary advice (62.1±18.4 g vs 49.6±19.9 g, $p = 0.004$). Appetite sensations were not significantly different between the 2 groups.[235]

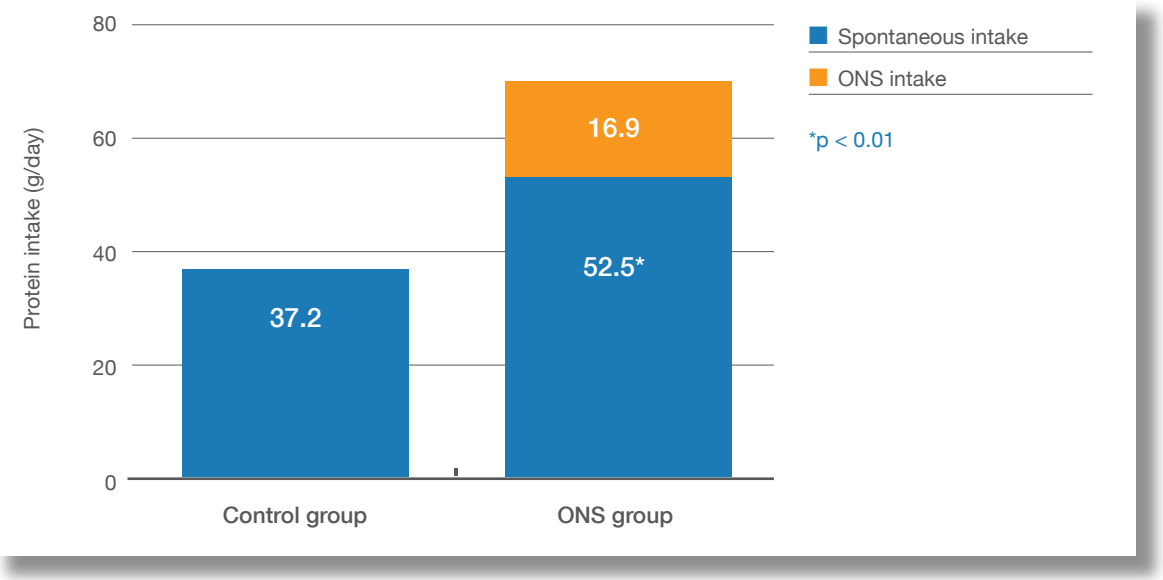

Figure 5.6 **Greater total protein intake with ONS** (adapted from Gazzotti et al. 2003).[232]
ONS started in hospital and continued in the community in the supplemented group vs the control group (60 days after inclusion in the study; *$p < 0.01$)

ONS increase micronutrient intakes and can be more effective than food snacks

- In a study of older people resident in nursing homes, a non-randomised subgroup analysis ($n = 66$) showed an increased intake of a wide range of vitamins and minerals in patients who received nutrient-enriched ONS compared with placebos ($p < 0.001$).[240]

- Food snacks are often used with the aim of increasing nutrient intake. However, in a trial of hospital patients with fractured neck of femur at risk of malnutrition (screened using 'MUST') ($n = 50$, median age 82 [range 46–97], median BMI 19 [range 12.5–26 kg/m^2]) randomised to receive either ONS (300 kcal per carton) or isoenergetic readily available snacks (typical snacks used in UK hospitals include full-fat yogurt, cheese and crackers, cake, and chocolate) ad libitum postoperatively, the ONS group had significantly greater intakes of protein, energy and water-soluble vitamins than the snack group (see Figure 5.7, and Table 5.1).[241;242] Although intakes of some vitamins were above the RNI, they fell within safe intakes.

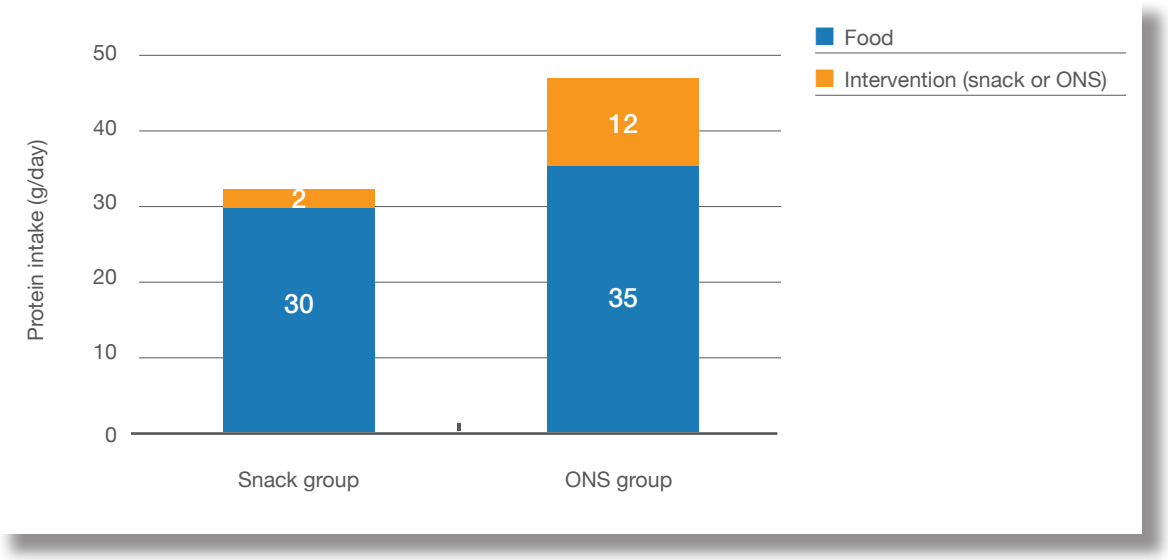

Figure 5.7 **Greater total protein intakes with ONS vs isoenergetic food snacks** (adapted from Stratton et al. 2006)[241]

Table 5.1 **Greater total mean intakes of water-soluble vitamins with ONS vs isoenergetic food snacks** (adapted from Stratton et al. 2006)[242]

VITAMIN	SNACK GROUP (*n* = 24) MEAN	SD	ONS GROUP (*n* = 26) MEAN	SD
Thiamin (mg/d)	0.73	0.38	1.59*	1.36
Riboflavin (mg/d)	0.98	0.49	1.80*	1.24
Vitamin B_6 (mg/d)	0.84	0.41	1.60**	0.75
Folate (µg/d)	108.00	49.60	221.00**	110.00
Niacin (mg/d)	7.98	4.73	15.80**	7.72
Vitamin C (mg/d)	37.40	20.10	77.00**	41.10

Mean total intakes for the ONS group were significantly higher than those for the food snack group (unpaired t test): *$p < 0.004$, **$p < 0.0005$. Intakes of biotin and pantothenate for the ONS group were significantly higher than those for the food snack group ($p < 0.0005$) (data not listed in Stratton et al. 2006)[242]

5.1.2 NUTRITIONAL STATUS

ONS lead to weight gain and prevention of weight loss in adult hospital patients

- In the hospital setting, ONS were found to improve body weight in 81% of trials (35 assessed weight), of which 46% were significant. Average weight change between supplemented and control patients was +3% (17 RCTs) across a variety of patient groups: surgical patients, older people, patients with COPD. A similar effect was seen in trials in which mean BMI was < 20 kg/m^2 or > 20 kg/m^2.[46]

- In a meta-analysis by NICE of ONS versus standard care in hospital patients who were malnourished or at risk of malnutrition, it was demonstrated that the use of ONS led to significant increases in weight (weighted mean difference 1.13 [95% CI 0.51–1.75, p = 0.0003]) (see Figure 5.8).[236]

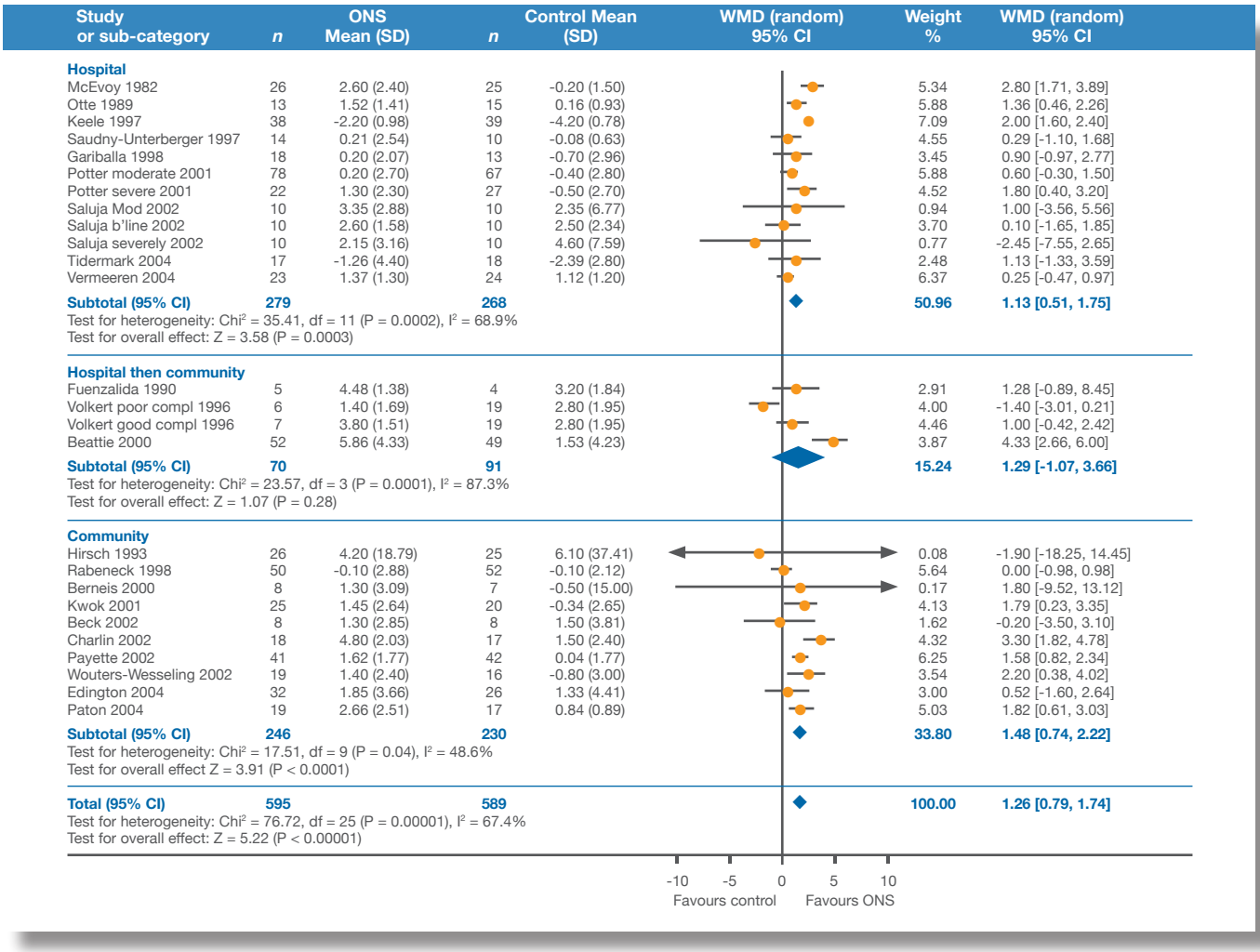

Figure 5.8 ONS versus standard care (all patients): weight change by setting (adapted from NICE 2006)[236]

ONS lead to weight gain and prevention of weight loss in adult patients in community settings

- In community patients, improvements in body weight were documented in 90% of RCTs assessing weight, of which 60% were significant increases. There was considerable variety between patient groups and individual trials; however, mean weight change in supplemented versus unsupplemented was greater in trials of patients with a mean BMI of < 20 kg/m^2 than with a BMI of > 20 kg/m^2 (+3.1% and +1.3%; 24 RCTs).[46]

- Meta-analysis of percentage weight change in 13 RCTs (COPD, older people, HIV, liver disease, cancer, post-surgical patients) showed a mean significant effect size with ONS of 0.61 (95% CI 0.50–0.71), though with considerable heterogeneity between the trials.[46]

- In the meta-analysis conducted by NICE of ONS versus standard care in patients who were malnourished or at risk of malnutrition, it was demonstrated that the use of ONS led to increases in weight in patients in the community (weighted mean difference 1.48 [95% CI 0.74–2.22, $p = 0.0001$]) (see Figure 5.8).[236]

- A systematic review and meta-analysis of the effects of oral nutritional intervention in care homes using ONS (3 RCTs [$n = 195$] found a significant difference in body weight (1.7 [95% CI 0.8–2.6] kg, $p < 0.001$ random effects model).[227]

High-protein ONS lead to weight gain in adult patients across healthcare settings

- Meta-analysis of 12 RCTs in patients across healthcare settings ($n = 1244$) (2 RCTs in hospital, 7 RCTs in the community and 3 RCTs across hospital and community) showed significantly increased weight in patients who received oral nutritional intervention with high-protein ONS versus controls (1.7 kg [95% CI 0.8–2.7], $p < 0.001$ random effects model) (see Figure 5.9).[228]

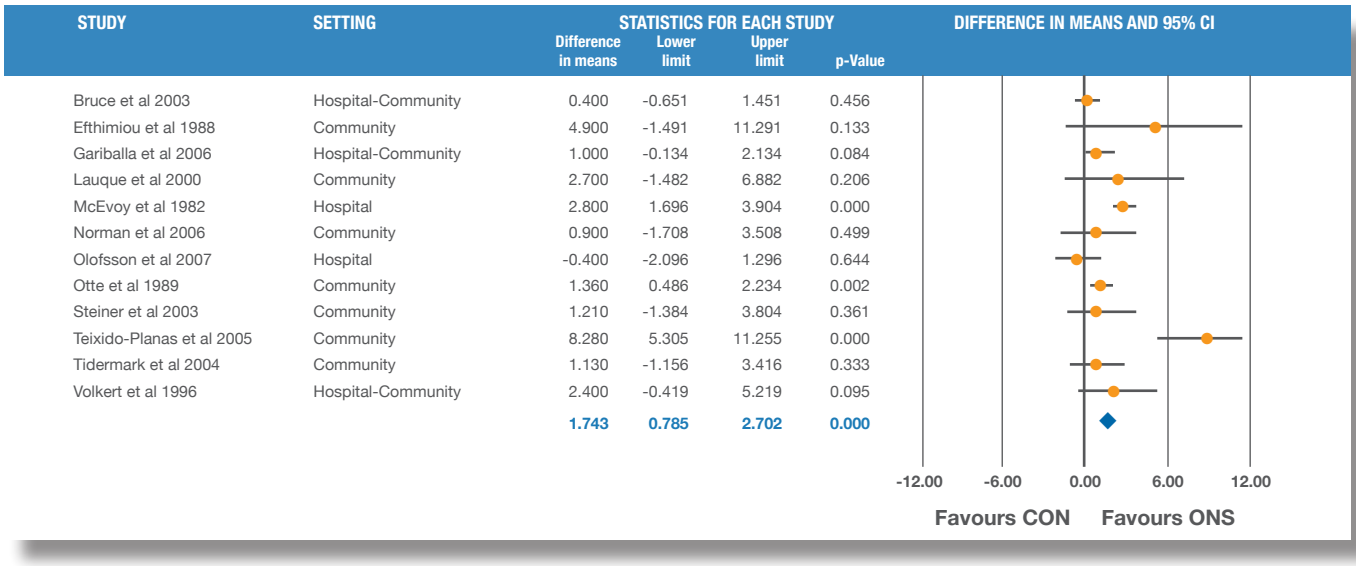

Figure 5.9 **Meta-analysis showing significant improvement in weight with oral nutritional intervention with high-protein ONS** (adapted from Cawood et al. 2012)[228]

ONS lead to weight gain in older people across healthcare settings

- In a large meta-analysis of studies in older people, greater weight gain was seen with supplementation compared with routine care (pooled weighted mean difference for percentage weight change was 2.15%; 95% CI 1.8–2.49) (variety of in-patient and community settings) (see Figure 5.10).[231] Analyses for weight change carried out in subgroups based on diagnosis showed a significant increase in weight with supplementation for:

  ~ a mixed group of patients with geriatric conditions (weighted mean difference 2.65%; 95% CI 2.19–3.10);

  ~ patients with chest conditions (weighted mean difference 1.58%; 95% CI 0.99–2.17).

- Dietary advice and ONS given for 4 months to older people at risk of malnutrition on discharge from a geriatric service resulted in prevention of weight loss, whereas controls lost 3.1 kg during the study.[243]

- Similar results have been shown (weight gain or weight maintenance) in older people with Alzheimer's disease in hospitals and day care centres[233,vii] and in older people during and after hospitalisation.[232,vii]

- ONS have been shown to increase body weight in community-dwelling undernourished older people compared with controls (weight gain mean difference of 1.17 kg [95% CI 0.07–2.27, $p = 0.04$] following adjustment for adherence).[244]

- A randomised double-blind placebo controlled trial (RDBPCT) in older care home residents has shown that oral nutrition intervention with ONS led to weight gain (1.6 kg difference in change, $p = 0.035$).[245]

- Mean change in MNA score was significantly higher in older medical undernourished patients who were randomised to receive individualised treatment in hospital and the community, which included ONS (Group 1) (3.0±2.6), than in patients who received individualised treatment (including ONS) in hospital only (Group 2) or standard hospital care (Group 3) (1.8±3.0, $p = 0.004$). Group 1 gained 0.5±2.84 kg weight over 6 months versus 0.15±2.72 kg in groups 2 and 3 (although this was not significant).[246]

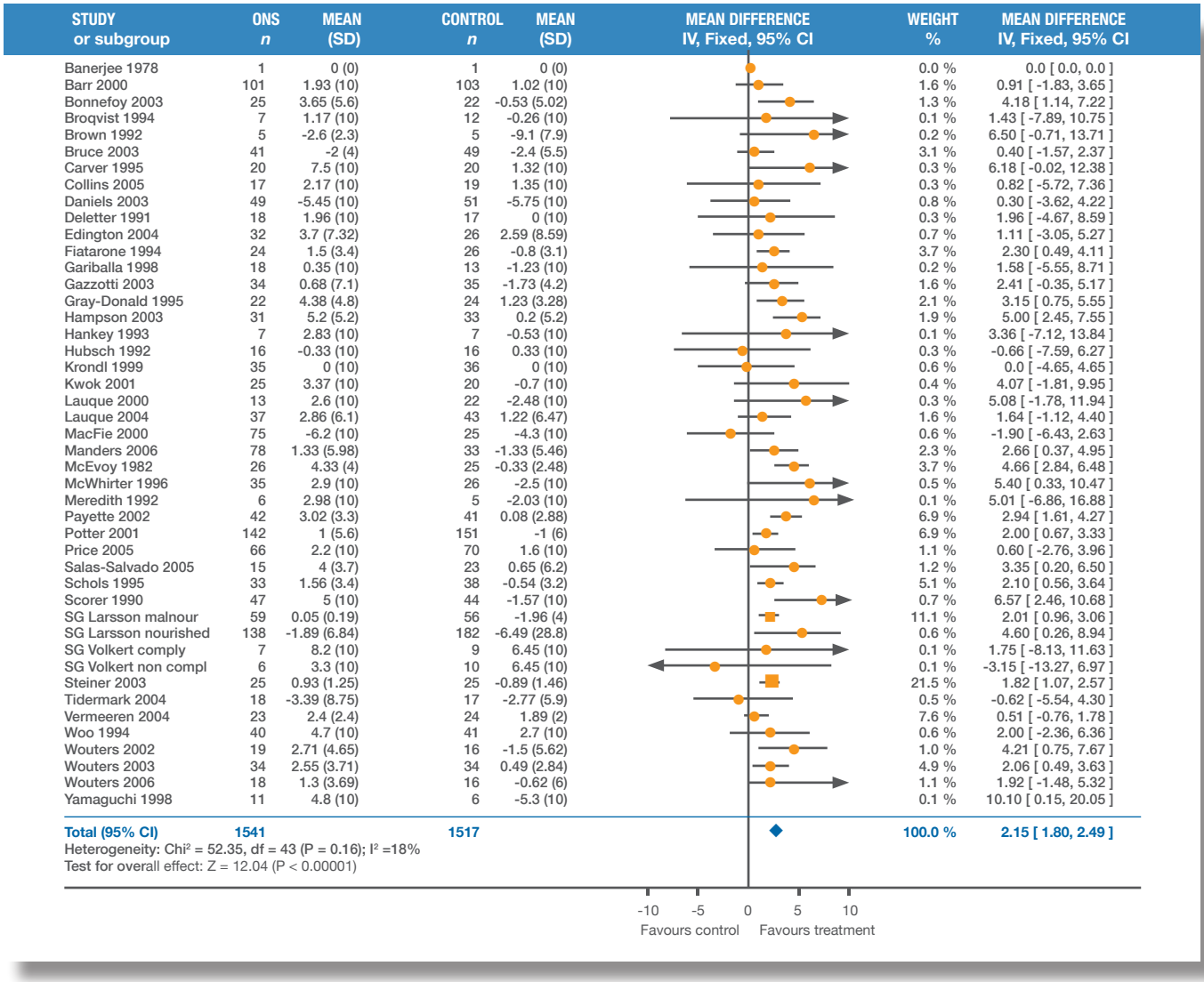

Figure 5.10 **Weight change in older people with protein and energy supplementation vs routine care** (adapted from Milne et al. 2009)[231]

[vii]also included in meta-analysis by Milne et al 2009

ONS improve micronutrient status

- NICE (2006) highlighted that care should be taken when using food fortification strategies as a means of increasing oral nutrient intake, as food fortification tends to increase energy and/or protein intake without increasing micronutrient intake. Oral nutritional support should contain a balanced mixture of protein, energy, fibre and micronutrients.[236] Under European law, Foods for Special Medical Purposes (FSMPs), which include ONS, must comply with compositional standards which specify required levels of vitamins and minerals.[10] Deviations are permitted but they must be based on a sound scientific rationale.

- In an RDBPCT of high-protein ONS during acute illness in older people (ONS continued after discharge), significant improvements were seen in markers of micronutrient status, e.g. red cell folate and plasma vitamin B12 levels, compared with the decrease seen in the placebo group. This effect was sustained at 6 months (see Figure 5.11).[247]

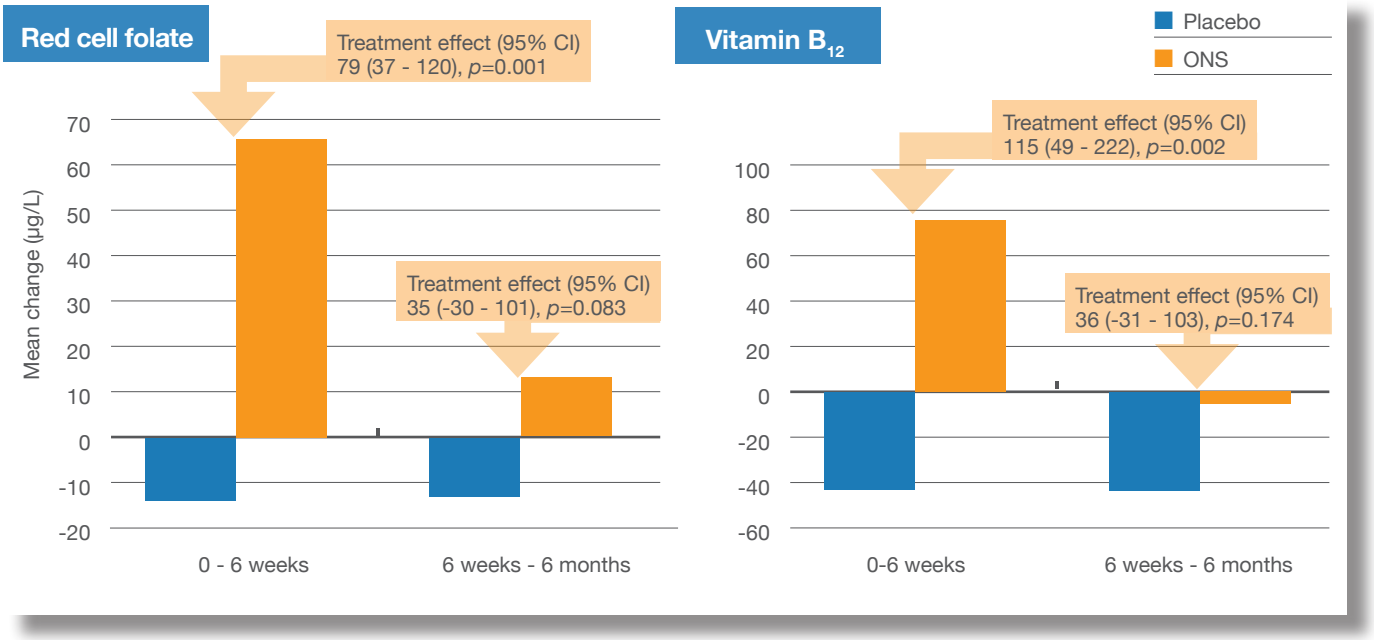

Figure 5.11 **Improved red cell folate and plasma vitamin B_{12} concentrations in patients supplemented with ONS compared with placebo group** (adapted from Gariballa et al. 2006)[247]

- An improvement in micronutrient status (vitamin B_1, thiamine diphosphate, vitamin B_6, vitamin B_{12}, folate and vitamin D) has also been observed following supplementation with ONS compared with placebos in a group of psycho-geriatric nursing home patients.[163]

- Improved plasma vitamin D, vitamin B_{12}, vitamin B_6, homocysteine and folate levels have been observed in older residents of care homes given ONS versus placebos.[245] Most vitamin deficiencies normalised, most notably vitamin D (10% vs 75% remained deficient in the ONS vs the placebo groups).[240]

ONS improve lean body mass in older people

Loss of lean body mass (LBM) (muscle) can lead to reduced muscle function and fatigue, and in turn reduced function, e.g. ability to self-care, ability to undertake normal daily activities, risk of falls (see also Section 5.2, Functional Benefits of ONS).

- Use of ONS has been demonstrated in clinical trials to improve LBM among:
  - ~ older people with Alzheimer's disease in hospitals and day care centres who are nutritionally at risk (significant increase in fat-free mass (FFM) 0.78±1.4 kg, $p < 0.001$);[233]
  - ~ older hospital patients who are malnourished (significant increase in FFM + 1.3 kg, $p < 0.001$);[238]
  - ~ older patients in a meta-analysis of 15 trials, $n = 1382$ (pooled weighted mean difference for percent arm muscle circumference change 1.20%; 95% CI 0.45–1.96%).[231]

High-protein ONS lead to improvements in body mass in adult patients across healthcare settings

- Meta-analysis of 4 RCTs ($n = 118$) (1 RCT in hospital and 3 RCTs in community patients) showed significant improvements in MAMC in patients who received oral nutritional intervention with high-protein ONS versus controls (mean difference 0.47 cm [95% CI 0.30–0.64], $p < 0.05$).[228]

ONS may improve body weight and growth in children with a variety of diseases

- A systematic review of the effect of ONS in children by Stratton et al. (2003) concluded that:[46]
  - ~ a rather limited evidence base suggests that ONS may increase body weight, muscle mass and growth in growth-retarded children with CD;
  - ~ non-randomised trials consistently show that use of ONS is associated with increased growth in growth-retarded children with cystic fibrosis.
- A multi-centre randomised parallel open study of nutritional counselling with or without ONS in children with growth faltering (mean age 48.5 months, range 36.0–61.0 months; $n = 92$) and picky eating behaviour not related to an underlying medical condition showed significantly greater increases in weight and height in the study group versus controls.[248]
- In an uncontrolled study of children with spastic quadriplegia ($n = 35$), ONS significantly improved anthropometric parameters (baseline vs 6-month follow-up), including height, weight, MAC, TSFT, weight z-score, WFA (%), WFH (%) and BMI.[249]
- In a prospective randomised study in children with malignant disease undergoing intensive chemotherapy ($n = 52$, mean age 7.5±3.0 years), significantly fewer patients in the intervention group (EPA-enriched ONS) showed a loss in body weight (6.1% vs 47.4%; $p = 0.001$) and BMI (12.1% vs 52.6%; $p = 0.002$), and a negative deviation in weight percentile (6.1% vs 31.6%; $p = 0.021$) compared to the control group at 3 months. After 6 months ($n = 23$), the percentage of patients with weight loss was significantly lower in the treatment group versus the controls (6.7% vs 50%; $p = 0.03$).[250]

5.2 Functional benefits of ONS

ONS lead to functional benefits in adult hospital patients

- In a review by Stratton et al. (2003), a number of individual RCTs in hospital patients showed significant improvements in functional measures with ONS compared with a control group, such as:[46]
  - ~ improved ventilatory capacity in patients with COPD;
  - ~ improved functional benefits, including increased activity (assessed using Norton scores) and activities of daily living (ADL) levels in older people;
  - ~ retention of skeletal (hand-grip) muscle strength and improved physical and mental health/QOL in surgical patients.
- In post-stroke patients admitted to a stroke service in a rehabilitation hospital and allocated to receive intensive ONS (higher energy, protein and vitamin C content) compared with standard ONS, significant improvements in functional and mobility measures were observed in the intensive ONS group (Functional Independence Measure [FIM] total score [31.49 intensive vs 22.94 standard, $p < 0.001$], FIM motor sub-score [24.25 vs 16.71, $p < 0.001$], 2-minute walk [101.60 vs 43.98, $p < 0.001$], and 6-minute walk [299.28 vs 170.59, $p < 0.001$]).[251]

ONS lead to functional benefits in adult patients in the community

- The comprehensive review undertaken by Stratton et al. (2003) showed that in individual randomised controlled studies, ONS led to significant improvements in functional parameters compared with controls in patients in the community, such as:[46]
  - ~ improved respiratory muscle function, hand-grip strength and walking distances in patients with COPD;
  - ~ increased ADL levels and reduced number of falls in older people.

ONS lead to significant functional benefits, particularly in older people in the community

- Significant functional improvements have been reported in patients receiving ONS in a number of trials, particularly in older people in the community (see Table A2.1, Appendix 2).
- In studies where older patients were given high-protein ONS, improvements in hand-grip strength, objective measures of physical activity, depressive symptoms and QOL, particularly in physical scales, have been reported compared with controls.[244;252;253]
- Supplementation with ONS for between 6 and 16 weeks has shown positive effects on functional outcomes (patients receiving supplements for 6 weeks commenced ONS in hospital and continued after discharge).[252;253]
- Improvement in Katz ADL levels was observed in older patients at risk of malnutrition randomised to receive ONS and dietary counselling on discharge from hospital for 4 months in treated-as-protocol analysis ($p < 0.001$; $p < 0.05$ between groups) (see Figure 5.12).[243]
- Milne et al. (2009) reported that meta-analysis of measures of functional status was not possible as the measures reported in trials were often disease-specific and too diverse to integrate for analysis.[231] Some studies were not included in this review and they appear to have been published after the point at which searches were completed, e.g. Norman et al. (2008) and Gariballa et al. (2007).[237;252;253]

- Edington et al. (2004) reported a significant improvement in hand-grip strength during supplementation of older malnourished patients in the community, but this was not sustained after supplementation was stopped. Furthermore, positive effects on QOL were not seen, although mobility scores were better in the ONS group than in the controls. The authors concluded that in a group of already malnourished subjects, who have many serious underlying disorders, it may be too late to expect to see improvements in functional or QOL parameters simply by providing a short course (8 weeks) of ONS, and that supplementation for a longer period may possibly have a more profound effect.[254]

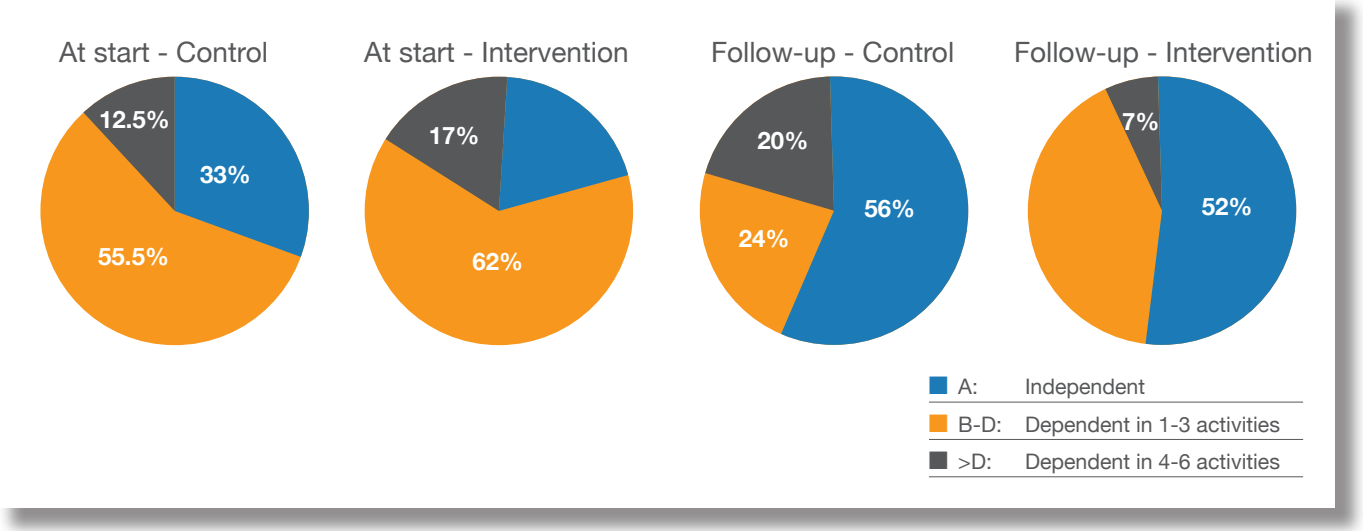

Figure 5.12 **Activities of daily life (ADL) registered by the Katz Index at the start and after 4 months of intervention** (adapted from Persson et al. 2007)[243]

Activities included: bathing, dressing, toilet, transfer, continence and feeding

- Malnourished older people with a variety of conditions randomised to receive ONS post hospital discharge had a significant decrease in functional limitations (mean difference -0.72, 95% CI -1.15 to -0.28) with no difference in costs compared with patients who received usual care.[255]

Emerging data demonstrates that ONS can improve QOL in care home residents

- QOL was significantly higher in care home residents at risk of malnutrition randomised to receive ONS than in residents who received dietary advice (UK).[256]

- Intervention with low-volume, energy and nutrient-dense ONS in malnourished or at risk of malnutrition nursing home residents (n = 77; 87±6 years, 91% female) increased positive self-perception (1 of 10 QOL categories) (Germany).[257]

High-protein ONS can improve hand-grip strength in older community patients

- A systematic review and meta-analysis of 4 RCTs in community patients with COPD, GI disease and hip fracture found that multi-nutrient, high-protein ONS can significantly improve hand-grip strength compared with the controls (1.76kg [95% CI 0.36–3.17], n = 219, p = 0.014 random effects model).[228]

ONS in combination with exercise training can improve muscle strength in older people

- Improvements in muscle strength and muscle power have been observed among frail older people in the community and in long-term care settings who received resistance training/ physical exercise in conjunction with ONS.[258;259]

5.3 Clinical benefits of ONS

5.3.1 MORTALITY

Meta-analyses consistently show a reduction in mortality in patients given ONS versus standard care

- Stratton et al. (2003) found that in hospital patients, mortality rates were significantly lower in supplemented (19%) than control (25%) patients (see Figure 5.13) (older people, liver disease, surgery and orthopaedics, $p < 0.001$; OR 0.61 [95% CI 0.48–0.78], meta-analysis of 11 trials, $n = 1965$; no significant heterogeneity between individual studies).[46] This represented a 24% reduction in mortality.

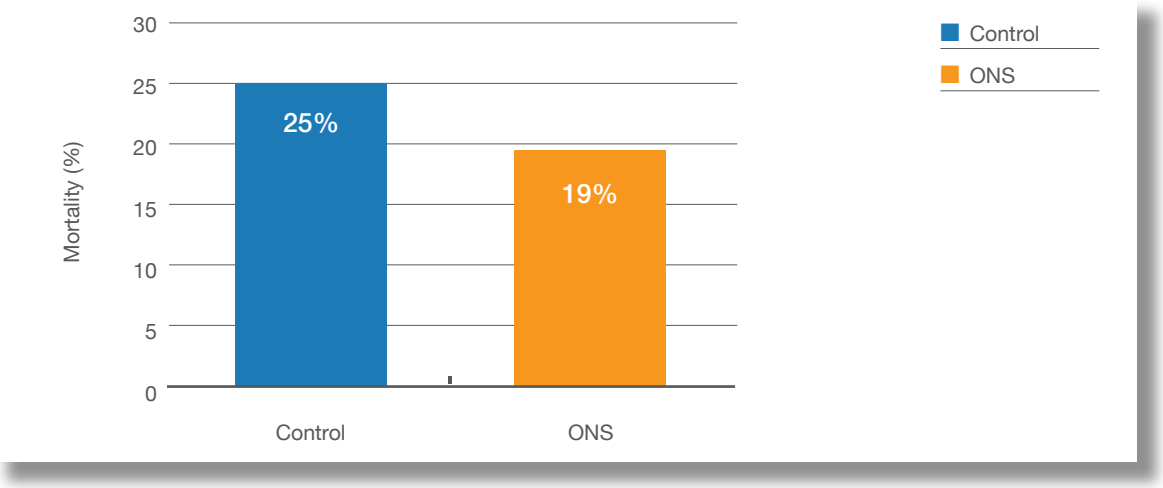

Figure 5.13 **Lower mortality in supplemented versus control patients** (adapted from Stratton et al. 2003)[46]

- The reduction in mortality with ONS tended to be greater in patient groups in which the average BMI was < 20 kg/m^2 than in those with a BMI > 20 kg/m^2.[46]

- Meta-analysis by NICE (2006) of RCTs of ONS versus standard care in malnourished patients across healthcare settings and diagnoses demonstrated a statistically significant reduction in mortality (25 studies, relative risk [RR] 0.82; 95% CI 0.69–0.98) (see Figure 5.14).[236]

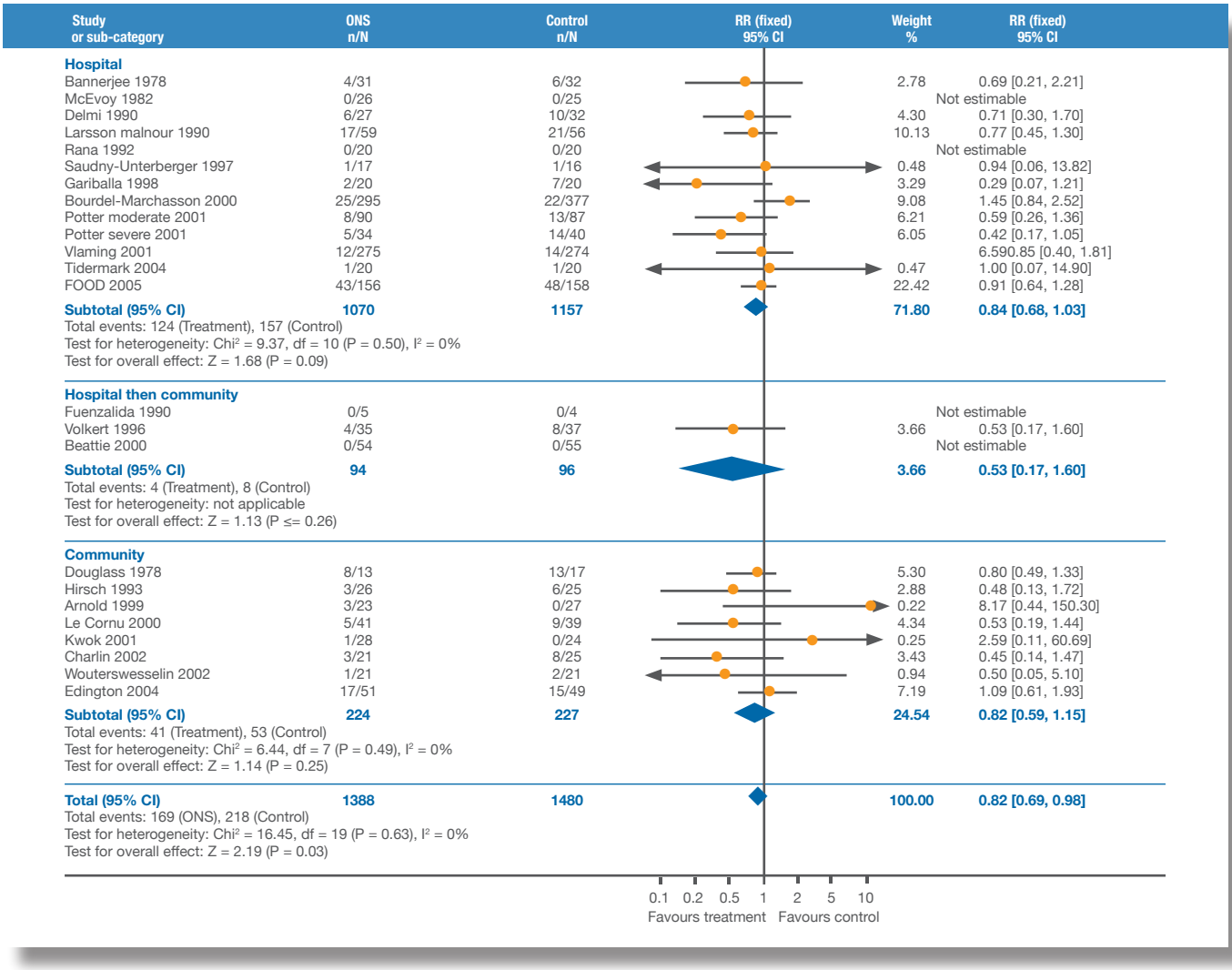

Figure 5.14 **ONS vs standard care (all patients): mortality by setting** (adapted from NICE 2006)[236]

Meta-analyses show a reduction in mortality in undernourished older patients given ONS

- A Cochrane systematic review (Avenell et al. 2006) of intervention with ONS among older hip fracture patients showed that significantly fewer patients had unfavourable outcomes (combined outcome of mortality and survivors with medical complications) with ONS versus routine care (RR 0.52; 95% CI 0.32–0.84).[260] A recent update of this review no longer shows a significant effect (original review intervention group *n* = 66 and control group *n* = 73, updated review intervention group *n* = 126 and control group *n* = 103).[261] The update includes 1 new study, i.e. a study of ONS in normally nourished or mildly malnourished older patients where malnourished individuals were excluded.[262]

- A Cochrane systematic review completed by Milne et al. in 2005 of protein and energy supplementation in older people reported that nutritional supplementation was associated with a statistically significant reduction in mortality (32 trials, *n* = 3021; RR 0.74; 95% CI 0.59–0.92). In subgroup analysis in this report, improved survival with ONS was observed in undernourished patients (21 trials, *n* = 1825; RR 0.72; 95% CI 0.55–0.94), when people were aged ≥ 75 years of age (24 trials, *n* = 2033; RR 0.69; 95% CI 0.54–0.87), when participants were not well (28 trials, *n* = 2628; RR 0.73; 95% CI 0.59–0.92), and when they were offered ≥ 400 kcal/d as ONS (19 trials, *n* = 2177; RR 0.71; 95% CI 0.56–0.90).[263]

- The reduction in mortality with ONS was borderline statistically significant in an update of this meta-analysis in 2006 (25 trials, *n* = 6852, OR 0.86; CI 0.74–1.00)[264] and not significant in a further update in 2009 (42 trials, *n* = 8031, RR 0.92; 95% CI 0.81–1.04).[231] The updates included the Feed Or Ordinary Diet (FOOD) trial,[265] which contributed 4,023 patients of whom only 8% were classified as malnourished at baseline. As most patients were well-nourished, it has been suggested that the wrong patient group was selected for nutritional support.[266] The results of the FOOD trial suggested that routine use of ONS in well-nourished stroke patients is unlikely to be useful; however, the potential benefit of ONS in malnourished patients was not investigated in this trial.[265] The patients most likely to benefit from nutritional support, i.e. severely malnourished patients, are often excluded from trials in nutritional support, as withholding treatment may be unethical.[267]

- The 2009 updated Cochrane review by Milne et al.[231] also included Gariballa et al. (2006), where the number of deaths reported at 6 months was higher in the supplemented group (32/223; 14%) compared with the placebo group (19/222; 9%), but this was not significant ($p = 0.6$).[247] Twelve of the deaths in the supplemented group and 7 in the placebo group occurred within the first 6 weeks of randomisation, and 15 of the patients who died in the supplemented group consumed 3 or less of the total number of ONS prescribed.[247] This may reflect the nature of the study group, i.e. acutely ill older patients.

