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REVIEW

To screen or not to screen for adult malnutrition?

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Summary
Background: There is some controversy about whether all adults receiving healthcare should be routinely screened for nutritional problems.
Methods: (i) A systematic review examined the proposition that malnutrition is under-recognised and under-treated, and that nutritional interventions in malnourished patients, identified through a screening procedure produce clinical benefits (assessed using randomised controlled trials, RCTs). (ii) A systematic review of nutritional screening interventions in populations of malnourished and well-nourished subjects (RCTs and non-RCTs).
Results: (i) The prevalence of malnutrition varies according to the criteria used, but is estimated to affect 10–60% of patients in hospital and nursing homes, 10% or more of older free-living subjects, and less than 5% of younger adults. In the absence of formal screening procedures, more than half the patients at risk of malnutrition in various settings do not appear to be recognised and/or are not referred for treatment. RCTs show that nutritional interventions in malnourished patients produce various clinical benefits. (ii) Interventions with nutritional screening in different care settings also generally suggest clinical benefits, but some are limited by small sample sizes and inadequate methodology. Factors that influence outcomes include validity, reliability and ease of using the screening procedure, the 'care gap' that exists between routine and desirable care and the need for other resources, which may increase or decrease following screening.
Conclusions: The frequent failure to recognise and treat malnutrition, especially where it is common, is unacceptable. In such circumstances, the routine use of a simple screening procedure is recommended. Each health care setting should have a transparent policy about nutritional screening, which may vary according to the 'care gap', available resources, and specific populations of patients, in which the prevalence of malnutrition may vary widely.

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Introduction

It is obvious that a condition, such as malnutrition, has to be identified before it can be treated. For this reason nutritional screening is widely recommended in various care settings, so that patients at risk of malnutrition can be identified, further evaluated, and treated. Malnutrition is known to predispose to disease, adversely affect its outcome, and detrimentally effect physical and psychological health.[1–3] Since it can also be readily treated, often at low cost, it is reasonable to suggest that efforts should be made to identify malnutrition, at least opportunistically. Indeed, it seems unacceptable not to do so when the opportunity arises, especially in care settings where it is common. However, with the increasing emphasis on evidence-based medicine, which relies heavily on randomised controlled trials (RCTs), there has been some controversy about the role of routine nutritional screening in some care settings, particularly among groups of individuals in whom malnutrition is uncommon. Therefore, there has been some polarisation in attitudes. On the one hand, there is support for nutritional screening, not only from enthusiasts, but also from a variety of professional organisations, governments, and international agencies. Table 1 illustrates the commitment to nutritional screening of various such bodies within the UK, the Council of Europe, and the European Society of Parenteral and Enteral Nutrition.[3–19] In some countries, such as Scotland,[6] and in specific regions within other countries (e.g. Copenhagen city region in Denmark) screening for malnutrition (used here to mean undernutrition) is a required standard procedure for all patients admitted to hospitals. Furthermore, in England nutritional screening can now be used by the Department of Health as one of the criteria for assessing the standard of hospital care (see PEAT in Table 1). In the USA, nutritional screening in hospitals is required for accreditation by the Joint Accreditation of Health Organisations.[20] Recommendations for hospitals and other care settings

Table 1 Recommendations for nutritional screening in the UK†.