- However, subgroup analyses in all 3 meta-analyses by Milne et al. (2005, 2006 & 2009) have consistently shown a statistically significant reduction in mortality in undernourished patients receiving ONS compared to routine care (21 trials, *n* = 1825, RR 0.72; 95% CI 0.55–0.94;[263] 17 trials, *n* = 2093, OR 0.73; CI 0.56–0.94;[264] 25 trials, *n* = 2466, RR 0.79; 95% CI 0.64–0.97[231]). Furthermore, an improvement in survival was also consistently shown in all three meta-analyses when patients were offered ≥ 400 kcal/d as ONS (19 trials, *n* = 2177, RR 0.71; 95% CI 0.56–0.90;[263] 15 trials, *n* = 6157, OR 0.85; CI 0.73–0.99;[264] 24 trials, *n* = 7307, RR 0.89; 95% CI 0.78–1.00[231]).

- Significantly lower mortality was found in older undernourished medical patients who were randomised to receive individualised treatment in hospital and the community, which included ONS (Group 1) (3.8%), than in patients who received individualised treatment (including ONS) in hospital only (Group 2) or standard hospital care (Group 3) (11.8%, $p = 0.046$).[246]

5.3.2 COMPLICATIONS (INCLUDING DEVELOPMENT OF PRESSURE ULCERS)

Meta-analyses consistently show a reduction in a variety of complications in patients given ONS compared with standard care

- Stratton et al. (2003) showed that complication rates (infective and others such as GI perforation, pressure ulcers, anaemia, cardiac complications) were significantly lower in supplemented (18%) than in unsupplemented (41%) hospital patients (see Figure 5.15) (surgical, orthopaedic, older people, neurology, $p < 0.001$; OR 0.31; 95% CI 0.17–0.56, meta-analysis of 7 trials, *n* = 384; no significant heterogeneity between studies).[46] This represented a 56% reduction.

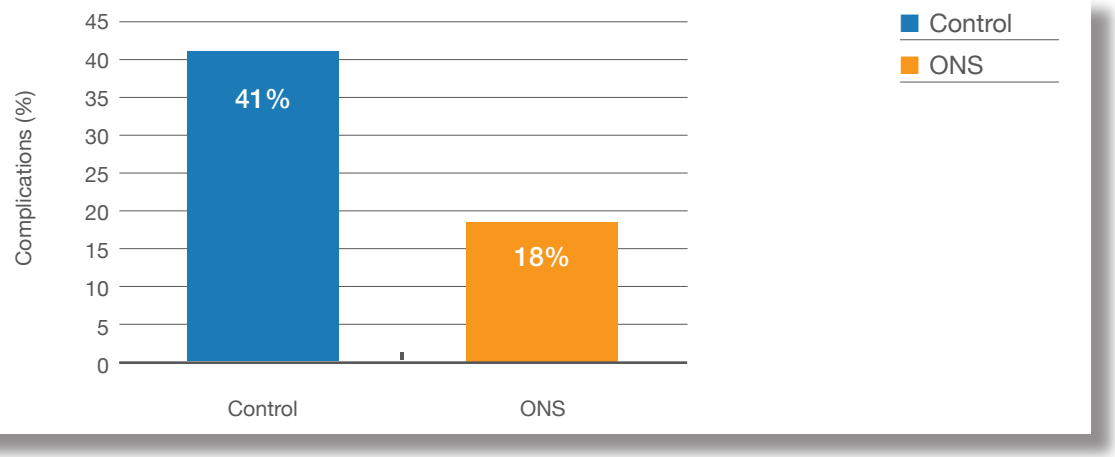

Figure 5.15 **Lower complication rates in supplemented vs control patients in hospital** (adapted from Stratton et al. 2003)[46]

- Complication rates were reduced by ONS in patient groups independent of BMI (with a BMI < 20 kg/m^2 [3 trials, 12% vs 27%; OR 0.38; 95% CI 0.07–1.97] and > 20 kg/m^2 [1 trial, 12% vs 27%]) or when BMI was unknown (3 trials, 38% vs 75%, OR 0.21; 95% CI 0.04–1.18).[46]

- NICE (2006) similarly found a significant reduction in complications in hospital patients given ONS versus standard care (9 trials, RR 0.75; CI 0.64–0.88) (see Figure 5.16).[236]

- Meta-analysis by Milne et al. (2009) showed a reduction in complications in older people treated with ONS compared to routine care (24 trials, *n* = 6225, RR 0.86; 95% CI 0.75–0.99) and in a subgroup analysis of patients with hip fracture (6 trials, *n* = 298, RR 0.60; 95% CI 0.40–0.91) but not in other patient subgroups (variety of hospital and community settings) (see Figure 5.17).[231]

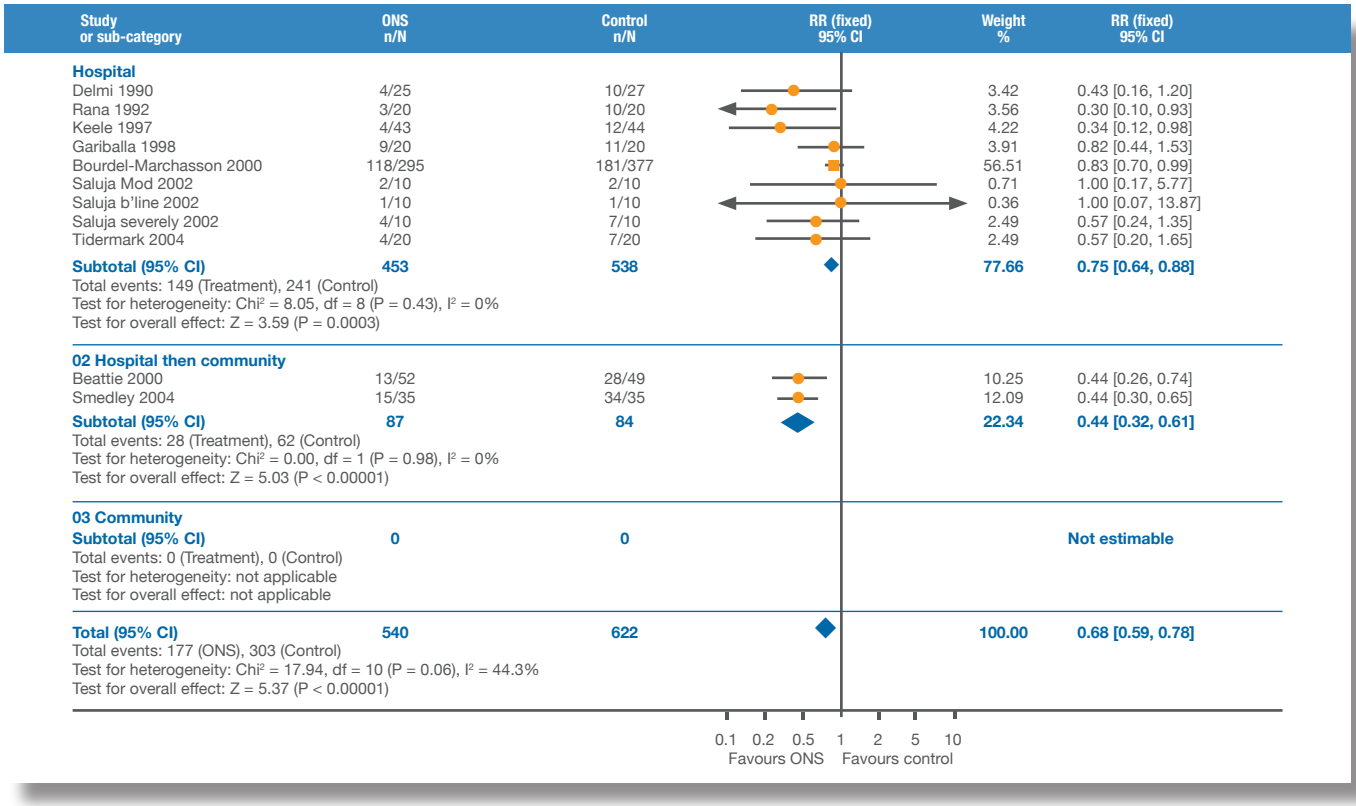

Figure 5.16 **ONS versus standard care (all patients): complications by setting** (adapted from NICE 2006)[236]

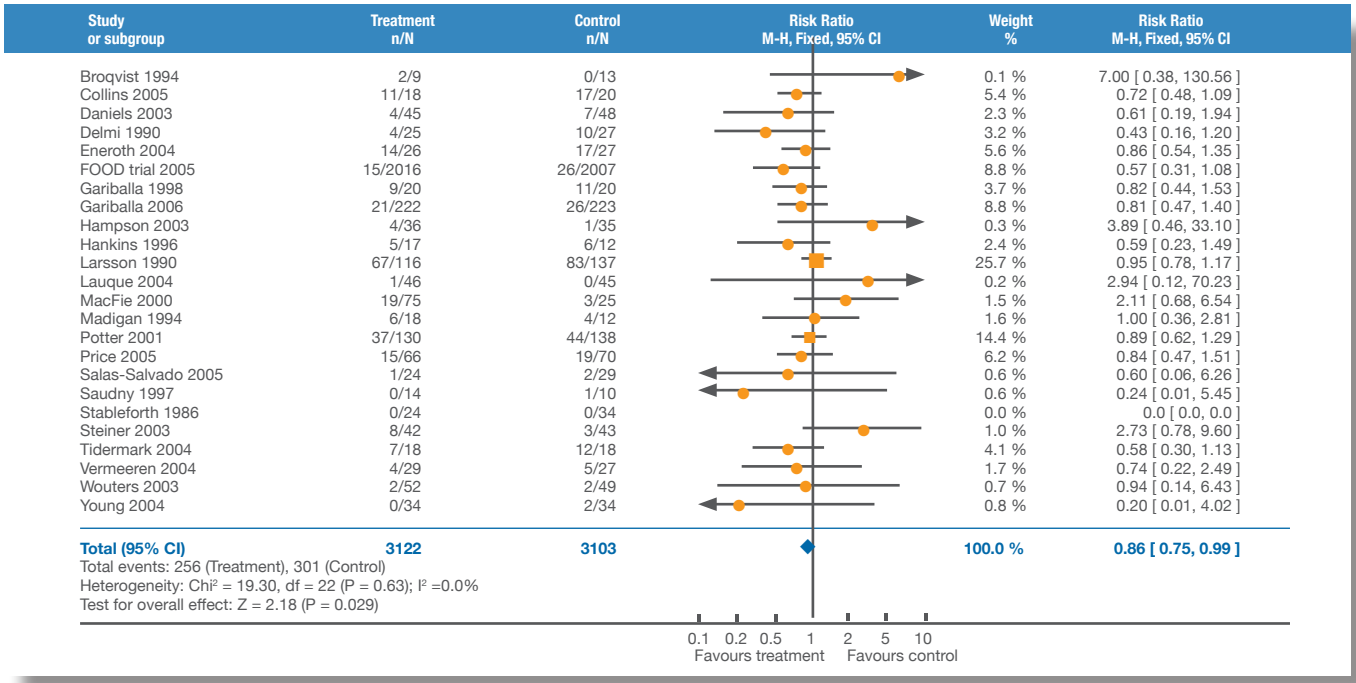

Figure 5.17 **ONS vs routine care in older patients (variety of settings): complications** (adapted from Milne et al. 2009)[231]

- Subgroup analysis showed a significant reduction in surgical site infections (Buzby criteria) in weight-losing patients admitted to hospital for elective curative surgery for colorectal cancer who received high-protein ONS preoperatively (p = 0.034) compared with patients who received dietary advice.[268]

ONS reduce complications in patients who start ONS in hospital and continue in the community

- The meta-analysis undertaken by NICE (2006) showed fewer complications in patients who started on ONS in the hospital setting and then continued in the community (2 trials, RR 0.44, CI 0.32–0.61).[236]

- In GI surgical patients undergoing a variety of procedures, a significant reduction in complication rates was seen in patients receiving ONS (250–600 kcal/d for 7 days to 10 weeks, 6 trials, OR 0.37, CI 0.23–0.60).[269]

- A systematic review of post-discharge supplementation with ONS in patients undergoing GI surgery highlighted the lack of available data specifically on the post-discharge period; nevertheless, it concluded that it would be sensible to offer nutritional support to malnourished patients at high risk of poor nutritional intake post discharge.[270]

Protein-rich supplements may be of special interest in reducing clinical complications

- A Cochrane systematic review (Avenell and Handoll 2010) of intervention with ONS among older hip fracture patients concluded that protein-enriched ONS (> 20% total energy from protein) reduce the number of long-term medical complications (RR 0.78; 95% CI 0.65–0.95).[261]

- Specifically, protein-rich ONS have been shown to significantly reduce the incidence of complications in hospital and community settings in patients with hip fracture, leg and pressure ulcers and acutely ill patients compared with controls (10 RCTs, n = 1830; OR 0.68, 95% CI 0.55–0.83, $p < 0.001$), corresponding to an average of 19% absolute reduction in complications (see Figure 5.18). The effect remained significant in subgroup analyses by setting (hospital: 3 RCTs, n = 932; OR 0.69, 95% CI 0.53–0.89, p = 0.005; community: 7 RCTs [4 starting in hospital], n = 846; OR 0.66, 95% CI 0.47–0.93, p = 0.017).[228]

Study	Setting	Odds ratio	Lower limit	Upper limit	z-Value	p-Value	Comp/Total ONS	Comp/Total Control
Botella-Carretero et al 2008	Hospital-Community	1.308	0.473	3.615	0.517	0.605	17/30	15/30
Bourdel-Marchasson et al 2000	Hospital	0.722	0.530	0.983	-2.071	0.038	119/295	181/377
Delmi et al 1990	Hospital-Community	0.383	0.104	1.402	-1.450	0.147	4/27	10/32
Eneroth et al 2004	Community	0.686	0.229	2.057	-0.672	0.501	14/26	17/27
Espaulella et al 2000	Hospital-Community	0.515	0.269	0.985	-2.006	0.045	44/80	57/81
Gariballa et al 2006	Hospital-Community	0.792	0.431	1.454	-0.754	0.451	21/222	26/223
Houwing et al 2003	Hospital	0.825	0.379	1.796	-0.485	0.628	27/51	30/52
Olofsson et al 2007	Hospital	0.482	0.252	0.921	-2.210	0.027	27/83	37/74
Otte et al 1989	Community	0.825	0.147	4.628	-0.219	0.827	3/13	4/15
Tidermark et al 2004	Community	0.359	0.100	1.294	-1.566	0.117	7/20	12/20
		0.676	**0.548**	**0.832**	**-3.683**	**0.000**	**282/847**	**389/931**

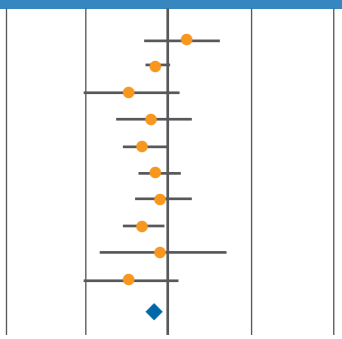

Figure 5.18 **Significantly lower rate of complications with high-protein ONS compared with controls** (adapted from Cawood et al. 2012)[228]

Protein-rich ONS are of particular interest in the prevention of development of pressure ulcers

- Pressure ulcers affect 10% of people in hospitals, and older malnourished people are at highest risk. Older people recovering from illness appear to develop fewer pressure ulcers when given 2 high-protein ONS daily.[271]

- Meta-analysis of studies using high-protein ONS showed a significant reduction in the risk of developing pressure ulcers in high-risk patient groups (by 25%) (4 trials, *n* = 1224, OR 0.75; 95% CI 0.62–0.89) (see Figure 5.19).[272]

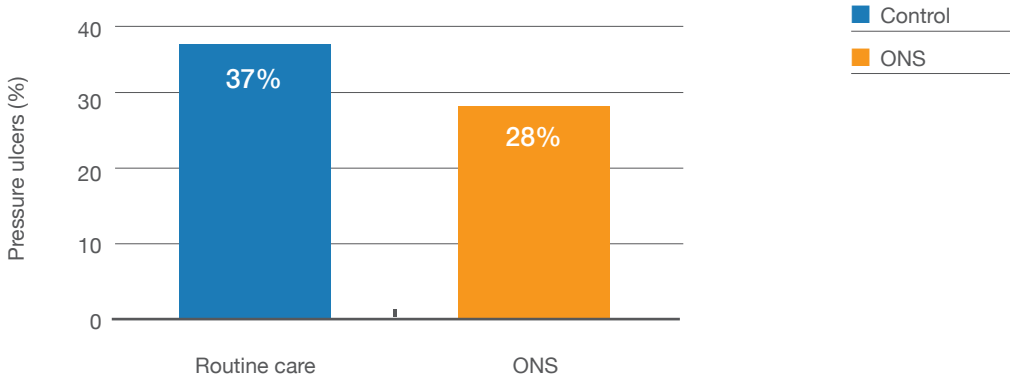

Figure 5.19 **Prevention of pressure ulcers in at risk patients with ONS (hospital and long-term care): summary of results from a meta-analysis** (adapted from Stratton et al. 2005)[272]

Clinical benefits of ONS in children

Complications

- A multi-centre randomised parallel open study of nutritional counselling with or without ONS in children with growth faltering (mean age 48.5 months, range 36.0–61.0 months; *n* = 92) and picky eating behaviour not related to an underlying medical condition showed a significantly lower percentage of upper respiratory tract infections in the study group versus the controls (28% vs 51%, *p* = 0.027).[248]

Other

- In a prospective randomised study in children with malignant disease undergoing intensive chemotherapy (n = 52, mean age 7.5±3.0 years), the remission rate was significantly higher in the group supplemented with protein- and energy-dense ONS (enriched with EPA) compared with the group who received usual care (87.9% vs 63.2%; p = 0.036).[250]

Nutritional intervention with ONS can improve energy intake and reduce weight loss in cancer patients

- Stratton et al. (2003) reviewed the effect of ONS in patients with cancer and found that ONS may improve total energy intake and food intake but that these improvements may not be sustained over time. Significant improvements in total energy intake were seen in 2 out of 3 RCTs.[46]

- Regular nutrition intervention (dietary counselling with ONS) has been demonstrated to improve nutrient intake and nutritional status during radiotherapy in patients with oesophageal and head and neck cancers in various stages.[273]

- A systematic review with meta-analysis of patients with cancers in various locations and of various grades undergoing radiotherapy demonstrated that that ONS significantly increased dietary intake by an average of 381 kcal/d (95% CI 193–569 kcal in 3 RCTs).[274]

- Patients admitted to hospital for elective curative surgery for colorectal cancer who received high-protein ONS had significantly higher total energy intake preoperatively compared with controls (who received dietary advice) (1722 [489] kcal/d vs 745 [366], p = 0.001).[268]

- A study investigating weight loss in patients with oropharyngeal cancers undergoing radiotherapy +/- chemotherapy demonstrated that all groups receiving ONS alongside dietary counselling showed significantly less weight loss than those not receiving ONS. In the radiotherapy group, a relative reduction in weight loss of 40% was seen versus routine care (p = 0.008), and in those undergoing radiotherapy, a 37% relative reduction was seen (p = 0.007).[275]

Nutritional intervention with ONS can improve QOL outcomes in malnourished patients with cancer

- Patients with GI or head and neck malignancies undergoing radiotherapy who received nutritional intervention comprising intensive counselling plus ONS versus usual care showed a significantly smaller decrease and faster recovery in global QOL (p = 0.009) and physical function (p = 0.012) over a 12-week period.[276]

Nutritional intervention with ONS may result in cost savings in patients with cancer

- Use of ONS alongside nutritional counselling in oropharyngeal patients undergoing radio therapy was associated with decreased need for Percutaneous Endoscopic Gastrostomy (PEG) tube placement (reduced from 31% to 6%), demonstrating potential cost savings from reduction in tubes, placement costs and complications.[275]

- The majority of studies published include patients with cancers of the head and neck or GI tract. A systematic review of patients with head and neck squamous cell carcinoma receiving radiotherapy with or without chemotherapy was published in 2010. Within this review, 80% of the studies demonstrated reduced weight loss in those patients receiving nutritional counselling and ONS and support the use of ONS as an adjunct to counselling by a professional dietitian.[277]

Benefits of EPA-enriched ONS in cancer patients

- The role of EPA, a long-chain polyunsaturated fatty acid derived from fish oil, has been of increasing interest in the management of patients with cancer. EPA may modulate many aspects of the systemic inflammatory response associated with cancer cachexia.[274;278] It has also been associated with reducing and reversing weight loss in cancer patients and improvements in QOL.[279]

- In clinical practice, EPA has been supplemented as capsules and also in the form of EPA-enriched energy- and protein-dense ONS, which may work together to manage a reduced nutritional intake alongside the metabolic changes.[278]

Nutritional intervention with EPA-enriched ONS lead to improved nutritional intake and reduced weight change in cancer patients

- Supplementation with EPA-enriched ONS (versus isocaloric, isonitrogenous standard ONS) in non-surgical malnourished lung cancer patients resulted in significant improvements in energy and protein intakes after 4 weeks: 2456 kJ ($p = 0.03$) and 25.0 g ($p = 0.01$) respectively. Intervention resulted in better weight maintenance (by 1.7 kg, $p = 0.04$) after 4 weeks and a smaller reduction in LBM (1.9 kg, $p < 0.05$) after 5 weeks.[280]

- A post-hoc dose response analysis of intake of EPA-enriched ONS versus standard ONS in patients with advanced pancreatic cancer showed significant correlations between supplement intake and weight gain in the EPA group ($r = 0.5$, $p < 0.001$) and increase in LBM ($r = 0.33$, $p = 0.036$) that were not seen in the control group.[281]

- A recent prospective observational study supplementing patients undergoing surgical treatment for squamous cell cancers of the head and neck with EPA-enriched ONS perioperatively showed that 70% maintained or gained weight prior to surgery, with 57% continuing to maintain or gain weight during hospital admission. There was a statistically significant increase in LBM (+3.21 kg over course of the study ($p < 0.01$) in the study group.[282]

- In a small study of colorectal cancer patients receiving EPA-enriched ONS prior to and during chemotherapy, a significant weight increase in the 3 weeks prior to the start of chemotherapy (mean 2.5 kg, $p = 0.03$) was maintained during the subsequent 6 weeks of treatment.[283]

Where weight gain occurs, this is associated with better QOL outcomes

- Functional status and symptom scale domains of the European Organisation for Research and Treatment of Cancer Quality of life Questionnaire (EORTC QLQ-C30) were significantly improved after 30 days and 60 days in patients with lung cancer undergoing chemotherapy, who gained weight when receiving EPA-enriched ONS ($p = 0.05$).[284]

- Intake of EPA-enriched ONS and weight gain correlate positively with QOL measured by the EQ-5D index in pancreatic cancer patients ($r = 0.37$, $p = 0.01$ and $r = 0.46$, $p < 0.001$).[281]

5.4 Economic benefits of ONS

5.4.1 HEALTHCARE RESOURCES

ONS reduce length of hospital stay

- Meta-analysis by Stratton et al. (2003) showed that length of hospital stay in supplemented compared with control patients was reduced significantly in all 9 RCTs that presented results, either as means or medians (9/9 trials; two-tailed binomial test, $p < 0.004$). The average reductions ranged from 2 days (in surgical patients) to 33 days (in orthopaedic patients). Meta-analysis of 4 trials that recorded the mean of LOS in surgical and orthopaedic patients indicated that ONS were associated with reduced LOS relative to control patients (effect size -0.80 days [95% CI -1.24–0.36]).[46]

- The reduction in LOS appeared to be greater in patient groups with a BMI < 20 kg/m^2 than when BMI was > 20 kg/m^2.[46]

- Meta-analysis of 9 RCTs in hip fracture and acutely ill patients ($n = 1227$) (ONS given in hospital [1 RCT], in the community [1 RCT] and across hospital and community [7 RCTs]) showed a significant reduction in length of stay in patients who received oral nutritional intervention with high-protein ONS versus controls (-3.77 [95% CI -7.37–0.17] days, $p = 0.040$ random effects model).[228]

- Meta-analysis shows that use of ONS significantly reduces the proportion of patients (variety of conditions) admitted or readmitted to hospital compared with routine care (24% vs 33%) (OR 0.60; 95% CI 0.43-0.82; $p = 0.001$).[285]

High-protein ONS reduce hospital readmissions by 30%

- Meta-analysis of 2 RCTs in acutely ill patients with a wide variety of conditions and in GI disease patients ($n = 546$) (ONS given in hospital and community in 1 trial and in the community in the other trial) showed that oral nutritional intervention with high-protein ONS had a significant effect on reduction of hospital readmissions compared with controls (OR 0.59 [95% CI 0.41–0.84] days, $p = 0.004$ random effects model) (see Figure 5.20).[228] High-protein ONS reduced overall readmissions by 30% (number of readmissions in the control group used as a reference).[228]

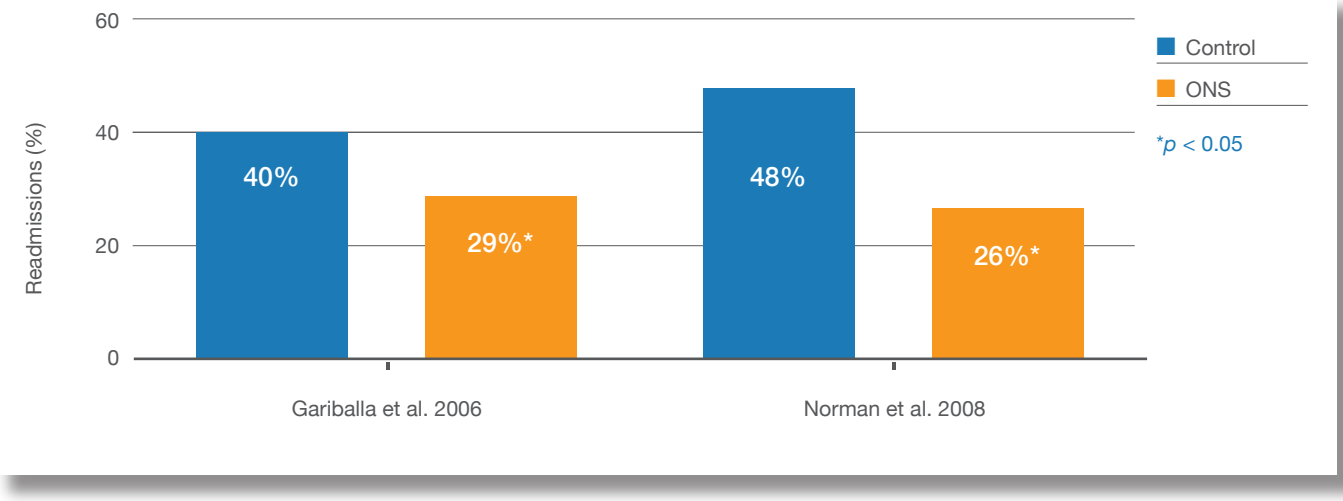

Figure 5.20 **Significant reductions in readmissions with high protein ONS** (adapted from Cawood et al. 2012)

ONS can improve rehabilitation outcome

- In undernourished patients admitted to a stroke service, those randomised to receive an intensive (higher energy, protein and vitamin C content) supplement (n = 51) were more likely to be discharged home (63%) compared with those (n = 51) given standard ONS (43%) ($p < 0.05$) (34% reduction in discharges to institutional settings).[251]

5.4.2 COST SAVINGS

ONS have economic benefits at patient and population levels in hospitals

- Lassen et al. (2006) performed a cost analysis that estimated the potential savings achieved by reducing the number of medical inpatient days through appropriate use of ONS. The analysis considered an average €168 (USD 226[vii] per day [1997 values]) cost reduction for each day less spent in hospital. The results of the analysis indicated that with appropriate use of ONS, there is a potential for hospitals in Denmark to realise cost savings of approximately €16.4 million (USD 22 million[vii]) in the period of a year.[286]

- In the Netherlands, the use of ONS reduces costs in treating abdominal surgery patients from €3,318 to €3,066, which corresponds to a €252 (7.6%) cost saving per patient compared with standard care without ONS. The costs of ONS are more than balanced by a reduction in hospitalisation costs (€3,318 to €3,044 per patient, 8.3% cost saving corresponding to 0.72 days reduction in length of stay). The use of ONS would lead to an annual cost saving of €40.4 million based on the number of abdominal procedures performed (160,283) per year in the Netherlands.[287]

- BAPEN undertook a cost analysis of the use of ONS in hospitals in the UK. Data was extracted from RCTs of ONS versus standard care. Three key variables were chosen for analysis: amount of supplement consumed, length of hospital stay, and complications. The study suggested that use of ONS in hospital patients results in cost saving in abdominal surgical patients (see Figure 5.21) and in orthopaedic surgical patients, elderly care and stroke patients. The pooled results from the analysis indicated a mean net cost saving from the use of ONS of €1,002 (£849[viii]) per patient based on bed-day costs or €352 (£298[viii]) per patient if calculated using complication rates.[211]

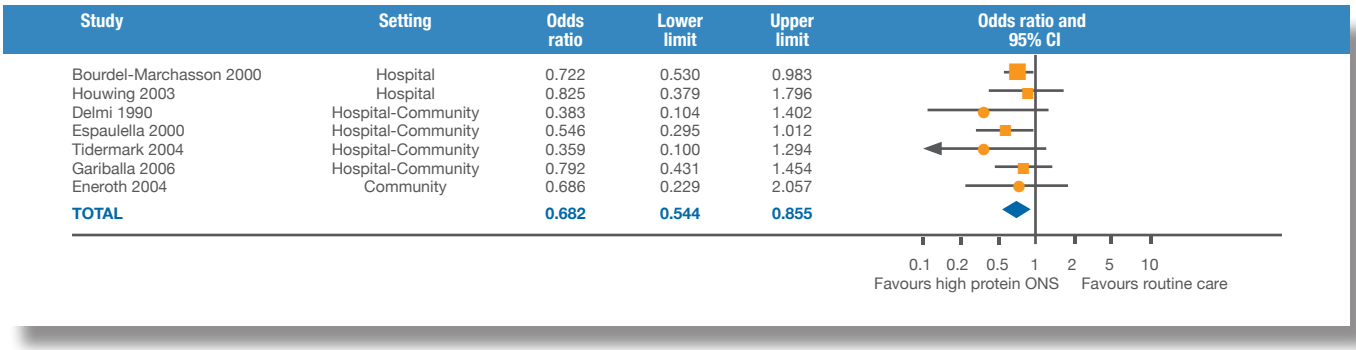

Figure 5.21 **Effect of ONS on net cost saving in surgical studies in the UK (based on bed-day costs)** (adapted from Elia et al. 2005)[211]

SMD: standardised mean difference

[vii]Calculated based on an exchange rate of USD to € of 0.74448 (Source: Interbank 29/02/2012)
[viii]Calculated based on an exchange rate of £ to € of 1.17993 (Source: Interbank 29/02/2012)

- A meta-analysis using a fixed effects model and standardised costs showed that for all stages of pressure ulcers, high-protein ONS result in net cost savings of between €6 (£5[ix]) (stage I) and €543 (£460[ix]) (stage IV) per patient when given to older patients at risk of developing pressure ulcers (compared with placebo or no ONS). The result was significant for stage III (effect size 0.12; 95% CI 0.00–0.11; $p = 0.04$) and stage IV ulcers (effect size 0.12; 95% CI 0.01–0.11; $p = 0.04$).[288]

- A retrospective cost analysis was undertaken by Stratton et al. (2003) of 9 RCTs (with and without use of ONS). This simple analysis demonstrated mean cost savings of between €415 (£352[ix]) and €9,651 (£8,179[ix]) per patient in surgical, orthopaedic, elderly and cerebrovascular accident patients.[46]

Community

ONS have economic benefits at patient and population levels in the community

- A prospective observational longitudinal cohort study undertaken by Arnaud-Battandier et al. (2004) evaluated the economic impact of using ONS among malnourished older people in the community in France. Intervention with ONS supported clinical and economic advantages including:[289]

  - reduction in healthcare utilisation;
  - fewer home nursing visits;
  - fewer GP and physiotherapist visits;
  - fewer hospital admissions;
  - shorter length of hospital stay with admission.

- After considering the investment required for ONS, the average reduction in medical care costs was €195 per patient (Table 5.2).[289]

Table 5.2 **Adjusted healthcare costs, mean per patient (€)** (adapted from Arnaud-Battandier et al. 2004)[289]

	Group 1 (*n* = 125)	Group 2 (*n* = 186)	Difference
Oral supplementation [90% CI]	37	565	+528 [+478; +578]
Other medical care			
Hospital admissions	2123	1572	-551
Nurse visits	362	217	-145
GP visits	42	32	-10
Physiotherapist visits	39	37	-2
Specialist visits	2	3	+1
Examinations	5	7	+2
Other costs	84	66	-18
Sub-total [90% CI]	2657	1934	-723 [-1444; -43]
Total cost [90% CI]	**2694**	**2499**	**-195 [-929; +478]**

[ix]Calculated based on an exchange rate of £ to € of 1.17993 (Source: Interbank 29/02/2012)

- A health economic analysis was carried out in Germany based on the use of ONS versus 'no ONS' in individuals in the community eligible for ONS due to risk of DRM. It was calculated that a reduction in hospitalisation costs (of €768 per patient) led to total cost savings of €234 per patient when the extra costs for ONS (€534) were accounted for. The extra costs for ONS were also offset by a reduction in hospitalisation costs (of €791 per patient), leading to cost savings of €257 per patient when a scenario-based analysis based on length of stay and per diem instead of disease-related group costs was used. National cost savings of between €604 million and €662 million can be realised respectively in the base case and the scenario analysis.[290]

- Based on the comparison of oral nutritional intervention using ONS versus 'no ONS' in older people (> 65 years of age) in the community in the Netherlands eligible for ONS due to DRM, a health economic analysis using a linear decision analytical model showed that using ONS leads to a €173 cost saving per patient (total costs reduced from €1,353 to €1,180). The costs of ONS are more than balanced by a reduction in hospitalisation costs.[291]

- The budget impact of ONS was assessed using a linear decision analytical model using ONS in older people (> 65 years) eligible for ONS due to DRM living in the community in the Netherlands. The use of ONS led to annual cost savings of €13.3 million (18.9%) when all eligible individuals were treated. The additional costs of ONS (€57.0 million) were more than balanced by a reduction in other healthcare costs (€70.3 million). The use of ONS in all sensitivity analyses led to cost savings.[292]

- A budget impact model was used to investigate the impact of using ONS to manage older people in the community in England at high risk of malnutrition ('MUST'). Pooled analysis of data showed reductions in pressure ulcers, infections, antibiotic prescriptions and hospital admissions (by 88%, 32%, 56% and 33% respectively) with oral nutritional intervention using ready-made ONS versus controls. Annual cost savings of €19 million (£16 million[x]) were demonstrated, and the resulting reduction in costs (-€104 million [-£88 million[x]]) more than offset the total costs of using ONS in conjunction with monitoring by healthcare professionals (€99 [£84 million[x]]).[293]

- One of the earliest analyses, performed by BAPEN in 2005 in the UK, suggested that overall economic benefits can be achieved from use of ONS in the community. If hospital admission is prevented, the cost of prescribing ONS in the community may well be offset.[211;294] An analysis of short-term preoperative oral nutritional intervention with ONS (based on data from 3 RCTs in community patients [2 in the UK, 1 in the USA] using ONS for 2 weeks prior to surgery) showed a cost saving per patient with ONS of €812 (£688[x]) (based on hospital bed-day costs) and €424 (£359[x]) (based on excess bed-day costs).[211]

ONS have economic benefits across healthcare settings

- A systematic review and meta-analysis of RCTs investigated the effect of high-protein ONS versus control (routine care, placebo) on length of stay, readmissions and costs (hospital and community). Meta-analysis of 9 RCTs showed an associated reduction in bed-day costs corresponding to €1,658 (£1,405[x]) per patient enrolled in the study resulting from significantly reduced length of stay compared to controls. Meta-analysis of 2 RCTs showed significant cost savings of €381 (£323[x]) (95%; CI €130–€629 [£110–£533[x]], $p = 0.003$) per patient enrolled associated with significant reductions in readmissions in favour of ONS.[295]

- Nutritional support in adults is listed in the top 6 of the NICE cost-saving guidance, with estimates suggesting that improving screening, assessment and treatment of malnourished patients could lead to cost savings of €33,595 (£28,472[x]) per 100,000 population (http://www.nice.org.uk/usingguidance/benefitsofimplementation/costsavingguidance.jsp).

[x]Calculated based on an exchange rate of £ to € of 1.17993 (Source: Interbank 29/02/2012)

Table 5.3 Summary of cost savings per patient and per annum with oral nutritional intervention using ONS by country and healthcare setting

COUNTRY	AUTHOR (year)	PATIENT GROUP	HEALTHCARE SETTING	COST-SAVING* PER PATIENT	COST-SAVING* PER ANNUM
HOSPITAL					
Denmark	Lassen et al. (2006)[286]	Medical	Hospital	-	€16.4 million (USD 22 million)**
The Netherlands	Freijer & Nuijten (2010)[287]	Abdominal surgery patients	Hospital	€252	€40.4 million
UK	Elia et al. (2005)[211]	Pooled results from analysis in surgical, elderly and stroke patients	Hospital	€1002 (£849) (bed day costs) €352 (£298) (complication costs)	-
UK	Elia & Stratton (2005)[288]	Older patients at risk of developing pressure ulcers (Stage IV)	Hospital	€543 (£460)	-
UK	Stratton et al. (2003)[46]	Surgical, orthopaedic, elderly and cerebrovascular accident patients	Hospital	€415-€9651 (£352-£8179)	-
COMMUNITY					
France	Arnaud-Battandier et al. (2004)[289]	Malnourished older people (>70 years of age)	Living in the Community	€195	-
Germany	Nuijten (2010)[290]	Eligible for ONS due to risk of DRM	Community	€234–€257	€604–€662 million
The Netherlands	Freyer & Nuijten (2010)[291]	Older people (> 65 years of age) eligible for ONS due to DRM	Community	€173	-
The Netherlands	Nuijten & Freyer (2010)[292]	Older people (> 65 years of age) eligible for ONS due to DRM	Community	-	€13.3 million
UK	Cawood et al. (2010)[293]	Older people (> 65 years of age) at high risk of malnutrition	Community	-	€19 million (£16 million)
UK	Elia et al. (2005)[211]	Pre-surgery (elective)***	Community	€812 (£688) (hospital bed-day costs) €424 (£359) (excess bed-day costs)	-
HOSPITAL AND COMMUNITY					
UK	Cawood et al. (2010)[295]	Hip fracture and acute illness† Patients with GI disease an acute illness¥	Acute & Rehab hospitals Community and, hospital + community	€1658 (£1405) (bed day costs) €381 (£323)	-

*See previous entries on pages 107-110 for details of exchange rates used **Based on medical inpatient days.
***Short-term ONS (about 2 weeks). †Meta-analysis of 9 RCT. ¥Meta-analysis of 2 RCT.

5.4.3 COST-EFFECTIVENESS

ONS are cost-effective in malnourished patients

- An RCT found that supplementation with high-protein ONS for 3 months in malnourished patients with benign GI disease was more cost-effective compared with dietary counselling on discharge from hospital. Although intervention was associated with higher costs (Incremental Cost Effectiveness Ratio [ICER]: €9,497 and €12,099/additional quality adjusted life year [QALY] respectively), this is considered cost-effective by standards in several European countries (< €50,000/QALY).[296] Note that this was a conservative estimate as not all outcome benefits associated with ONS were taken into account.

- Economic modelling undertaken by NICE (2006) of the use of ONS within the context of a screening programme undertaken in older hospital patients suggests cost-effectiveness in terms of cost per QALY, i.e. €8,024 (£6,800[xi]), which is well below the NICE threshold of €23,599–€35,398 (£20,000–€30,000[xi])/QALY for treatments deemed to be good value for money.[236]

- An RCT of malnourished (based on BMI and weight loss) older people (n = 105; ≥ 60 years) admitted to hospital and followed up until 3 months post discharge demonstrated that oral nutritional intervention with an enriched diet, ONS, calcium and vitamin D supplement and dietary advice led to a significant improvement in functional limitations in the intervention group compared with the control group (usual care) and was neutral in terms of cost. The differences in QALYs after the 3-month follow-up were small, leading to a large incremental cost-effectiveness ratio of €26,962: 1 additional QALY. Cost-effectiveness for QALYs and physical activities could not be demonstrated, but a €6,500 investment is necessary to reach a 95% chance of improvement in functional limitations (in the Netherlands, an investment of below €20,000 is regarded as cost-effective).[255]

The cost-effectiveness plane

Figure 5.22 depicts a cost-effectiveness plane. The origin is the standard of care, the y-axis represents the costs, and the x-axis represents the effects.

- All values in the north-west quadrant depict more costly but also less effective interventions. These interventions are not considered cost-effective, and based on these grounds they will be rejected by decision-makers.

- All interventions in the south-east quadrant depict less costly but also more effective interventions. These will therefore be considered cost-effective and should be adopted by decision-makers.

- The results in the north-east quadrant are more costly but also more effective. The decision made about results in this section is related to the amount of money decision-makers are willing to pay for the added benefit.

- The results in the south-west quadrant represent less costly and also less effective choices. Most authorities do not consider interventions that are less effective than the standard of care. However, if the standard of care weighs very heavily on healthcare budgets, interventions in the south-west quadrant will be considered for subgroups with mild disease severity.

QALY is an index of survival that is adjusted to account for the patient's quality of life. QALYs have the advantage of incorporating changes in both quantity (longevity/mortality) and quality (morbidity, psychological, functional, social and other factors) of life. QALYs are used to measure benefits in cost-utility analysis.

[xi]Calculated based on an exchange rate of £ to € of 1.17993 (Source: Interbank 29/02/2012)

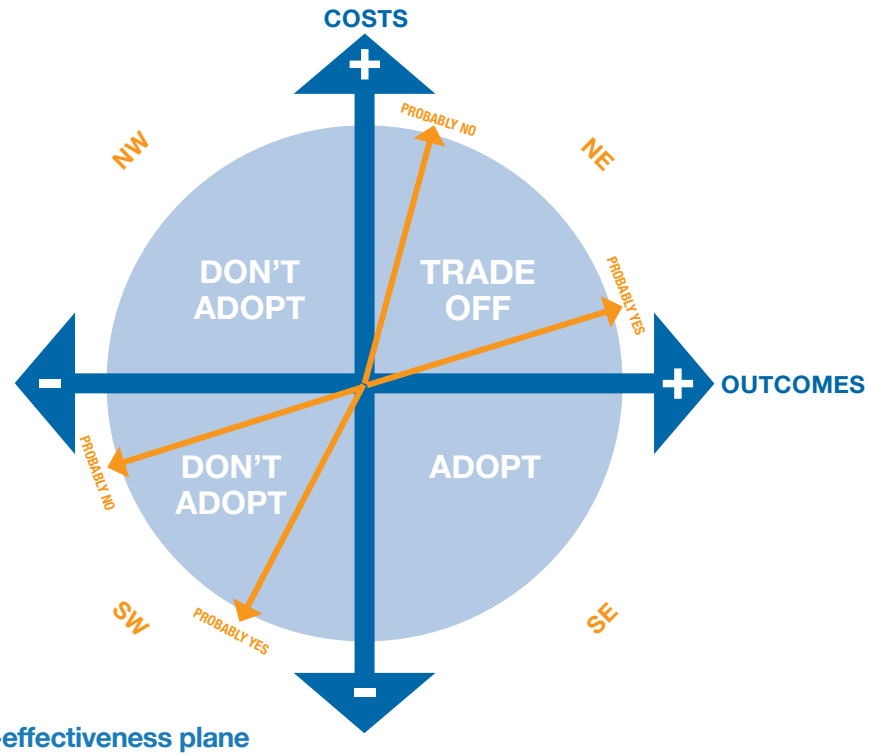

Figure 5.22 **The cost-effectiveness plane**

- Some of the studies discussed earlier in this section show that oral nutritional intervention with ONS leads to cost savings. Therefore, these results always depict the south quadrants. The studies discussed in Section 5.3 Clinical Benefits of ONS show that most studies place the use of ONS in the east quadrants. As explained above, interventions in the south-east quadrant should be adopted because they are more effective and less costly. Those in the north-east quadrant may be cost-effective depending on the ceiling ratios or thresholds considered by decision-makers (willingness to pay for added value to the healthcare system) (see Figure 5.23).

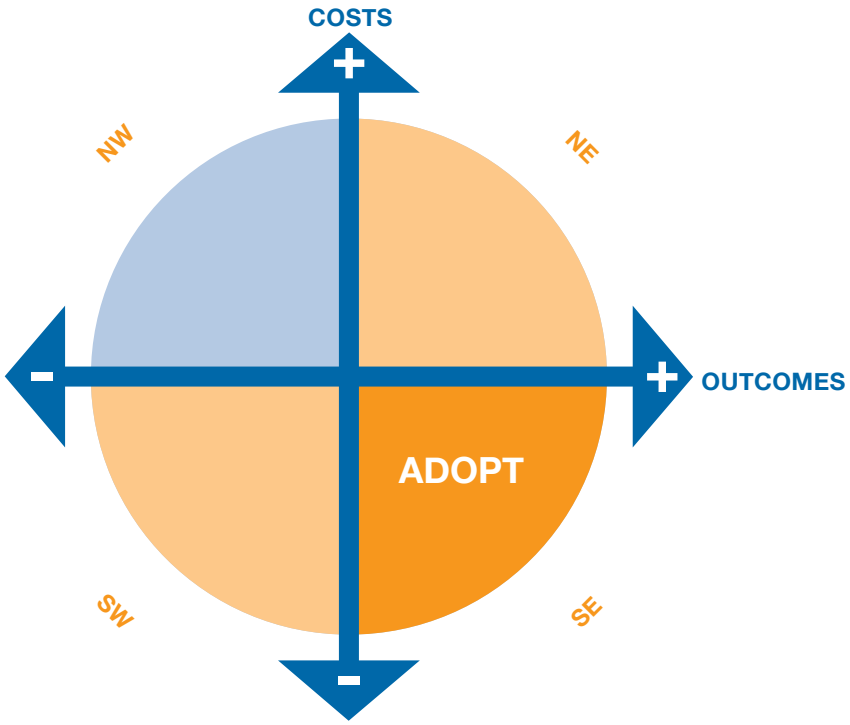

Figure 5.23 **Based on clinical trials, oral nutritional intervention with ONS has clinical benefits, placing the use of ONS in the east quadrants. Studies which have demonstrated cost savings place the use of ONS in the south quadrants.**

Cost savings and cost-effectiveness of ONS in children

- To date, there have been no health economic analyses of the economic benefit of oral nutritional intervention with ONS in children. In the absence of this data, it is worth keeping in mind that ONS has been shown to generate significant cost savings on a per patient and per population basis in adults and that ONS have been shown to be cost-effective.

Other forms of oral nutritional intervention

- A variety of oral nutritional intervention strategies other than ONS are used in clinical practice for the management of malnutrition, including dietary advice, food snacks, and food fortification, although evidence of their effectiveness is lacking.

Evidence for the benefits of dietary advice and food fortification in managing disease-related malnutrition is lacking or is of variable quality

- NICE (2006) was unable to demonstrate any evidence of the effect of dietary advice; studies were too small and heterogeneous to allow any conclusions to be drawn, and many failed to report outcomes of interest.[236]

- A review designed to assess the specific impact of the provision of adequate nutritional care (including the routine provision of food and drink) rather than proprietary nutritional support (e.g. ONS) concluded that there is a serious lack of evidence to support interventions designed to improve nutritional care, meaning that firm conclusions for practice could not be made.[297]

- A systematic review of the effects of oral nutritional interventions in care homes (searches up to December 2009) did not identify any trials comparing dietary advice and routine care in this healthcare setting.[227]

- In a systematic review and meta-analysis of 45 RCTs in adults with DRM in a variety of healthcare settings (n = 3186), Baldwin and Weekes (2011) compared dietary advice (DA) with a) no DA, b) ONS, and c) DA + ONS. In addition, they compared DA + ONS if required with no DA or ONS. Table 5.4 summarises the main results and shows that DA alone may improve body weight and MAMC, but the studies are of variable quality. DA combined with ONS improves nutritional status.[298]

- No significant differences were seen in any comparison between groups for mortality or morbidity. This is in contrast to previous systematic reviews (see Section 5.3.1 and 5.3.2). Almost half of the studies included in this review that reported on mortality (14 of 31 trials across groups) reported no deaths at all. Very few trials reported morbidity data (5 studies in total across all groups).

- There was appreciable clinical (and statistical) heterogeneity between patient groups in these trials, and it is acknowledged that in most of the studies there was minimal information provided on the nature and intensity and duration of dietary advice provided. Within the groups using ONS, the amount, composition and duration of use varied considerably.

Table 5.4 **Summary of the main results for primary outcomes from a systematic review and meta-analysis of dietary advice (with or without ONS) for DRM in adults**[298]

Primary Outcomes	Measures	Comparison	Mean difference (95% CI)	Notes
Clinical	Mortality	No comparison showed a significant difference between groups		
	Morbidity*			
Nutritional status	Body weight	DA vs no DA	3.75 kg (0.97–6.53) 1.47 kg (0.32–2.61)	For interventions lasting > 12 months All studies combined (significant heterogeneity)
		DA + ONS if required vs no DA	2.20 kg (1.16–3.25)	
	MAMC	DA vs no DA	0.81 mm (0.31–1.31)	All studies combined (moderate heterogeneity)
		DA + ONS vs no DA	-0.89 mm (-1.35–0.43)	
	TSFT	DA + ONS vs no DA	-1.22 mm (-2.34–0.09)	Studies on TSFT heterogeneous

*Measured as risk of hospital admission, readmission and length of hospital stay

- A systematic review of the effects of oral nutritional intervention in care homes (searches up to December 2009) found that 1 fortification trial reported small non-significant changes in energy intake. No significant differences were reported in the few food fortification trials that reported functional outcomes, and no food fortification trials reported clinical outcomes.[227] Additionally, trials of ONS in this review did not report functional outcomes; however, significant clinical outcomes such as reductions in infections and bed-days, improved pressure ulcer healing, and increases in energy intake and body weight were reported (see Section 5 for details).[227]

- Food fortification is employed widely with the aim of increasing the energy and nutrient density of food; however, care should be taken with this approach since high levels of fortification have been shown to have detrimental effects on the aesthetic ratings of commonly fortified foods, such as soup and milk puddings, potentially making them unappealing and less likely to be consumed.[299]

ONS have been shown to be more effective than dietary advice or snacks

- In a trial of hospital patients with fractured neck of femur at risk of malnutrition (screened using 'MUST') (n = 50, median age 82 [range 46–97], median BMI 19 kg/m^2 [range 12.5–26 kg/m^2]) randomised to receive either ONS (300 kcal per carton) or isoenergetic readily available snacks ad libitum post-operatively, significantly fewer patients in the ONS group had complications than in the snack group (27% vs 58%, p = 0.04). Although not significant, a reduction in the incidence of specific complications was also observed, i.e. infections, 17% vs 33%, and wound-related complications (poor wound healing, pressure ulcers), 17% vs 38%.[300]

- See Table A4.1, Appendix IV for a comparison of the average nutrient content of ONS with typical food snacks.

- An RCT comparing the effectiveness of ONS with DA in care home residents (n = 104) at risk of malnutrition (using 'MUST' [medium and high risk]) showed that energy and protein intakes were significantly higher in residents randomised to receive ONS than in residents who received dietary advice. Appetite sensations were not significantly different between the 2 groups.[235]

Compliance to ONS is good. Compliance to other methods of oral nutritional intervention need investigation

- A systematic review investigating whether patients' compliance to ONS (amount consumed relative to amount prescribed) varied according to healthcare setting, ONS type, volume or duration and patient characteristics such as age or condition found that:[301]

  - Overall pooled mean compliance to ONS was 78.2% (SD 15, range 37-100%; n = 52 studies) and in 62% of studies compliance was ≥ 75%;
  - Mean percentage compliance to ONS was 80.9% in studies in the **community** (included patients attending hospital outpatients, residents in care homes and free-living individuals) (SD 13, n = 33 studies), 67.2% in studies in **hospitals** (SD 12, n = 10) and 80.7% (SD 8, n = 3) in studies in **multiple settings** (included patients in both hospital and community);
  - Energy density was the main ONS-related factor positively associated with compliance (r^2 = 0.093) with significantly higher mean percentage compliance to ONS containing ≥ 2 kcal/ml than ONS with 1-1.3 kcal/ml or 1.5 kcal/ml (91% vs 77% vs 78% respectively, $p < 0.05$);
  - Duration of ONS intervention or volume of ONS prescription did not appear to be correlated with compliance (duration: r^2 = 0.055, p = 0.124, n = 44 studies; volume: r^2 = 0.0002, p = 0.774, n = 39 studies);
  - Compliance was negatively associated with age (r^2 = 0.148, p = 0.01, n = 44 studies), but no significant difference in compliance to ONS was found in different patient groups (p = 0.130);
  - Compliance to ONS was positively associated with greater ONS energy intake (r^2 = 0.106, p = 0.024, n = 48 studies) and total energy intakes (energy from food plus ONS) (r^2 = 0.307, p = 0.002, n = 29 studies).

Emerging data of special interest

- A systematic review and meta-analysis of 13 RCTs (n = 439) of nutritional support in the management of malnutrition in COPD patients found that nutritional support (mainly in the form of ONS) increases total intake, anthropometric measures and grip strength.[302]

6 ONS IN KEY GUIDELINES

Summary

ONS are increasingly recognised as an integral part of the overall patient management strategy for malnutrition, in hospitals and in the community, based on the overwhelming evidence that ONS lead to improvements in nutritional intake, body composition, clinical, functional and economic outcomes.

In many countries evidence-based guidelines on the management of malnutrition have been developed by national authorities, government agencies, health departments and professional organisations and in many cases through collaboration and joint working by these stakeholders. The guidance available covers different patient groups in different care settings but they consistently include ONS as an integral part of patient care. Some include practical advice for healthcare practitioners on how and when to use different forms of nutritional intervention, including ONS, but unambiguous and practical advice should be included more routinely in guidance documents.

Patients with complex and often chronic conditions are highly susceptible to the negative consequences of malnutrition. Professional groups with expertise in nutrition including ESPEN, ASPEN and the American Dietetic Association have led the field in developing extensive guidance on the management of malnutrition in a variety of patient groups including older people, people with cancer, gastrointestinal disease, COPD and spinal injury. These evidence-based guidelines describe the circumstances in which ONS should be used as part of a range of strategies to meet patients' nutritional needs.

The importance of nutritional care and the role of ONS are increasingly recognised by government level organisations such as NICE, SIGN and organisations specialising in specific conditions such as the Clinical Oncology Society of Australia through their condition-specific guidance for healthcare providers and practitioners. This is a critical step in raising the awareness of the issue of malnutrition with specialist healthcare practitioners who otherwise may miss malnutrition and who are ideally placed to recognise the problem early and instigate appropriate nutritional care.

A key aspect of many of guidance documents is the correct targeting of nutritional intervention, including the use of ONS, at patients who have been identified as malnourished or at risk of malnutrition. It is clear that appropriate use of nutritional intervention is part of the wider task of identifying patients at nutritional risk and implementing timely and appropriate care. There is emerging evidence that screening may reduce the prevalence of malnutrition and that screening programmes that include intervention and care planning can contribute to improved outcomes.

Conclusion

Many national, international and professional guidelines exist that include ONS as an integral part of patient care. However, continued effort is needed to ensure guidelines are updated to reflect the evidence base, to integrate good nutritional care into guidelines for specific diseases (e.g. nutritional support as part of cancer care guidelines), and to ensure that these guidelines are recognised and established as a credible and essential basis for good patient care. Translation of "academic guidelines" into practical advice for healthcare providers is needed to achieve both improved patient outcomes and to ensure appropriate use of resources.

Recommendations

On the issue of **ONS as an integrated part of guidelines** the MNI makes the following recommendation:

Action	Issues to consider
Guidance on managing malnourished patients or patients at risk of malnutrition should reflect current evidence and should provide healthcare providers and practitioners with clear and practical advice about how and when to use different forms of nutritional intervention, including ONS	• Nutrition experts have a key role in collaborating with other groups to ensure that the issue of malnutrition and the opportunity for effective management is included in guidance for patients with specific diseases • Efforts should be made to ensure that the guidance is widely disseminated and adopted

Examples

Evidence-based guidelines for the nutritional management of patients with a variety of conditions are listed. This list is not exhaustive, and other existing and newly developed national and professional guidelines could extend this overview in the future. Guidelines from around the world have been included if available in English or if an English translation could be obtained.

This unique overview is a starting point which it is hoped will encourage a review of key guidelines and prompt the sharing of information.

6.1 Recommendations from international, national and professional guidelines

Tables 6.1 to 6.4 include the results of efforts made to identify evidence-based national and professional guidelines referring to ONS as an integral part of patient and disease management across the world. Relevant professional and national organisations were contacted or searches of websites were undertaken, including the US Department of Health and Human Sciences National Guideline Clearinghouse (www.guideline.gov), searches of the published literature from 2002 to 2012 were completed, and approaches were made to contacts in relevant areas. Other guidelines may exist but are not included as they were not identified using the above strategies or we were unable to obtain information in the English language for inclusion. We would welcome information about other guidelines that could be included in future editions of this report.

In addition, guidelines for nutrition support exist in the following countries and are to our knowledge based on the guidelines developed by ESPEN:

- China (www.cspen.org);
- Czech Republic

Note: Terminology referring to ONS is not consistent within the various guidelines; therefore, the term [ONS] has been inserted in place of these terms to avoid confusion

GENERAL

Table 6.1 **Summary of some examples of evidence-based national and professional guidelines referring to ONS as an integral part of patient and disease management - General** (parts of guidelines relevant to ONS are presented here, standard ONS formulae only)

Country	Body	Patient Group	Title	Recommendation, guideline or standard [grade of evidence, where available]
Denmark	The National Board of Health (2008)	Patients in hospitals	Screening and treatment of patients at nutritional risk. Guidelines for physicians, dietitians, nurses and other HCPs	There is a positive effect of ONS in patients where there is an indication for intensive nutritional therapy according to NRS-2002 ONS recommended for: • Patients who need an energy-dense diet • Patients with low food intake • Patients with chewing and swallowing difficulties, such as patients with dysphagia, patients with painful mouth and throat, patients with paralysis and generally impaired condition because of dementia or amyotrophic lateral sclerosis
Denmark	The Danish Veterinary and Food Administration (2009)	Patients in institutions	Recommendations for Food in Danish Institutions	ONS recommended for: • Patients with chewing and swallowing difficulties, such as patients with dysphagia, patients with painful mouth and throat, patients with paralysis and generally impaired condition because of dementia or amyotrophic lateral sclerosis • Patients with chronic disease, patients with general low energy and protein intake, for recovery after surgery – before considering enteral nutrition
Denmark	– The Danish Veterinary and Food Administration – The National Board of Health – DTU National Food Institute –Danish Diet & Nutrition Association –The Association of Danish Clinical Dietitians	Any patient (not infants)	The National Diet Handbook	ONS recommended for: • Patients with chewing and swallowing difficulties • Patients with chronic disease, patients with general low energy and protein intake, for recovery after surgery • Patients where there is an indication for intensive nutritional therapy according to NRS-2002

Table 6.1 Continued

Country	Body	Patient Group	Title	Recommendation, guideline or standard [grade of evidence, where available]
England and Wales	National Institute for Health and Clinical Excellence (NICE) (2006)	All patients in hospital and in the community	Nutrition Support for Adult Oral Nutrition Support, Enteral Tube Feeding and Parenteral Nutrition[236]	Indications for oral nutrition support: • Healthcare professionals should consider oral nutrition support* to improve nutritional intake for people who can swallow safely and are malnourished** or at risk of malnutrition*** [A] • Healthcare professionals should ensure that the overall nutrient intake of oral nutrition support offered contains a balanced mixture of protein, energy, fibre, electrolytes, vitamins and minerals [D (GPP)] • Oral nutrition support should be stopped when the patient is established on adequate oral intake from normal food [D (GPP)] Note: see Table 6.5 for summary of grading of recommendations *NICE has commenced work on a Quality Standard for Nutrition Support in Adults which will be developed from this guideline. NICE quality standards are 'a set of specific, concise statements and associated measures. They set out aspirational, but achievable, markers of high-quality, cost-effective patient care, covering the treatment and prevention of different diseases and conditions'*
Finland	National Nutrition Council (2010)	All patients in hospital, community, care/elderly homes and rehabilitation centres	Nutrition treatment recommendation	Intensive nutrition treatment is recommended in case of poor appetite or malnutrition or risk of malnutrition. Intensive nutrition treatment includes, for example, food fortification, snacks, ONS and tube feeds. Protein-rich ONS are recommended in the case of protein-rich intensive nutrition treatment **– This recommendation concerns all diseases (e.g. cancer, renal, ulcerative colitis [UC]) and also elderly patients and children** Modified food diet: • Liquid food – ONS are always recommended • Puréed food – ONS can be recommended depending on the situation
Norway	Norwegian Directorate for Health (2009)	All patients in hospital and in the community	National scientific guidelines for prevention and treatment of malnutrition	Use an appropriate high energy and nutrient-dense diet in combination with ONS for people at risk of malnutrition [A]

Table 6.1 Continued

Country	Body	Patient Group	Title	Recommendation, guideline or standard [grade of evidence, where available]
Spain	2007	Hospital patients	Nutrition Support in Hospital Patients: update on guidelines and consensus statements	A review of key international professional guidelines on nutrition support in hospital patients
Sweden	The National Board of Health and Welfare (2000) SWESPEN	All patients within healthcare	Problems with nutrition within healthcare: prevention and treatment A small practical handbook to have in the pocket: Nutritional treatment within healthcare	Summary: [ONS] have positive effects when given to patients at risk of or with manifest malnutrition. This applies for some chronic diseases but not all; more studies are needed [ONS] should be given when the need for energy and nutrients is not covered by the usual food
The Netherlands	Quality Institute for Healthcare (CBO, 2007)	Surgical patients in general	Perioperative Feeding Guidelines	Summary: guidelines on how to screen for and treat malnutrition before, during and after surgery (general) • It is recommended to screen for malnutrition and treat malnutrition before surgery. The best way to treat serious malnutrition is to start immediately with artificial supplements or tube feeding. Start 7–10 days before surgery [D] • If malnutrition is diagnosed, [ONS] must be used instead of trying to improve the nutritional status with DA [A1] • [ONS] are preferred over parenteral feeding when treating malnutrition prior to surgery [C] Grading of recommendations: A1) Systematic reviews of at least some A2-level clinical trials that have shown consistent results A2) Randomised comparative clinical trials of good quality (randomised double-blind controlled trials), good sample size and consistency B) Randomised clinical trials of poor quality, insufficient sample size or other comparative trials (non-randomised, comparative, cohort research, patient-controlled research) C) Non-comparative research D) Expert opinion, for example, from committee members

Table 6.1 Continued

Country	Body	Patient Group	Title	Recommendation, guideline or standard [grade of evidence, where available]
The Netherlands	Steering Committee Malnutrition (Stuurgroep Ondervoeding, 2009)	Malnutrition in general, all lines of healthcare) (including children)	Guidelines Malnutrition: screening and treatment	Summary: guidelines for all lines in healthcare about screening with screening tools and how to treat malnourished patients. A table is used to show how to treat malnourished patients with regard to their nutritional intake • When 75–100% of the nutritional requirements is met, use protein and energy-rich food, if necessary combined with ONS • When 50–75% of the nutritional requirements is met, use protein- and energy-rich food and combine with ONS • When < 50% of the nutritional requirements is met, use protein- and energy-rich food, continue ONS if possible, and start tube feeding
UK	Malnutrition Advisory Group of BAPEN (2003)	All	The 'MUST' Report Nutritional screening of adults: a multidisciplinary responsibility[13]	There is substantial evidence of the beneficial clinical effects of [ONS] containing a mixture of macro- and micronutrients in particular groups of patients in hospital and the community, and of greater benefit in individuals with a BMI of < 20 kg/m^2 than > 20 kg/m^2, particularly patients in the community. [A – at least 1 RCT as part of the body of literature of overall good quality and consistency addressing the specific recommendation]
UK	BAPEN (2000)	Patients in the community	Guidelines for the detection and management of malnutrition[12]	• Treatment typically begins with food but may progress to the use of [ONS]. In some patients it may begin with food and [ONS] • If ordinary food is ineffective in improving nutritional status and ineffective in achieving the goals set at the beginning of treatment, [ONS] (mixed micro- and macronutrient supplements in solid or liquid form) can be of value. This is because they are readily available, easy to consume between meals, require little or no preparation, and are largely additive to food intake in undernourished subjects [A – at least 1 RCT as part of the body of literature of overall good quality and consistency addressing the specific recommendation]
USA	American Medical Directors Association (2001)	With or at risk of malnutrition	Altered nutritional status	• Distribute [ONS] during the medication pass • Evidence suggests that [ONS] given approximately 60 minutes before a meal do not reduce food consumption

Table 6.1 Continued

Country	Body	Patient Group	Title	Recommendation, guideline or standard [grade of evidence, where available]
USA	Council for Nutritional Strategies in Long-Term Care (2000)	With or at risk of malnutrition	Nutritional management in long-term care: development of a clinical guideline	• [ONS] can increase dietary intake and produce weight gain • [ONS] must be given between meals in order not to substitute for calorie intake at meals
USA	American Society for Parenteral & Enteral Nutrition (2011)	Adults	Nutrition Screening, Assessment and Intervention in Adults	• Nutrition support intervention is recommended for patients identified by screening and assessment as at risk for malnutrition or malnourished [C]
Australia	Dietitians Association of Australia Malnutrition Guideline Steering Group (2009)	Malnutrition in adult patients across care settings	Evidence-based practice guidelines for the nutritional management of malnutrition in adult patients across the continuum of care	• [ONS] (high energy and/or protein) may improve outcomes See full guidelines for details of evidence base for outcomes in specific settings (across settings, acute care, rehabilitation, residential aged care and community) Note: See Table 6.6 for summary of grading of recommendations Nutrition goals, intervention, monitoring practice tips: When providing [ONS], consider the following (see full guidelines for individual references): ~ Base individual prescription on gap between oral intake and estimated requirements not met through oral intake alone ~ Continue the nutrition support for an adequate timeframe since this is cor related with improved weight change ~ Avoid administering high energy and protein [ONS] at mealtimes ~ Deliver the [ONS] via the medication round to facilitate adherence ~ Encourage a supportive environment to facilitate adherence ~ Use dietetic assistants to improve adherence to meal plans and [ONS]

*Oral nutrition support includes any of the following methods to improve nutritional intake: fortified food with protein, carbohydrate and/or fat, plus minerals and vitamins; snacks; ONS; altered meal patterns; the provision of DA
**Malnourished: BMI < 18.5 kg/m^2, unintentional weight loss > 10% within the last 3–6 months, a BMI < 20 kg/m^2 and unintentional weight loss > 5% within the last 3–6 months
***At risk of malnutrition: eaten little or nothing for more than 5 days and/or likely to eat little or nothing for the next 5 days or longer or poor absorptive capacity, and/or high nutrient losses and/or increased nutritional needs from causes such as catabolism

OLDER PEOPLE

Table 6.2 **Summary of examples of evidence-based national and professional guidelines referring to ONS as an integral part of patient and disease management – Older People** (parts of the guidelines relevant to ONS are presented here, standard ONS formulae only)

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
Europe	European Society for Clinical Nutrition and Metabolism (Volkert et al 2006)	ESPEN Guidelines on Enteral Nutrition: Geriatrics[303]	• In patients who are undernourished or at risk of under-nutrition, use ONS to increase energy, protein and micronutrient intake, maintain or improve nutritional status, and improve survival [A] • In frail elderly, use ONS to improve or maintain nutritional status [A] • In geriatric patients after hip fracture and orthopaedic surgery, use ONS to reduce complications [A] • In early and moderate dementia, consider ONS – and occasionally tube feeding – to ensure adequate energy and nutrient supply and to prevent under-nutrition [C] • ONS, particularly with high protein content, can reduce the risk of developing pressure ulcers [A] • In the case of nutritional risk (e.g. insufficient nutritional intake, unintended weight loss > 5% in 3 months or > 10% in 6 months, BMI < 20 kg/m^2), initiate ONS and/or tube feeding early [B] Note: see Table 6.7 for summary of grading of recommendations
Denmark	The Danish Veterinary and Food Administration (2002)	Elderly with low food intake (patients in institutions and elderly in home care)	ONS recommended for: Dietary management of malnutrition, decreased appetite and weight loss
Denmark	The National Board of Health (2007)	Older people – guidelines for municipalities	ONS recommended for: • Older people with low energy and protein intake to prevent underweight and loss of function and strength because of malnutrition
Finland	National Nutrition Council (2010)	Nutrition recommendation for elderly "Ravitsemussuositukset ikääntyneille" (from free-living elderly to hospitalised patients)	• ONS are recommended for elderly people who have acute disease, hip fracture, too-low body weight (recommendations BMI > 23) or weight loss > 3 kg/3 months. ONS are also recommended for use after surgery • ONS are often also recommended for cancer, COPD, heart failure and dysphagia patients and patients who have poor appetite

Table 6.2 Continued

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
France	Haute Autorité de Santé (2011)	Clinical practice guidelines from the French Health High Authority: Nutritional support strategy in protein-energy malnutrition in the elderly[304]	Methods of nutritional support: Oral nutritional support. This comprises nutritional guidance, assistance during eating, provision of enriched food and oral nutritional supplements, some of which are reimbursed **Choice of method of nutritional support:** The choice of a nutritional support strategy is based on the patient's nutritional status and on spontaneous food energy and protein intake (see Table 6.8). It also takes into account the nature and severity of any underlying disease(s) and associated disabilities as well as their foreseeable outcome (swallowing disorders, for example). Nutritional support strategy must also take into account the opinion of patients and their close relatives as well as ethical considerations. Apart from situations contra-indicating oral feeding, nutritional support should, as a priority, be initiated by providing DA and/or fortified foods, [C] if possible in collaboration with a dietitian. Oral nutritional supplements (ONS) may be given if these supportive measures are ineffective or from the onset in patients with severe malnutrition [C] **Practical measures:** *Oral nutritional support:* Studies on malnourished elderly patients have shown an improvement in body weight and survival and a reduction in the incidence of complications after oral nutritional support [A] **ONS:** High energy and/or high-protein ONS come in different flavours, with or without lactose, and in a variety of forms (liquid, cream, etc.). Several types of products are available, including dairy desserts, soups, complete meals, fruit juices, etc. Preference should be given to high energy (> 1.5 kcal/ml or/g) and/or high-protein products (proteins > 7.0 g/100 ml or 100 g or proteins > 20% of total energy intake) *ONS are prescribed as follows:* • ONS may be eaten as a snack or during meals. When they are provided during meals, they must be eaten in addition to meals and not as a meal replacement. As a snack, they should be given about 2 h before or after a meal in order not to spoil the appetite • The prescription of an ONS should supply an additional food intake of 400 kcal/day and/or 30 g protein/day; this generally requires 2 units per day • Patients should be told that ONS are a treatment for malnutrition to encourage consumption • The taste of the prescribed ONS should be suited to patient preferences in terms of being salty or sweet, creamy or not, and in terms of flavour. A vanilla or plain product may be modified by adding flavours (fruit syrup, caramel, coffee, chocolate powder, etc.). Consumption may be encouraged by varying products and flavours and respecting patient preferences

Table 6.2 Continued

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
			• ONS should be adapted to any disabilities (difficulties in swallowing or in gripping objects, etc.). The texture of drinks may be modified with a thickening powder (not included on the list of reimbursed products) • ONS intake may be encouraged by serving them at the correct temperature. Sweet products are often preferred cold. ONS that should be served hot may often be heated up in a double boiler or microwave oven. Once opened, the supplement may be kept for 2 h at room temperature and for up to 24 h in the refrigerator • A regular check should be performed to ensure that the prescribed ONS are actually consumed • When patients live at home, the first prescription is made for a maximum period of 1 month. After medical reassessment, subsequent prescriptions may be made for a maximum period of 3 months. Medical reassessment should be based on the following: ~ body weight and nutritional status ~ clinical course of underlying disease(s) ~ estimation of spontaneous food intake ~ tolerability of ONS ~ level of compliance with the ONS prescription
Australia	Developed by the Clinical Epidemiology and Health Service Evaluation Unit, Melbourne Health. Previously commissioned on behalf of the Australian Health Ministers' Advisory Council (AHMAC) by the AHMAC Care of Older Australians Working Group	Best practice approaches to minimise functional decline in the older person across the acute, sub-acute and residential aged care settings (This version updated by the Victorian Government Department of Human Services. Update 2007)	• There is some evidence to support the use of high-protein-containing [ONS] to reduce LOS for older people in inpatient rehabilitation and other high risk settings • There is good evidence to support the use of ONS (protein and energy) to reduce mortality and complications and to improve nutritional status in undernourished hospitalised older patients, and it may be considered for those who would benefit from weight gain

Table 6.2 Continued

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
USA	Hartford Institute for Geriatric Nursing – Academic Institution (2008)	Nutrition. In: Evidence-based geriatric nursing protocols for best practice	Provide [ONS] [ONS] should not replace meals but rather be provided between meals but not within the hour preceding a meal or at bedtime [Level IV]. See National Collaborating Centre for Acute Care Clinical Guideline (2006) for algorithm for use of [ONS] (see Figure 6.2 in this report)
USA	University of Texas at Austin School of Nursing, Family Nurse Practitioner Program – Academic Institution (2006)	Unintentional weight loss in the elderly	Management/Treatment Non-pharmacological therapy • Increasing nutrition through food should be the first step prior to initiating dietary supplements [ONS]. [Strength of Recommendation: B; Quality of Evidence: Fair] • If the patient's caloric needs cannot be met with 3 meals and 3 snacks per day, high energy and nutritionally-dense [ONS] should be added. [Strength of Recommendation: B; Quality of Evidence: Fair/Poor] • [ONS] are associated with weight gain and reduced fatality. [Strength of Recommendation: A; Quality of Evidence: Good] • [ONS] should be given between meals and not with meals to minimise appetite suppression and compensatory decreased intake of food at mealtimes. [Strength of Recommendation: A; Quality of Evidence: Good] • Get the patients to sample the [ONS] and give them a variety. Presentation of the supplement should also be varied. [Strength of Recommendation: B; Quality of Evidence: Fair/Poor] • A liquid supplement [ONS] in which the energy is supplied by glucose instead of fat is less likely to cause satiation. [Strength of Recommendation: B; Quality of Evidence: Fair]
USA	American Dietetic Association (ADA) (2009)	Unintended Weight Loss (UWL) in Older Adults Evidence-based Nutrition Practice Guideline	**Indications for [ONS]*** The Registered Dietitian (RD) should recommend [ONS] for older adults who are undernourished or at risk of under-nutrition (i.e. those who are frail, those who have infection, impaired wound healing, pressure ulcers, depression, early to moderate dementia and/or after hip fracture and orthopaedic surgery). Studies support [ONS] as a method to provide energy and nutrient intake, promote weight gain and maintain or improve nutritional status or prevent under-nutrition [Strong] *Note that the guidance uses the term 'medical food supplements' but to avoid confusion with vitamin and mineral food supplements, the term ONS has been inserted in its place

Table 6.2 Continued

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
USA	American Society for Parenteral and Enteral Nutrition (2006)	Standards for Specialised Nutrition Support for Adult Residents of Long-Term Care Facilities Free access available. User must create an account to log in	• Whenever possible, nutrition therapy is provided through oral diet with supplementation [ONS]. If oral intake is not adequate but the GI tract is functional and available, the GI tract is the preferred route for nutrition support and it should be used to administer specialised nutrition support

CHILDREN

Table 6.3 **Summary of examples of evidence-based national and professional guidelines referring to ONS as an integral part of patient and disease management – Children** (parts of the guidelines relevant to ONS are presented here, standard ONS formulae only)