PEAT (2004)††.[4,5] This document by the Department of Health provides guidance on assessment of good clinical practice in English hospitals. The check list includes routine weighing and nutritional screening in at least 50% of hospitalised patients.
The 'MUST' report (2003).[3] This report, produced by the Malnutrition Advisory Group of the British Association for Parenteral and Enteral Nutrition (BAPEN), recommends nutritional screening of various patient groups in different care settings. It provides the evidence base for the 'Malnutrition Universal Screening Tool' ('MUST'). The report has the seals of support of BAPEN, The British Dietetic Association, The Royal College of Nursing, and The Registered Nursing Home Association. MUST is also supported by the Royal College of Physicians (London).
ESPEN guidelines for nutritional screening (Educational and Clinical Practice Committee) (2003)††.[5] The European Society for Clinical Nutrition and Metabolism (ESPEN), which has a strong membership from the UK, recommends that all patients admitted to hospital or other institutions should be screened, and that the screening process must be linked to defined courses of action.
'Food & Healing' Conference (2003). A Department of Health/NHS Estates report of a conference held in Queen Elizabeth II Conference Centre (Westminster, London) on 21st January 2003, emphasises the need for routine use of nutritional screening in clinical practice.
Improving Health in Wales Nutrition and Catering Framework (2002). This document, produced by the All-Wales Catering/Nutrition Group for the Welsh Assembly Government (May 2002), recommends that nutritional screening should be undertaken on all patients admitted to hospital.
Food, Fluid and Nutritional Care in Hospitals (2003).[6] This report by NHS Quality Improvement Scotland made nutritional screening a mandatory routine procedure for all patients admitted to hospital (an essential standard).
Nutrition in Medicine: a doctor's responsibility (2002).[7] This report, produced by the Royal College of Physicians, emphasises the doctor's responsibility in preventing and managing nutritional problems, as part of an integrated, multidisciplinary programme that begins with nutritional screening.
Food and Nutritional Care in Hospitals: how to prevent under-nutrition (2002 and 2003).[8,9] This report by the Council of Europe sets out a strategy for treating malnutrition which affects up to 30% of patients admitted to hospital throughout Europe. It emphasises that the first step in management is nutritional risk assessment.
Care Homes for Older People (2001).[10] This report, published by the Department of Health, provides minimum national standards for care homes, as part of the Care Standards Act 2000. The report recommends that nutritional risk screening in care homes should be undertaken on admission, and subsequently on a periodic basis. It also recommends that the findings should be recorded, and appropriate action implemented.
The National Service Framework (NSF) for Older People (2001).[11] This report, published by the Department of Health, recommends that routine nutritional screening should be undertaken and appropriate action plans implemented. It refers to *Essence of Care*[12] for more specific standards on nutritional screening. The NSF for Older people also advocated a single integrated assessment framework rather than multiple independent assessment procedures. *The Single Assessment Process for Older People* (http://www.doh.gov.uk/scg/sap), provides recommendations for implementing a single assessment process with a scale and depth according to needs, so that assessments converge in an effective way without duplication.
Essence of Care (2001).[12] This report, published by the Department of Health provides a benchmarking toolkit to support professionals in working with patients to get the basics right. One of the aspects of care considered is nutrition, which includes two benchmarks on screening and ongoing assessment of nutritional status.
Acute Hospital Portfolio: Hospital Catering Report (2001).[13] This report, by the Audit Commission raised concern that many Trusts did not systematically screen patients for malnutrition.
National Nutritional Audit of Elderly Individuals in Long-term Care (2000).[14] This report, published by the Clinical Resource and Audit Group (CRAG) of the Scottish Executive, recommends that high priority should be given to decrease the high prevalence of malnutrition in long-term care facilities. It also recommends that all residents should be screened for risk of malnutrition within one week of admission and at monthly intervals thereafter.
Managing nutrition in hospital: a recipe for quality (2000).[90] This report produced by the Nuffield Trust, stresses the importance of recognising nutrition as part of routine clinical management.
Detection and Management of Malnutrition (2000).[15] This report, by the Malnutrition Advisory Group of the British Association for Parenteral and Enteral Nutrition (BAPEN), reported on the high prevalence of unrecognised and untreated malnutrition and produced a screening tool linked to a care plan to combat the problem in the community.
Eating matters (1997).[16] This is a report produced by the Centre for Health Services Research and the Institute for Health of the Elderly, University of Newcastle, which was funded by the Department of Health in response to nurses to improve standards of dietary care in hospital. It was developed for use by a variety of ward staff, but particularly nurses and doctors, and stresses the importance of nutritional screening and assessment, and provides practical guidelines.

Table 1. (*continued*)

Hungry in Hospital (1997).[17] This report, produced by the Community Health Councils, as part of their role in monitoring the Health Service on behalf of the public, has raised serious concerns about 'hunger' in hospital and has compiled a series of reasons why 'hunger' occurs. It recommends that the nutritional state of patients should be established on admission to hospital.
Malnutrition in Hospital (1996).[18] A report by the British Dietetic Association, states that healthcare workers, such as registered nurses or clinicians should detect most nutritional problems on admission to hospital and refer appropriate patients to the dietitian. It also emphasises the need for increased awareness of malnutrition in the community setting, so that continuity of care can be established.
The Kings Fund report, 'A positive approach to nutrition as treatment' (1992).[19] This report, which has helped raise the profile of clinical nutrition in the UK during the last decade, concluded that the full benefits of nutritional treatment will only be realised when the assessment of every patient's status has become routine.

†Based on the MUST report[3] and two other documents (††).

have also been made by the ASPEN Board of Directors.[21,22] On the other hand, there has been a strong resistance to nutritional screening, especially in primary care, for two main reasons. First, nutritional screening is only one of the large and increasing number of procedures that health professionals are asked to perform during their busy schedules. Second, the clinical and economic benefits of nutritional screening do not appear to have been convincingly demonstrated for a range of conditions in different care settings using the criteria demanded by evidence-based medicine. The arguments for and against nutritional screening can be better understood by first considering some general issues about screening tests and screening programmes.

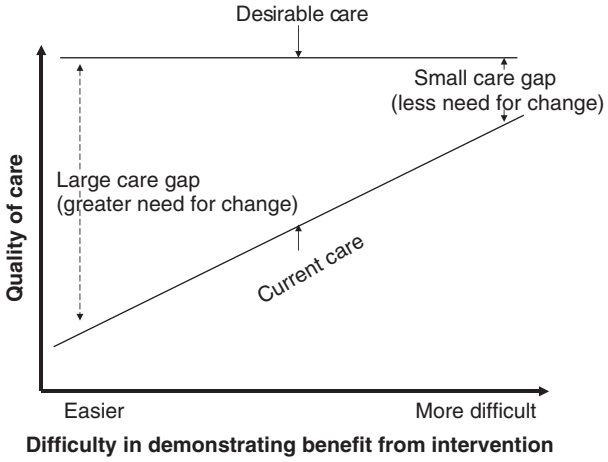

Figure 1 Relationship between 'care gap' (difference between desired and actual quality of care) and difficulty in demonstrating benefit from interventions that aim to improve the quality of care.

General issues concerning screening

Desired and actual quality of care

Health indicators are often selected to reflect current problems within societies, especially those requiring improvement. When these have been improved substantially, the cost of improving them further may be disproportionately high, and perhaps unacceptable to policy makers. Therefore, new policies are established and resources redirected towards other more pressing health problems in the general population. The new indicators may not only be used as markers of health but also to develop concepts, and even definitions of health. In interpreting trials involving nutrition screening, it is necessary to consider the gap that exists between desired and current practice of care, termed the 'care gap'. When the 'care gap' is small, it is generally harder to improve care even further and to demonstrate benefit from an intervention than when the gap is large (Fig. 1). Therefore, studies generally require more subjects and more financial support to demonstrate a significant benefit when the 'care gap' is small. These considerations should be taken into account in planning and reporting results of studies on screening, and are discussed further below.