Country/Region	Body	Title	Recommendation, guideline or standard [grade of evidence]
Europe	European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) Committee on Nutrition	Practical approach to paediatric enteral nutrition: A comment by the ESPGHAN Committee on Nutrition	• [ONS]* should be given only as an addition to other foods when enhancement of oral energy and substrate intake is necessary *Note: The term 'supplement feeds' (sip feeds) is used in the original paper but it has been replaced here with 'ONS' to avoid confusion
England and Wales	British Society of Paediatric Gastroenterology Hepatology and Nutrition (BSPGHAN) (2008)	Guidelines for the Management of Inflammatory Bowel Disease (IBD) in Children in the United Kingdom	• Exclusive enteral nutrition (given either orally or enterally) is effective first line therapy for small and large bowel disease, inducing remission in 60–80% of cases (EL +1 -1) • Supplementary therapy may reduce the risk of relapse and may improve growth and nutritional status (EL 2-) • Nutritional support should be considered as adjunctive therapy for any patient with CD or UC who has malnutrition. Nasogastric/gastrostomy tube feeding can be considered • Supplemental enteral feeding or cyclical enteral nutrition for children with CD in remission may improve growth and help to maintain remission

SPECIFIC DISEASES

Table 6.4 **Summary of examples of evidence-based national and professional guidelines referring to ONS as an integral part of patient and disease management – Specific Diseases and Conditions** (parts of guidelines relevant to ONS are presented here, standard ONS formulae only)

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with hip fracture	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2009)	Management of hip fracture in older people	Rehabilitation: supplementing the diet of hip fracture patients in rehabilitation with high [ONS] containing minerals and vitamins should be considered [A] Note: see Table 6.5 for summary of grading of recommendations. (Grade A similar to NICE)
	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Geriatrics[303]	In geriatric patients after hip fracture and orthopaedic surgery, use ONS to reduce complications [A] Note: see Table 6.7 for summary of grading of recommendations
	Australia	Developed by the Clinical Epidemiology and Health Service Evaluation Unit, Melbourne Health. Previously commissioned on behalf of the Australian Health Ministers' Advisory Council (AHMAC) by the AHMAC Care of Older Australians Working Group	Best practice approaches to minimise functional decline in the older person across the acute, sub-acute and residential aged care settings (This version updated by the Victorian Government Department of Human Services. Update 2007)	• There is good evidence to support the use of oral multi-nutrient and high-protein [ONS] for the prevention of unfavourable outcomes in older people recovering from hip fracture • There is limited evidence to support the use of resistance training, used in combination with [ONS], to improve weight gain in older nutritionally at risk inpatients following a lower limb fracture
	New Zealand	New Zealand Guidelines Group (2003)	Best Practice Evidence-Based Guideline: Acute management and immediate rehabilitation after hip fracture amongst people aged 65 years and over	[ONS] reduce unfavourable outcome (death or postoperative complication) after hip fracture [A] Note: see Table 6.5 for summary of grading of recommendations – grade A similar to NICE (except no reference to NICE technology appraisals)

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with pressure ulcers	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Geriatrics[303]	• ONS, particularly with high protein content, can reduce the risk of developing pressure ulcers [A] • Based on positive clinical experience, enteral nutrition (by means of ONS or tube feeding) is also recommended in order to improve healing of pressure ulcers [C] Note: see Table 6.7 for summary of grading of recommendations
	International (Europe and USA) Translated into many languages see website for details	European Pressure Ulcer Advisory Panel (EPUAP) and National Pressure Ulcer Advisory Panel (NPUAP) (2009) www.npuap.org	Pressure Ulcer Prevention	• Offer high-protein mixed ONS and/or tube feeding, in addition to the usual diet, to individuals with nutritional risk and pressure ulcer risk because of acute or chronic diseases or following a surgical intervention. [A] Oral nutrition (via normal feeding and/or with additional sip feeding) is the preferred route for nutrition and it should be supported whenever possible. ONS are of value because many pressure-ulcer-prone patients often cannot meet their nutritional requirements via normal oral food intake. Moreover, ONS seem to be associated with a significant reduction in pressure ulcer development compared to routine care. Enteral (tube feeding) and parenteral (delivered outside the alimentary tract) nutrition may be necessary when oral nutrition is inadequate or not possible based on the individual's condition and goals • Administer ONS and/or tube feeding between the regular meals to avoid reduction of normal food and fluid intake during regular mealtimes [C] [A – The recommendation is supported by direct scientific evidence from properly designed and implemented controlled trials on pressure ulcers in humans (or humans at risk of pressure ulcers), providing statistical results that consistently support the guideline statement (Level 1 studies required)] [C – The recommendation is supported by indirect evidence (e.g. studies in normal human subjects, humans with other types of chronic wounds, animal models) and/or expert opinion]
	International (Europe and USA) Translated into many languages see website for details	European Pressure Ulcer Advisory Panel (EPUAP) and National Pressure Ulcer Advisory Panel (NPUAP) (2010)	Pressure Ulcer Treatment	• Provide enhanced foods and/or ONS between meals if needed [B] [B – The recommendation is supported by direct scientific evidence from properly designed and implemented clinical series on pressure ulcers in humans (or humans at risk of pressure ulcers), providing statistical results that consistently support the recommendation (Level 2, 3, 4, 5 studies required)]

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with Pressure Ulcers	USA	American Dietetic Association (ADA) (2009)	Spinal Cord Injury (SCI) Evidence-Based Nutrition Practice Guideline	**Nutrition Intervention to Prevent Development of Pressure Ulcers** If a patient with SCI is at risk of pressure ulcer development as indicated by bio chemical, anthropometric and lifestyle factors, the RD should implement aggressive nutrition support measures. The range of options may include [ONS]* and enteral and parenteral nutrition. Research suggests that improved nutrition intake, body weight and biochemical parameters may be associated with reduced risk of pressure ulcer development [Strong Conditional] **Nutrition Prescription for SCI Patients with Pressure Ulcers** A nutrition prescription should be formulated as part of the nutrition intervention for patients with SCI and pressure ulcers which includes the energy, protein, fluid and micronutrient requirements. Evidence suggests that additional energy and protein is needed for optimal healing of pressure ulcers. Fluid and micronutrient needs will vary depending on the patient's status. See the Assessment of Nutritional Needs for Pressure Ulcers for determining levels of each of these [Consensus Imperative] *Note that the guidance uses the term 'Medical food supplements' but to avoid confusion with vitamin and mineral food supplements, the term ONS has been inserted in its place
	Australia	Trans-Tasman Dietetic Wound Care Group (2011) Endorsed by Dietitians Association of Australia & Dietitians New Zealand	Evidence-based practice guidelines for the dietetic management of adults with pressure injuries	• Nutritional interventions should start with modification of current dietary intake and progress to the use of [ONS] before considering enteral support [III–3; Grade C] Note: see Table 6.6 for summary of grading of recommendations
	England	National Institute for Health and Clinical Excellence (NICE) (2005)	The prevention and treatment of pressure ulcers[305]	Nutritional support should be given to patients with an identified nutritional deficiency [C]† Nutritional support/[ONS] for the treatment of patients with pressure ulcers should be based on: [D] • nutritional assessment (using a recognised tool, e.g. 'MUST') • general health status • patient preference • expert input supporting decision-making (dietitian or specialists) † The link between correcting this deficiency and its causal relationship with pressure ulcer healing has not been clearly established Note: see Table 6.5 for summary of grading of recommendations

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with Pressure Ulcers	Finland	National Nutrition Council (2010)	Nutrition treatment recommendation "Ravitsemushoito – Suositus sairaaloihin, terveyskeskuksiin, palvelu- ja hoitokoteihin sekä kuntoutuskeskuksiin"	**Pressure ulcers and chronic wounds:** Intensive nutrition treatment and at least 1 protein-rich ONS/day
Patients undergoing radiotherapy and patients with upper GI cancer	Europe	European Society for Clinical Nutrition and Metabolism (Arends et al 2006)	ESPEN Guidelines on Enteral Nutrition: Non-surgical oncology[306]	Use intensive DA and ONS to increase dietary intake and to prevent therapy-associated weight loss and interruption of radiation therapy [A] Note: see Table 6.7 for summary of grading of recommendations
	Australia	Dietitians Association of Australia (2008)	Evidence-based Practice Guidelines for the Nutritional Management of Patients Receiving Radiation Therapy	Regular nutrition intervention (dietary counselling and/or supplements) improves energy and protein intake and nutritional status during radiation therapy [A] Nutrition intervention reduces treatment breaks and unplanned hospital admissions resulting in decreased costs compared with usual care [C] Nutrition intervention (dietary counselling and/or [ONS]) during and post radiation therapy improves patient-centred outcomes (QOL, physical function, and patient satisfaction [B] Note: See Table 6.6 for summary of grading of recommendations
	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2006)	Management of oesophageal and gastric cancer	Patients undergoing surgery for oesophageal or gastric cancer who are identified as being at high nutritional risk should be considered for preoperative nutritional support [B]
	England and Wales	NHS Executive (2001)	Guidance on Commissioning Cancer Services: Improving Outcomes in Upper Gastro-intestinal Cancers	[ONS] are likely to be appropriate, both for patients who have undergone surgery and for poorly-nourished patients

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with cancer in hospital and the community	Norway	National Council for Nutrition (1997)	Nutrition Treatment and Dietary Counselling for Cancer Patients, Report No. 4	The recommendations include: • optimising regular food/hospital food intake if the GI tract is functioning • **using ONS in addition to step 1** • tube feeding • total parenteral nutrition *Further guidelines are currently being developed*
Patients with head and neck cancer	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2006)	Diagnosis and Management of Head and Neck Cancer	After screening, at risk patients should receive early intervention for nutritional support by an experienced dietitian [C]
	USA	American Dietetic Association (ADA) (2007)	ADA Oncology Evidence-based Nutrition Practice Guideline	**Head and neck cancer: [ONS]* and radiation** Dietitians should consider use of [ONS] to improve protein and calorie intake for patients with head and neck cancer undergoing radiation therapy. Use of [ONS] may be associated with fewer treatment interruptions and a reduction of mucosal damage, and it may minimise weight loss
	Australia	Clinical Oncology Society of Australia (2011)	Evidence-based practice guidelines for the nutritional management of adult patients with head and neck cancer	**Surgery** Preoperative nutrition intervention in malnourished patients may lead to improved out comes, such as quality of life, and reduce adverse related consequences of malnutrition [Recommendation Grade: B] **Radiotherapy and chemotherapy** Nutrition intervention (dietary counselling and/or [ONS] and/or tube feeding) improves/ maintains nutritional status [Recommendation Grade: A] Nutrition intervention (dietary counselling and/or [ONS] and/or tube feeding) improves patient-centred outcomes (QOL, physical function, and patient satisfaction) [Recommendation Grade: B] **Post treatment** Nutrition intervention (dietary counselling and/or [ONS]) for 3 months post treatment improves/maintains nutritional status [Recommendation Grade: A] Nutrition intervention (dietary counselling and/or [ONS]) for 3 months post treatment improves/maintains QOL [Recommendation Grade: A] Note: See Table 6.6 for summary of grading of recommendations

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Cancer patients undergoing anticancer treatment & hematop-oietic cell transplan-tation	USA	ASPEN	Clinical Guidelines: Nutrition support therapy during anticancer treatment and in hematopoietic cell transplantation	N-3 Fatty acid supplementation may help stabilise weight in cancer patients on oral diets experiencing progressive, unintentional weight loss. [Recommendation Grade: B]
Patients with cancer	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2004)	Post operative management in adults. A practical guide to post operative care for clinical staff	All malnourished cancer patients should be considered for nutritional advice and [ONS] in the postoperative period and for a period following discharge
	Spain	(2008)	Consensus document on Nutrition in Cancer (Nutr Hosp Suplementos. 2008;1(1):13)	• Nutritional care should be provided early and it should be part of the overall treatment plan for oncology patients • The cancer patient's diet should be in line with healthy nutrition guidelines (balanced, varied, desirable and sufficient to meet needs) • When DA is not enough, nutritional support should be given • Symptoms such as anorexia, nausea and vomiting as a result of the cancer or its treatment make it difficult for patients to meet their nutritional needs • Cancer patients may need artificial nutrition (same indications as non-cancer patients) with an appropriate formula to meet their particular needs • The effectiveness of nutritional support must be balanced with the risk of its use (Summary in English of section on Nutritional Intervention Criteria: goals, directions and evidence)

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with COPD	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Cardiology and Pulmonology[307]	Frequent small amounts of ONS are preferred to avoid postprandial dyspnoea and satiety and to improve compliance [B] Note: see Table 6.7 for summary of grading of recommendations
	International (Europe and USA)	American Respiratory Society and European Respiratory Society (2004)	Standards for the Diagnosis and Treatment of Patients with COPD: A Summary of the ATS/ERS Position Paper[308]	Nutritional therapy may only be effective in combination with exercise or other anabolic stimuli
	England and Wales	National Institute for Health and Clinical Excellence (NICE) (2010)	Chronic Obstructive Pulmonary Disease: Management of Chronic Obstructive Pulmonary Disease in Adults in Primary and Secondary Care (partial update)[309]	If the BMI is low, patients should also be given [ONS] to increase their total calorific intake and be encouraged to take exercise to augment the effects of nutritional supplementation
	International	Global Initiative for Chronic Obstructive Lung Disease (2011)	Global Initiative for Chronic Obstructive Lung Disease[310]	Present evidence suggests that oral nutritional supplementation (ONS) alone may not be a sufficient strategy. Increased calorie intake is best accompanied by exercise regimens that have a nonspecific anabolic action, and there is some evidence that this also helps even in those patients without severe nutritional depletion. Nutritional supplements (e.g. creatine) do not augment the substantial training effect of multi disciplinary pulmonary rehabilitation for patients with COPD

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with COPD	USA	American Dietetic Association (ADA) (2008)	Chronic Obstructive Pulmonary Disease (COPD) Evidence-based Nutrition Practice Guideline	**Macronutrient Composition of [ONS]*** RDs should advise that the selection of [ONS] for individuals with COPD should be influenced more by patient preference than the percentage of fat or carbohydrate. There is limited evidence to support consumption of a particular macronutrient composition of [ONS] [Fair] **COPD: Frequent Small Amounts of [ONS]** RDs should recommend frequent small amounts of [ONS] for individuals with COPD. Studies report that frequent small amounts of [ONS] are preferred to avoid postprandial dyspnoea and satiety and to improve compliance [Fair] **COPD: [ONS] for Inpatients** For inpatients with COPD who have low BMI (less than 20 kg/m^2), unintentional weight loss, reduced oral intake or who are at nutritional risk, registered dietitians should initiate provision of [ONS]. Studies report that [ONS] for 7–12 days results in increased energy intake in the inpatient setting [Fair] **COPD: [ONS] for Outpatients** For outpatients with COPD who have low BMI (less than 20 kg/m^2), unintentional weight loss, reduced oral intake or who are at nutritional risk, RDs should recommend consumption of [ONS]. In the outpatient setting, studies report that [ONS] results in increased energy intake, with weight gain more likely when combined with exercise [Fair] *Note that the guidance uses the term 'Medical food supplements' but to avoid confusion with vitamin and mineral food supplements, the term ONS has been inserted in its place
Patients with acute or chronic pancreatitis	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Pancreas[311]	Acute pancreatitis • Oral feeding (normal food and/or ONS) can be progressively attempted once gastric and outlet obstruction has resolved, provided it does not result in pain, and complications are under control [C] Chronic pancreatitis • 10–15% of all patients require ONS [C] Note: see Table 6.7 for summary of grading of recommendations
Patients with liver disease	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Liver Disease[312]	Alcoholic steatohepatitis • In general, ONS are recommended [B] Liver cirrhosis • If patients are not able to maintain adequate oral intake from normal food, use ONS [C] Note: see Table 6.7 for summary of grading of recommendations

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Patients with HIV and chronic infectious diseases	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Wasting in HIV and Other Chronic Infectious Diseases[313]	**HIV** • Diarrhoea does not prevent a positive effect of ONS on nutritional status [A] • Nutritional counselling with ONS or counselling alone are equally effective at the beginning of nutritional support and/or for preserving nutritional status [B] • In settings where qualified nutritional counselling cannot be provided, ONS may be indicated in addition to normal food, but this should be limited in time [C] **Chronic infectious diseases** • Nutritional support should be given to patients with under-nutrition resulting from infectious diseases – prefer ONS [B] Note: see Table 6.7 for summary of grading of recommendations
Patients with renal disease	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Adult Renal Failure[314]	**Acute Renal Failure (ARF)** • In uncomplicated ARF, when spontaneous alimentation is insufficient, ONS may be useful to meet estimated requirements [C] **Patients on maintenance haemodialysis (HD) therapy** • Use ONS to improve nutritional status [A] • ONS should be the preferred route in conscious HD patients Note: see Table 6.7 for summary of grading of recommendations
	Canada	Canadian Society of Nephrology	Clinical practice guidelines and recommendations on peritoneal dialysis adequacy (2011)	[ONS] should be considered for patients with mild-to-severe malnutrition [B]. However, certain supplements may be poorly tolerated by individual patients, and thus close monitoring is required [A]
Patients with GI disease	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Gastroenterology[315]	**CD** • In the case of persistent intestinal inflammation (e.g. steroid-dependent patients) use ONS [B] • Use ONS in addition to normal food to improve nutritional status and to eliminate con sequences of under-nutrition such as growth retardation [A] • Using ONS, a supplementary intake of up to 600 kcal/day can be achieved in addition to normal food [A] **Short bowel syndrome** • Use ONS or tube feeding if normal nutritional status cannot be maintained by normal food alone [C] Note: see Table 6.7 for summary of grading of recommendations

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Surgical patients	Europe	European Society for Clinical Nutrition and Metabolism	ESPEN Guidelines on Enteral Nutrition: Surgery including Organ Transplantation[316]	• Encourage patients who do not meet their energy needs from normal food to take ONS during the preoperative period [C] • Before transplantation, in under-nutrition, use additional ONS [C] Note: see Table 6.7 for summary of grading of recommendations
	Europe	European Society for Clinical Nutrition and Metabolism (2005)	Enhanced Recovery after Surgery: A Consensus Review of Clinical Care for Patients Undergoing Colonic Resection[317]	Postoperative nutritional care • Patients should be encouraged to commence oral food intake 4 hours after surgery. ONS should be taken (approximately 400 ml energy-dense ONS) from the day of surgery until a normal level of food intake is achieved. Continuation of ONS at home is recommended for nutritionally-depleted patients
	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2004)	Postoperative management in adults. A practical guide to post-operative care for clinical staff	• Patients who are malnourished either at the time of, or shortly following, major abdominal or vascular surgery have a more rapid recovery of nutritional status, physical function and QOL if given nutritional advice and prescribed routine [ONS] in the immediate postoperative period and the following 2 months [1+] • The evidence supporting the short-term routine use of [ONS] in patients who are not malnourished is not clear
	England and Wales	National Institute for Health and Clinical Excellence (NICE) (2006)	Nutrition Support for Adults: Oral Nutrition Support, Enteral Tube Feeding and Parenteral Nutrition[236]	Oral nutrition support for surgical patients • Perioperative oral nutrition support would be considered for surgical patients who can swallow safely and are malnourished [B] Note: see Table 6.5 for summary of grading of recommendations
Stroke patients	England and Wales	National Institute for Health & Clinical Excellence (NICE) (2008)	Stroke: National Clinical Guideline for Diagnosis and Initial Management of Acute Stroke and Transient Ischaemic Attack (TIA)[318]	Nutritional support should be initiated for people with stroke who are at risk of malnutrition. This may include ONS, specialist DA and/or tube feeding

Table 6.4 Continued

Patient Group	Country	Body	Title	Recommendation, guideline or standard [grade of evidence]
Stroke patients	Scotland	Scottish Intercollegiate Guidelines Network (SIGN) (2010)	Management of Patients with Stroke: identification and management of dysphagia Management of patients with stroke: Rehabilitation, prevention and management of complications, and discharge planning	Following nutritional screening, those identified as undernourished and those at risk of becoming undernourished should be referred to a dietitian and considered for prescription of [ONS] as part of their overall nutritional care plan [C] Note: see Table 6.5 for summary of grading of recommendations (Grade C similar to NICE)
	Australia	National Stroke Foundation (2010)	Clinical Guidelines for Acute Stroke Management	[ONS] should be offered to people whose nutritional status is poor or deteriorating [A] Note: See Table 6.6 for summary of grading of recommendations
Patients with SCI	USA	American Dietetic Association (ADA) (2009)	Spinal Cord Injury (SCI) Evidence-based Nutrition Practice Guideline	**Nutrition Intervention to Prevent Development of Pressure Ulcers** If a patient with spinal cord injury is at risk of pressure ulcer development as indicated by biochemical, anthropometric and lifestyle factors, the RD should implement aggressive nutrition support measures. The range of options may include [ONS]* and enteral and parenteral nutrition. Research suggests that improved nutrition intake, body weight and biochemical parameters may be associated with reduced risk of pressure ulcer development [Strong Conditional] **Nutrition Prescription for SCI Patients with Pressure Ulcers** A nutrition prescription should be formulated as part of the nutrition intervention for patients with SCI and pressure ulcers which includes the energy, protein, fluid and micronutrient requirements. Evidence suggests that additional energy and protein is needed for optimal healing of pressure ulcers. Fluid and micronutrient needs will vary depending on the person's status. See the Assessment of Nutritional Needs for Pressure Ulcers for determining levels of each of these [Consensus Imperative]

Table 6.5 **NICE Guidelines: Grading of recommendations** (adapted from NICE 2006)[236]

Grade	Evidence
A	• At least one meta-analysis, systematic review or RCT rated as 1++ (i.e. high-quality meta-analyses, systematic reviews of RCTs or RCTs with a very low risk of bias), directly applicable to the target population, or • A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+ (i.e. well-conducted meta-analyses, systematic reviews of RCTs or RCTs with a low risk of bias), directly applicable to the target population and demonstrating overall consistency of results, or • Evidence drawn from a NICE technology appraisal
B	• A body of evidence including studies rated as 2++ (i.e. high-quality systematic reviews of case-control or cohort studies, high-quality case-control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal), directly applicable to the target population and demonstrating overall consistency of results, or • Extrapolated evidence from studies rated as 1++ or 1+
C	• A body of evidence including studies rated as 2+ (i.e. well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal), directly applicable to the target population and demonstrating overall consistency of results, or • Extrapolated evidence from studies rated as 2++
D	• Evidence level 3 (i.e. non-analytic studies, e.g. case reports, case series) or 4 (i.e. expert opinion), or • Extrapolated evidence from studies rated as 2+, or • Formal consensus
D (GPP)	• A good practice point (GPP) is a recommendation for best practice based on the experience of the Guideline Development Group

Table 6.6 **Dietitians Association of Australia Guidelines: Grading of recommendations**

Grade	Description*
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its (their) application
D	Body of evidence is weak and recommendation(s) must be applied with caution

*Full details of level of evidence according to type of research question available from NHMRC[319]

Table 6.7 **ESPEN Guidelines: Grading of recommendations** (adapted from Schutz 2006)[320]

Grade	Level of evidence	Requirement
A	Ia Ib	• Meta-analysis of randomised controlled trials (RCTs) • At least one RCT
B	IIa IIb III	• At least one well-designed controlled trial without randomisation • At least one other type of well-designed quasi-experimental study • Well-designed non-experimental descriptive studies such as comparative studies, correlation studies, case-control studies
C	IV	• Expert opinions and/or clinical experience of respected authorities

6.2 Guidelines: From theory to practice for enhanced patient care

Practical guidance for healthcare professionals about when to use ONS is essential and should be a key component of many guidelines

- The method of nutrition support included in these practical guides should be carefully considered and should take account of the evidence base, condition of the patient (both clinical and nutritional), their prognosis and preferences. Although not based on robust evidence, food fortification is often recommended as the first line approach with ONS reserved for if/when this strategy is not successful. Care must be taken to review patients on a regular basis and to quickly identify if nutritional goals are not being met so that an alternative strategy can be used e.g. ONS. NICE (2006) highlight that oral nutrition support strategies are not exclusive and can be used in combination.[236]

- Practical advice on the use of ONS in clinical practice has been formulated by Stratton and Elia (2007) in a review of reviews on the evidence base for ONS across different patient groups (Figure 6.1).[321]

- Other examples include an Oral Nutrition Support Algorithm in the UK NICE guideline (Figure 6.2), a table with information about grade of risk of malnutrition, and contribution of spontaneous food intake in the Haute Autorité de Santé recommendations in France (Table 6.8).

- In 2012 the National Health Service National Prescribing Centre in the UK published 'Prescribing of adult Oral Nutritional Supplements (ONS): Guiding principles for improving the systems and processes for ONS use' (Table 6.9) with the aim of helping organisations ensure that patients can obtain ONS when clinically appropriate and that the systems and processes are in place to:

  ~ monitor on-going requirements for ONS;

  ~ monitor concordance (compliance or adherence) and;

  ~ monitor patients' clinical condition after a decision is made to discontinue ONS when it appears it is no longer clinically indicated

- 'Managing Adult Malnutrition in the Community', a new practical guide based on clinical evidence and best practice, has been developed in the UK by a multi-professional consensus panel. It has been endorsed by 10 key healthcare professional associations and has been designed to support GPs and other community healthcare professionals to identify and manage individuals at risk of disease-related malnutrition. Amongst other relevant topics it includes:

  ~ information about managing malnutrition according to risk category, including practical tips to aid clinical judgement

  ~ a pathway for using ONS in the management of malnutrition (see Figure 6.3);

  ~ information on optimising oral intake, providing an overview of the practical elements and evidence for dietary advice and ONS

- These practical guides allow healthcare professionals to make decisions about the appropriate use of ONS.

- Identify malnutrition or risk of malnutrition using routine screening across healthcare settings with a valid, evidence-based tool such as 'MUST'. Implement appropriate nutritional treatment as part of a care plan for malnutrition as soon as possible.
- Consider ONS as part of the care plan for the treatment of malnutrition*:
  - ONS can be used if improvements in energy, protein and micronutrient intakes are required. ONS tend not to suppress appetite or voluntary food intake. ONS can be particularly effective at improving total nutritional intake in acutely ill, elderly and post-surgical patients
  - For patients requiring longer-term oral nutritional support, often in the community, it is likely that a variety of types of ONS (e.g. flavours, textures, consistencies) and encouragement to comply with ONS would be beneficial to maintain improvements in nutritional intake
  - ONS can be used to attenuate weight loss in the acutely ill patient or aid weight gain in chronically ill patients. Improvements in weight (> 2 kg), especially in the underweight, are associated with improvements in function in the chronically ill
  - ONS (~250-600 kcal/d) can be used to help improve clinical outcome in hospitalised patients, acutely ill elderly, patients undergoing GI surgery and in hip fracture patients
  - Consider high protein ONS to reduce the risk of development of pressure ulcers in high-risk groups (frail elderly, hip fracture, poor mobility) and to help improve outcome in hip fracture patients
- When providing ONS, consider patients needs for energy, protein and micronutrients. Any specific identifiable nutrient deficiencies (trace elements, minerals, vitamins) should be corrected where possible.
- The goal(s) of treatment with ONS should be identified for an individual patient at the start of treatment. Thereafter, regular and frequent monitoring of patients receiving ONS should be undertaken to:
  - Assess ONS acceptability
  - Monitor ONS effectiveness by monitoring the patients' progress towards the treatment goal(s). These could include measures of energy and nutritional intake, appetite, nutritional status, functional measures, clinically relevant outcomes (pressure ulcer size, infection, quality of life)
  - Encourage compliance with ONS where appropriate
  - Assess whether ONS are still required or if other forms of nutritional support (e.g. tube feeding) are warranted
  - Monitor changes in clinical and nutritional status

*The care plan, including when to refer to a dietitian or nutrition support team, should be devised by a multidisciplinary team according to local policy and resources

Figure 6.1 **Recommendations for use of ONS in clinical practice** (adapted from Stratton and Elia 2007)[321]

Table 6.8 **Example of a nutritional management strategy detailing when to use ONS for older people** (adapted from Haute Autorité de Santé 2011)[304]

Spontaneous dietary intake	Nutritional Status: Normal	Nutritional Status: Malnutrition	Nutritional Status: Severe Malnutrition
Normal	• Monitoring	• Dietary advice • Fortified diet • Reassessed* at 1 month	• Dietary advice • Fortified diet & **ONS** • Reassessed* at 15 days
Reduced, but more than half of usual intake	• Dietary advice • Fortified diet • Reassessed* at 1 month	• Dietary advice • Fortified diet • Reassessed* at 15 days and if failure: **ONS**	• Dietary advice • Fortified diet and **ONS** • Reassessed* at 1 week, if failure: Enteral Nutrition
Very reduced and less than 50% of normal intake	• Dietary advice • Fortified diet • Reassessed* at 1 week, and if failure: **ONS**	• Dietary advice • Fortified diet and **ONS** • Reassessed* at 1 week, and if failure: Enteral Nutrition	• Dietary advice • Fortified diet and Enteral Nutrition from outset • Reassessed* at 1 week

*Reassessment should include: Weight and nutritional status, clinical condition and prognosis, estimation of spontaneous food intake, tolerance and compliance with treatment

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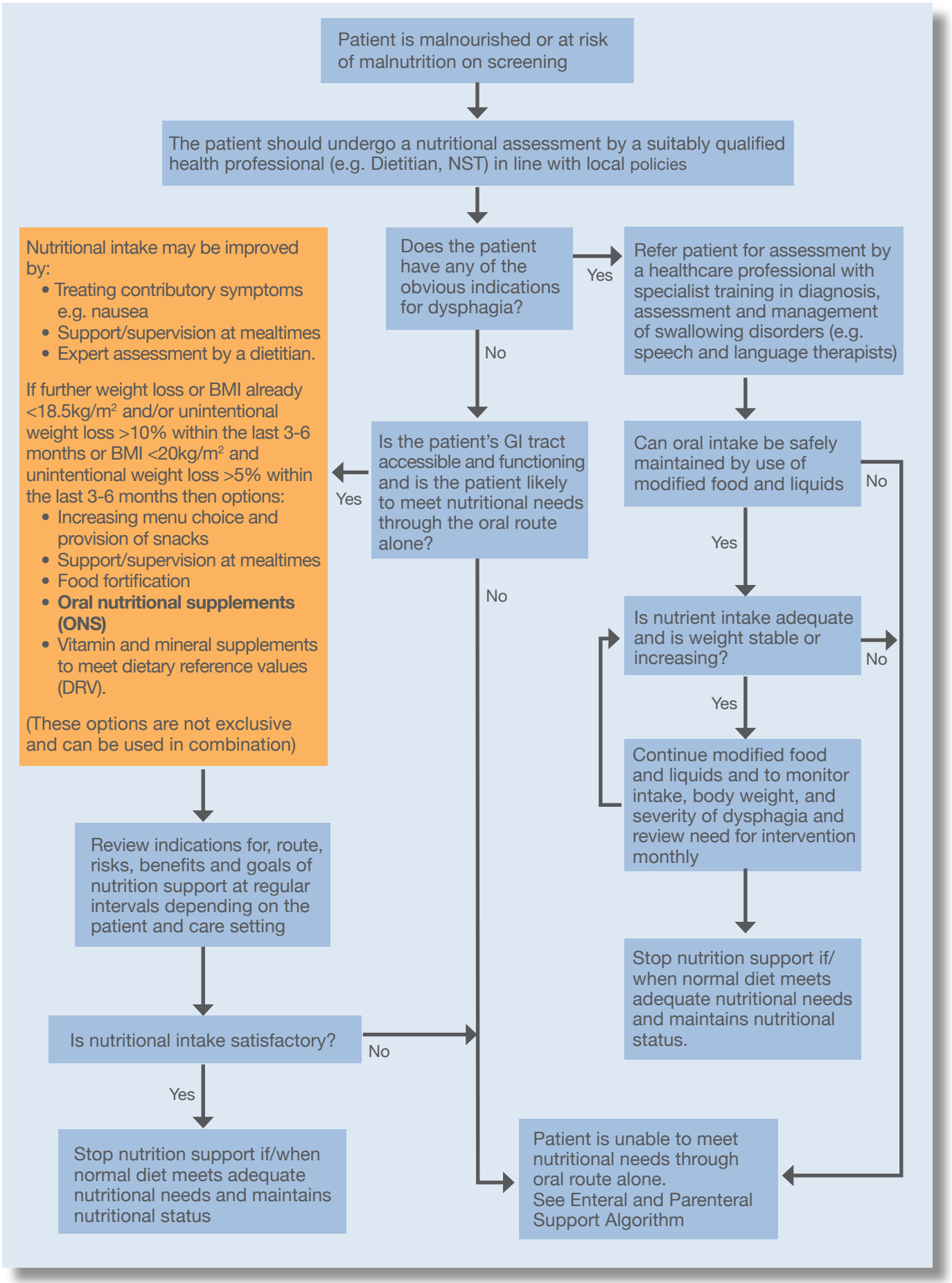

Figure 6.2 **Oral Nutrition Support Algorithm** (adapted from NICE, 2006)[236]

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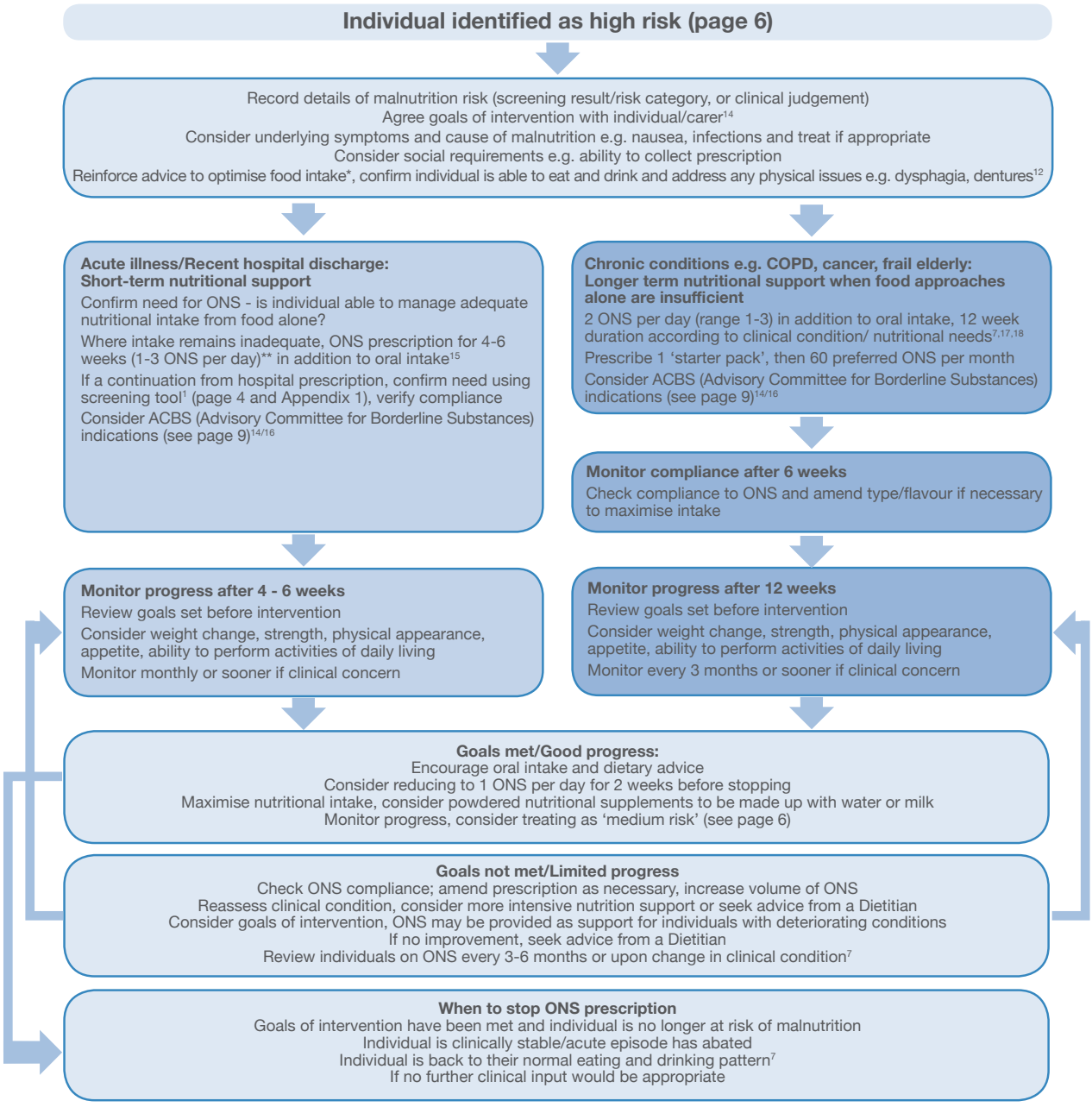
Table 6.9 **Ten Guiding Principles for improving the systems and processes for ONS use**
(adapted from NHS National Prescribing Centre [NPC]: Prescribing of adult ONS, 2012)*

1	Local health economies should understand their local clinical need for adult oral nutrition support and map this against local work force expertise.
2	Local health economies should understand their local procurement arrangements for adult ONS in primary, secondary and social care.
3	Commissioners should review prescribing arrangements for adult ONS.
4	Local health economies should ensure that a validated screening tool such as the 'Malnutrition Universal Screening Tool' ('MUST') is embedded into everyday care so that the results of screening are linked to a care plan.
5	Local health economies should develop standard templates for care plans to be used with 'at risk' adult patients across primary, secondary and social care. Goals should be set and the care plan monitored and reviewed so that oral nutritional supplements are used appropriately.
6	Local health economies should work with care home commissioners and providers to ensure high standards of nutritional screening, education and assessment for oral nutritional support is embedded in the care home environment.
7	Local health economies should assess local training needs for all health and social care staff for the identification and treatment of adult undernutrition and implement an education programme for all appropriate front line staff, carers and patients. Competencies for basic skills should be developed.
8	Local health economies should develop measurements for assessing the quality of the provision of adult ONS.
9	Commissioners should consider incentives to improve adult oral nutrition support and prescribing practice.
10	Local health economies should consider setting up local fora to oversee nutrition issues in primary, secondary and social care with an emphasis on the interface.

*In April 2011 the NPC integrated into the National Institute for Health and Clinical Excellence (NICE). However, the guiding principles do not constitute formal guidance of the National Institute for Health and Clinical Excellence. More information available at http://www.npc.nhs.uk/quality/ONS/index.php

Pathway for using Oral Nutritional Supplements (ONS) in the Management of Malnutrition



ONS – oral nutritional supplements/sip feeds/nutrition drinks (BNF section 9.4.2)[16] (see pages 8-9)

Advice on ONS prescription according to consensus clinical opinion. ONS prescription-units to prescribe per day e.g. 2 ONS = 2 bottles/units of ONS per day
** For more detailed support or complex conditions seek advice from a Dietitian*
***Some individuals may require more than 3 ONS per day – seek dietetic advice*
***NOTE:** ONS requirement will vary depending on nutritional requirements, patient condition and ability to consume adequate nutrients, ONS dose and duration should be considered*

This pathway has been taken from 'Managing Adult Malnutrition in the Community' – for more information and references please go to www.malnutritionpathway.co.uk

Figure 6.3 **Pathway for using Oral Nutritional Supplements (ONS) in the Management of Malnutrition**

Reproduced with kind permission from Anne Holdoway, Panel Chair. For details of references cited within this table and further information please refer to the original document available at http://malnutritionpathway.co.uk/

6.3 Guideline implementation: Benefits for patients and healthcare systems

Published guidelines demonstrate that ONS are recognised as a key component of care across a wide variety of patient groups. The implementation of guidelines that include the use of ONS in practice have been shown to positively influence clinical practice and patient outcome, for example, in the prevention and management of pressure ulcers, in surgical patients and in patients with hip fracture as documented in the examples below.