Screening tests and screening programmes

A screening test refers to the detection of an otherwise unrecognised condition, which is usually amenable to treatment. In contrast, a screening programme refers to the whole management pathway, which begins with diagnosis and continues with treatment and follow-up. The main effort and

cost of a programme may be due to the care and follow-up rather than to the screening procedure. This means that identification of a problem does not necessarily result in improved outcomes unless there is an effective care pathway to deal with the problems that have been identified. It also means that in assessing the clinical effectiveness of a nutritional screening test it is important to consider the adequacy of the entire management pathway (screening programme). Unfortunately, such information is often inadequate or lacking from published studies, making it difficult to assess the value of specific nutritional screening tests. Thus, an adequate description of the elements that make up multidisciplinary nutritional care is often incomplete or lacking.

Different types of nutrition screening tests

A recent review has identified over 70 tests or tools for detection of malnutrition,[23] but there are probably an even greater number of unpublished tools that are used in clinical practice. Unfortunately, the tests differ considerably in their validity, reliability, ease of use and acceptability.[3] Failure to demonstrate benefit with one tool does not mean that nutritional screening in general is ineffective. The situation is made even more complicated by the lack of a universally accepted definition of malnutrition, and lack of a screening test/tool that can be used as a gold standard for identifying malnutrition. Many tools appear to be based on unsubstantiated criteria and cut-off points, rather than fundamental well-founded nutritional principles; an issue discussed elsewhere.[3] However, the criteria, cut-off points, and the weightings applied to the criteria in several tools appear to be based on sound principles (e.g. see 'MUST' report[3]), which also predict response to treatment. One tool was based on an analysis of the clinical outcomes of controlled clinical trials that investigated the effects of nutritional support.[24]

Value of screening according to the prevalence of malnutrition

The predictive value of the same screening test may vary depending on the prevalence of the condition. For example, when a test with 95% sensitivity (% of patients with conditions that test positive) and specificity (% of patients who do not have the conditions that test negative) is applied to a population with 20%, it can be shown that 86% of those who test positive (positive predictive value) will have the condition, but when applied to a population with 4% prevalence of the condition, only 44.2% of those who test positive will have the condition. In the latter situation most of the resources for subsequent evaluation will be directed to those with false positive tests. It is not possible to establish the exact specificities/sensitivities, and predictive values of malnutrition screening tests because there is no universally accepted definition or reference gold standard for malnutrition. Nevertheless, the prevalence of malnutrition is known to vary considerably,[2,3] being typically high in hospitals, nursing homes, and older subjects with at risk conditions (e.g. those with aggressive inflammatory disease, such as cancer, the socially isolated, bereaved, and recently discharged from hospital) and considerably lower in primary care, especially among patients with minor inter-current problems. In the last situation the widespread routine application of a screening test may require substantial effort for relatively little return. Therefore, conclusions about the application of screening tests are contextual (see recommendations at the end of this review).

Other screening considerations

Fig. 2 illustrates several factors related to the prevalence of a condition that need to be considered before policies on screening are implemented extensively in different groups of subjects in various settings (Fig. 2). One of the factors that affects prevalence of malnutrition is age, and another is the setting, e.g. malnutrition is more common in hospitals than in athletic training institutions.

An important requirement for screening is that it can detect conditions that would otherwise be unrecognised. If a condition is recognised, either by the subject suffering from the condition or by health workers during routine clinical care, screening would have limited value, unless it can identify the condition at an earlier stage, permitting a more timely intervention. Economic considerations are also important, but societal values about specific conditions that are deemed to be unacceptable may sometimes override economic considerations. Such judgements affect nutritional and non-nutritional tests.

Study designs

Undertaking RCTs is not always the best way to evaluate clinical guidelines, or potential guidelines, such as those involving nutritional screening. One

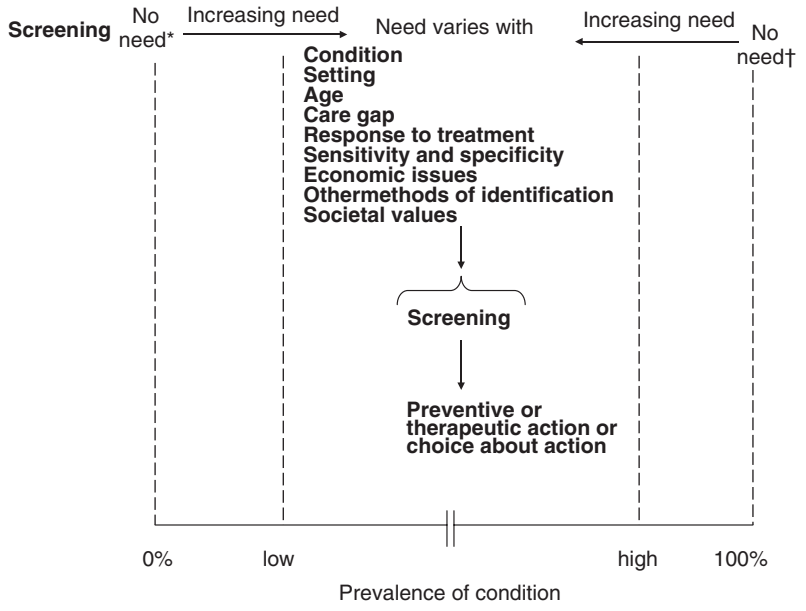

Figure 2 Factors that can influence the need for screening according to the prevalence of malnutrition.