Screening and use of ONS is more frequent in patients with pressure ulcers (hospital and community)

- A cross-sectional survey of 363 institutions and home-care settings in the Netherlands, Germany and the UK (hospitals 46.9%, nursing homes 25.8% and home care 21.6%) showed that 66.1% of organisations had implemented the European Pressure Ulcer Advisory Panel Guidelines for Pressure Ulcer Prevention and Treatment:[322]
  - ~ nutritional screening in pressure ulcer care was conducted significantly more frequently in organisations where the nutritional guideline was used compared with institutions and organisations not using the guidelines (18.3% 'never' performed screening vs 3.0%; $p = 0.001$);[322]
  - ~ ONS were used more frequently in organisations using the guidelines, whereas tube feeding was used equally in the 2 groups. PN was given less frequently in the group using the guidelines.[322]

Better energy intake and reduced pressure ulcers in patients with hip fracture (hospital)

- A pre- and post-test comparison group study of patients with hip fracture ($n = 100$, mean age 81 years) showed that the use of nutritional guidelines (including preoperative carbohydrate loading and postoperative ONS) compared with standard hospital food and regular nutrition support according to doctors' and nurses' knowledge and goodwill significantly increased energy intake ($p < 0.001$). In addition, 5 days postoperatively, fewer patients in the intervention group developed pressure ulcers (18%) compared with the control group (36%) ($p = 0.043$).[323]

Improved clinical outcomes in surgical patients (hospital)

- Clinical benefits were observed in a study of older patients ($n = 117$, median age 67 years, range 60–85) who received a multidisciplinary protocol of perioperative care established by the ACERTO project ($n = 75$) (included early instead of delayed postoperative feeding and preoperative nutrition support for malnourished patients) compared with patients who received traditional care ($n = 42$). The number of hours of preoperative fasting decreased, and patients were fed 1 day earlier after the introduction of the new protocol:[324]
  - ~ surgical site infection was significantly reduced (9/42; 28.1% vs 2/75; 2.6%; OR 9.9, 95% CI 2.0–48.6; $p < 0.01$);
  - ~ overall postoperative morbidity diminished (16/42; 38.1% vs 16/75; 21.3%; OR 2.2, 95% CI 0.98–5.2; $p = 0.05$);
  - ~ both total length of stay (10 [2–44]) vs 4 [2–140] days) and postoperative stay (6 [1–43] vs 2 [1–99] days, $p < 0.01$) reduced.

Screening guidelines: benefits of implementation

A key aspect of many of the guidelines listed in Table 6.1 to Table 6.4 is the correct targeting of nutritional support, including the use of ONS, at patients who have been identified as malnourished or at risk of malnutrition. It is clear that appropriate use of nutritional support is a key part of the wider task of identifying patients at nutritional risk and implementing timely and appropriate care plans to address their needs. Nutritional screening has become mandatory in some countries (Scotland, the Netherlands and Denmark), although this is not yet widespread across Europe. Documentation of nutritional status as part of clinical examination and treatment is included in legislation in Norway. Evidence is emerging that screening may reduce the prevalence of malnutrition (see country example The Netherlands) and that the use of screening programmes that include intervention and care planning can contribute to improved outcomes, although more work is needed in this area.

Implementation of screening guidelines in the hospital setting

- In a study investigating the prevalence of under-nutrition in Swiss hospitals, the proportion of patients found to be at risk of under-nutrition remained constant (1 in 5); however, the proportion of nutritional interventions increased from 63% (in year 1) to 72% (in year 2) to 78% (in year 3) ($p < 0.05$ by analysis of variance), providing a promising indication that participating hospitals became more aware over the course of the study.[79]

- In a study of hospital in-patients undergoing orthopaedic surgery ($n = 98$), weekly screening by nurses using the NRS-2002 tool was used to help to implement a preventative nutrition policy (patients with an NRS score ≥ 3 were referred to the Clinical Nutrition Unit for nutritional assessment and intervention). Data was collected at 3 time points: Group A = baseline, Group B = 6 months after implementation of NRS-2002, Group C = at 3 years:[325]

  - proportion of patients with weight loss > 5% reduced significantly (58% vs 33% vs 29%, $p < 0.05$);
  - proportion of patients referred to the Clinical Nutrition Unit significantly increased (16% vs 63% vs 82%, $p < 0.05$);
  - hospital length of stay was reduced in Group C (50±47 days) compared with Group A (72±52) ($p < 0.05$).

- In a group pre- and post-test study in patients aged > 65 years admitted to sub-acute geriatric and rehabilitation wards, the use of nutritional screening and an early intervention programme (referral to a dietitian, nutritional assessment and nutrition care plan) led to significantly increased energy ($p = 0.0001$) and protein intake ($p = 0.01$) and improvements in health-related QOL ($p < 0.05$).[326]

- Implementation of nutrition guidelines improved nutrition screening performance ($p = 0.012$ from 1st to 8th point in prevalence survey) in a Norwegian University hospital but not the fraction of patients treated ($p = 0.66$).[327]

- Implementation of nutrition standards (defined by the Danish Health Quality Programme) improved records for screening (NRS-2002) (56% to 77%; $p < 0.001$), nutrition plans (21% to 56%; $p < 0.0001$) and monitoring (29% to 58%; $p < 0.0001$), with an improvement in energy intake (> 75% of energy requirements) from 52% to 68% ($p < 0.007$) and protein intake (33% vs 52%; $p < 0.001$).[328]

Implementation of screening guidelines in the community setting

- A study of the implementation of a written food and meal policy, systematic screening (using the MNA-SF) and nutrition care planning (including energy and protein drinks, small meals and snacks) in nursing home residents (n = 20, time series design, i.e. residents used as their own controls, quarterly measurements from December 2004 to December 2005) showed:[329]
  - ~ a significant increase in the proportion of weight-stable residents over the study (52.6% at baseline vs 87.7% at the end of the study, $p < 0.01$);
  - ~ a significant reduction in the proportion of residents losing weight (42% to 13.3%, $p < 0.01$).
- Implementation of screening using 'MUST' in line with NICE guidelines[236] in 6 care homes in the UK (n = 208 residents, median age 86 (37–105) years, data collected on the same residents before and after implementation for 3 months) showed:[330]
  - ~ a significant increase in documentation of nutritional information (height 43–100%, weight 75–100%, and proportion screened using 'MUST' 57–100% [$p < 0.001$]);
  - ~ a 32% increase in the use of nutritional care plans;
  - ~ a 31% reduction in hospital admissions (13% vs 9%) (27% reduction in emergency admissions, 11% vs 8%), although this was not significant;
  - ~ a significant reduction in length of hospital stay (58%, mean length of stay reduced from 2.67 days±11.48 to 1.13 days±4.74, $p < 0.005$) and hospital costs (mean saving £599 per resident over 3 months).

Nutritional screening as part of a programme of nutritional care

A review of the evidence for the impact of improving nutritional care on nutritional and clinical outcomes and cost suggested that screening alone may be insufficient to achieve beneficial effects with the following implications for practice:[297]

- Consensus on screening suggests that adequately validated and reliable screening tools are a useful way of identifying patients at risk of malnutrition.
- Nutritional screening together with appropriate intervention may confer benefits on patients in terms of outcome. Nutritional screening alone is unlikely to result in measurable benefits.
- Provision of optimal nutritional care encompasses not only screening and assessment, but also food service provision, eating environment, feeding assistance, recognition of individual needs and preferences, monitoring and documentation.
- Such improvements are likely to benefit from a multidisciplinary approach, with input from senior managers and clinicians.

Implementation in practice: A national example – Scotland

- Nutritional screening is mandatory in Scottish hospitals. Under the terms of the Scotland Act1 998, the devolved administration in Scotland has the power to pass laws on a range of issues including health.

- Figure 6.4 provides an overview of some of the key milestones in the evolution of strategies to improve nutritional care in NHS Scotland.

- The introduction of mandatory government standards for Food, Fluid and Nutritional Care in Hospitals in Scotland in 2003 ensured that under-nutrition was highlighted as a key issue at NHS Board level in every locality (see Table 6.10 for a summary of the standards).

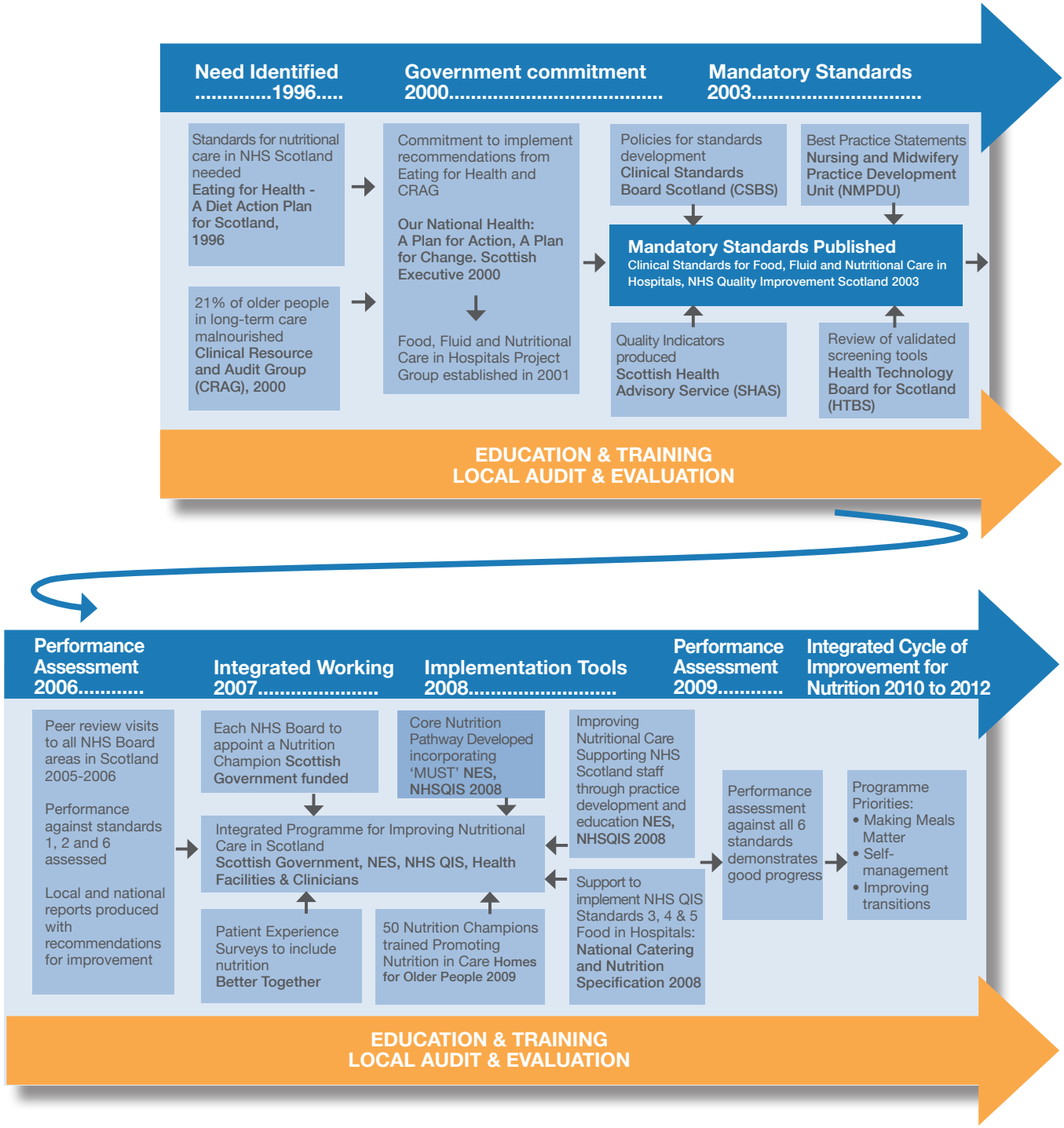


Figure 6.4 **Overview of some key milestones in the evolution of strategies to improve nutritional care in Scotland**

Table 6.10 Summary of Clinical Standards for Food, Fluid and Nutritional Care in Hospitals, NHS Quality Improvement Scotland 2003

Standard	Standard statement
1. Policy and Strategy	Each NHS Board has a policy, and a strategic and co-ordinated approach, to ensure that all patients in hospitals have food and fluid delivered effectively and receive a high quality of nutritional care.
2. Assessment, Screening and Care Planning	When a person is admitted to hospital, an assessment is carried out. Screening for risk of undernutrition is undertaken, both on admission and on an ongoing basis. A care plan is developed, implemented and evaluated.
3. Planning and Delivery of Food and Fluid to Patients	There are formalised structures and processes in place to plan the provision and delivery of food and fluid.
4. Provision of Food and Fluid to Patients	Food and fluid are provided in a way that is acceptable to patients.
5. Patient Information and Communication	Patients have the opportunity to discuss, and are given information about, their nutritional care, food and fluid. Patient views are sought and inform decisions made about the nutritional care, food and fluid provided.
6. Education and Training for Staff	Staff are given appropriate education and training about nutritional care, food and fluid.

- Performance assessments of standards 1, 2 and 6 in 2005–2006 revealed that work had begun, with many NHS Boards having made progress with implementing screening. Work was still needed, especially education and training.

- A range of new innovative strategies was subsequently developed to help NHS Boards to implement the guidelines. A multi-agency Integrated Programme for Improving Nutritional Care in Scotland was established, funding for Nutrition Champions was made available by the Scottish Government, and a Core Nutrition Pathway (Figure 6.5) and an Education Framework for Nutritional Care were developed. Patients' views were also sought.

- In 2009, each NHS Board undertook a local self-assessment followed by an external peer review visit to assess performance against standards 1, 2 and 6 and a full report against standards 3, 4 and 5. The national overview and local reports are available **here**. The national overview report also includes examples of good practice.

- After the first review, 5 challenges were set for NHS Boards, and progress against these, as described in the national report, is listed below:

  ~ implementing nutritional assessment, screening and care planning by 2009: this has been achieved by almost every NHS Board in Scotland;

  ~ planning and implementing improved care for patients with complex nutritional needs: this has been achieved by most NHS Boards, although some organisations find it challenging to formalise access to all key members of the complex nutritional care team;

~ including nutritional care in job/personal development plans (as appropriate): this has been achieved across Scotland;

~ demonstrating leadership commitment and reporting to the Board: this has been achieved in every NHS Board;

~ ensuring budgets and resources are allocated to underpin improvement: nutritional care is clearly funded across NHS Scotland. However, while it is relatively straightforward to budget for catering and supplement requirements, it is less easy to define and cost clinical requirements.

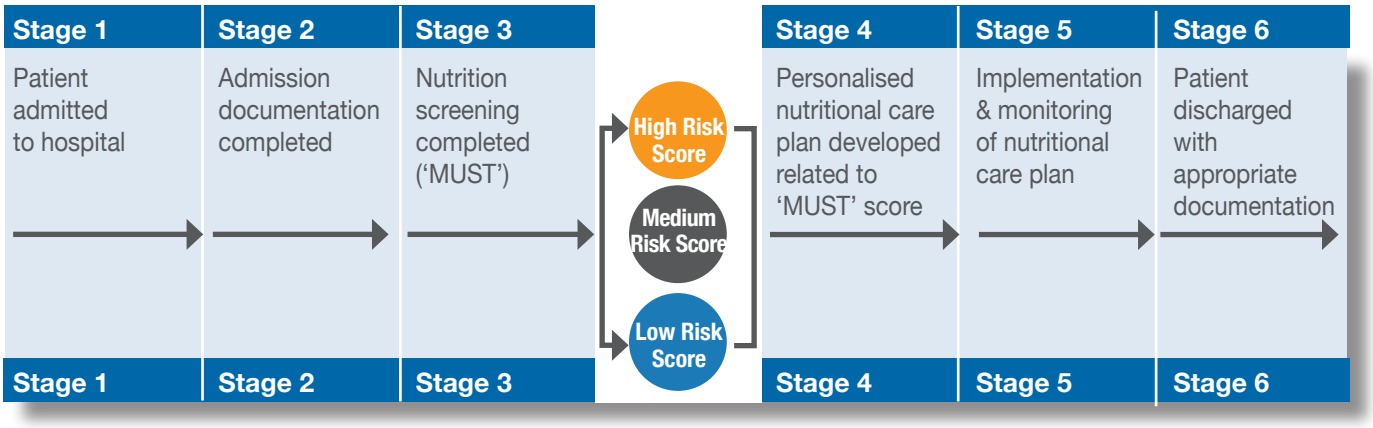


Figure 6.5 **The Core Nutrition Pathway** (adapted from NHS Education for Scotland, NHS Quality Improvement Scotland 2008)

- The Improving Nutritional Care Programme is now under the remit of the Healthcare Improvement Scotland Patient Safety Programme. It is the second phase of the Integrated Programme for Improving Nutritional Care and it will run until 2012. It aims to build on progress to date by undertaking targeted improvement activities to improve nutritional care for people at risk of malnutrition in identified priority areas as outlined in Figure 6.6.

- The Nutrition Champions have a key leading role; learning sessions have been delivered to build capacity and capability, and a series of initiatives have been put in place to gather and share experience. Full details, including a series of case studies, are available in the **interim report**. A range of resources designed to support implementation are also available **here**.

Figure 6.6 **The Improving Nutritional Care Programme priority areas** (adapted from Health Improvement Scotland, 'Improving Nutrition... Improving Care' March 2012)

Implementation in practice: A national example – The Netherlands

- In the Netherlands, screening for malnutrition is mandatory in hospital (including children) and in nursing and residential homes. Figure 6.7 illustrates the events that led to this change.

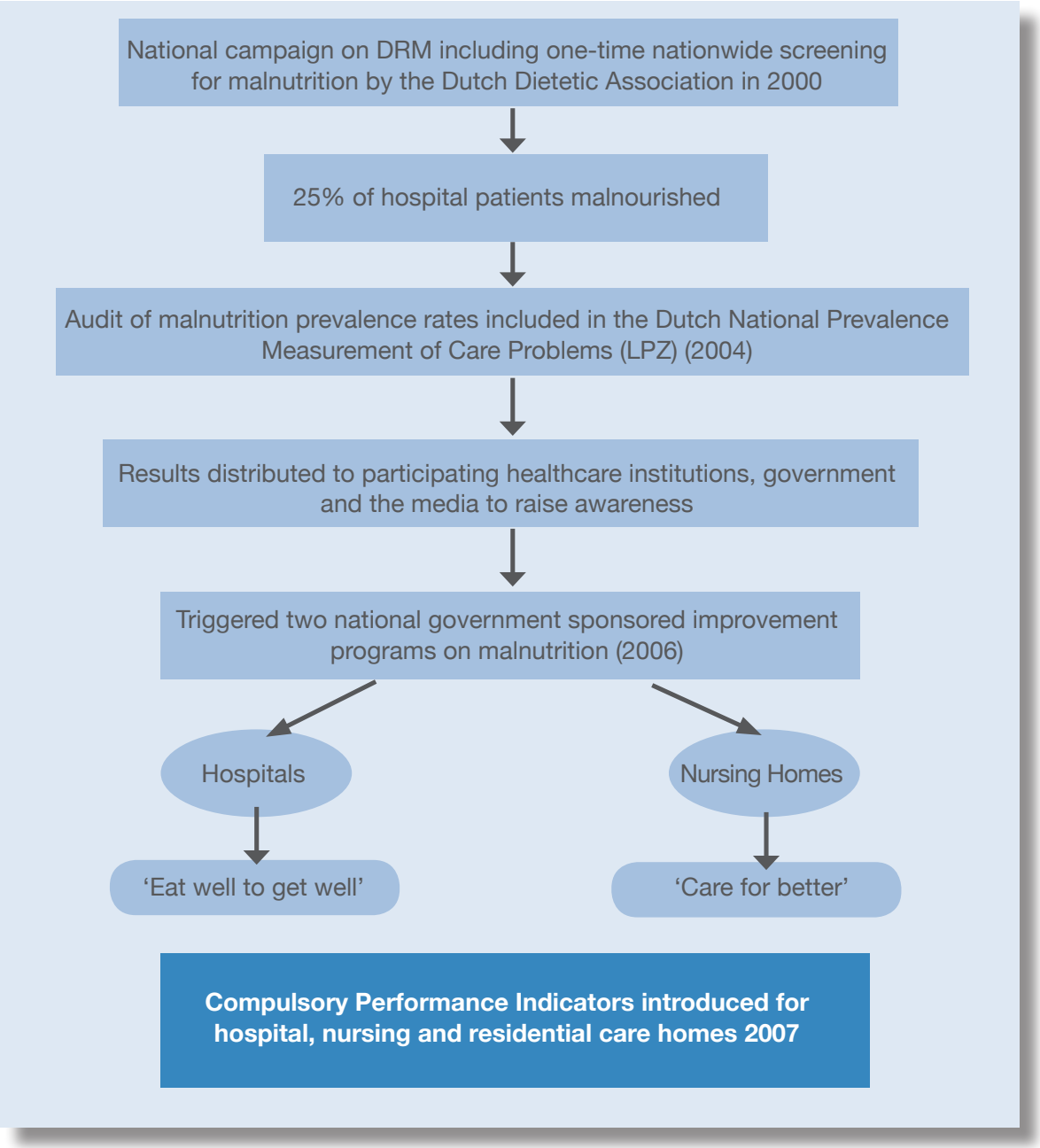


Figure 6.7 **Evolution of strategies to tackle malnutrition in the Netherlands**[331]
(LPZ: Landelijke Prevalentiemeting Zorgproblemen)

- An analysis of the results from national audits conducted in The Netherlands from 2004 to 2010 shows that the prevalence of malnutrition is decreasing (Figure 6.8). Furthermore, the more often hospitals and home care organisations participated in the annual audits, the lower the prevalence of malnutrition ($p < 0.001$). Participation in the national improvement programmes also resulted in lower prevalence rates ($p = 0.027$), suggesting that increasing awareness and actively working towards improvement could be important in lowering the rate of malnutrition.[331]

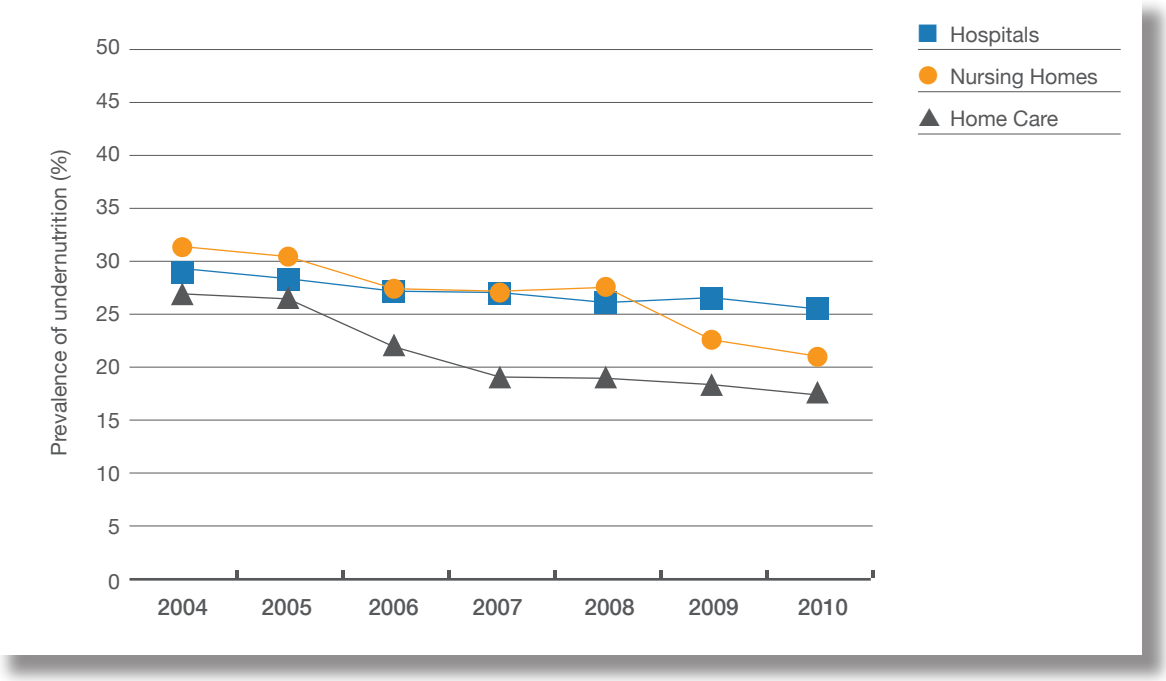


Figure 6.8 **Malnutrition prevalence rates from 2004 to 2010.** LPZ

- Extensive information about the Dutch approach, including details of methodology, implementation strategies and toolkits, is available on the Fight Malnutrition website at http://www.fightmalnutrition.eu/. The following 10 steps summarise the Dutch approach:
  - ~ a multidisciplinary steering group with national key people;
  - ~ up-to-date prevalence data to create and sustain awareness;
  - ~ quick and easy screening tools with treatment plans;
  - ~ screening as a mandatory quality indicator;
  - ~ evidence-based validated tools and cost-effectiveness research;
  - ~ Ministry of Health as a key stakeholder;
  - ~ implementation of projects in all care settings;
  - ~ toolkit with free accessible half fabricates and best practices;
  - ~ multidisciplinary project teams in all institutions;
  - ~ training programmes and workshops.

7 NUTRITIONAL CARE: GOOD PRACTICE EXAMPLES

Summary

Evidence based guidelines can only improve patient care if implemented successfully in practice.

Good practice in nutritional care at professional, political and societal level should focus on ensuring that there is awareness of the issue. It should also include action by government and professional organisations to put in place policies and mechanisms to ensure that health and social care providers implement safe, cost-effective, sustainable and practical nutritional quality improvement programmes to enhance patient care. Many good examples of such work exist. The Medical Nutrition International Industry (MNI) is committed to supporting this work through an annual grant for the most innovative national initiative to fight malnutrition and increase the awareness of malnutrition.

Good practice in nutritional care in social and health care settings should incorporate a range of strategies and activities designed to ensure that each patient receives the most appropriate individually tailored and timely nutrition intervention to optimise nutritional intake and status with a view to improving outcome. A search of the literature and for unpublished work revealed some examples that demonstrate benefits in patient care:

- Implementation of screening using 'MUST' improved nutritional care, improved appropriate use of care plans and reduced hospital stay and costs;
- Use of dietetic assistants to provide intensive feeding support, including ONS (as recommended by the Welsh Assembly Government guidelines), in older women with hip fracture significantly increased energy intake and reduced mortality both in the acute trauma ward and at 4-month follow-up;
- Implementation of a nutritional care protocol for patients with cancer in a Spanish hospital led to attenuation of weight loss in 60% of patients and weight gain in 17% of patients;
- Implementation of a nutritional care programme for older people in a Belgian hospital led to a significant reduction in length of hospital stay.

Most likely other examples exist but are not available in the public domain; efforts need to focus on encouraging the sharing of experience and good practice. Examples of such initiatives include the NICE implementation programme and 33rd ESPEN Congress theme 'Nutrition in translation – bridging science and practice'.

"Translating evidence and guidelines into best practice is a key to ensuring that people who require nutrition support receive the right intervention at the right time in the course of their illness, irrespective of the healthcare setting."

Professor Olle Ljungqvist (2007)*

*Clin Nutr 2007;2(Suppl 1)1-2

Conclusion

There are some good examples of where implementation of nutritional guidelines can have positive effects for patients and healthcare providers. However, it is often difficult to identify examples either because gaps still exist between guidelines that are in place but are not yet fully implemented or because good practice has not been documented and shared. Healthcare professionals need the time, the right skills and resources, and the right forum in which to share good practice. Consideration should be given to innovative ways to facilitate the sharing of good practice at local, national and international level.

Recommendations

On the issue of **Nutritional care: good practice examples** the MNI makes the following recommendation:

Action	Issues to consider
Examples of good practice should be shared widely to facilitate the implementation of nutritional guidelines and ensure best use of resources	• There is potential for more effective use of limited resources if examples of good practice are shared more widely. Healthcare providers and practitioners can share experience of what has been found to be effective and what does not work in practice. Locally developed resources can often be used in other areas saving time and duplication of effort • Sharing good practice should be embedded as a routine part of professional practice and delivery of good patient care

Table 7.1 **Summary of the main output of a selection of MNI grant submissions***

Country (year of submission)	Organisation	Project Title	Main actions/outcomes/achievements
Belgium (2011)	Members of Société Belge de Nutrition Clinique and Vlaamse Vereniging voor Klinische Voeding en Metabolisme	"Interactions between experts in clinical nutrition and Public Health Authorities"	• Recommendations for malnutrition screening tools in various settings • National Quality Charter • Action for promoting implementation of nutrition teams in hospital settings • Participation in Nutrition Day survey • Awareness campaign during the week of Nutrition Day
Denmark (2009) (Award winner 2009)	Danish Society for Clinical Nutrition and Metabolism (DAPEN) and The Danish National Board of Health	"Fighting Malnutrition with a Multi-modal Strategic Approach: The Danish Experience 2007-9"	National guidelines and accreditation within nutrition in all Danish hospitals achieved by a multi-modal approach including: • Cooperation between DAPEN, National Board of Health, Danish Veterinary and Food Administration and politicians, industry and local forces • Systematic evidence-based approach to development of nutritional pathway led by experts in the field • Awareness raised through education, tools and media contact • A basis for an implementation procedure established • National fund created for projects in clinical nutrition • Follow-up studies undertaken to insure goals achieved
Spain (2010) (Award winner 2011)	Spanish Society for Parenteral and Enteral Nutrition (SENPE)	"Fighting hospital malnutrition in Spain: From awareness to action"	• Current burden of hospital malnutrition was assessed at a national level with the PREDyCES study[xii]: ~ 24% of hospitalised patients malnourished in Spain ~ associated with an additional cost of €5,829 per patient • Main findings of the study where used to define the action plan to fight against hospital malnutrition in Spain – malnutrition coding, nutrition screening recommendations, quality indicators for nutrition units • Development of a Multidisciplinary consensus on hospital malnutrition in Spain led by SENPE and involving 22 medical societies, presented to the Spanish Ministry of Health (2011 grant submission)
The Netherlands (2010) (Award winner 2010)	Dutch Society on Parenteral and Enteral Nutrition (NESPEN)	"Top-down and bottom-up approach of malnutrition leads to a decrease in prevalence rates in all health care settings in The Netherlands"	• Ongoing collection and feedback of malnutrition data • Mandatory screening and treatment • Annual audit and feedback • Malnutrition in main list of quality indicators in Dutch health care • Protein and energy goals for malnourished patients defined • Recognition of malnutrition as a healthcare problem as important as overweight • Malnutrition defined as 1 of the 4 topics in the National Safety Management system for all Dutch hospitals • Malnutrition (risk of) has become an official indication for reimbursement of medical nutrition in the basic health insurance

[xii]Full details available at http://www.nutricionhospitalaria.com/pdf/5986.pdf

Table 7.1 Continued

Country (year of submission)	Organisation	Project Title	Main actions/outcomes/achievements
UK (2011) (Award winner in 2008)	British Association for Parenteral and Enteral Nutrition (BAPEN)	"Patients to Parliament - A Quality improvement strategy for optimising nutritional care"	• BAPEN toolkit to meet quality standards in nutritional care • BAPEN's OFNOSH and 'Digesting OFNOSH' (Organisation of Food and Nutrition Support in Hospitals) promoted in national improvement programme to support teams to organise for good nutritional care • BAPEN 'MUST' e-learning modules for hospitals and community • BAPEN Nutrition Screening Week 2007 to 2011: establishing the risk of malnutrition on admission to hospital and care settings and indicating prevalence in the community • Implementation of BAPEN's 4 tenets of good nutritional care • Quality improvement methodology with local tests of change • Working across organisational boundaries to develop nutritional care pathways • Delivery of exemplar practice • BAPEN invited to write opinion papers targeted at executive level managers

*Further details and a full list of all submissions available at http://www.medicalnutritionindustry.com/mni-grant/

Examples of initiatives to encourage implementation of good practice

- In the UK, NICE has developed an extensive implementation programme to support the NHS, local authorities and the private and voluntary sector to implement NICE guidance. The programme includes implementation tools such as costing tools, slide sets, educational tools and audit support materials. NICE has developed Good Practice Awards, a Shared Learning initiative (either submit or search for good practice or innovations) and a team of Implementation Consultants (more information available at http://www.nice.org.uk/usingguidance/). To help to support the implementation of the NICE Nutrition Support Guidelines for Adults, BAPEN has joined with NICE in its Shared Learning initiative by inviting applicants to submit their example of good practice for discussion at the BAPEN Annual Conference and for publication on the BAPEN and NICE websites.

- In 2011, the 33rd ESPEN Congress theme was 'Nutrition in translation – bridging science and practice', with a key focus on translating science into clinical practice. Speakers discussed the theory and challenges surrounding the task of guideline implementation, knowledge translation, implementation strategies and models. This is a good example of how international professional societies can help to disseminate both the results of clinical research and help practitioners to use the results in day-to-day practice to enhance patient care.

- The unique contribution of patient and carers should not be forgotten; the views of patients, carers and patient/carer organisations should be sought and considered at policy and practice level. Action should be taken to make practical information available to patients and carers to help them recognise the issue of disease-related malnutrition and take appropriate steps to help towards their own good nutritional care. An innovative example in this area is the online resource for patients and carers developed by Carers UK and Nutricia Advanced Medical Nutrition 'Care about nutrition. Care with Nutrition.' (see http://nutricia.co.uk/carewithnutrition/).

7.1 Examples of good practice

Table 7.2 **Effectiveness of implementing 'MUST' in care homes within Peterborough Primary Care Trust, England** (adapted from Cawood 2009)[330]

Country: UK	**Setting:** Care homes	**Patient Group:** Care home residents

Guideline:
National Institute for Health and Clinical Excellence (NICE) Nutrition Support in Adults Clinical Guideline 32 (2006)[236]

Aim:
- To investigate the effect of implementation of nutritional screening using 'MUST' in care homes on nutritional care and hospital admissions

Method/Intervention:
- The implementation programme included education on malnutrition and management, practical training sessions using 'MUST', standardised care plans, and ongoing follow-up support
- The programme was implemented in 6 care homes (n = 208 residents; median age 86 years [range 37–105 years]; 75% female)
- Staff satisfaction was assessed using a questionnaire
- The effectiveness of the programme was assessed by collecting information on the same residents for 3 months before and after the implementation. Documentation on nutritional information (e.g. weight, height), use of screening and nutrition care plans, and number and duration of hospital admissions was collected

Results:
Implementation of the nutritional screening programme resulted in:
- A significant increase in documentation on nutritional information (height 43–100%, weight 75–100%, and proportion screened using 'MUST' 57–100% [$p < 0.001$])
- A 32% increase in the use of nutritional care plans
- A 31% reduction in hospital admissions (13% vs 9%) (27% reduction in emergency admissions, 11% vs 8%), although this was not significant
- A significant reduction in length of hospital stay (58%, mean LOS reduced from 2.67 days±11.48 to 1.13 days±4.74, $p < 0.005$) and hospital costs (mean saving £599 per resident over 3 months)
- Overall satisfaction with the programme was high (mean 100%)

Conclusion:
- 'In accordance with national guidelines, implementing 'MUST' in care homes improved appropriate use of nutritional care plans, significantly reduced hospital stay and costs, and significantly improved nutritional care'

Further information:

- The implementation programme followed an earlier cross-sectional study of nutritional care in 19 care homes (*n* = 703 residents) in the Peterborough Primary Care Trust, which showed that 32% of residents were at risk of malnutrition (13% medium risk, 19% high risk). In that survey, 64% of residents at high risk of malnutrition were not receiving any form of nutritional support, whereas 9% of residents at low risk were receiving nutritional intervention such as ONS, dietetic care or food fortification[69]

- This project has been included in the NICE Shared Learning Database accessible at www.nice.org.uk (go to the Shared Learning Implementing NICE Guidance, search examples of implementation)

- This project has been included in 'Appropriate Use of Oral Nutritional Supplements in Older People: Good Practice Examples and Recommendations for Practical Implementation' compiled by an expert panel and endorsed by key healthcare professional organisations in the UK (access at http://manage.nutricia.com/uploads/documents/ONS_Guide.pdf). Includes summary details of the nutrition care plan for risk categories including guidance on use of ONS

Table 7.3 **Using dietetic assistants to improve the outcome of hip fracture: a randomised controlled trial of nutritional support in an acute trauma ward**[230]

Country: UK	**Setting:** Hospital	**Patient Group:** Hip fracture

Guideline:
Welsh Assembly Government. National Service Framework for Older People in Wales (2006) (recommends that all hip fracture patients receive ONS)

Aim:
- To assess the effect of intensive feeding support provided by dietetic assistants on postoperative clinical outcome in hospitalised older women with hip fracture (with or without cognitive impairment)

Method/Intervention:
- Subjects randomised to receive either conventional care (usual nurse and dietitian-led care with ONS for all patients) or conventional care plus the personal attention of the dietetic assistant
- The role of the dietetic assistant was to ensure that patients received appropriate help in meeting their nutritional needs, including:
  - ~ Checking food preferences
  - ~ Co-ordinating appropriate meal orders with catering
  - ~ Ordering ONS
  - ~ Provision of feeding aids
  - ~ Assistance with food choice, portion size and positioning at mealtimes
  - ~ Providing encouragement or assistance with feeding for the frailest of patients
  - ~ Collecting data to assist the dietitian with nutritional assessment
- Primary outcome measure: postoperative mortality in the acute trauma unit
  Secondary outcome measures: postoperative mortality at 4 months after hip fracture, length of hospital stay, energy intake and nutritional status.

Results:
- Patients who received the care of a dietetic assistant had significantly reduced postoperative mortality both on the acute ward (4.1% vs 10.1%, $p = 0.048$) and at 4 months (13.1% vs 22.9%, $p = 0.036$) compared with the patients who received conventional care
- Mean daily energy intake was significantly better in dietetic assistant-supported patients (1105 kcal/d vs 756 kcal/d, 95% CI 259–440 kcal/d, $p < 0.001$)
- There was no significant difference in energy intake from conventional food between the two groups; however, the dietetic assistant-supported patients consumed significantly more energy from ONS compared with the patients who received conventional care (123 kcal/d vs 409 kcal/d, 95% CI 232–339, $p < 0.001$)
- A significantly smaller reduction in MAC was observed in dietetic assistant-supported patients (0.39 cm, $p = 0.002$), but no other significant differences were observed in nutritional status between the 2 groups

Conclusion:
- The use of dietetic assistants to deliver intensive feeding support including ONS significantly reduced mortality in the acute trauma ward, and this effect persisted at 4-month follow-up

Further information:

- This project has been included in 'Appropriate Use of Oral Nutritional Supplements in Older People: Good Practice Examples and Recommendations for Practical Implementation' compiled by an expert panel and endorsed by key healthcare professional organisations in the UK (access at http://manage.nutricia.com/uploads/documents/ONS_Guide.pdf). Includes summary details of the nutrition care plan for risk categories, including guidance on use of ONS

- Winner of the 2006 British Dietetic Association Rose Simmonds Award for published scientific work

Table 7.4 **Overview of a nutritional care programme for patients with cancer in Spain** (adapted from Caro 2008)[332]

Country: Spain	**Setting:** Outpatients	**Patient Group:** Cancer

Supported by:
Sociedad Espanola de Nutricion Basica y Aplicada (SENBA)

Aim:
- To develop strategies to improve the quality of nutritional intervention in cancer patients

Method/Intervention:
- A multidisciplinary group developed a protocol describing nutritional assessment and intervention in the form of algorithms based on literature and personal experience. Patients were classified in a 3-step process:
  - ~ type of cancer treatment (curative or palliative);
  - ~ nutritional risk associated with the anti-cancer treatment (low, medium or high risk);
  - ~ nutritional risk assessed by a patient-generated SGA.
- Patients were classified as having:
  - ~ adequate nutritional state;
  - ~ malnutrition or risk of malnutrition;
  - ~ severe malnutrition.
- The protocol was used over a 1-year period in 226 randomly selected patients aged > 18 years of age

Results:
- 64% of patients were suffering from malnutrition, increasing to 81% in patients undergoing palliative treatment. Most patients were treated curatively (83%), received oncology treatment, and had moderate or high nutritional risk (69%). 68% of patients were affected by some feeding difficulty
- Mean percentage weight loss was 6.64% (±0.87, range 0–33%). More than half of the patients required nutritional counselling to control symptoms which made food intake difficult. One-third of patients needed ONS
- Following the nutritional intervention, weight maintenance was observed in about 60% of patients and weight gain was seen in one-sixth of patients

Conclusions:
- The application of the protocol was useful and easy, and it helped in the detection of malnutrition in patients with cancer
- It provided the opportunity to select patients who could benefit from a specific nutritional intervention
- Nutrition support proved effective for most patients

Recommendation:
- The application of the protocol should be started immediately after diagnosis of cancer

Table 7.5 **Overview of a nutritional care programme for older people in hospital in Belgium** (adapted from Pepersack 2005)[333]

Country: Belgium	**Setting:** Hospital	**Patient Group:** Older people

Supported by:
Belgian Ministry of Social Affairs, Public Health and the Environment

Aims:
- To assess the quality of care concerning nutrition among Belgian geriatric units
- To include more routine nutritional assessments and interventions in comprehensive geriatric assessment
- To assess the impact of nutritional recommendations on nutritional status and on length of hospitalisation

Method/Intervention:
- A prospective observational and interventional 6-month trial. For the first 3 months, the nutritional status of patients was assessed (MNA and serum prealbumin [PAB]) on admission and discharge without particular recommendations for nutritional intervention (observational study – phase 1)
- A standardised nutritional intervention was implemented for the last 3 months (intervention study – phase 2)
- Nutritional intervention was started when MNA was < 23.5 and/or PAB, 0.2 g/l. Treatable causes of malnutrition were identified using the 'meals on wheels' approach (Figure 7.1), and caloric supplementation commenced in line with the algorithm in Figure 7.2

Results:
- 1,139 consecutive patients were admitted during the study, mean age 82.9±7.3 years, 70% of the patients were women. MNA was measurable in 73% of cases with a median value of 18.5 points (range 9–29), mean admission PAB concentration was 18.5±7.6 mg/100 ml, and C-reactive protein (CRP) was 5.3±7.5 mg/100 ml
- The proportion of patients receiving caloric supplementation significantly increased during the interventional period (20% vs 25% of patients; $p < 0.01$)
- Length of hospital stay was significantly shorter during phase 2 than during phase 1 (21.7±15.1 days vs 27.1±21.9 days, $p < 0.001$)

Conclusions:
- Nutritional assessment should be part of routine clinical practice in older hospitalised patients

Recommendation:
- The experience from this project should be extended to other hospital wards as malnutrition is common in patient groups other than older people

Medications
Emotional problems (depression)
Anorexia nervosa (tardive) and abnormal attitudes to food
Late-life paranoia
Swallowing problems

Oral problems
No money

Wandering and other dementia behaviours
Hyperthyroidism, hyperparathyroidism
Entry problems (malabsorption)
Eating problems (physical and cognitive)
Low salt, low cholesterol diets
Shopping (food availability)

Figure 7.1 **The 'meals on wheels' approach to diagnosing treatable causes of malnutrition used in the nutritional care programme in geriatric units in Belgium**
(adapted from Pepersack 2005)[333]

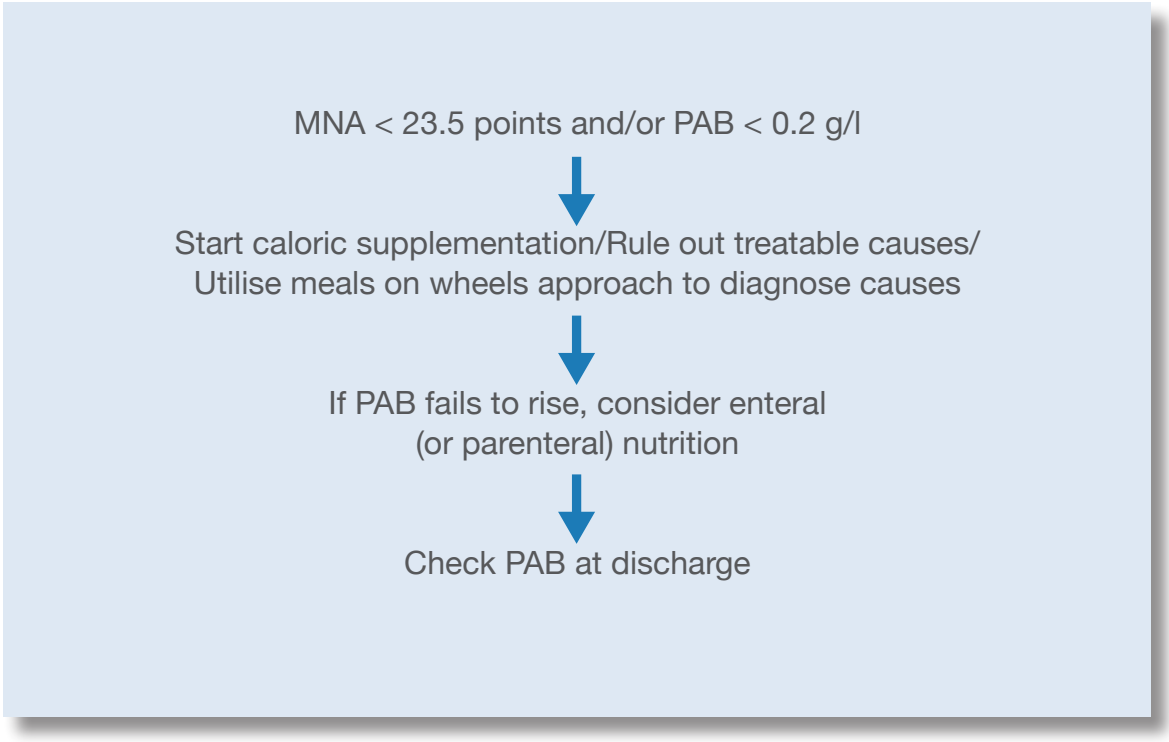


Figure 7.2 **Flowchart suggesting a rational approach to the management of malnutrition used in the nutritional care programme in geriatric units in Belgium**
(adapted from Pepersack 2005)[333]

I PREVALENCE OF MALNUTRITION – Tables A1.1 to A1.8

Table A1.1 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – hospital (general)**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Bosnia-Herzegovina	Vanis & Mesihovic (2008)[334]	Randomly chosen hospitalised patients	2200	Hospital (during hospital stay)	**58.3** **52** **55.3**	'MUST' (no further details given) Nutrition Risk Screening 2002 (NRS-2002) (no further details given) MNA (no further details given)
Denmark	Rasmussen et al. (2004)[57]	> 14 years of age	590	Hospital – internal medicine, gastro and orthopaedic surgery (hospitalised patients on the specific day of investigation)	**39.9**	NRS-2002 but note no adjustment made for age
Denmark	Kondrup et al. (2002)[56]	> 15 years of age	740	Hospital – university, regional & local (on admission)	**22**	**Nutritionally at risk = score ≥ 3**. Severe malnutrition = score 3 (BMI < 18.5 kg/m^2, recent weight loss > 5% in the last month or an intake of 0–25% of requirement). Moderate malnutrition = score 2 (BMI 18.5–20.5 kg/m^2, recent weight loss > 5% in the last 2 months or an intake of 25–50% of requirement). Slight malnutrition = score 1 (recent weight loss > 5% in the last 3 months or an intake of 50–75% of requirement). Patients' general condition and disease severity also taken into account
Germany	Pirlich et al. (2006)[83]	> 18 years of age	1886	Hospital – community, teaching & university (on day of admission)	**27.4** (17.6 + 9.8)	SGA (**moderate + severe**)
Germany	Pirlich et al. (2003)[144]	> 18 years of age	502	Hospital – university & district (on day of admission)	**24.2**	SGA (**moderate + severe**). Not reported separately

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Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Hungary	Lelovics et al. (2008)[335]	All adult patients	1266	Hospital – teaching (on admission)	**41** (13 + 28)	'MUST' (**medium + high**)
Iceland	Westergren et al. (2010)[336]	All adults > 18 years of age	95 (2006) 92 (2007)	Hospital (point prevalence on specified day in 2006 & 2007)	**25** (2006) **17** (2007)	**Nutritionally at risk** defined by presence of at least 2 of: involuntary weight loss; BMI < 20 kg/m² if ≤ 69 years, BMI < 22 kg/m² if ≥ 70 years; eating difficulties according to Minimal Eating Observation Form Version II
Italy	Cereda et al. (2010)[337]	> 18 years of age	559	Regional hospitals with > 400 beds (within 36 hours of admission)	**57.2**	NRS-2002
Italy	Lucchin et al. (2009)[87]	Adults aged > 18 years of age	1284	Regional hospitals with > 400 beds (within 36 hours of admission)	**28.6**	NRS-2002. '**At risk**' of malnutrition = score ≥ 3
Poland	Dzieniszewski et al. (2005)[338]	Adults aged 16–100 years of age	3310	Hospital – teaching, provincial & county (first day of admission & day of discharge)	**10.43** (admission) **11.21** (discharge)	BMI (classification of risk of malnutrition BMI < 20 kg/m²)
Portugal	Amaral et al. (2010)[339]	> 18 years of age	1144	Hospital – university, district & oncology (on admission)	**36**	NRS-2002
Portugal	Amaral et al. (2007)[340]	> 18 years of age	469	Hospital (on admission)	**42**	NRS-2002 (based on BMI, % recent weight loss, recent change in food intake and disease severity). Mild/slight: score 1, moderate: score 2, severe: score 3. For patients > 70 years of age, one point was added to the score. Patients with a total **score of ≥ 3 were considered nutritionally at risk**, patients with a score < 3 were not considered nutritionally at risk
Republic of Ireland	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 18 years of age	1102	Hospital (within 72 hours of admission)	**27** (7 + 20)	'MUST' (**medium + high**)

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Republic of Ireland	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 18 years of age	1602	Hospital (within 72 hours of admission)	**33** (8 + 25)	'MUST' (**medium + high**)
Spain	Velasco et al. (2011)[341]	≥ 18 years of age	400	University hospitals (within 36 hours of admission)	**34.5** **31.5** (14 +17.5) **35.3** (28.5 + 6.8) **58.5** (44 + 14.5)	NRS-2002 MUST (**medium + high**) SGA (**suspected malnourishment + severe**) MNA (**at risk + poor nutritional status**)
Spain	Martinez Olmos et al. (2005)[85]	> 18 years of age	360	Hospital (stratified random sample of hospitalised patients on specified days)	**46.9** (37.2 + 9.7)	SGA (**moderate + severe**)
Spain	Planas et al. (2004)[208]	Adult patients	400	Hospital – university-affiliated (within 48 hours of admission)	**26.7** (anthropometry) **46** (SGA)	Anthropometry (classification as undernourished: BMI < 18.5 kg/m^2 or BMI < 20 kg/m^2 and TSFT or Arm Muscle Circumference < 15th centile) SGA (**moderate + severe**). Not reported separately
Spain	Pablo et al. (2003)[342]	> 18 years of age	60	Hospital – public general (within 48 hours of admission)	**63.3** (36.7, 18.3 + 8.3) SGA 90 (6.7, 60 + 23.3) Nutritional Risk Index **80** (20, 15 + 45) INA **78.3** Combined Index	SGA (**mild, moderate + severe**) NRI: 1.519 x serum albumin (g/l) + 41.7 x (present/usual weight)) (**mild:** NRI 97.5–100, **moderate:** NRI 83.5 to < 97.5, **severe:** NRI < 83.5 Instant Nutritional Assessment (INA) **1st degree:** serum albumin ≥ 3.5 g/dl; blood lymphocyte count < 1500 cells/mm^3, **2nd degree:** serum albumin < 3.5 g/dl; blood lymphocyte count < 1500 cells/mm^3, **3rd degree:** serum albumin < 3.5 g/dl; blood lymphocyte count ≥ 1500 cells/mm^3, **4th degree:** serum albumin < 3.5 g/dl; blood lymphocyte count < 1500 cells/mm^3

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment	Prevalence % (risk category)	Method and details of risk category where reported
Sweden	Westergren et al. (2009)[343]	>18 years of age	1197 824 370	Large hospitals > 500 beds Medium hospitals 200–500 beds Small hospitals < 200 beds (point prevalence, data collected on hospitalised patients on a single day)	**34** (26.4 + 7.6) **26.2** (21.1 + 5.1) **21.6** (17.7 + 3.9)	**Moderate/high risk** of under-nutrition defined as the occurrence of at least two of: involuntary weight loss, BMI below limit (BMI < 20 kg/m^2 if ≤ 69 years, BMI < 22 kg/m^2 if ≥ 70 years), eating difficulties according to Minimal Eating Observation Form – Version II
Sweden	Westergren et al. (2008)[155]	All patients	874	Hospitals (hospitalised patients, timing not specified)	**27**	At risk of under-nutrition if 2–3 of the following 3 criteria fulfilled: (1) involuntary weight loss (irrespective of time and amount), (2) BMI below limit (< 20 kg/m^2 if ≤ 69 years, < 22 kg/m^2 if ≥ 70 years), and (3) presence of eating difficulties. **Low risk:** 1 criterion fulfilled, **moderate risk:** 2 criteria fulfilled, **high risk:** 3 criteria fulfilled. Not reported separately
Switzerland	Imoberdorf et al. (2010)[79]	All adult medical admissions	32837	Hospital (on day of admission)	**18.2** (range 13–20% across 7 participating hospitals)	NRS-2002. Severe under-nutrition or high risk for developing under-nutrition: score ≥ 3
Switzerland	Venzin et al. (2009)[344]	All medical admissions	430	Hospital – medium-sized general teaching (MNA within 24 hours of admission, physician's assessment on admission)	**30.5** (20.1 + 10.4) **14**	MNA. **At risk of malnutrition**: score of 17–23.5, **frank malnutrition** score of < 17 Physician's assessment (judgement based on patient history, physical examination and laboratory results)

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Switzerland	Kyle et al. (2006)[345]	All adult medical/ surgical admissions	995	Hospital (on hospital admission)	**39** (29 + 10) **37** (10 +27) **28** (19 + 9) **25** (20 + 5)	SGA (**moderate + severe**) MUST (**medium + high**) NRS-2002 (**medium + high risk**) NRI (**medium + high risk**) (1.519 x serum albumin g/l) = (14.7 x present/usual body weight [BW]). NRI score > 100 indicates no risk, 97.5–100 low risk, 83.5–97.5 medium risk, ≤ 83.5 high risk
Switzerland	Kyle et al. (2002)[86]	All adult medical/ surgical admissions	995	Hospital (within 3 hours of admission)	**61.4** (38.3 + 23.1)	SGA (**moderate + severe**)
The Netherlands	Meijers et al. (2009)[346]	≥ 18 years of age	8028	Hospital (cross-sectional, point prevalence on specified day)	**23.8**	Malnutrition defined according to one of the 3 following criteria: (1) BMI < 18.5 kg/m^2 (2) unintentional weight loss (6 kg in previous 6 months or 3 kg in the previous month) or (3) BMI 18.5–20 kg/m^2 in combination with no nutritional intake for 3 days or reduced intake for > 10 days
The Netherlands	Bavelaar et al. (2008)[58]	All newly admitted patients	395	Hospital general medical wards (within 72 hours of admission)	**31.9** (31.1 + 0.8)	BMI and/or SNAQ score (**severe:** BMI < 18.5 kg/m^2 and/or SNAQ score ≥ 3 points + **moderate:** BMI 18.5–20.0 kg/m^2 and/or SNAQ score ≥ 2 points)
The Netherlands	Kruizenga et al. (2003)[347]	> 18 years of age	6150	Hospital (convenience sample, timing not clear)	**26** (13 + 13)	Involuntary weight loss (**at risk:** 5–10% unintentional weight loss during the past 6 months + **malnourished:** unintentional weight loss > 10% during the past 6 months)

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Turkey	Nursal et al. (2005)[348]	All adult patients admitted to wards	2211	University referral centre (within 48 hours of admission)	**11** **15.6**	SGA (**moderate + severe**). Not reported separately Combination criteria: diagnosed with malnutrition if positive for at least 2 of the following 6 criteria: (1) > 10% weight loss during the past 6 months; (2) BMI < 20 kg/m^2; (3) TSFT no higher than the 5th centile; (4) MAMC no higher than the 5th centile; (5) serum albumin level < 3 g/dl; and (6) serum prealbumin level < 0.2 g/dl
UK	Lamb et al. (2009)[61]	Adult inpatients ≥ 16 years of age	328 226	Hospital – general medicine, general surgery, orthopaedics and critical care (all patients assessed on a single day, 1st May 2007)	**43.9** (11.9 + 32) **32.7** (19 + 13.7)	'MUST' (**medium + high**) Northumbria Nutrition Score Chart (NNSC) validated for reproducibility and ease of use only. Patients scored according to psychological state, BMI, weight loss, ability to swallow and co-morbid medical illness. **Low** risk of malnutrition: 0-3, **moderate** risk: 4–5, **high** risk: ≥ 6
UK	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 18 years of age	7541	Hospital (within 72 hours of admission)	**25** (7 + 18)	'MUST' (**medium + high**)
UK	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 18 years of age	9669	Hospital (within 72 hours of admission)	**34** (14 + 21)	'MUST' (**medium + high**)
UK	Russell & Elia (2009)[81] (summer 2008)	Adults ≥ 18 years of age	5089	Hospital (within 72 hours of admission)	**28** (6 + 22)	'MUST' (**medium + high**)
UK	Russell & Elia (2008)[80] (autumn 2007)	Adults ≥ 18 years of age	9336	Hospital (within 72 hours of admission)	**28** (6 + 22)	'MUST' (**medium + high**)

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
USA & CANADA						
Canada	Singh et al. (2006)[349]	Adults ≥ 20 years of age	48	Hospital – medical admission/teaching unit (within 10 days of admission)	**69** (39 + 30)	SGA (**moderate + severe**)
USA	Robinson et al. (2003)[350]	≥ 18 years of age	320	Hospital – tertiary (blood taken within 48 hours of admission & nurse screening within 24 hours of admission)	**51** **33**	Plasma prealbumin concentration Standard hospital nutrition screening/assessment protocol (nursing screening questionnaire regarding nutritional status and nutritional intake). If any positive responses, a dietitian informed and perform a formal nutrition assessment within 48 hours
USA	Liang et al. (2008)[351]	Adults 18–80 years of age	200	Hospitals – teaching, Baltimore, USA (newly admitted + 2 weeks post admission or discharge)	**51** (admission) **41.4** (discharge or 2 weeks post discharge)	NRS-2002
CENTRAL & SOUTH AMERICA						
Argentina	Wyszynski et al. (2003)[352]	Adults > 18 years of age	997	Hospital (not specified June-November 1999)	**47.3** (36.1 + 11.2)	SGA (**moderate + severe**)
Brazil	Leandro-Merhi et al. (2011)[203]	Adults 20-60 years of age	230	Hospital – surgical wards (preoperatively)	**20.1** (19.3 + 0.8)	SGA (**slightly malnourished + moderately malnourished**)
Brazil	Correia & Campos (2003)[353]	Adults > 18 years of age	9348	Hospitals – general and at least 200 beds	**50.2** (39.0 + 11.2)	SGA (**moderate + severe**)
Cuba	Barreto Penié (2005)[354]	Adults > 19 years of age	1905	Hospitals – secondary & tertiary (not specified)	**41.2** (30.1 + 11.1)	SGA (**moderate + severe**)

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
ASIA						
China	Liang et al. (2008)[351]	Adults 18–80 years of age	300	Hospitals – teaching (newly admitted and 2 weeks post admission or discharge)	**39** (admission) **38.5** (discharge or 2 weeks post admission)	NRS-2002
Singapore	Lim et al. (2011)[63]	Adults 18–74 years of age	818	Acute tertiary hospital (within 48 hours of admission)	**29** (25 + 4)	SGA (**moderate + severe**)
Singapore	Raja et al. (2004)[355]	Adults	715 (admission episodes) 681 (patient episodes) 152 (cases)	Hospitals – medical & surgical wards (within 72 hours of admission by dietitian using MST)	**14.7** **22.3** **69.1** (37.5 + 31.6)	Those episodes identified as at risk of malnutrition/malnourished by both MST and SGA Initial assessment by dietitians using Ferguson, Bauer, Banks & Capra MST. MST is a questionnaire developed and validated in an Australian hospital. Patients are scored based on the following criteria: recent weight loss; if yes, how much; eating poorly due to decreased appetite? Score ≥ 2 classified as at **risk of malnutrition** SGA (**moderate + severe**)
Vietnam	Pham et al. (2006)[356]	Abdominal surgery patients	438 total of which major surgery 274	Hospital – general (not specified)	**55.7** (28.8 + 26.9) **77.7** (35.4 + 42.3)	SGA (**moderate + severe**) SGA (**moderate + severe**)
MIDDLE EAST						
Iran	Hosseini et al. (2006)[357]	≥ 18 years of age	156	Hospital > 400 beds (within 24 hours of admission + on discharge)	**5.8** (admission) **10.9** (discharge) **0.6** (admission) **1.3** (discharge)	BMI **severely undernourished** < 16 kg/m^2 BMI **undernourished** < 18.5 kg/m^2

Table A1.1 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
AUSTRALIA & NEW ZEALAND						
Australia & New Zealand	Agarwal et al. (2012)[42]	≥ 18 years of age	3080	Acute care hospitals (data collected over 1–3 24 hour periods during June & July 2010)	**32** **30** (24 + 6) **8** **41**	Combined SGA + BMI SGA (**suspected or moderately malnourished + severely malnourished**) BMI < 18 kg/m^2 Malnutrition risk (MST)
Australia	Thomas et al. (2007)[358]	> 18 years of age	64	Hospital Acute Admissions Unit (within 48 hours of admission)	**53** (43.8 + 9.4)	Patient Generated-SGA (PG-SGA) (**moderately malnourished + severely malnourished**). An extension of SGA, with a higher numerical score reflecting a greater risk of deterioration of nutritional status. PG-SGA global rating can identify malnutrition and the score is used to assess subtle changes in nutritional status/nutritional risk that cannot be detected by SGA. (No further details given)
Australia	Lazarus & Hamlyn (2005)[359]	≥ 18 years of age	324	Hospital: not-for-profit private (not specified August–October 1999)	**42.3** (36.4 + 5.9)	SGA (**moderate + severe**)
Australia	Banks et al. (2007)[90]	All available subjects (excluding paediatric, obstetric, mental health and same-day patients)	774 1434	Hospitals (a single day for each facility 2002 + 2003)	**34.7** (27.8 + 7.0) **31.4** (26.1 + 5.3)	Mean MNA (**moderate + severe**) Mean MNA (**moderate + severe**)

Table A1.2 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – hospital (older people)**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Belgium	Vanderwee et al. (2011)[60]	≥ 75 years of age	2094	Hospital – geriatric wards (cross-sectional survey between 16th May &15th June 2007)	**31.9** (range 0–90.9% across participating wards)	MNA-SF
Germany	Volkert et al. (2010)[70]	≥ 75 years of age	205	Community hospital – geriatric ward (first day after admission)	**25.4** **60** (34.6+ 25.4) **90.2** (60.0 + 30.2) **5.9**	BMI (**undernourished** < 22 kg/m^2) SGA (**moderate + severe**) MNA (**at risk + undernourished**) Clinical judgement of physician
Italy	Orsitto et al. (2009)[94]	> 65 years of age	588	Hospital – geriatric ward (on admission)	**82** (58 + 24)	MNA (**at risk + malnourished**)
Norway	Söderhamn et al. (2011)[360]	> 65 years of age	153 154 153 158	Hospital – medical wards (during the first days on the wards)	**60.8** (43.8 + 17) **64.9** **44.4** **62** (29.1 + 32.9)	MNA (**at risk + undernourished**) MNA-SF (**at risk**) NRS-2002 (**at risk**) Nutritional Form for the Elderly (Norwegian) (NUFFE-NO) (≥ 6 indicating **medium risk of under-nutrition** + ≥ 11 indicating **high risk of under-nutrition**). Ordinal scale containing 15 3-point items: weight loss, changes in dietary intake, appetite, intake of prepared food, portion size, intake of fruit and veg, possibility of obtaining food products, company at meals, activity, dental and swallowing difficulties, fluid intake, GI problems, eating assistance, number of drugs, difficulties in eating because of impaired health

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Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Portugal	Cansado et al. (2009)[92]	≥ 65 years of age	341	Hospital – surgery (within 48 hours of admission and 24 hours of discharge)	**93.3** (0.0 + 93.3) admission **61.5** (8.2 + 53.3) discharge	'MUST' (**medium + high**)
					77.9 (26.6 + 51.3) admission **77.1** (33.7 + 43.4) discharge	MNA (**at risk + undernourished**)
			190	Hospital – medicine (within 48 hours of admission and 24 hours of discharge)	**92.6** (0.0 + 92.6) admission **50.9** (15.2 + 35.7) discharge	'MUST' (**medium + high**)
					91.5 (48.9 + 42.6) admission ***95.7*** (44.7 + 51.0) discharge	MNA (**at risk + undernourished**)
Republic of Ireland	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 65 years of age	Total study population *n* = 1262, of which 51% aged ≥ 65 years. ('MUST' data only available for *n* = 1102)	Hospital (within 72 hours of admission)	**28**	'MUST' (**medium + high**)

Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Republic of Ireland	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 65 years of age	Total study population *n* = 1636, of which 48% aged ≥ 65 years. ('MUST' data only available for *n* = 1602)	Hospital (within 72 hours of admission)	**34**	'MUST' (**medium + high**)
Spain	de Luis et al. (2011)[88]	> 65 years of age	493	Hospital (not specified)	**72.1** (49.6 + 22.5)	MNA (at risk + undernourished)
Spain	de Luis & Lopez Guzman (2006)[361]	> 70 years of age	213	Hospital internal medicine departments (randomly selected hospitalised patients)	**74.1** (23.9 + 50.2)	MNA (**malnourished:** score < 17 points + **at risk:** score 17–23.5)
Switzerland	Drescher et al. (2010)[362]	78–89 years of age	104	Hospital – geriatric ward (within 3 days of admission)	**70** (48 + 22) **34**	MNA (**at risk + undernourished**) NRS-2002
Switzerland	Imoberdorf et al. (2010)[79]	Adults	Total study population *n* = 32,837, no details of number of patients aged > 65 years available	Hospital – general medical departments 65–84 years of age > 85 years of age (day of admission)	 **22** **28**	 NRS-2002 NRS-2002 Patients ≥ 70 years were given an additional score point

Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 65 years of age	Total study population *n* = 9132, of which 56% aged ≥ 65 years. ('MUST' data only available for *n* = 7541)	Hospital (within 72 hours of admission)	**28**	'MUST' (**medium + high**)
UK	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 65 years of age	Total study population *n* = 9932, of which 59% aged ≥ 65 years. ('MUST' data only available for *n* = 9669)	Hospital (within 72 hours of admission)	**39**	'MUST' (**medium + high**)
UK	Russell & Elia (2009)[81] (summer 2008)	Adults ≥ 65 years of age	Total study population *n* = 6068, of which 52% aged ≥ 65 years. ('MUST' data only available for *n* = 5089)	Hospital (within 72 hours of admission)	**32**	'MUST' (**medium + high**)

Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Russell & Elia (2008)[80] (autumn 2007)	Adults ≥ 65 years of age	Total study population *n* = 9563, of which 55% aged ≥ 65 years. ('MUST' data only available for *n* = 9208)	Hospital (within 72 hours of admission)	**30**	'MUST' (**medium + high**)
UK	Stratton et al. (2006)[186]	Acutely ill older people	150	Hospital elderly care wards (within 48–72 hours of admission)	**58** (17 + 41)	'MUST' (**medium + high**)
USA & CANADA						
USA	Covinsky et al. (1999)[363]	> 70 years of age	369	Hospital – general medical unit (between 2nd & 4th day after discharge)	**40.7** (24.4 + 16.3)	SGA (**moderate + severe**)
CENTRAL & SOUTH AMERICA						
Brazil	Leandro-Merhi et al. (2011)[203]	≥ 60 years of age	120	Hospital – surgical wards (preoperatively)	**43.9** (32.9 + 11.0)	MNA (**at risk + malnourished**)
Brazil	Coelho et al. (2006)[364]	≥ 60 years of age	192	Hospital – geriatric unit (between October 2004 & March 2005)	**29.7** **54.7**	BMI (WHO classification **underweight** < 18.5 kg/m^2) BMI (Nutrition Screening Initiatives classification **underweight** < 22 kg/m^2)

Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
ASIA						
China	Lei et al. (2009)[365]	> 60 years of age	184	Hospital (within 5 days of admission)	**72.8** (53.2 + 19.6)	MNA (**at risk + malnourished**)
China	Shum et al. (2005)[366]	≥ 60 years of age	77 120	Convalescent & rehabilitation hospital – geriatric wards (within 48 hours of admission)	**61.1** (44.2 +16.9) **16.7**	Chinese MNA (**at risk:** 18.5–23.5 + **malnourished:** score < 18.5) (no further details given) BMI < 18.5 kg/m^2 and albumin level of < 35g/l: at risk
China	Woo et al. (2005)[367]	≥ 65 years of age	867	Hospitals & nursing homes (not specified)	**36** (25.8 + 10.1)	Chinese Nutrition Screening (CNS) (**at risk + malnourished**). A questionnaire based on MNA, specifically orientated to Chinese elderly in hospitals and nursing homes. 16 questions regarding lifestyle, health and dietary care tailored to suit Chinese healthcare system, diet, culture and customs. It omits anthropometry and has a maximum score of 32. The higher the score, the better the nutrition status. Further detail unavailable
India	Karmakar et al. (2010)[368]	> 60 years of age	76	Hospital – tertiary, inpatients and outpatients (not specified)	**27.6** (of which 61.9) **42.1** (of which 57.1)	BMI undernourished < 18.5 kg/m^2 (**severely undernourished** < 16 kg/m^2) IBW undernourished < 85% (**severely undernourished** < 70%)
MIDDLE EAST						
Israel	German et al. (2008)[369]	≥ 65 years of age	195	Hospital (within 24 hours of admission)	**39**	MNA (no further details given)

Table A1.2 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
AUSTRALIA & NEW ZEALAND						
Australia	Vivanti et al. (2011)[370]	Older people	194	Hospital – geriatric assessment and rehabilitation unit (within 72 hours of admission)	**39** (35.1 + 3.6)	SGA (**moderate + severe**)
Australia	Adams et al. (2008)[59]	≥ 70 years of age	100	Hospital – tertiary (within 24–48 hours of admission)	**91** (61 + 30)	MNA (**at risk + malnourished**)

Table A1.3 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – outpatients**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting†	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Italy	Bozzetti (2009)[112]	Adults with cancer	1000	Outpatients	**33.8** **39.7**	NRS-2002. Score ≥ 3 = **malnourished** Significant weight loss (≥ 10%)
The Netherlands	Leistra et al. (2009)[65]	> 18 years of age	2288	General outpatient departments in 9 hospitals	**7.1** (2 + 5.1) Wide variation depending on type of department (see Figure 2.8)	**Moderate malnutrition** = BMI ≥ 18.5 kg/m² with 5–10% unintentional weight loss in the last 6 months. **Severe malnutrition** = one or more of the following present: BMI < 18.5 kg/m² and/or intentional weight loss of > 5% in the last 1 month or > 10% in the last 6 months
The Netherlands	Neelemaat et al. (2008)[111]	Adults aged > 18 years	705 979	General outpatients Preoperative outpatients	**12** (7 + 5) **17** (9 + 8)	SNAQ. 3 questions: 'Did you lose weight unintentionally (> 6 kg in the last 6 months and/or > 3 kg in the last 1 month)? Did you use supplemental drinks or tube feeding over the last month? Did you experience difficulties when eating and drinking over the last month? (**moderate** = score of ≥ 2 and severe = score of ≥ 3)
The Netherlands	Vermeeren et al. (2006)[115]	Adults aged 40–75 years with COPD	389	Outpatients in 39 centres	**27**	Nutritional depletion defined as BMI ≤ 21 kg/m² and or Fat-Free Mass Index (FFMI) ≤ 15 kg/m² (females) or ≤ 16 kg/m² (males)
Turkey	Halil (2009)[117]	Older people aged ≥ 65 years	2327	Geriatric medicine outpatient clinic	**28**	MNA-SF. **Malnutrition risk** = MNA ≤ 11 points
UK	Collins et al. (2010)[114]	Adults with COPD	425	Outpatients (overall) Mild disease Moderate disease Severe disease	**21** (7 + 14) **13** **12** **26**	'MUST' (**medium + high risk**)
UK	Rust et al. (2010)[110]	Adults	321	General hospital outpatients	**15.9** (10.9 + 5)	'MUST' (**medium + high risk**)

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Table A1.3 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting†	Prevalence % (risk category)	Method and details of risk category where reported
UK	Renshaw et al. (2008)[113]	Adults with cancer	207	Medical oncology outpatients	**83** (upper GI) **76** (lung/ mesothelioma) **73** (gynaecological) **60** (breast) **50** (colorectal) **45** (urological)	Nutritional risk determined using local trust validated Nutrition Screening Tool (includes questions on unintentional weight loss, appetite reduction in previous 3–6 months, height, usual and current weight and BMI). Details of validation not given
UK	Stratton et al. (2004)[116]	Adults	50	Gastroenterology outpatients	**30** (18 + 12)	'MUST' (**medium + high risk**)

†Timing not specified in studies; assume on attendance during the period of the study

Table A1.4 Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – care homes (majority of participants were older people)

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Austria	van Nie-Visser et al. (2009)[67]	Residents of care homes (age not reported)	221	Care homes (on admission)	**28**	**Malnutrition** prevalence measured by assessing BMI, undesired weight loss and nutritional intake (no further details given)
Denmark	Beck & Ovesen (2002)[371]	> 65 years of age	180	Nursing homes (not specified)	**33** (22)	BMI < 20 kg/m^2 (BMI < 18.5 kg/m^2)
Finland	Suominen et al. (2009)[120]	Older people	1043	Long-term elderly care facilities (all patients during 2 weeks in September 2003)	**97.4** (40.7 + 56.7) **15.2**	**At risk** MNA 17–23.5 points, malnourished MNA < 17 points Nurse assessment using BMI
France	Bourdel-Marchasson et al. (2009)[123]	Older people	517	Nursing Homes† (random sample of 15 residents from each home at the time of the interview visit)	**54.9** (13.1)	**At risk** MNA-SF score ≤ 11 (of whom **malnourished** MNA score < 17)
			84	Long-term care homes† (random sample of 15 residents from each home at the time of the interview visit)	**90.4** (42.9)	**At risk** MNA-SF score ≤ 11 (of whom **malnourished** MNA score < 17)
Germany	Volkert et al. (2011)[124]	> 65 years of age	350	Nursing home (not specified)	**79.6** (52.9 + 26.7)	MNA (**at risk + malnourished**)
Germany	Smoliner et al. (2009)[125]	Older people	114	Nursing home (not specified)	**80.7** (57.9 + 22.8)	**At risk** MNA 17–23.5 points, **malnourished** < 17 points
Germany	van Nie-Visser et al. (2009)[67]	Residents of care homes (age not reported)	2444	Care homes (on admission)	**26**	**Malnutrition** prevalence measured by assessing BMI, undesired weight loss and nutritional intake (no further details given)

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Table A1.4 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – care homes (majority of participants were older people)**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Germany & Austria	Valentini et al. (2009)[121]	> 50 years age	2137	Nursing homes (one-day cross-sectional audit on 22nd February 2007)	**16.7** (13.9) **9.2** (14.3)	**Malnourished:** BMI < 20 kg/m^2 (at **risk of malnutrition:** BMI 20–21.9 kg/m^2) Subjectively assessed by staff. (**Malnourished (at risk of malnutrition**)
Germany	Norman et al. (2007)[126]	Age range 79.1–91.4 years	112	Nursing home (not specified)	**80.3** (71.4 + 8.9)	MNA (**at risk + malnourished**)
Hungary	Lelovics et al. (2009)[131]	Older people > 60 years	1381	Nursing homes (unclear)	**38.1** (8.0 + 30.1)	'MUST' (**medium + high**)
Italy	Santomauro et al. (2011)[127]	≥ 65 years of age	463	Nursing homes	**80.8** (58.3 + 22.5)	MNA (**at risk + malnourished**)
Italy	Cereda et al. (2009)[372]	Older people	241	Long-term care for older people (not specified)	**51.8** (39 + 12.8) **56.8** (36.1 + 20.7)	**At risk** MNA 17–23.5 points, **malnourished** < 17 points GNRI **moderate risk:** GNRI 92–98, **high risk:** GNRI < 92
Italy	Pezzana et al. (2009)[128]	Older people	738	Nursing homes (not specified)	**78**	MNA-SF (no further details given)
Republic of Ireland	Russell & Elia (2012)[62] (spring 2011)	> 18 years of age*	29 (Note: only 6 homes took part)	Care homes (overall) Nursing homes only Residential homes only Other homes (restricted to adults admitted within the previous 6 months)	**21** (7 + 14)** **25** **0** **20**	'MUST' (**medium + high**)

Table A1.4 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
Republic of Ireland	Russell & Elia (2011)[77] (winter 2010)	> 18 years of age*	153	Care homes (overall) Nursing homes only Residential homes only Other homes (restricted to adults admitted within the previous 6 months)	**32** (16 + 16)** (*n* = 143) **34** **9** **32**	'MUST' (**medium + high**)
Spain	Ruiz-Lopez et al. (2003)[129]	Women aged 72–98 years	89	Nursing homes – private	**69.7** (61.8 + 7.9)	MNA (**at risk + malnourished**)
Sweden	Westergren et al. (2008)[155]	All residents*	1726	Special accommodation –nursing home-type setting (not specified)	**27**	At risk of under-nutrition if 2–3 of the following 3 criteria fulfilled: (1) involuntary weight loss (irrespective of time and amount), (2) BMI below limit (< 20 kg/m^2 if ≤ 69 years, < 22 kg/m^2 if ≥ 70 years), and (3) the presence of eating difficulties. **Low risk:** 1 criterion fulfilled, **moderate risk:** 2 criteria fulfilled, **high risk:** 3 criteria fulfilled. Not reported separately
The Netherlands	Meijers et al. 2009)[346]	≥ 18 years of age*	2061	Nursing homes (cross-sectional, point prevalence on specified days)	**19.2**	Malnutrition defined according to one of the 3 following criteria: (1) BMI < 18.5 kg/m^2 (2) unintentional weight loss (6 kg in previous 6 months or 3 kg in previous month) or (3) BMI 18.5–20 kg/m^2 in combination with no nutritional intake for 3 days or reduced intake for > 10 days
The Netherlands	van Nie-Visser et al. (2009)[67]	Residents of care homes (age not reported)	583	Care homes (on admission)	**27**	Malnutrition prevalence measured by assessing BMI, undesired weight loss and nutritional intake (no further details given)
The Netherlands	Kruizenga et al. (2003)[347]	> 18 years of age*	808	Nursing homes (convenience sample, timing not clear)	**18** (12 + 6)	**At risk of malnutrition:** 5–10% unintentional weight loss during the past 6 months , **malnourished:** unintentional weight loss > 10% during the past 6 months

Table A1.4 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Parsons et al. (2010)[68]	Residents of care homes*	1176	Care homes – overall (not specified)	**39** (14 + 25)	'MUST' (**medium + high**)
UK	Parsons et al. (2009)[373]	Residents of care homes*	1176	Nursing homes Residential homes (cross-sectional survey)	**40** **36**	'MUST' (**medium + high**)
UK	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 18 years of age*	523	Care homes (overall) Nursing homes only Elderly mentally ill homes only Residential homes only Other homes (restricted to adults admitted within the previous 6 months)	**41** (16 + 25)** **46** **40** **41** **39**	'MUST' (**medium + high**)
UK	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 18 years of age*	821	Care homes (overall) Nursing homes only Elderly mentally ill homes only Residential homes only Other homes (*n* = 815) (restricted to adults admitted within the previous 6 months)	**37** (15 + 23)** **45** **26** **30** **36**	'MUST' (**medium + high**)

Table A1.4 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Russell & Elia (2009)[81] (summer 2008)	> 18 years of age*	614	Care homes (overall) Nursing homes only Elderly mentally ill homes only Residential homes only Other homes (*n* = 581) (restricted to adults admitted within the previous 6 months)	**42** (11 + 30)** **46** **59** **36** **43**	'MUST' (**medium + high**)
UK	Russell & Elia (2008)[80] (autumn 2007)	> 18 years of age*	1610	Care homes (overall) Nursing homes only Residential homes only Other homes (restricted to adults admitted within the previous 6 months)	**30** (10 + 20) **35** **22** **32**	'MUST' (**medium + high**)
UK	Elia & Stratton (2005)[84]	> 65 years of age	202	Institution (secondary analysis of the National Diet and Nutrition Survey)	**20.8** (8.9 + 11.9)	'MUST' type criteria applied, i.e. a score of current weight status added to the weight loss score (**medium + high**)