of the concerns is that the intervention provided to the control group of patients may be 'contaminated' by the investigator's (health worker's) knowledge of the guidelines (e.g. nutritional guidelines), so that the real effects of the guidelines are underestimated.[25] In contrast, in studies where health workers or hospitals or GP practices are randomised (e.g. for nutritional screening[26]), the Hawthorne effect (changes produced simply by participating in a scientific investigation) may influence the intervention group to a greater extent than the control group. A trial with a cross-over design (e.g. a cross-over supplementation study according to ward[27]) may overcome this effect. Studies with controlled before-and-after designs, including nutritional screening studies, which are discussed in a subsequent section (impact of nutritional screening in clinical practice) may also reduce some of the problems associated with the Hawthorne effect, especially if the screening studies include a comparator group.[28] Geographic separation of control and intervention groups also has advantages in that the risk of contamination from one site to another is reduced.[29] Such designs are not free of problems, but they should not be ignored.

With the above information in mind, the remaining part of this review considers two themes about the value of nutritional screening in clinical practice. The first is the proposition that malnutrition is common, and in the absence of screening, is under-recognised and under-treated, to the detriment of the individual and health service. Surprisingly, there has been little attempt to specifically assess studies in developed countries of patients with malnutrition (most reviews have included studies with either unspecified nutritional status or variable nutritional status, with and without malnutrition). The second, which has also been previously neglected, concerns the overall impact of nutritional screening on different populations with variable proportions of well nourished and malnourished individuals. These two themes are then discussed in relation to resource implications and other screening issues, including development of guidelines for nutritional screening in routine clinical practice.

Malnutrition is common, under-recognised and under-treated

A case for routine screening in particular health care settings or specific patient groups can be made if it can be demonstrated that malnutrition is common, frequently unrecognised (see Stratton Green Elia[2] for evidence base), and treatment of the affected individual confers clinically significant

benefits. This line of enquiry is systematically considered below.

Malnutrition is common in several care settings and in patients with disease

Although different criteria are used to detect malnutrition,[2] there is overwhelming evidence that it is common in nursing homes and hospitals (generally 15–60%). A systematic analysis of malnutrition according to health care setting, clinical condition and diagnostic criteria is available elsewhere.[2] Malnutrition risk increases with age, with an estimated prevalence of over 10% of the population aged 65 years and over in England.[30]

Malnutrition is under-recognised

Failure to identify and treat malnutrition has been a major concern among various national and international organisations and various workers involved in clinical practice[3] (Table 1). Failure to recognise hospital inpatients with malnutrition or to refer them for further assessments and treatment has been reported in 60–85% of patients in UK hospitals,[31–33] where recommendations to evaluate nutritional risk is patchy,[34] in 64% in a Norwegian hospital,[35] and 73% in a Singaporean hospital.[36] There is also a frequent failure to identify malnutrition in hospital outpatients (e.g. failure to identify it in 57% of older subjects and 88% of younger subjects with malnutrition, according to a study in the USA[37]), nursing homes,[38] and in the community in both adults and children (e.g. 15–50% of children with failure to thrive may not be identified[39,40]). The Clinical Resource and Audit Group, on behalf of the Scottish Executive, reported that 50% of elderly residents in long-term care settings were not recognised as being underweight.[14] In various settings many cases of malnutrition are deemed to be treatable. For example, in the outpatient study of Wilson et al.,[37] in which malnutrition was largely unrecognised, it was deemed treatable in nearly 90% of all subjects. Other studies involving hospitalised patients also suggest that malnutrition associated with unintentional weight loss is mostly treatable.[41,42] However, if a case is to be made for nutritional screening, it is necessary to demonstrate that when malnutrition has been identified, treatment can alter outcome compared to routine care. This issue is considered below using RCTs.

Malnutrition is under-treated (randomised controlled trials investigating benefit from nutritional intervention in malnourished patients)

The intervention studies described in this section specifically assess the effects of treatment in patients identified as being malnourished by a screening procedure (typically, these are based on weight status, weight loss, and dietary intake) A wide range of nutritional options are available for treatment: dietary counselling, educational leaflets, oral nutritional supplements (ONS), enteral tube feeding (ETF), and parenteral nutrition (PN), and combinations of these. There are also drug treatments that can be used to treat malnourished patients. For example, a RCT found that the use of the anabolic steroid, nandrolone, in patients with chronic renal failure on haemodialysis increased lean body mass and mobility, and reduced fatigue.[43] In this review (largely based on information gathered by Stratton et al.[2]) only the use of ONS and ETF will be considered, starting with the treatment of patients suffering from a specific condition, progressing to groups of related conditions (e.g. patients on general surgical wards undergoing abdominal surgery), and continuing to a wider range of conditions found on specific wards and different types of wards found in entire hospitals. Progression along this spectrum is associated with increasing variability in the type of patients and in clinical outcomes. Studies in which there is wide variability in outcome measures generally require larger sample sizes to demonstrate significant differences between groups. Therefore, larger sample sizes are likely to be required in studies involving patients with a wide range of diagnoses found in an entire hospital or groups of hospitals compared to a study involving a group of patients with a single diagnosis on a specific ward. Table 2 contains only RCTs involving more than 30 subjects, who are considered to be at risk of malnutrition. It is recognised that this excludes some positive and negative trials involving less than 30 subjects. A more comprehensive summary of RCTs and non-RCTs is provided by Stratton et al.,[2] but this does not include more recent papers (although Refs. 44,45 are indicated in Table 2).