Table A1.4 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
ASIA						
China	Woo et al. (2005)[367]	≥ 65 years of age	867	Nursing homes & hospitals (not specified)	**36** (25.8 + 10.1)	CNS (**at risk + malnourished**). A questionnaire based on MNA, specifically orientated to Chinese elderly in nursing homes and hospitals. 16 questions regarding lifestyle, health and dietary care tailored to suit Chinese health care system, diet, culture and customs. It omits anthropometry and has a maximum score of 32. The higher the score, the better the nutrition status. Further details unavailable
Singapore	Chan et al. (2010)[374]	Older people	154	Nursing homes – voluntary welfare (not specified)	**52** **97** **39**	BMI – **underweight** < 18.5 kg/m^2 MNA-SF (**at risk**) MNA (**malnourished** score < 17)
Taiwan	Chang & Roberts (2011)[130]	≥ 60 years of age with dementia	83	Nursing homes with > 15 residents with dementia (not specified)	**90.4** **19**	MNA-SF BMI (< 18.5 kg/m^2)
MIDDLE EAST						
Saudi Arabia	Alhamdan (2004)[122]	Adult males < 60 years of age Elderly males ≥ 60 years of age	39 45	Nursing homes (not specified)	**12.8** **11.1**	BMI – **underweight** < 18.5 kg/m^2

Table A1.4 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
AUSTRALIA & NEW ZEALAND						
Australia	Grieger et al. (2009)[375]	Aged care residents	74	High-level care nursing homes & low-level care hostels (not specified)	**53** (37 + 16)	MNA (**at risk + malnourished**)
Australia	Gaskill et al. (2008)[89]	Older people	346	Residential aged care facilities (6-week period, late 2005)	**49.5** (43.1 + 6.4) (range 72.1–31.8% across 8 facilities)	SGA (**moderate + severe**)
Australia	Banks et al. (2007)[90]	Older people	381 (2002) 458 (2003)	Residential aged care facilities (a single day for each facility 2002 + 2003)	**50.0** (41.6 + 8.4) **49.2** (41.6 + 8.4)	Median MNA (**moderate + severe**) Median MNA (**moderate + severe**)

†In France, long-term care homes receive older people with functional impairment and severe disease requiring continuous medical care; in contrast, nursing homes do not provide continuous presence of nurses
*Participants' age in years mean (±SD): special accommodation 85.4 (±7.7),[155] nursing homes 80.3 (±10.0),[346] nursing homes well-nourished 80 (±11), at risk 81 (±11), malnourished 83 (±9),[347] care homes 86.5 (±8.7),[68;373] UK care homes 83.3 (±9.5),[80] 84.2 (±8.4),[81] 83.1 (±9.7),[77] 80.4 (±11.8)[62]. Republic of Ireland care homes 80.8 (±9.3),[77] 83.5 (±7.0)[62]
** Figures rounded to the nearest 1%

Table A1.5 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – sheltered accommodation (majority of participants were older people)**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Finland	Vikstedt et al. (2011)[136]	> 60 years of age	375	Serviced housing (not specified)	**86** (21 + 65)	MNA
Sweden	Odlund Olin et al. (2008)[137]	Frail older people	49	Serviced flats (before and after intervention with additional meal)	**90** (27 + 63) (baseline)	MNA (**malnourished:** score < 17 + **at risk of malnutrition** score: 17–23.5)
Sweden	Ödlund Olin et al. (2005)[138]	Elderly 68–96 years of age	80	Serviced flats (not specified)	**89** (59 + 30)	MNA (**at risk + malnourished**)
UK	Ralph et al. (2010)[135]	Individuals in sheltered housing*	1353	Sheltered housing schemes (overall) > 80 years of age < 80 years of age (individuals screened during invited coffee mornings over 6-month period)	**12** (7 + 5) **14** **9**	'MUST' (**medium + high**)
UK	Elia & Russell (2009)[376]	Older people	335	Sheltered accommodation (not specified)	**14** (5 + 9)	'MUST' (**medium + high**)
UK	Harris et al. (2007)[377]	> 65 years of age	100	Sheltered accommodation (not specified)	**10** **12** **17**	Dietitian assessment 'MUST' (**medium + high risk**). Not reported separately MNA (screening score < 12)

* Participants' age in years mean (±SD): 78 (±10.4)

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Table A1.6 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – free-living (majority of participants were older people)**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
Denmark	Beck & Ovesen (2002)[371]	> 65 years of age	200	Home care districts (not specified)	**30** (12)	BMI < 20 kg/m^2 (BMI < 18.5 kg/m^2)
Republic of Ireland	O'Dwyer et al. (2009)[133]	Older people	63	Meals on wheels recipients (not specified)	**36.5** (27 + 9.5)	**At risk** MNA 17–23.5, **malnourished** MNA < 17
Sardinia	Buffa et al. (2010)[378]	≥ 70 years of age**	170	Free-living (not specified, in 2005)	**37.1** (35.9 +1.2)	MNA (**at risk + malnourished**)
Spain	de la Montana & Miguez (2011)[379]	> 65 years of age	728	Home-living	**59** (46.7 + 12.4) **70.1** (57.6 + 12.5)	MNA-SF (**at risk + malnourished**) MNA (**at risk + malnourished**)
Spain	Cuervo et al. (2008)[82]	> 65 years of age	22007	Community-dwelling (cross-sectional survey)	**29.7** (25.4 + 4.3)	**At risk** MNA ≥ 17 to ≤ 23.5, **malnourished** MNA < 17
Sweden	Johansson et al. (2009)[380]	Older people	579	Home-living Baseline At follow-up 1–4 (between 2001 & 2006) (prospective study, assessed at baseline & follow-up as above)	**14.5** **7.6 –16.2**	**At risk** MNA 17–23.5, **malnourished** MNA < 17
The Netherlands	Meijers et al. (2009)[346]	≥ 18 years of age*	2794	Home care (cross-sectional, point prevalence)	**21.7**	**Malnutrition** defined according to one of the 3 following criteria: (1) BMI < 18.5 kg/m^2 (2) unintentional weight loss (6 kg in previous 6 months or 3 kg in previous month) or (3) BMI 18.5–20 kg/m^2 in combination with no nutritional intake for 3 days or reduced intake for > 10 days
The Netherlands	Kruizenga et al. (2003)[347]	> 18 years of age*	533	Home care (convenience sample, timing not clear)	**13** (7 + 6)	**At risk of malnutrition:** 5–10% unintentional weight loss during the past 6 months , **malnourished:** unintentional weight loss > 10% during the past 6 months

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Table A1.6 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Skinner et al. (2010)[134]	Older people	111	Meals on wheels recipients (not specified)	**31** (16 + 15)	'MUST' (**medium + high**)
UK	Elia & Stratton (2005)[84]	> 65 years of age	953	Free-living (secondary analysis of the National Diet and Nutrition Survey)	**12.5** (6.6 + 5.9)	'MUST' type criteria applied, i.e. a score of current weight status added to the weight loss score (**medium + high**)
USA & CANADA						
USA	Fodero & Wunderlich (2008)[381]	≥ 60 years of age	34	Convenience sample enrolled on Congregate Dining Programme and tai chi classes (not specified)	**5.9** (5.9 + 0)	MNA (**at risk + malnourished**)
CENTRAL & SOUTH AMERICA						
Brazil	De Andrade et al. of age (2009)[382]	> 60 years	834	Non-institutionalised – participating in Family Health Programme & Community Agents Health Programme (not specified)	**2.1**	BMI (**underweight** < 18.5 kg/m^2)
Cuba	Da Silva Coqueiro et al. (2010)[383]	≥ 60 years of age	1688	Free-living (Data from Survey on Health, Aging and Well-being of the Elderly SABE 2000)	**33**	BMI (**underweight** < 22 kg/m^2)

Table A1.6 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
ASIA						
China	Han et al. (2008)[384]	≥ 65 years of age	162	Community-dwelling (convenience sample, July–September 2007)	**44.4** (36.4 + 8.0)	MNA (**at risk + undernourished**)
Japan	Iizaka et al. (2008)[385]	≥ 65 years of age	130 (missing data *n* = 3)	Attendees of Setagya Senior College (November–December 2006)	**12.6** (12.6 + 0)	MNA (**at risk + undernourished**)
Taiwan	Tsai et al. (2010)[386]	≥ 65 years of age	2802 (1534 male, 1268 female)	Free-living (data from 'Survey of Health and Living Status of the Elderly in Taiwan' SHLSET)	**18** (15.1 + 2.9) male **24** (21.2 + 2.8) female	MNA (**at risk + malnourished**)
					14.3 (12.0 + 2.3) male **17.3** (15.6 + 1.7) female	MNA-Taiwan version-1 (MNA-T1) (**at risk + malnourished**). Modified version of MNA altering the questions on protein intake to emphasise the frequency of consumption rather than the number of servings. Also contains Taiwanese-specific anthropometric cut-offs (no details given)
					14.3 (12.3 + 2.0) male **16.3** (14.8 + 1.5) female	MNA-Taiwan version-2 (MNA-T2) (**at risk + malnourished**). Modified version of MNA with questions relating to protein intake as MNA-T1. Also, the BMI question omitted and redistributed BMI score to MAC – 1 point and calf circumference (CC) – 2 points
Taiwan	Tsai et al. (2008)[387]	≥ 65 years of age	2400	In-home interviews, part of population-based "The Survey of Health & Living Status of the Elderly in Taiwan" (not specified)	**15.1** (13.1 + 2.0)	MNA (**at risk + undernourished**)

Table A1.6 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
AUSTRALIA & NEW ZEALAND						
Australia	Leggo et al. (2008)[388]	Older people requiring help with daily tasks and younger people with impaired functional ability	1145	Home and Community Care recipients (not specified September 2003 – June 2005)	**15**	MST. The MST was modified with an additional question 'client appears very underweight or frail', with 'yes' recommending dietetic referral, score 0–1 indicates **low risk**, 2 **at risk**, 3–4 **higher level of risk**, 5 **very high risk of malnutrition**
Australia	Visvanathan et al. (2003)[389]	≥ 65 years of age	250	Domiciliary care service recipients (between January and December 2000)	**43.0** (38.4 + 4.8)	MNA (**at risk + malnourished**)
New Zealand	Teh et al. (2010)[390]	75–79 years of age (Maori) 85 years of age (non-Maori)	108	Free-living (not specified January – August 2008)	**52**	Seniors in the Community: Risk evaluation for Eating and Nutrition Version II (SCREEN II). Weight change, food intake, risk factors for food intake (meal frequency, diet restriction, appetite, chewing and swallowing difficulties, meal replacement, eating alone, meal preparation, shopping difficulties). Each item scores 0–4, lower scores indicating problems indicating nutrition risk. Total scores 0–64, < 50 = **at significant nutrition risk**
New Zealand	Wham et al. (2011)[391]	80–85 years of age	51	Free-living (convenience sample April – July 2006)	**31**	SCREEN II < 50 score = **at significant nutrition risk**

*Participants' age in years mean (±SD): home care 76.2 (±12.0),[346] home care well-nourished 59 (±20), at risk 64 (±23), malnourished 66 (±23)[347]
**Age ranges of sample: 70–79 years *n* = 103, 80–89 years *n* = 66, 90+ years *n* = 31

Table A1.7 **Prevalence of malnutrition or risk of malnutrition in some examples of studies reported after 2002 according to country and healthcare setting – other care settings**

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
EUROPE						
The Netherlands	Poels et al. (2006)[392]	Stroke patients > 18 years of age*	69	Stroke rehabilitation centre (on admission)	**35** (primary criteria) **73** (if malnutrition defined by the presence of at least one of the primary or secondary criteria)	Malnutrition assessed by a dietitian. Primary criteria for malnutrition were unintentional weight loss of > 5% in 1 month or > 10% in 6 months or a BMI < 18 kg/m^2 (< 65 years) or < 22 kg/m^2 (≥ 65 years). Secondary criteria for malnutrition: (1) serum albumin < 25 g/l, (2) Free-fat Mass (FFM) ≤ 16 kg/m^2 (men), ≤ 15 kg/m^2 (women), (3) TSFT < 90% of 12.5 mm (men) or 16.5 mm (women), (4) MAMC < 90% of 25.3 cm (men) or 23.3 cm (women)
UK	Russell & Elia (2012)[62] (spring 2011)	Adults ≥ 18 years of age*	543	Mental health units (Acute units within 72 hours of admission, long-stay/rehab units within previous 6 months)	**19** (9 + 10)	'MUST' (**medium + high**)
UK	Russell & Elia (2011)[77] (winter 2010)	Adults ≥ 18 years of age*	146	Mental health units (Acute units within 72 hours of admission, long-stay/rehab units within previous 6 months)	**18** (12 + 7)**	'MUST' (**medium + high**)
UK	Russell & Elia (2009)[81]	Adults ≥ 18 years of age*	185	Mental health units (Acute units within 72 hours of admission, long-stay/rehab units within previous 6 months)	**20** (5 + 15)	'MUST' (**medium + high**)

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Table A1.7 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening/assessment)	Prevalence % (risk category)	Method and details of risk category where reported
UK	Russell & Elia (2008)[80]	Adults ≥ 18 years of age*	332	Mental health units (Acute units within 72 hours of admission, long-stay/rehab units within previous 6 months)	**19** (7 + 12)	'MUST' (**medium + high**)
ASIA						
China	Chai et al. (2008)[393]	Adults with history of stroke, mean age 76 years	61	Cheshire Home Infirmary (not specified)	**8.2**	BMI < 18.5 kg/m^2 + serum albumin <35 g/l
Taiwan	Tsai et al. (2011)[119]	Adults with schizophrenia bipolar disorder major depression	120	Mental health units (convenience sample, not specified)	**21.1** (11.5 + 9.6) **12.5** (12.5+0) **55.6** (50.0 + 5.6)	MNA-Taiwan version 1 (MNA-T1) (**at risk + malnourished**). Content-equivalent version of MNA. MNA-T1 adopted Taiwanese-specific anthropometric cut-off points. For Item G 'can live independently', those psychiatrically stable individuals who could carry out daily activities were considered to live independently and given one point in the study
MIDDLE EAST						
Iran	Amirkalali et al. (2010)[394]	≥ 65 years of age	221	Kahrizak Charity Foundation† (not specified)	**46.6** (43.4 + 3.2)	MNA (**at risk + malnourished**)

*Participants' age in years mean (±SD): stroke rehabilitation centre 56.7 (±11.0),[392] mental health units 59.2 (±20.0),[80] 66.4 (±20.1),[81] 50.0 (±19.0),[77] 55.9 (±21.6)[62]
**Figures do not add up due to rounding
†Private non-governmental non-profit charitable organisation where physically handicapped or elderly with no financial resources are cared for free of charge

Table A1.8 Prevalence of malnutrition or risk of malnutrition in children in hospital in studies reported after 2000 according to country

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
EUROPE								
Austria	Wildham et al. (2007)[100]	Children aged 3–18 years	100	Hospital (admission)	**3** (2 + 1) **18** (13 + 5)	**17** (8 + 9)	**15** (15 + 0)	Waterlow Score (stunting)** (**moderate + severe**) Waterlow Score (wasting)* (**moderate + severe**) Gomez score (WFA)† (**moderate + severe**) Vienna score (**moderate + severe**): Based on albumin, total lymphocyte count, haemoglobin measures (see Wildham et al. 2007 for cut-off points), total weight loss of > 5% relative to pre-illness body weight (4 weeks), weight/height centile < 10th centile and lack of appetite
France	Lambe et al. (2010)[395]	All children admitted to paediatric neurology and orthopaedic surgery wards with length of stay > 2 days	348	Tertiary care paediatric hospital (Timing of assessment not specified)			**4.9** (4 + 0.9) **2.3** (1.4 + 0.9) **20**	Orthopaedic surgery (**moderate + severe**) Neurology (**moderate + severe**) All (**mild, moderate + severe** for both specialities) Data collection (weight, height, growth charts, clinical history) performed by a dietitian. Nutritional status assessed by a specialist paediatrician. No details given regarding cut-off points for mild, moderate or severe protein-energy malnutrition
France	Marteletti et al. (2005)[74]	Children aged between 2 months & 16 years hospitalised for > 48 hours	280 No age break-down	One-day cross-sectional study over 3 different seasons	**11**			**Malnourished:** WFH z-score less than -2 SD

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Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
France	Hankard et al. (2001)[44]	Children aged > 6 months admitted to medical or surgical wards for > 48 hours	58 No age break-down	One-day cross-sectional study			**21** **12**	**Malnourished:** BMI below -2 SD When patients with anorexia nervosa excluded Note: Patients receiving nutritional support (parenteral, enteral or special regimens for metabolic diseases) were excluded (represented 19% of total number of patients admitted on the day of the survey)
France	Sermet-Gaudelus et al. (2000)[36]	Children aged > 1 month with a hospital stay of ≥ 48 hours admitted to medical or surgical wards	296 1–12 months *n* = 133 12–72 months *n* = 87 > 72 months *n* = 76	Within 48 hours of hospital admission			**26** **85.2** (40.9 + 44.3) No age breakdown	**Undernourished:** percentage IBW < 85% Simple Paediatric Nutritional Risk Score: Takes account of food intake, pain and pathology. Maximum score 5 (see Sermet-Gaudelus et al. 2000 for further details). **Low risk** of nutritional depletion: score 0 **Moderate risk:** score 1–2 **High risk:** score ≥ 3 Note: Children with conditions that involved large variations in hydration were excluded

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
Germany	Pawellek et al. (2008)[72]	All children admitted to 1 of 2 general paediatric wards or 1 surgical ward	475 (< 1–17 years) < 1 year *n* = 28 2–5 years *n* = 164 6–12 years *n* = 186 13–17 years *n* = 97	Hospital admission	**6.1** (4.4+1.7)	 **14.2** (7.1+7.1) **4.3** (4.3+0.0) **5.9** (4.8+1.1) **7.2** (3.1+4.1)	**17.2** (7.5+9.7)	Waterlow criteria: **Mild** malnutrition: 81–90% centile WFH **Moderate** malnutrition: 70–80% centile WFH **Severe** malnutrition: < 70% centile WFH TSFT: Malnutrition: 5th–9th centile **Severe** malnutrition: < 5th centile

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
Italy	Campanozzi et al. (2009)[45]	All children aged 1 month to 16 years admitted to medical paediatric ward with ±Grade 1 conditions	496 1–12 months *n* = 174 13–24 months *n* = 72 25–36 months *n* = 48 37–72 months *n* = 84 > 72 months *n* = 118	Hospital admission			**10.2** No age breakdown	**Malnourished:** BMI z-score < -2 ±Grade 1 conditions involve mild stress factors, e.g. admissions for diagnostic procedures, minor infection, other episodic illnesses or minor surgery (American Academy of Pediatrics and American Dietetic Association criteria) Patients with < 72 hour hospital stay, patients aged < 1 month, patients with chronic conditions and patients requiring IV fluid/electrolyte therap or who were dehydrated were excluded
The Netherlands	Hulst et al. (2010)[38]	Children aged > 1 month, admission to paediatric ward and expected stay at least 1 day	424 No age break-down	Hospital admission			**62** (54+8)	$STRONG_{kids}$ includes: 1) SGA 2) high risk disease 3) nutritional intake and losses and 4) weight loss or poor weight increase (**moderate + high risk**)

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
The Netherlands	Joosten et al. (2010)[101]	Children aged > 1 month, admission to medium care unit and expected stay at least 1 day	424 < 1 year 2–5 years 6–12 years 13–17 years	Hospital admission	**11** **14** **14** **7** **10**	**9** **6** **8** **12** **11**	**19** **18** **21** **17** **19**	**Acute** malnutrition: WFH < -2 SD **Chronic** malnutrition: HFA < -2 SD Overall malnutrition rate: presence of **acute** and/or **chronic malnutrition**
Poland	Horvath et al. (2008)[102]	Series of unselected children (age not specified)	96 No age break-down	Timing of assessment not specified Paediatric teaching hospital			**16** **14** **19**	Malnutrition was defined as: BMI < 3rd centile for age BMI z-score < -2 SD MAC < 5th centile for age
Spain	Moreno Villares et al. (2005)[396]	Children aged 1 month to 19 years	268 < 2 years *n* = 132 2–7 years *n* = 69 > 7 years *n* = 62				**17.2**	

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
Turkey±	Dogan et al. (2005)[103]	Children aged 1 month to 23 years No age breakdown	528 (223 female)	Hospital admission	**52.4** **40.9**	**27**	**45.7**	**Acute** malnutrition: based on WFA based on WFH Chronic malnutrition (based on HFA) BMI below -2 SD
Turkey±	Ozturk et al. (2003)[104]	Children aged > 1 month to 17 years	170	Hospital admission			**30.4** (21.7 + 5.8 + 2.9)	**Mild, moderate and severe** malnutrition **Mild:** 80–89% of ideal body WFH **Moderate:** 70–79% of ideal body WFH **Severe:** < 70% of ideal body WFH
UK	McCarthy et al. (2012)[35]	All children aged 2–17 years admitted to participating medical & surgical wards No age breakdown	238	Timing of screening/ assessment not reported Large paediatric hospital			**18** **14**	STAMP. Consists of 3 scored elements: clinical diagnosis, nutritional intake, anthropometric measures. An overall score of ≥ 4 considered as 'at nutrition risk' Full nutritional assessment by a RD, consisting of a face-to-face interview to obtain dietary, personal and clinical information from medical and nursing notes

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
UK	Gerasimidis et al. (2010)[37]	All children aged 1 - 16 years admitted to 4 paediatric wards (Tertiary paediatric hospital [TPH], 3 medical & 1 surgical, District general hospital [DGH] 1 general paediatric)	247 No age break-down	Within 24 hours of hospital admission District general hospital (DGH) Tertiary paediatric hospital (TPH)			DGH **19.4** (10.4 + 9) TPH **19.5** (9 + 10.5)	PYMS (**medium + high risk**) STEP 1: BMI below 2nd centile (-2 SD) on UK 1990 growth chart STEP 2: history of recent weight loss STEP 3: recent change in nutritional intake for at least the past week STEP 4: the likely effect of the current medical condition on the nutritional status of the patient for at least the next week. Each step bears a score of 0–2 and the total score reflects the degree of the nutrition risk of the patient **Low risk of malnutrition:** score of 0 **Moderate risk of malnutrition:** score of 1 **High risk of malnutrition:** score of ≥ 2 Note: Patients from cardiology, renal and orthopaedic specialities, critical care and day assessment were not included
USA & CANADA								
Canada	Groleau & Babakissa (2008)[98]	Children aged 0–18 years No age breakdown	173	On hospital admission			**79.8** **28** **35**	Nutritional paediatric nutrition score published in 2000 (likely to be Sermet-Gaudelus et al. 2000) Canadian Paediatric Society's recommendations (no details given) Waterlow score (no details given on whether this was acute or chronic)

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
Canada	Secker & Jeejeebhoy (2007)[39]	Consecutive children aged 31 days to 17.9 years scheduled for surgery	175 31 days –2 years *n* = 51 2–5 years *n* = 22 5–12 years *n* = 45 12–17 years *n* = 57	Nutritional assessment undertaken either the day before surgery or the morning of surgery for same-day admissions Large paediatric academic hospital			**51** (36 + 15) No age-related breakdown of prevalence	Subjective Global Nutritional Assessment (SGNA) (**moderate + severe**) Note: requiring major abdominal or non-cardiac thoracic surgery on a nonemergency basis and who had not undergone surgery in the 30 days before screening
CENTRAL & SOUTH AMERICA								
Brazil±	Fernandez et al. (2008)[107]	Children aged < 3 years	67 (46% < 2 years old)	Within 48 hours of admission Hospital general paediatric unit	**43**			Gomez score (WFA) Categories not reported separately, prevalence reported as 'had some degree of malnutrition'

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
Brazil±	Rocha et al. (2006)[43]	Children: average age 21.6 ±15.4 months (62.2% aged < 24 months)	203 Aged 3–11 months *n* = 69 12–23 months *n* = 57 24–59 months *n* = 77	Within 48 hours of admission	**18.7** **6.9**		 **18.2**	Weight for? age (**moderate and/or severe**) Weight/stature (**moderate and/or severe**) Stature for? age (**moderate and/or severe**) Classified in accordance with WHO criteria¥: **Mild** malnutrition: z-score from -1 to -2 SD **Moderate** malnutrition: z-score from -2 to -3 SD **Severe** malnutrition: z-score less than -3 SD Ages corrected for children with gestation age < 37 weeks Note: Children with chronic liver or renal disease, surgical pathologies or cerebral palsy or who were admitted to intensive care or oncology units with rehospitalisation during the study period were excluded
Cuba±	Jimenez et al. (2008)[105]	All children (age not specified) No additional data	162	On admission Tertiary level national paediatric hospital			**17.3**	Malnutrition: < 3rd centile WFH; National Growth Charts (**severe malnutrition**)
MIDDLE EAST								
Iran±	Mahdavi et al. (2009)[99]	Consecutive admissions aged 2–12 years	140 No age breakdown	Within 3 days of hospitalisation Paediatric hospital			**70.7** **48.5**	SGA (SGA B/C) Objective assessment (Waterlow criteria) includes **mild, moderate and severe** malnutrition Note: Admissions to surgical, inflectional, oncology, ENT and internal medicine wards (gastroenterology, nephrology, respiratory, neurology, cardiology, metabolic disorder)

Table A1.8 Continued

Country	Author (year)	Study population	Patients (*n*)	Healthcare setting (and timing of nutritional screening /assessment)	Prevalence % (risk category)			Method and details of risk category where reported
					Acute	Chronic	Overall	
AFRICA								
South Africa±	Marino et al. (2006)[106]	Patients in all medical and surgical wards and in some specialist outpatient clinics	227	Timing of assessment not reported			**35**	Undernourished defined as ≤ 2 z-scores for following:
			< 12 months		**40/27**	**33.5**	**34**	WFA/WFH and HFA
			13–60 months	Hospital	**27/21**	**31**	**32**	
			Children > 60 months		**29/14**	**31**	**19**	
AUSTRALIA & NEW ZEALAND								
Australia	Aurangzeb et al. (2012)[108]	Aged > 1 month	157	Tertiary paediatric hospital (new admissions during one week in September 2006)	**4.5**			WFA z-score ≤ -2
					2.5			WFH z-score ≤ - 2
						8.9		HFA z-score ≤ -2
							47.8	NRS (No nutritional risk: 0–3, **moderate risk:** 4–5 and **high risk:** ≥ 7)

*Acute malnutrition Waterlow score (wasting):[397] mild: 80–90% WFH; moderate: 70–80% WFH; severe: < 70% WFH
**Chronic malnutrition Waterlow score (stunting):[397] mild: 95–87.5% HFA; moderate: 87.5–80% HFA; severe: < 80% HFA.
†Acute malnutrition Gomez score (WFA)[398]: mild: 75–90% WFA; moderate: 60–74% WFA; severe: < 60% WFA.
ᵞWHO criteria:[399] moderate: symmetrical oedema – no, WFH -3 ≤ SD-score < -2 (70-79%), HFA -3 ≤ SD-score < -2 (85-89%); severe: symmetrical oedema – yes, WFH SD-score < -3 (<70%), HFA SD-score < -3 (<85%).
±Countries classed as Upper Middle Income Economies see http://data.worldbank.org/about/country-classifications/country-and-lending-groups for more information.

II FUNCTIONAL BENEFITS OF ONS – Table A2.1

Table A2.1 **Some examples of trials reported after 2002 describing significantly improved functional outcomes with ONS in a variety of healthcare settings**

Trial	Design	Subjects (setting)	Intervention (*n*)	Control (*n*)	Duration	Functional outcome
Feldblum et al. (2011)[246]	RCT 3-arm	Older medical patients (hospital + follow-up post discharge)	Individualised DC + ONS in hospital and post discharge (78)	Individualised DC + ONS in hospital (73) Routine care (108)	6 months	• Significantly lower mortality in group 1 (3.8%) vs groups 2 and 3 (11.6%, $p = 0.046$). No significant differences in other functional cognitive parameters
Rufenacht et al. (2010)[400]	RT	Undernourished patients (hospital)	Individualised DC + ONS (18) ONS (18)		10–15 days	• Both groups demonstrated improved QOL parameters from baseline to discharge (NT group $p < 0.001$, ONS group $p < 0.003$). No significant differences between groups. NT group showed further significant improvement in QOL 2 months post discharge ($p = 0.016$)
McMurdo et al. (2009)[244]	RCT	Older people, malnourished. (Community-dwelling, admitted to hospital with acute illness. Residents of care homes excluded. ONS provided upon discharge)	ONS (126)	Control supplement (127)	4 months	• Significant improvement in hand-grip strength in ONS group compared with controls • Significantly more vector movement (objective measure of physical activity using accelerometry) in the ONS group compared with controls
Neelemaat et al. (2012)[255]	RCT	Malnourished elderly (> 60 years) patients, various conditions. (Community - post hospital discharge)	ONS (105)	Usual care (105)	3 months	• Significant decrease in functional limitations (mean difference -0.72, 95% CI -1.15 to -0.28) with no difference in costs

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Table A2.1 Continued

Trial	Design	Subjects (setting)	Intervention (*n*)	Control (*n*)	Duration	Functional outcome
Norman et al. (2008)[237]	RCT	Adult malnourished SGA B or C, benign GI disease (post hospital)	HP ONS + DC (38)	DC (42)	3 months	• Significant improvement in hand-grip strength and peak expiratory flow in ONS group, unchanged in DC group • Significant improvement in all 8 scales of QOL in ONS group, whereas improvement in 3 scales in DC group only. Significantly higher increases in physical functioning, role physical, vitality and general health scales in ONS group • Change in hand-grip strength correlated with the change in 2 physical scales (physical functioning and physical role)
Rabadi et al. (2008)[251]	RDB Trial	Undernourished (2.5% weight loss in 2 weeks) (patients admitted to a stroke rehabilitation unit)	Intensive ONS	Standard ONS	From within 72 hours of arrival on unit to discharge	• Significant improvement in the Intensive ONS group in total FIM score, FIM motor sub-score, 2-minute walk and 6-minute walk
Gariballa & Forster (2007)[252]	RDBPCT	Acutely ill older people (hospital and post discharge)	NHD + HP ONS (106)	NHD + placebo (119)	6 weeks	• Significant increase in number of patients with no symptoms of depression and decrease in those with symptoms of mild or severe depression among ONS group compared with placebo group
Gariballa & Forster (2007)[253]	RDBPCT	Acutely ill older people (hospital and post discharge)	NHD + HP ONS (106)	NHD + placebo (119)	6 weeks	• Significantly better QOL scores in the ONS group compared with placebo group at 6 months but not at 6 weeks. Effect of supplementation was seen in higher physical function, role physical and social function scores
Persson et al. (2007)[243]	RCT	Older acutely ill/trauma patients at risk of malnutrition MNA-SF (on hospital discharge to home/nursing home)	ONS + DC (29)	Brief written DA (25)	4 months	• Treated-as-protocol analyses showed Katz ADL index improved in the ONS + DC group
Price et al. (2005)[234]	RCT	Undernourished* older people (on hospital discharge to community)	ONS (70)	Usual care (66)	8 weeks	• Improvement in hand-grip strength in both groups, but ONS group showed significantly greater increase over 12 weeks compared with controls Intention-to-treat analysis showed a 13.9% increase in the ONS group compared with 7.2% in the control group

Table A2.1 Continued

Trial	Design	Subjects (setting)	Intervention (*n*)	Control (*n*)	Duration	Functional outcome
Edington et al. (2004)[254]	RCT	Older malnourished** patients (community)	ONS (51)	Standard care (49)	8 weeks	• Significant improvement in hand-grip strength during supplementation but not sustained from week 8 to week 24 • No difference between groups in QOL utility score or health status; however, ONS group scored significantly higher on the mobility score at week 24 than controls, possibly indicating an improvement in strength
Payette et al. (2002)[401]	RCT	Frail older people at high nutritional risk (community)***	ONS + DC (41)	Visited monthly, no advice/ONS (42)	16 weeks	• When results analysed by gender, significant reduction in the meantime to execute 'up and go' test was seen in women in the ONS group, and knee extensor strength increased in men in the ONS group • The number of days subjects had to stay in bed significantly increased in the control group over the course of the study compared with baseline; in contrast, no change in bed disability days seen in the ONS group

HP – high-protein (> 20% energy from protein), DC – dietary counselling, RDBPCT – Randomised Double Blind Placebo Controlled Trial, NHD – Normal hospital diet

*BMI ≤ 24 kg/m^2, TSFT or MAMC below the 10th centile and/or weight loss ≥ 5% during hospital stay
**(a) BMI < 20 kg/m^2 or (b) BMI ≥ 20 kg/m^2 but < 25 kg/m^2 with documented evidence of weight loss of ≥ 10% in the 6 months prior to study period or ≥ 5% in the 3 months prior to study period
***(a) involuntary weight loss > 5% body weight in the past month, > 7.5% in the past 3 months or > 10% in the past 6 months and BMI < 27 kg/m^2 or (b) BMI < 24 kg/m^2

III SUMMARY OF TRIALS: SETTING, POPULATION, INTERVENTION & OUTCOME – Tables A3.1 to A3.4

The studies listed here are key individual trials that have been mentioned within the text to illustrate specific points; therefore, this list is not an exhaustive list of all trials using ONS. For example, studies which have been included in key systematic reviews and meta-analyses have not been listed here.

For trials up to 2002, see Stratton et al. (2003)[46]. Key systematic reviews and meta-analyses include: Stratton et al. (2003),[46] Langer et al. (2003),[271] Stratton et al. (2005),[272] Milne et al. (2005, 2006 & 2009),[231;263;264] NICE (2006),[236] Elia et al. (2006),[274] Lidder et al. (2009)[270] and Cawood et al. (2012).[228]

Adverse effects/intolerance of ONS

- A review of systematic reviews concluded that 'overall, ONS can be regarded as a safe intervention as no systematic reviews or meta-analyses or individual RCTs show significant adverse effects of ONS on clinical outcome. There may be minor GI symptoms, although the majority of trials do not thoroughly assess GI tolerance.'[321]

- A systematic review by Milne et al. (2009) of ONS in older people at risk from malnutrition (62 trials, n = 10,187) reported that 'adverse events included nausea and diarrhoea.'[231] On further assessment, it appears that adverse effects were reported in 12 trials, i.e. < 20% of the total number of trials included in the review. The FOOD trial[265] dominated the analysis, contributing 4,023 patients, of whom 2,016 received a protein energy supplement compared with 2,007 controls. Twenty-eight per cent of patients stopped the supplement due to disliking the taste, weight gain or nausea, and therefore the proportion of patients with true intolerance is not known. Poor glycaemic response was indicated in 33 patients. However, compliance with ONS was actually reported to be very high (mean 76%, median 93%). Note that only 8% (n = 564) of patients included in the FOOD trial were actually malnourished at baseline. Excluding the FOOD trial, in total only 92 of 3,078 patients, i.e. 3%, experienced adverse effects or intolerance of ONS in the review by Milne et al. (2009), rising to 13% when patients from the FOOD trial are included, thus illustrating that actual numbers of adverse effects are low.

Table A3.1 Summary of trials: setting, population, intervention and outcome – community studies

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Bonnefoy et al. (2003)[259]	Retirement homes	Frail older people	RCT factorial design	57	2 x 200 ml daily given at 10.00 & 16.00 hours Group 1 – ONS plus memory Group 2 – ONS plus exercise	Placebo in identical packaging, contained no energy, protein or micronutrients Group 3 – placebo plus exercise Group 4 – placebo plus memory	9 months	**Nutritional** Increase in BMI at 3 and 9 months with ONS ($p = 0.004$, $p = 0.007$ respectively) Trend towards increase in FFM in ONS group and decrease in placebo group at 3 and 9 months **Functional** ONS improved muscle power at 3 months (+ 56.8%, $p = 0.03$) Improved 5-time chair rise with exercise at 9 months ($p = 0.014$) but no significant effect on muscle function or nutritional status at 3 or 9 months
Bunout et al. (2001)[258]	Community -dwelling (free-living)	Older people	RCT	149	Two servings soup/ porridge-style supplement daily Group 1 – ONS plus resistance exercise training Group 2 – ONS, no training Group 3 – no ONS, resistance exercise training	Group 4 – no ONS, no training	18 months	**Nutritional** No change in body weight or FFM, fat mass increased in all groups. Bone mineral density decreased less in ONS groups than in trained groups ($p < 0.01$) **Functional** ADL remained constant in ONS groups and decreased in non-ONS groups. Exercise had no effect Mini-mental scores increased in all groups, no differences among groups No effect of ONS on walking capacity, muscle strength and maximal inspiratory pressure

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Edington et al. (2004)[254]	Community (post discharge from hospital)	Older people, malnourished	RCT	100	Intakes between 600 kcal and 1000 kcal/day prescribed in order to achieve a weight gain of at least 0.5 kg/ week (plus telephone contact by dietitian)	Standard care	8 weeks*	**Nutritional** Higher energy intake at week 12 (p = 0.041) Improved nutritional status (BMI, weight and TSFT) between baseline and 24 weeks in ONS group but no significant difference between groups **Functional** Improvement in hand-grip strength at 8 weeks in ONS group (p = 0.04) (not sustained), trend towards significance at 8 weeks between groups Fewer mobility problems in ONS vs control group at 24 weeks (p = 0.022) **Economic** No difference in health economic outcomes between groups at 24 weeks
Lauque et al. (2004)[233]	Geriatric wards and day care centres	Older people with Alzheimer's disease, at risk of under-nutrition	RCT	91	300–500 kcal/ day in addition to the patients' spontaneous food intake	Usual care (some patients from the control group who received ONS prescribed during the study not excluded but ONS prescription recorded)	3 months	**Nutritional** Improved energy and protein intakes between baseline and 3 months in the intervention group leading to significant improvement in weight and FFM **Functional/clinical** No difference in dependence, cognitive function or biological markers at 3 months or in fractures, pressure ulcers or hospitalisation at 6-month follow-up

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Manders et al. (2009)[245]	Residents of care homes for older people	Older people	RDBPCT, parallel	176	2 x 125 ml dairy drinks between meals (250 kcal/day)	Placebo drink, no energy, vitamins or minerals. Contained water, cloudifier, thickener, flavouring, colourant and non-calorific sweetener	6 months	**Nutritional** Weight gain, 1.6 kg difference in change ($p = 0.035$) Increased CC, 0.9 cm difference in change ($p = 0.48$) Improved plasma vitamin D, B12, B6, homocysteine, folate and methylmalonic acid ($p < 0.01$) **Functional** Better performance on language sub-score of Alzheimer's Disease Assessment Scale in a subgroup with BMI < 24.4 kg/m^2 ($p = 0.01$) No significant effects on physical performance (e.g. hand-grip strength, ADL), verbal fluency or depression score
Manders et al. (2009)[240]	Residents of care homes for older people (homes for the elderly $n = 3$, nursing homes $n = 3$, mixed homes $n = 3$)	Older people	RDBPCT, parallel	176	2 x 125 ml dairy drinks between meals (250 kcal/day) in addition to usual diet	Placebo drink, no energy, vitamins or minerals. Contained water, cloudifier, thickener, flavouring, colourant and non-calorific sweetener	6 months	**Nutritional** Increased intake of vitamins and minerals except vitamin A ($p < 0.001$) (non-randomised sub-sample $n = 66$) Most vitamin deficiencies normalised, most notably vitamin D (10% vs 75% remained deficient in ONS vs placebo group) (vitamin levels also reported in Manders 2009)[245] Non-significant positive effect on macronutrient intake and body weight. Energy intake decreased to the same extent in both groups. No effect on blood proteins or biochemical indicators of general health

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
McMurdo et al. (2009)[244]	Community-dwelling (admitted to hospital with acute illness). Residents of care homes excluded	Older people, under-nourished	RCT	253	2 x 200 ml ONS daily	Control supplement based on skimmed milk containing 200 kcal, 12.4 g protein	4 months	**Nutritional** Weight gain† mean difference of 1.17 kg (95% CI 0.07–2.27, $p = 0.04$) **Functional** Hand-grip strength¥ mean difference of 1.48 kg (95% CI 0.46–2.50, $p = 0.005$) Physical activity (accelerometry)¥ mean difference in % change in vector movement 1.71 (95% CI 0.26–3.17, $p = 0.02$ No change to ADL, health-related QOL, falls, rehab input, time spent walking, death, unplanned admissions or other adverse events, trend towards improvement in sit-to-stand test in ONS group

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Neelemaat et al. (2011)[402]	Community (post hospital discharge)	Malnourished elderly (> 60 years) patients, various conditions	RCT	210	2 x 200 ml HP ONS daily plus 500 mg/400IE vitamin D supplement and DC	Usual care	3 months	**Nutritional** Patients in the intervention group tended to gain more weight than controls (mean difference 1.5 kg, 95% CI -0.2–3.1 ns). A significant increase in weight was demonstrated in the highest body weight category > 63.9 kg (mean difference + 3.4 kg, 95% CI 0.2–6.6). No differences in FFM and hand-grip strength Compliance with ONS 80% **Functional** A positive though non-significant trend of a reduction in functional limitations for both men and women in intervention group after 3 months (mean difference -0.5, 95% CI -1.0–0.1). No significant improvement seen in physical activities and performance **Cost-effectiveness** Second paper reported significant decrease in functional limitations (mean difference -0.72, 95%CI -1.15 to -0.28) with no difference in costs
Neelemaat et al. (2011)[255]								

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Norman et al. (2008)[237]	Community	Malnourished patients with GI disease	RCT	101	Up to 3 x 200 ml daily. Patients advised to drink ONS slowly and between meals (≥ 1 h before a meal) (plus standard DC session as per control, contacted once per month)	Standard DC session (verbal advice, 45 min) by an RD. Advised on improving protein and energy intake with normal food. All patients actively contacted once per month	3 months	**Nutritional** Higher energy and protein intake in ONS group vs control ($p < 0.0001$) **Functional** Improved hand-grip strength and peak flow in ONS group vs controls ($p = 0.002$, $p = 0.047$ respectively) Body weight and BMI increased in both groups Significantly improved QOL in 4 areas in ONS group vs controls (physical functioning, physical role, general health and vitality, $p < 0.05$) **Clinical** Control patients had more readmissions than ONS group ($n = 20$ vs $n = 10$, $p = 0.041$)
Payette et al. (2002)[401]	Community	Frail older under-nourished people	RCT	83	2 x 235 ml daily. Choice of ONS. Encouraged to attain max tolerable energy intake to gain 0.5 kg body weight per week. Instructed to use ONS and increase overall food intake (plus nutrition counselling by phone every 2 weeks between visits)	Visited monthly, no advice/ONS	16 weeks	**Nutritional** ONS group had higher energy intake ($p < 0.001$) and weight gain ($p < 0.001$) No significant differences in other anthropometric indexes, muscle strength or functional measures **Clinical** Number of bed disability days significantly increased in control group compared with baseline ($p = 0.04$), no change in bed disability days seen in ONS group

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Persson et al. (2007)[243]	Community (recruited in hospital, ONS on discharge)	Older people at risk of malnutrition	RCT	108	1–2 x 200 ml daily of a choice of either a complete or an incomplete formula (plus 2 individualised counselling sessions by a dietitian, telephone contact from dietitian at 3 time points, advised to increase fat and eat more snacks between meals)	Brief written DA	4 months	**Nutritional** In both intention to treat and per protocol analyses, ONS group maintained weight while controls lost weight ($p < 0.001$) **Functional** Improved ADL in ONS group in the treated-as-protocol analyses ($p < 0.05$ between groups)
Price et al. (2005)[234]	Community, on discharge from hospital (nursing home residents excluded)	Older people following acute illness	RCT	136	2 x 200 ml daily	Usual care	8 weeks	**Nutritional** Higher energy intake in ONS group vs controls ($p = 0.022$) **Functional** Improved hand-grip strength in ONS group vs controls over 12 weeks ($p = 0.02$), mean increase of 19.9% vs 6.6%; intention to treat analysis 13.9% vs 7.2%, $p = 0.055$

Table A3.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Wouters-Wesseling et al. (2002)[163]	Nursing homes	Physo-geriatric patients	RCT	42	2 x 250 ml daily during day between main meals. Patients were helped and encouraged by nursing staff to drink the ONS (plus regular dietary intake)	Placebo (2 x 250 ml) consisting of water, cloudifier, flavourant and non-calorific sweetener to resemble ONS in taste and appearance. No energy, no vitamins, no minerals	3 months	**Nutritional** Improved body weight with ONS vs placebo ($p = 0.03$) Significant improvement in homocysteine, vitamins B1, B6, B12, D, thiamine diphosphate and folic acid levels in ONS group vs placebo group **Functional** No significant change in ADL

*Mean actual duration of supplementation was 99.4 days (range 6–169).
†Per protocol analysis
¥Intention to treat analysis.
Note that actual intake often not recorded, may differ from target level.