Specific conditions

Table 2 shows the anthropometric, physiological and clinical benefits associated with ETF of malnourished patients with fracture neck of femur[46] and cirrhosis.[47] Patients who have suffered

Table 2 Some examples of randomised controlled trials (RCT) involving at least 30 patients identified to be at risk of malnutrition[†].

Condition (type of ward)	*N*	Intervention	Effect of intervention
Selected conditions			
Fracture of femur (Orthopaedic)[46]	122	ETF in hospital vs. routine diet	Rehabilitation time ↓*; LOS ↓*; tendency for ↓mortality*
Cirrhosis (Medical Gastroenterology)[47]	35	ETF (BCAA) vs. low salt diet	↓mortality*; ↑ hepatic reserve*
Selected conditions in specific wards			
Abdominal (+some vascular) surgery (Surgical)[48]	101	ONS vs. hospital diet	↓ chest & wound infection*; ↓ antibiotic requirement*; better grip strength and anthropometry*
Head and neck cancer (Specialist)[49,50]	32/34	ETF pre & post-op vs. pre-op only	↑ Physical function*; ↑ emotional function*; ↓ dyspnoea*; survival and LOS, NS
Advanced GI cancer (Ward providing chemotherapy)[51]	62	ETF* vs. routine care	↓ Mortality ?NS; ↑ lymphocyte count*; ↑ phytohaemaglutinin skin response*
Wide range of conditions in specific wards			
Elderly patients in hospital ward[53]	72	ONS vs. routine care	↑ activity of daily living, NS; ↑ in fat and lean body mass*
General Medical Wards[52]	86	ETF or ONS vs. routine diet	↑ weight and muscle anthropometry*
Hospital			
Wide range of conditions (medical and surgical departments) in 3 hospitals[45]	212	Counselling, care plan and advice about ETF* and PN* vs. routine care	↓ LOS only in those with complications* (overall LOS index, complications, mortality and quality of life; NS)
Community (only ONS in elderly)			
Elderly various conditions (free living)[54]	48	ONS vs. routine care	↑ weight*
Elderly various conditions (free living)[55]	46	ONS vs. routine care	↑ independence (activities of daily living)*
Elderly various conditions (free living)[44]	100	ONS (various types) vs. routine care	↓ hospital costs*; GP consultation and prescription costs NS.
Elderly various conditions (nursing homes)[91,92]	35	ONS (various types) vs. routine care	↑ intake and weight*

[†](i) Abbreviations and symbols: *N* = total number of subjects in study; ETF = Enteral tube feeding; PN = Parenteral nutrition; ONS = Oral nutritional supplement; BCAA = feed enriched with branched chain amino acids; NS = statistically not significant; *Significant result in favour of intervention. (ii) The tests for malnutrition have varied from MNA[93,94] (for Ref.[91,92]), ESPEN approved tool for hospitals[5] (for Ref.[45]) and a variety of other tools for the remaining studies. One of the criteria used in the study of Cabre et al.[47] incorporates plasma albumin, which is mainly influenced by non-nutritional factors.

major accidents/burns may not be malnourished on admission to hospital but they are at the risk of developing malnutrition during their hospital stay, especially if they are unconscious, confused, suffer from severe anorexia, or are unable to eat. Here too, there is evidence from RCTs that nutritional interventions in critically ill and burned patients can produce clinical benefits.[2]

Selected conditions within specific wards

A study of abdominal surgery can be used to illustrate the benefits of recognising malnutrition[48] (Table 2). The intervention group that received ONS suffered less chest and wound infections with lower antibiotic requirements than the control group (relative risk 0.43; $P<0.05$) and significant improvements in physical and mental health compared to the control group ($P<0.001$). The same group of workers reported that most patients with malnutrition in their hospital were unrecognised, including patients in surgical, medical, orthopaedic, and geriatric wards.[31] Table 2 also shows the benefits associated with specific nutritional treatments of malnourished patients with head and neck cancer[49,50] and advanced gastrointestinal cancer.[51]

Specific wards

Intervention studies in general medical wards involving malnourished patients with a wide range of diagnoses are few, possibly because of the need for such studies to include large numbers of patients, in order to assess clinically relevant but variable outcomes, such as mortality, complications, LOS, and quality of life. A study on a general medical ward showed that ONS or ETF increased total energy and protein intake, body weight and upper arm muscle circumference, which were significant[52]; and another study of an elderly care ward, also showed significant increases in body weight and lean body mass, and a tendency for the activities of daily living to increase, which was not significant.[53]

Hospitals

In the study of Johansen et al.,[45] three Danish hospitals were used to identify malnourished patients using a screening procedure supported by ESPEN. The patients were randomised to receive either routine nutritional care or targeted nutritional care. The targeted care involved a specialised nutrition team (nurse and dietitian) that visited patients and staff to motivate, provide a detailed nutritional plan, assure delivery of prescribed food, and advise on enteral or PN. Even after exclusion of some patients according to preset criteria, there was a very wide range of medical and surgical diagnoses in the 212 malnourished patients who participated in the study. No overall difference was found between intervention and control groups with respect to LOS and quality of life, mortality or complications (although LOS in those with complications was significantly reduced in the intervention group). However, the variability in several of the outcomes was large, which means that large sample sizes would be required to demonstrate any real effects that may exist. There is also uncertainty about the magnitude of the gap between standards of desired care and routine care practiced in this study.

Community

A number of RCTs have been undertaken in malnourished patients in the community.[2] Table 2 summarises three RCTs involving the use of ONS in older individuals with different diseases. The first two[54,55] suggest some clinical benefits as a result of the intervention, and the third[44] a possible economic benefit. Other RCTs have assessed interventions in specific conditions. For example, a recent RCT of 50 malnourished patients (mean age 69 years) with chronic obstructive pulmonary disease reported that dietary advice and food fortification resulted in improvements in weight, dyspnoea and physical activity scores compared to the control group receiving routine care.[56]

In summary, it appears that a number of RCTs specifically involving malnourished patients have shown benefit from nutritional interventions compared to routine care. If malnourished patients are to be targeted with such interventions, it is obviously necessary to first identify the affected individuals. Failure to do so would deny them the benefits of the interventions. In addition, absence of evidence in some areas does not mean evidence of absence. In planning individual studies that include patients with a wide range of different diagnoses, it is necessary to consider using a larger number of patients than in many of the previously published studies.[2] In the meantime, it is necessary to establish a policy on nutritional screening using all the available information, including case control studies, and physiological and clinically relevant responses to depletion and repletion in individuals with and without disease.

Impact of nutritional screening in clinical practice

In contrast to the above studies, which aimed to asseses the effect of specific nutritional options after malnourished patients have been identified,

the effect of nutritional screening on the outcome of all patients (well nourished and malnourished), requires a different set of considerations and different experimental approaches. This is not only because screening has resource implications (especially in settings where malnutrition is uncommon and benefits are few), but also because of possible physical and psychological detriments associated with erroneous identification of malnutrition (false positive test) and any unnecessary treatment associated with such identification. These principles apply to all screening procedures to a lesser or greater extent. In the case of nutritional screening, concern has been raised about possible anxiety that may result from incorrectly identifying malnutrition, especially in children, who are constitutionally small, and prescription of any unnecessary nutritional support. The resource implications may be substantial especially in settings where malnutrition is uncommon. Such issues have received little attention, partly because of the need to undertake large scale studies in both malnourished and well-nourished individuals. Such studies involve more variable groups of subjects and more variable outcomes, than studies of either well nourished or malnourished individuals. For example, the overall LOS in a gastroenterology ward[57] was reported to be 12 ± 8 days and in 3 geriatric wards[29] $\sim 32 \pm 23$ days. To detect a difference between intervention and control groups of 2 days with 80% power and significance of $P < 0.05$, the number of subjects required is 194 patients per group in the gastroenterology ward and 2077 patients per group in the geriatric wards. In such studies the variability in outcomes increases, not only because both malnourished and well-nourished patients are being studied simultaneously, but also because patients with a range of ages, diagnoses, and disease severity are involved. However, this variability differs according to whether specific conditions, wards or hospitals are to be targeted. The outcomes may also depend on whether the intervention involves nutritional screening alone or in conjunction with other types of screening or evaluation procedures (e.g. comprehensive evaluation of health in geriatric care).

Evaluating nutritional screening interventions

To address the impact of interventions with nutritional screening, this systematic review was planned and conducted using published guidelines.[58] The following databases were searched until November 2004, using 'screening', 'assessment', with 'nutritional' and 'malnutrition' as key words: PubMed, CAB abstracts, CINAHL, EMBASE, Cochrane Library, and HMIC. In addition, cross referencing of bibliographies and consultation with experts in the field were undertaken. A total of 19,227 reports were identified. Studies with all types of designs in all settings involving adults of all ages were selected for review. One investigator (LZ) identified potentially relevant studies and two other investigators independently confirmed study eligibility (ME, RS). Only nine studies with clinically relevant outcome measures were included in the review.[26,28,29,59–64] These are discussed below and summarised in Table 3, according to whether the intervention involved individual conditions, or a mixed group of conditions in wards, hospitals and the community. Several publications were also identified, where documentation of malnutrition as a co-morbidity affected reimbursement.[36,57,65–68] This issue is also discussed below in relation to the overall economic impact of nutritional screening. A brief synthesis of the information is undertaken below in conjunction with Table 3. Since grading of the quality of trials typically depends on whether the trials are RCTs and the associated randomisation procedure, the overall quality of this group of studies, only two of which were RCTs, is poor.