Table A3.2 Summary of trials: setting, population, intervention and outcome – hospital studies and hospital to community

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Bos et al. (2001)[238]	Hospital inpatients	Malnourished older people	Controlled trial	23	2 units daily providing total of 400 kcal, 30 g protein. Advised to consume between meals or at bedtime	No ONS, but careful nutrition attention from nursing staff (advice on finishing meals)	10 days	**Nutritional** Increased energy and protein intake, ($p < 0.005$ and $p < 0.0002$ respectively) **Functional** FFM and BMI changes between day 7 and 17 ($p < 0.02$ and $p < 0.005$ respectively) No significant effect on biological markers or hand-grip strength
Botella-Carretero et al. (2008)[262]	Hospital (ONS started 48 h after surgery and continued until after discharge)	Normally nourished or mildly under-nourished older hip fracture patients	RCT (3-arm)	90	Group: 4 x 10 g packets protein powder providing 36 g protein and 152 kcal/day dissolved in water, milk or soup Group B: 2 x 200 ml liquid ONS providing 37.6 g and 500 kcal/day	Standard or texture-modified diet	ONS started 48 hours after operation and maintained after hospital discharge	**Nutritional** No significant effects on nutritional status (albumin, prealbumin, BMI, tricipital fold or midbrachial circumference **Functional/clinical** No differences in hospital stay, mobilisation, blood transfusions, complications

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Botella-Carretero et al. 2010)[229]	Hospital (ONS started on admission prior to surgery and continued until discharge)	Normally nourished or mildly under-nourished older hip fracture patients	RCT	60	2 x 200 ml liquid ONS providing 40 g protein and 400 kcal/day	Standard or texture-modified diet	ONS started 48 hours after operation and maintained after hospital discharge	**Nutritional** Larger decrease in serum albumin ($p = 0.002$) and prealbumin ($p = 0.045$) in control group after surgery and worse postoperative recovery vs intervention group No significant effects on anthropometric parameters (BMI, tricipital fold or midbrachial circumference) Compliance with supplement was 52.2±12.1% of prescribed amount daily. Intervention group had significantly higher total energy and protein intake vs control group ($p < 0.05$) **Clinical** Non-significant tendency for higher postoperative complication rate in the control group
Burden et al. (2011)[268]	Hospital (ONS started on admission prior to surgery and continued until surgery min 10 days)	Elective curative surgery for colorectal cancer	RCT	116	2 x 200 ml HP ONS providing 24 g protein and 600 kcal/day plus DA ($n = 54$)	DA ($n = 62$)	> 10 days preoper-atively	**Nutritional** Intervention group had significantly higher total energy intake preoperatively: 1722 (489) kcal/d vs 745 (366), $p = 0.001$). No difference demonstrated for protein intake preoperatively: intervention group 51.8 (33.6) g vs control group 33.0 (16.0) g, $p = 0.157$ Full compliance with ONS 72% No significant benefit of ONS on postoperative complications demonstrated. Subgroup analysis showed significant reduction in surgical site infections (Buzby criteria) in weight-losing patients from intervention group preoperatively ($p = 0.034$)

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Feldblum et al. (2011)[246]	Hospital and post discharge	Elderly medical under-nourished patients (MNA-SF < 10 or > 10% weight loss in previous 6 months) stratified into at risk or under-nourished	RCT (3-arm)	259	Group 1: in hospital and community treatment Group 2: in hospital treatment* Treatment: individualised plans to ensure > 35 kcal/kg/d and 1–1.5 g protein/kg/d using diet and food/ONS supplements	Group 3: standard in-hospital care	Contact monthly for 6 months	**Nutritional** Mean change in MNA score significantly higher in group 1 (3.0±2.6) than in groups 2 and 3 (1.8±3.0, $p = 0.004$). Group 1 gained 0.5± 2.84 kg weight over 6 months vs 0.15±2.72 kg in groups 2 and 3 (ns). Trend towards higher intakes of macronutrients seen in group 1 after 3-month follow-up but not significant No significant haematological/ biochemical differences seen between groups, apart from significantly fewer patients in group 1 had low albumin levels (< 3.5 g/dl) after 6 months (9.7%) compared with groups 2 and 3 (22.9%, $p = 0.03$) **Functional** No significant impact of intervention on functional cognitive or depression status Lower mortality in group 1 (3.8%) vs groups 2 and 3 (11.8%, $p = 0.046$)
Gariballa et al. (2007)[252]	Hospital, continued in the community	Older people with acute illness	RDBPCT	225	2 x 200 ml daily at 8.00 a.m. and 12 noon (plus NHD)	NHD plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content [60 kcal])	6 weeks	**Functional** Increase in number of patients with no depressive symptoms and decrease in patients with mild or severe depression with ONS compared to placebo ($p = 0.007$)

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Gariballa et al. (2007)[253]	Hospital, continued in the community	Older people with acute illness	RDBPCT	225	2 x 200 ml daily at 8.00 a.m. and 12 noon (plus NHD)	NHD plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content [60 kcal])	6 weeks	**Functional** After adjustment for baseline QOL, age and gender, better QOL score with ONS at 6 months (physical function $p = 0.04$, physical role $p = 0.047$, and social function $p = 0.05$) but not at 6 weeks Overall QOL scores better at 6 months with ONS ($p = 0.003$), no significant difference in cumulative change between the two groups No difference in ADL
Gariballa et al. (2006)[247]	Hospital, continued in the community	Older people with acute illness	RDBPCT	445	2 x 200 ml daily at 8.00 a.m. and 12 noon (plus NHD)	NHD plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content [60 kcal])	6 weeks	**Nutritional** Improved red-cell folate and plasma vitamin B12 in ONS group compared to decrease seen in controls At 6 months, no difference between groups in weight, BMI, MUAC, TSFT or transferrin **Clinical** Reduced readmission rate (29% vs 40%, $p < 0.05$)
Gazzotti et al. (2003)[232]	Hospital, continued in the community	Older people at risk of malnutrition	RCT	80	2 x 200 ml daily (one of each energy density to provide total of 500 kcal and 21 g protein daily) (plus standard diet)	No nutritional supplementation	2 months	**Nutritional** MNA scores higher in ONS group vs control group at day 60 ($p < 0.01$) Spontaneous protein and energy intake higher in ONS group vs controls ($p < 0.01$) Mean weight loss in controls 1.23±2.5 kg ($p = 0.01$), ONS groups showed non-significant weight increase 0.28±3.8 kg ($p = 0.6$) **Clinical** No difference in LOS or discharge destination

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Lauque et al. (2004)[233]	Geriatric wards and day care centres	Older people with Alzheimer's disease at risk of under-nutrition	RCT	91	300–500 kcal/day in addition to the patients' spontaneous food intake	Usual care (some patients from the control group who received ONS prescribed during the study not excluded but ONS prescription recorded)	3 months	**Nutritional** Improved energy and protein intakes between baseline and 3 months in intervention group leading to significant improvement in weight and FFM **Functional/clinical** No difference in dependence, cognitive function or biological markers at 3 months or in fractures, pressure ulcers or hospitalisation at 6-month follow-up

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Miller et al. (2006)[403]	Hospital, continued in the community (on discharge 52 went to rehab programme, 12 to community hospital, 16 to higher level care and 20 returned to pre-injury admission accommod-ation)	Older people at risk of under-nutrition with fall-related lower limb fracture	RCT	100	Supplement volumes were prescribed to meet 45% of individual estimated total energy requirements (range 580–800 ml/day). 4 doses of equal volume administered daily plus usual clinical care Group 1: ONS Group 2: ONS plus resistance training exercise Group 3: resistance training exercise	Group 4 – Attention control (received tri-weekly visits to match the home visits of the active intervention groups; discussions limited to general information, e.g. benefits of regular exercise and nutrient-dense meals)	42 days	**Nutritional** Patients in resistance training group lost more weight than those in ONS plus exercise group ($p = 0.029$) **Functional/clinical** No significant difference in quadriceps strength, gait speed, QOL or healthcare utilisation

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Neumann et al. (2004)[239]	Rehabilitation hospital	Older people following hip fracture	RDB, parallel	46	At least 2 x 8 oz (227 ml*) daily	Compared with standard ONS (110 kcal and 3.9 g protein per 100ml†)	28 days	**Nutritional** Protein, fibre, calcium, vitamin K and phosphorus intake greater in HP ONS group **Clinical** Trend towards shorter rehab LOS but not significant (23 vs 28 days, $p = 0.27$) **Functional** No differences in FIM
Rabadi et al. (2008)[251]	Stroke rehabilitation hospital	Under-nourished patients	RDBCT	102	120 ml dose of an intensive ONS every 8 hours by mouth	Compared with standard ONS (127 kcal, 5 g protein). Standard ONS contained 36 mg vitamin C compared with 90 mg in the intensive ONS	From within 72 hours of arrival on unit to discharge	**Nutritional** Non-significant greater increase in body weight in intensive group **Functional** Improved total FIM and motor FIM sub-score ($p < 0.001$) and 2-minute and 6-minute walk test ($p < 0.001$) in the intensive ONS group vs controls Higher % returned home in the intensive group (63% vs 43%, $p < 0.05$)

Table A3.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Rufenacht et al. (2010)[400]	Hospital	Under-nourished patients	RT	36	NT group – Individualised nutritional plan including fortified diet, snacks and energy-dense ONS ONS group – energy-dense ONS (2 x 200 ml 1.5 kcal/ml 12 g protein), no other advice		Length of hospital stay (10–15 days)	**Nutritional** Both groups demonstrated significant improvements in both energy intake ($p < 0.001$) and protein ($p < 0.001$) intake from baseline. No significant differences seen between groups Both groups demonstrated improved QOL parameters from baseline to discharge (NT group $p < 0.001$, ONS group $p < 0.003$). No significant differences between groups. NT group showed further significant improvement in QOL 2 months post discharge ($p = 0.016$)
Stratton et al. (2006)[241] Stratton et al. (2006)[242] Stratton et al. (2007)[300]	Hospital	Patients with fractured neck of femur at risk of malnutrition	RCT	50	Choice of liquid ONS ad libitum	Isoenergetic food snacks, e.g. cakes, biscuits, puddings	Postoper-atively until discharge	**Nutritional** Significantly greater energy and protein intake with ONS vs snacks Significantly greater mean total intake of all water-soluble vitamins in ONS group vs snack group Significantly fewer patients in ONS group had complications than in snack group (27% vs 58%, $p = 0.04$) Non-significant reduction in the incidence of specific complications, i.e. infections 17% vs 33% and wound-related complications (poor wound healing, pressure ulcers) 17% vs 38%

*1 fluid oz = 28.4 ml
†Calculated from the description of the ONS used in the study. Note that actual intake often not recorded, may differ from target level

Table A3.3 Summary of trials in children: setting, population, intervention and outcome

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Alarcon et al. 2003[248]	Community	Mean age 48.5 months (range 36.0–61.0 months) Picky eaters below 25th percentile WFH (children with underlying acute/chronic disease excluded	Multi-centre randomised, parallel group, open study	92	Physician-directed nutritional counselling with ONS	Physician-directed nutritional counselling without ONS	90 days	Significantly greater increase in WFH percentiles from baseline to day 60 ($p = 0.002$) and day 90 ($p < 0.001$) in study group vs controls Significantly greater increase in WFH percentiles from baseline to day 90 ($p < 0.001$) in study group vs controls – Philippines only Significantly greater increases for weight, height, WFH, WFA and HFA percentiles in study group compared to control group at all time points ($p < 0.05$) except HFA at day 30 Upper respiratory tract infections significantly lower in the study group vs controls (28% vs 51% respectively, $p = 0.027$)
Bayram et al. 2008[250]	Not specified	Mean age 7.5±3.0 years Children with malignant disease undergoing intensive chemo-therapy	Prospective randomised single centre open label study	52	Protein- and energy-dense EPA containing ONS in addition to normal dietary intake (2 x 240 ml/day)	Usual dietary care	3 months	At 3 months, significantly fewer patients in treatment group showed a loss in body weight (6.1% vs 47.4%, $p = 0.001$) and BMI (12.1% vs 52.6%, $p = 0.002$), and a negative deviation in weight percentile (6.1% vs 31.6%, $p = 0.021$) compared to the control group After 6 months ($n = 23$), the % of patients with weight loss was significantly lower in the treatment group vs controls (6.7% vs 50%, $p = 0.03$). No significant differences in BMI and negative deviation from weight percentile at this time point At 3 months, the remission rate in the treatment group was significantly greater in the treatment group vs controls (87.9% vs 63.2%, $p = 0.036$)

Table A3.3 Continued

Trial	Setting	Population	Design	Sample size	Intervention (ONS)	Control	Duration	Outcome
Soylu et al. 2008[249]	Community	Children with spastic quadriplegia (mal-nourished)	Un-controlled intervention study	45	Nutritional support including DA and ONS	No control group	6 months	Significant changes in weight, height, MAC, TSFT, weight z-score, WFA, WFH, BMI and number of infections after treatment compared to baseline

Table A3.4 Summary of trials of EPA-enriched ONS in cancer patients: setting, population, intervention and outcome

Trial	Setting	Population	Intervention	Control	Duration	Outcome
Fearon et al. (2003)[281]	Multi-centre RCT	Advanced pancreatic cancer patients with cachexia	474 ml EPA-enriched ONS (providing 2.2 g EPA, 620 kcal, 32 g protein and enhanced levels of antioxidants) (n = 95)	474 ml Isocaloric, isonitrogenous standard ONS (n = 105)	8 weeks	Significant increase in total (diet plus supplement) energy and protein intake from baseline in experimental group completing 8 weeks (mean 224 kcal, $p = 0.001$ and 15 g protein/day, $p < 0.001$) compared to control group increase 68 kcal/day, ns and 6 g protein ($p = 0.036$) Post hoc analysis demonstrated significant correlation between supplement intake and weight gain in the EPA group ($r = 0.5$, $p < 0.001$) and an increase in LBM ($r = 0.33$, $p = 0.036$) in the study group that were not seen in the control group Significant correlation between 8-week plasma EPA level and an increase in weight ($r = 0.50$, $p < 0.001$) and LBM ($r = 0.51$, $p < 0.001$) were also seen in the study group Intake of EPA-enriched supplement correlated positively with QOL (EQ-5D index) ($r = 0.46$, $p < 0.001$)

Table A3.4 Continued

Trial	Setting	Population	Intervention	Control	Duration	Outcome
Guarcello et al. (2007)[284]	Blinded RCT	Malnourished patients with lung cancer undergoing chemotherapy	474 ml EPA-enriched ONS (providing 2.2 g EPA, 590 kcal, 32 g protein and enhanced levels of antioxidants) (n = 46)	474 ml isocaloric, isonitrogenous standard ONS (n = 105)	60 days	Significant improvements seen in body weight, oral energy and protein intake from diet seen from baseline (T0) in EPA-enriched ONS group (weight T0: 57.7 kg [42.7–70.6] – end 58.6 kg [46.0–73.0], $p < 0.05$; kcal intake T0: 1300 kcal [850–1700] – end 2000 [900–3300], $p < 0.05$; protein intake T0: 40 g [20–55] – end 60 g [35–80], $p < 0.05$). No differences seen in control group No between-group comparisons reported
Read et al. (2007)[283]	Open label phase II study	Stage IV colorectal cancer patients undergoing chemotherapy	480 ml EPA-enriched ONS (providing 2.2 g EPA, 0.92 g DHA, 600 kcal, 32 g protein and enhanced levels of antioxidants) (n = 23)	-	9 weeks	Mean weight increase 2.5 kg seen after 3 weeks ($p = 0.03$) prior to commencement of treatment; weight was then maintained through course of treatment. No significant increase in LBM seen
Van der Meij et al. (2010)[280]	RDBPCT	Stage 3 non-small -cell lung cancer undergoing multi-modality treatment	480 ml EPA-enriched ONS (providing 2.2 g EPA, 0.92 g DHA, 600 kcal, 32 g protein and enhanced levels of antioxidants) (n = 20)	400 ml Ensure plus® (n = 20)	5 weeks	EPA-enriched ONS group demonstrated significant improvements in energy and protein intakes after 4 weeks – 2456 kJ ($p = 0.03$) and 25.0 g ($p = 0.01$) respectively. The intervention group demonstrated better weight maintenance (by 1.7 kg, $p = 0.04$) after 4 weeks and a smaller reduction in LBM (by 1.9 kg, $p < 0.05$) after 5 weeks compared with control group
Weed et al. (2011)[282]	Prospective observational study	Perioperative head and neck small-cell cancer (SCC) (grade II+) patients with weight loss < 5% in previous 6 months	480 ml EPA-enriched ONS (providing 2.2 g EPA, 0.92 g DHA, 600 kcal, 32 g protein and enhanced levels of antioxidants) (n = 38)	-	Approx. 4 weeks	70% maintained or gained weight prior to surgery (mean + 0.71 kg), with 57% continuing to maintain or gain weight during hospital admission (mean + 0.66 kg). There was a statistically significant increase in LBM (+ 3.21 kg over the course of the study ($p < 0.01$) and a reduction in fat mass by 3.19 kg ($p < 0.001$)

IV NUTRIENT CONTENT OF ONS vs TYPICAL FOOD SNACKS – Table A4.1

Table A4.1 Comparison of average nutrient content of some examples of ONS with typical snack foods used with the aim of increasing nutrient intake

		Fortisip† (Nutricia)	Ensure Plus† (Abbott Nutrition)	Fresubin Energy† (Fresenius Kabi)	Clinutren 1.5/ Resource Energy† (Nestle Nutrition)	Fruit yogurt	Cheese & crackers	Chocolate cake	Mars Bar
		per 200ml	per 220ml	per 200ml	per 200ml	per 150g	per portion*	per portion**	Per 65g bar
Energy	kcal	300	330	300	300	164	299	313	307
Protein	g	12	13.75	11.2	11.2	6	11.6	3.7	2.9
Carbohydrate	g	36.8	44.44	37.6	42	26.6	9.7	33.1	50.2
Sugars	g	13.4	15.2	7.8-12.6‡	10.4	24.9	0.1	22.3	43
Fat	g	11.6	10.82	11.6	10	4.5	24	19.3	11.9
Saturates	g	1.2	1.06	0.8	1.4	3	14.6	N/A	6.7
Dietary fibre	g	0¥	0¥	0¥	< 0.5¥	0	0.4	1	0.3
Sodium	mg	180	202	160	160	87	435	273	98
Potassium	mg	318	352	270	340	255	50	91	163
Chloride	mg	174	242	200	300	269	632	299	195
Calcium	mg	182	264	270	160	183	313	38	62
Phosphorus	mg	156	220	160	160	144	220	104	72
Magnesium	mg	46	66	42	60	20	15	23	21
Iron	mg	4.8	4.6	4	3.4	0.18	0.36	0.98	0.78
Zinc	mg	3.6	4.0	3	3	0.6	1.75	0.59	0.46
Copper	µg	540	396	0.6	0.3	0	0.04	0.2	0.20
Manganese	mg	1	1.1	0.8	0.6	0	0.01	0.1	0
Fluoride	mg	0.3	0	0.4	0.3	N/A	N/A	N/A	N/A
Molybdenum	µg	30	35	30	22	N/A	N/A	N/A	N/A
Selenium	µg	17.2	18	20	15	3	3	3	1
Chromium	µg	20	17	20	15	N/A	N/A	N/A	N/A
Iodine	µg	40	48	60	30	41	18	19	0
Vitamin A	µg RE	246 (600µg carotenoids)	257	240 (beta-carotene 600µg)	260	54	241 (117 µg carotene)	0	20 µg retinol (26 µg carotene)
Vitamin D	µg	2.2	4.4	4	3	0.15	0.21	1.83	0.2
Vitamin E	mg-α-TE	3.8	4.7	6	4	0.27	0.57	1.96	0.31
Vitamin K	µg	16	26	33.4	16.6	0	2.62	0	3.12
Thiamin B1	mg	0.46	0.44	0.46	0.36	0.18	0.04	0.05	0.03
Riboflavin B2	mg	0.48	0.59	0.64	0.4	0.24	0.17	0.06	0.13
Niacin B3	mg NE	5.4	5.7	6	3.6	0.15	0.28	0.26	0.13
Pantothenic acid B5	mg	1.6	2.4	2.4	1.5	0.6	0.25	0.26	0.59
Vitamin B6	mg	0.52	0.59	0.66	0.52	0.02	0.08	0.03	0.02
Folic acid	µg	80	88	100	72	15	15	6	3
Vitamin B12	µg	0.64	1.2	1.2	1.1	0.45	0.99	0.65	0
Biotin	µg	12	13	15	9	1.7	2.1	3.9	1.3
Vitamin C	mg	30	26	30	30	1.5	0	0	0
Choline	mg	110	121	53.4	0	N/A	N/A	N/A	N/A
Data Source		www.nutricia.com. Accessed 26.04.10	Provided by Abbott Nutrition 30.04.10	www2.fresenius-kabi.com. Accessed 26.04.10	www. nestlenutrition.com. Accessed 26.04.10	McCance and Widdowson The Composition of Foods[205]			

†Required to comply with the minimum and maximum values for vitamins, minerals and trace elements within Commission Directive 1999/21/EC on dietary foods for special medical purposes. *Portion = 2 crackers, 40g cheddar cheese & 10g butter, **portion = 65g chocolate cake with butter icing. ‡Depending on flavour. ¥Fibre variants available. N/A, not available.

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V SUMMARY OF TRIALS: TYPE, REGIMEN AND DURATION OF ONS USED – Tables A5.1 to A5.3

Table A5.1 Community studies

Table A5.2 Hospital studies and hospital to community studies

Table A5.3 Studies in children

- A variety of different ONS were used in the trials discussed, but in general, liquid multi-nutrient ONS were used.
- The duration of supplementation with ONS ranged from 10 days to 18 months (not specified in some trials).
- The energy density ranged from 0.85 kcal/ml to 2.5 kcal/ml and protein content ranged from 3.4 g/100 ml to 13 g/100 ml.
- Energy intakes from ONS ranged from 400 kcal to 1000 kcal per day and 17 g to 50 g of protein per day.

Table A5.1 Summary of trials: Type, regimen and duration of ONS used – community studies

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Bonnefoy et al. (2003)[259]	Retirement homes	Frail older people	RCT factorial design	57	1 kcal/ml	2 x 200ml daily given at 10.00 and 16.00 hours Group 1: ONS plus memory Group 2: ONS plus exercise	100	7.5	ONS provided 50% of Recommended Daily Allowances for vitamins and minerals	Placebo in identical packaging, contained no energy, protein or micronutrients Group 3: placebo plus exercise Group 4: placebo plus memory	9 months
Bunout et al. (2001)[258]	Community (free-living)	Older people	RCT	149	N/R	2 servings soup/porridge-style supplement daily Group 1: ONS plus resistance exercise training Group 2: ONS, no training	400 (per 100g)	13 (per 100g)	Contained 25% of daily vitamin and mineral requirements	Group 3: no ONS, resistance exercise training Group 4: no ONS and no training	18 months
Edington et al. (2004)[254]	Community (post-discharge from hospital)	Older people, mal-nourished	RCT	100	Various - N/R	Intakes between 600 kcal and 1000 kcal/day prescribed in order to achieve a weight gain of at least 0.5 kg/week (plus telephone contact by dietitian)	Choice offered. Variety of different energy/protein contents - N/R		N/R. Some known to be nutritionally complete	Standard care	8 weeks*

Table A5.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Lauque et al. (2004)[233]	Geriatric wards and day care centres	Older people with Alzheimer's disease, at risk of under-nutrition	RCT	91	Various (1-1.5 kcal/ml)	300 - 500 kcal/ day in addition to the patients spontaneous food intake	100 - 150	5 - 8	Enriched with vitamins and minerals	Usual care (some patients from the control group who received ONS prescribed during the study not excluded, but ONS prescription recorded)	3 months
Manders et al. (2009)[245]	Residents of care homes for older people	Older people	RDBPCT parallel	176	1 kcal/ml	2 x 125ml dairy drink between meals (250 kcal/ day)	100	3.5	Added vitamins, minerals & trace elements (25-175% of U.S. RDA, enhanced levels of antioxidants)	Placebo drink, no energy, vitamins or minerals. Contained water, cloudifier, thickener, flavouring, colourant and non-calorific sweetener	6 months
Manders et al. (2009)[240]	Residents of care homes for older people (homes for the elderly *n* = 3, nursing homes *n* = 3, mixed homes *n* = 3)	Older people	RDBPCT parallel	176	1 kcal/ml	2 x 125ml dairy drink between meals (250 kcal/ day) in addition to usual diet	100	3.5	Added vitamins, minerals & trace elements (25-175% of Dutch RDA, with added antioxidants)	Placebo drink, no energy, vitamins or minerals. Contained water, cloudifier, thickener, flavouring, colourant and non-calorific sweetener	6 months

Table A5.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
McMurdo et al. (2009)[244]	Community (admitted to hospital with acute illness). Residents of care homes excluded	Older people, under-nourished	RCT	253	1.5 kcal/ml	2 x 200ml daily	150	10	Nutritionally complete	Control supplement based on skimmed milk containing 200 kcal, 12.4 g protein	4 months
Neelemaat et al. (2011)[255]	Community (post hospital discharge)	Mal-nourished elderly (> 60 years) patients, various specialities	RCT	210	1.5 kcal/ml HP	2 x 200 ml daily. Alongside high energy/protein diet. Also received 400IE vitamin D3 and 500 mg calcium/d	150	6	Nutritionally complete	Usual care	3 months
Norman et al. (2008)[237]	Community	Mal-nourished patients with GI disease	RCT	101	1.5 kcal/ml, HP**	Up to 3 x 200ml daily. Patients advised to drink ONS slowly and in between meals (≥1 h before a meal) (plus standard DC session as per control, contacted once/month)	150	10	Nutritionally complete	Standard DC session (verbal advice, 45 min) by a registered dietitian. Advised on improving protein and energy intake with normal food. All patients actively contacted once/month.	3 month

Table A5.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Payette et al. (2002)[401]	Community	Frail, older under-nourished people	RCT	83	Various: N/R	2 x 235 ml daily. Choice of ONS. Encouraged to attain max tolerable energy intake to gain 0.5 kg body weight per week. Instructed to use ONS and increase overall food intake (plus nutrition counselling by phone every 2 weeks between visits)	Choice offered. Variety of different energy/protein contents - N/R		N/R. Some known to be nutritionally complete	Visited monthly, no advice/ONS	16 weeks
Persson et al. (2007)[243]	Community (recruited in hospital, ONS on discharge)	Older people at risk of mal-nutrition	RCT	108	1.2 kcal/ml or 0.85 kcal/ml	1 - 2 x 200ml daily of a choice of either a complete or an incomplete formula (plus 2 individual-ised counselling sessions by a dietitian, telephone contact from dietitian at 3 time points, advised to increase fat, eat more snacks between meals)	120 (complete) 85 (in-complete)	5 4	Vitamins D, B6, B12, Folacin, Mg, Ca, Zn + multi vitamin supplement (nutrients as above except Mg, Ca)	Brief written dietary advice	4 months

Table A5.1 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Price et al. (2005)[234]	Community, on discharge from hospital (nursing home residents excluded)	Older people following acute illness	RCT	136	1.5 kcal/ml	2 x 200ml daily	150	12	N/R. Known to be nutritionally complete	Usual care	8 weeks
Wouters-Wesseling et al. (2002)[163]	Nursing Homes	Psycho-geriatric patients	RCT	42	1.1 kcal/ml	2 x 250 ml daily during the day between main meals. Patients were helped and encouraged by nursing staff to drink the ONS (+ regular dietary intake)	109†	3.4†	Contained a range of vitamins and minerals	Placebo (2 x 250ml) consisting of water, cloudifier, flavouring and non-caloric sweetener to resemble ONS in taste and appearance. No energy, no vitamins, no minerals.	3 months

N/R Not reported.
*Mean actual duration of supplementation was 99.4 days (range 6–169).
**HP ≥ 20% energy from protein.[6]
†Calculated from the description of the ONS used in the study.
Note that actual intake often not recorded, may differ from target level

Table A5.2 Summary of trials: Type, regimen and duration of ONS used – hospital studies and hospital to community studies

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Bos et al. (2001)[238]	Hospital inpatients	Mal-nourished older people	Controlled trial	23	N/R	2 units daily providing total of 400 kcal, 30 g protein. Advised to consume between meals or at bedtime	N/R	N/R	Contained a range of vitamins and minerals	No ONS, but careful nutrition attention from nursing staff (advice on finishing meals)	10 days
Botella-Carretero et al. (2008)[262]	Hospital (ONS started 48 hrs after surgery and continued until after discharge)	Normally nourished or mildly under-nourished older hip fracture patients	RCT (3-arm)	90	N/R 1.25 kcal/ml	Group A - 4 x 10g packets protein powder providing 36 g protein and 152 kcal/day dissolved in water, milk or soup Group B - 2 x 200ml liquid ONS providing 37.6 g and 500kcal/day	N/R 125	N/R 9.4	N/R N/R	Standard or texture modified diet	Started 48 hours after operation and main-tained after hospital dis-charge
Botella-Carretero et al. (2010)[229]	Hospital (ONS started on admission prior to surgery and continued until discharge)	Normally nourished or mildly under-nourished older hip fracture patients	RCT	60	1 kcal/ml	2 x 200 ml daily	100	10	ONS provided full range vitamins and minerals	No ONS	Up to 23 days

Table A5.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Burden et al. 2011)[268]	Hospital pre-operative	Elective colorectal cancer	RCT	116	1.5 kcal/ml HP ONS	2 x 200 ml daily advised between meals. Advised on high protein and energy menu choices	150	6	Nutritionally complete	DA only	Until discharge
Feldblum et al. (2011)[246]	Hospital and post discharge	Elderly medical under-nourished patients (MNA-SF < 10, or > 10% weight loss in previous 6 months), stratified into at risk or under-nourished	RCT 3-arm	259	Liquid or pudding 1.5 kcal/ml 237 g can	Varied according to individualised patient plan (including fortified meals and snacks, multivitamin supplement as appropriate)	150	6.5	15% RDI for vitamins and minerals in 237 ml pack	Usual care (some patients in control group received ONS prescribed during the study as part of routine care	6 months
Gariballa et al. (2007)[252]	Hospital, continued in the community	Older people with acute illness	RDBPCT	225	2.5 kcal/ml, HP†	2 bottles x 200ml daily at 8.00 am and 12 noon (plus NHD)	249*	12.4*	100% RNI for vitamins & minerals for healthy older person	Normal hospital diet plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content (60 kcal))	6 weeks

Table A5.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Gariballa et al. (2007)[253]	Hospital, continued in the community	Older people with acute illness	RDBPCT	225	2.5 kcal/ml, HP†	2 bottles x 200ml daily at 8.00 am and 12 noon (+ NHD)	249*	12.4*	100% RNI for vitamins & minerals for healthy older person	Normal hospital diet plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content (60 kcal))	6 weeks
Gariballa et al. (2006)[247]	Hospital, continued in the community	Older people with acute illness	RDBPCT	445	2.5 kcal/ml, HP†	2 bottles x 200ml daily at 8.00 am and 12 noon (+ NHD)	249*	12.4*	100% RNI for vitamins & minerals for healthy older person	Normal hospital diet plus placebo (identical to the supplement but contained no protein or micronutrients and with a minimal kcal content (60 kcal))	6 weeks
Gazzotti et al. (2003)[232]	Hospital, continued in the community	Older people, at risk of malnutrition	RCT	80	1 kcal/ml 1.5 kcal/ml	2 x 200ml cups daily (1 of each energy density to provide total of 500 kcal and 21 g protein daily) (+ standard diet)	100 150	N/R	N/R - ? Nutritionally Complete	No nutritional supplementation	2 months
Lauque et al. (2004)[233]	Geriatric wards and day care centres	Older people with Alzheimer's disease, at risk of under-nutrition	RCT	91	Various (1-1.5 kcal/ml)	300 - 500 kcal/day in addition to the patients' spontaneous food intake	100 - 150	5 - 8	Enriched with vitamins and minerals	Usual care (some patients from the control group who received ONS prescribed during the study not excluded, but ONS prescription recorded)	3 months

Table A5.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Miller et al. (2006)[403]	Hospital, continued in the community (on discharge 52 went to rehab programme, 12 to community hospital, 16 to higher level care and 20 returned to pre-injury admission accommod-ation)	Older people at risk of under-nutrition with fall-related lower limb fracture	RCT	100	1.5 kcal/ml	Supplement volumes were prescribed to meet 45% of individual estimated total energy requirements (range 580–800 ml/day). 4 doses of equal volume administered daily + usual clinical care Group 1: ONS Groups 2: ONS + exercise	150	6*	Complete	Group 3 – exercise Group 4 –attention control (received tri-weekly visits to match the home visits of the active intervention groups; discussions limited to general information, e.g. benefits of regular exercise and nutrient-dense meals)	42 days
Neumann et al. (2004)[239]	Rehabilitation hospital	Older people following hip fracture	RDB, parallel	46	1.1 kcal/ml HP	At least 2 x 8 oz (227 ml¥) daily	106*	6.6	Contains vitamins and minerals	Compared with standard ONS (110 kcal and 3.9 g protein per 100ml*)	28 days
Rabadi et al. (2008)[251]	Stroke rehabilitation hospital	Under-nourished patients	RDBCT	102	N/R	120 ml dose of an intensive ONS every 8 hours by mouth	240 kcal per ?	11 g protein per ?	Accompanied by multivitamins with minerals. ONS nutritionally complete	Compared with standard ONS (127 kcal, 5 g protein). Standard ONS contained 36 mg vitamin C compared with 90 mg in the intensive ONS	From within 72 hours of arrival on unit to discharge

Table A5.2 Continued

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Rufenacht et al. (2010)[400]	Hospital	Under-nourished	RT	36	1.5 kcal/ml	NT group: Individualised regimen including fortified meals and energy-dense snacks + ONS	150	6	N/R (Assume as per ONS group drink)		10–15 days
						ONS group: 2 x 200 ml 1.5 kcal/ml ONS with 12 g protein. Nutritionally complete (Nutridrink, Nutricia)	150	6	Full range of vitamins, minerals and trace elements		
Stratton et al. (2006) [241;242;300]	Hospital	Patients with fractured neck of femur, at risk of malnutrition	RCT	50	1.5 kcal/ml	Choice of liquid ONS ad libitum	150	Various	Contained vitamins and minerals	Isoenergetic food snacks, e.g. cakes, biscuits, puddings	Post-operatively until discharge

N/R Not reported.
†HP ≥ 20% energy from protein6.
*Calculated from the description of the ONS used in the study.
†1 fluid oz = 28.4 ml.
Note that actual intake often not recorded, may differ

Table A5.3 Summary of trials: Type, regimen and duration of ONS used – children

Trial	Setting	Population	Design	Sample size	Intervention					Control	Duration
					ONS Type	ONS regimen (+ other care, if provided)	Energy (kcal) per 100ml	Protein (g) per 100ml	Micronutrients		
Alarcon et al. 2003[248]	Community	Mean age 48.5 months (range 36.0–61.0 months) Picky eaters below 25th percentile WFH (children with underlying acute/chronic disease excluded	Multi-centre randomised, parallel group, open	92	1 kcal/ml nutritionally complete paediatric supplement (Paediasure)	40 ml/kg/day in addition to diet (physician-directed nutritional counselling)	100	2.8	Complete	Physician-directed nutritional counselling without ONS	90 days
Bayram et al. 2009[250]	Hospital	Mean age 7.5±3.0 years Children diagnosed with malignant disease undergoing intensive chemotherapy	Prospective, randomised, single centre, open	52	1.25 kcal/ml HP ONS containing EPA (Prosure)	2 x 240 ml cartons daily	125	6.67	Range of vitamins, minerals, anti-oxidants and EPA	No ONS	3 months
Soylu et al. 2008[249]	Community	Children with spastic quadriplegia (malnourished)	2-centre intervention study	45	1–1.5 kcal/ml nutritionally complete paediatric supplement (Paediasure/ Fortini)	DA including texture modification and ONS	100–150	2.8–3.4	Nutritionally complete	No control	6 months

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