Although the clinically relevant outcome data are few, they suggest that nutritional screening, linked to a care plan, has benefits in specific conditions and in specific wards/hospital. Only one study involved treatment of a specific condition (stroke) (see Table 3 for reported outcome effects, which were largely beneficial). The others involved a wide range of different conditions that were investigated using a variety of study designs. Of the nine studies with clinically relevant information, seven incorporated a before-and-after design either with or without a comparator group. One study was a RCT in the community, and the other was a prospective controlled non-RCT.[29] This last study design which involved geographical separation of the intervention and control groups, may limit the potential spread of the intervention by staff involved in the care of both groups of patients on the same ward. In this study in The Netherlands both centres had similar numbers of clinical staff and nurses with similar training, both admitted 90% of their patients from within a 15–20 km distance, and both recruited patients that were similarly matched for age, sex, admission weight, activities of daily living, and nutritional characteristics, according to the short form of the Mini Nutritional Assessment (MNA). Table 3 summarises some of the important clinical endpoints including a reduction

Table 3 Nutrition screening interventions with clinical outcome measures

Condition (ward/setting; country) and Study design	Screening test/programme	N	Outcome
Specific conditions			
Stroke (12 wards with stroke patients; UK))[59] Controlled before-and-after design	Nutritional guidelines for screening (Nutritional Risk Score) assessment and support, according to local policy	200+200	↓ chest infections*; ↓ urinary tract infections and pressure sores in those with catheters*; ↓ time oral or artificial nutrition (9 vs. 3.6 days)*. ↑ use of safe procedures for nasogastric tube insertion*; ↑ referrals to dietitian (NS) and physiotherapists/occupational therapists*; NS change in use of tube feeding; LOS; discharge destination, or mortality
Specific wards (multiple conditions)			
Various (Geriatric; Netherlands)[29] Controlled intervention	Mini-nutritional assessment (+dysphagia and dehydration) with follow up care vs. routine care	298	↓ nosocomial infections*; ↑ weight*; ↓ pressure sores (NS); ↓ LOS (NS); ↓ costs (NS)
Various (Surgical/Internal; Netherlands)[60] Before-and-after design	Short nutrition assessment questionnaire (followed by dietetic advice+snack; pre-intervention = routine care)	292+297	↓ LOS (14 vs. 11.3 days)*
Various (General Medical; USA)[61] Before-and-after design	Local nutrition screening form	68	↑ detection of malnutrition (12. vs. 100%)*; ↑ consultation*; prescription of supplements, NS.
Various (Medical; UK)[28] Before-and-after design+comparator ward	Nurses nutrition screening tool	175	↑ nutrition-related documentation*; No increase in referrals to dietitians or changes in LOS
Various (Medical/Surgical/Orthopaedic; UK) Before-and-after design[62]	Local screening test+management pathway	180+180	↑ nutrition awareness among nurses; ↑ documentation; more effective use of dietetic services ↑ artificial feeding, supplements and high protein meals (no statistics)
Hospitals			
Various (Community hospital; USA)[63] Before-and-after design (1994–1998)	Local screening tool and management pathway	635 for LOS	1994–1996: ↑ detection of malnutrition 26 vs. 86%). 1996–1998: ↓ LOS (10.8 vs. 8.1 days); ↓ major complications (73.5 vs. 17.5%); ↓ 30 day readmission (16.5 vs. 7.1%) (no statistics)
Community			
Various (26 office practices; USA)[26] Randomised controlled trial	Screening for multiple health problems, including malnutrition (<45 kg or >4.5 kg unintentional weight loss in previous 6 mo.)	261	Detection rates of malnutrition using stated criteria were unaffected by the screening process
Various (Community Medicare; USA)[64] Before-and-after design	Nutrition screening initiative	?	↑ patient satisfaction; less claims and medical emergencies; (no quantitative data presented; no statistics); 538% return on investments

in the frequency of nosocomial infections. The reduction in LOS was not significant (31.1 versus 32.7 days), which is not surprising in view of the large variability in LOS, which had a standard deviation of ~23 days. Cluster randomisation of multiple geriatric departments in different hospitals involving larger numbers of patients would have provided an alternative and probably more desirable study design, but such a study would have required more funds and more centres, which did not seem to be available at the time. Another study in the Netherlands,[60] which involved a before-and-after design in surgical and internal (medical) wards, reported that the intervention was associated with a significant reduction in LOS, from 14.0±13.3 days before intervention to 11.5±8 days after intervention, but this reduction might not be entirely attributable to the intervention since a seasonal variation in LOS cannot be excluded. It is possible that temporal effects that are independent of the intervention could contribute to some of the outcomes in a number of such studies, including the study of Brugler et al.,[63] which reported multiple benefits in a community hospital in the USA after introduction of a screening procedure. In an attempt to overcome such temporal problems a ward based study in the UK employed a before-and-after design in association with a comparator ward in the same hospital.[28] This study with a smaller sample size than the previous study[60] in The Netherlands, showed no significant reduction in LOS. However, like other studies (Table 3), it reported other benefits, including significantly increased nutrition-related documentation, such as weight, which rose from 26% to 79% in the intervention ward and decreased from 30% to 8% in the comparator ward. This could have implications for reimbursement in some countries.

Other studies set out to address specific issues related to the provision of health care rather than patient outcomes. Several have reported that coding for malnutrition in hospitals enhances reimbursement in a variety of countries, such as USA,[66–68] Germany,[57] and Singapore.[36] The extent of reimbursement (if any) depends on the country, the health care system, and whether malnutrition occurs in isolation or part of multiple co-morbidities. However, it is obvious that reimbursement cannot occur unless malnutrition is identified. Nutritional screening offers a simple method for doing so. However, a full economic evaluation including the effect of treating the malnutrition remains to be undertaken. Some studies have reported that a screening programme may increase referrals to the management team[59,61] and increases the use of supplements or tube feeding[62] (Table 3). Although this increases cost, it may be counteracted or more than counteracted by the positive financial gains associated with clinical benefits, such as reduced complications and reduced length of hospital stay. Furthermore, other studies have reported that nutritional screening does not change referral rates to dietitians[28] or use of oral nutritional supplements, or ETF.[59] In a community study involving eight community dietitians, the introduction of a nutritional screening procedure was linked to a reduced prescription of sip feeds.[69]

Finally, a study in California, USA,[26] aimed to assess the effectiveness of a 10 min office-staff administered screen to detect malnutrition, visual impairment, hearing loss, cognitive impairment, urinary incontinence, depression, physical limitations, and reduced mobility among older persons seen in office practice. Twenty six office practices were randomised to either apply or not apply the tool to a total sample of 261 patients aged 70 years and over. Only hearing loss was detected and evaluated with increased frequency. The detection rates of nutritional problems were unaffected (only 4% in control and intervention groups). The criteria for nutritional problems were unintentional loss of weight of 10 ib (4.5 kg) in the previous 6 months, and a weight of less than 100 ib (45 kg). This weight is very low, and for an individual with a height of 1.75 m, this would correspond to a body mass index of less than 15 kg/m^2, which represents severe malnutrition. The use of this stringent criterion may help explain the low incidence of malnutrition reported in the study, and the lack of difference between the intervention and control groups (severe malnutrition is relatively uncommon in primary care, but when present is more likely to be detected routinely than milder forms of malnutrition).

Comprehensive evaluation of health programmes that include nutritional screening

Nutritional screening/assessment has been included as part of comprehensive evaluations of health, especially in geriatrics.[70–73] Several RCTs have shown significant benefits of such evaluations. In an outpatient study[70] the intervention included the Nutrition Screening Initiative to detect malnutrition risk. Over a period of 12–18 months the experimental participants were significantly less likely than controls to lose functional ability, to experience health related restrictions in their daily activities, to have possible depression, and use home health care services. The health care costs were slightly lower in the intervention group but

these did not differ significantly from the control group. In another outpatient study[72] the geriatric evaluation included unexplained weight loss. There was significant improvement in diagnosis of common health problems, and even with limited follow-up care, the authors concluded that the geriatric assessments had potentially important clinical benefits. In contrast, a study involving comprehensive assessment of hospitalised patients aged 65 years and over found no health benefits after 3 and 12 months.[73] To explain this lack of effect the authors considered the possibility that the patients were already receiving a high standard of care (small 'care gap'), that there was inadequate implementation of some of the recommendations, and the type of care, which was consultative rather than continuous. Another RCT that included screening for malnutrition as part of a general evaluation and management programme, reported some benefits.[71] Although there were no significant effects on mortality, there were significant reductions in the functional decline of inpatients, and improvements in the management of outpatients with mental health problems, with no increase in costs. A large number of other controlled and randomised studies have been undertaken,[70,72–80] but it is not clear to what extent nutritional screening was included in physical, and psycho-social evaluation. Overall, it seems that the results of the more recent studies were less dramatic than some of the earlier studies,[74,75] especially with respect to the sustained effects on mortality. Improvements in geriatric care over time (reduction in the 'care gap'—Fig. 1) may have made additional improvements from interventions more difficult to demonstrate.

It is difficult or impossible to assess the independent effects of the various components of the screening/evaluation procedure on outcome from many of these reports. However, it seems that an overall package of comprehensive evaluation that includes nutritional screening/assessment can have beneficial effects, especially if the baseline care is inadequate. It is also noteworthy that several studies have involved substantial numbers of patients (generally a few hundred to over 2000 patients[73]) to take into account the heterogeneity of patients and clinical outcomes.

Other issues related to screening for malnutrition

Resource implications

Screening procedures may be associated with resource implications, such as education and training, staff time to screen, establishment and maintenance of equipment necessary for screening (e.g. weighing scales), and management of patients testing positive with the screening test. Studies on the resource implications of nutritional screening are few, often focussing on specific components of the programme; and the results have been variable. Some studies have reported that introduction of nutritional screening has led to increased referrals for evaluation and treatment,[61,81] but this has not always been the case.[28] There have been reports of an increase in prescription of ONS or artificial feeding following introduction of nutritional screening,[62] but others indicate no change,[59,82] or even a reduction in prescriptions for ONS.[69] Some studies have reported that introduction of a nutrition screening procedure reduced the time needed for individual evaluation from 25 to 5 min and results in 1.5 h time saving per day per clinical dietitian.[83] Interpretation of these results in isolation is difficult because of uncertainties about the organisational infrastructure of nutrition services and the 'care gap' (Fig. 1). In situations where treatable malnutrition was previously missed, an increase in the direct costs of providing nutritional support (e.g. cost of feeds and ancillary equipment) is expected. Such a cost can be easily justified if it is small and associated with important economic or clinical benefits.[84] It is more difficult to justify a cost if it is large and associated with few or no overall clinical or financial benefits. It is obviously necessary to consider the clinical and economic consequences of the entire screening programme rather than of the screening test alone. For example, major reductions in LOS costs may far outweigh the cost of nutritional screening. Nutritional screening could also potentially reduce inappropriate referrals and help establish a more efficient referral system. Furthermore, not all patients requiring nutritional treatment need necessarily be referred to specialists, such as dietitians for further evaluation and/or treatment. Policies need to take into account local resources, but at the same time ensure that adequate standards of care are maintained.

Other benefits of nutritional screening

One of the most common signs and/or symptoms of severe disease is unplanned weight loss. Since changes in weight are commonly included in nutrition screening tools, the results can help clinicians decide whether to investigate and how to monitor patients. Weight, with or without height measurements, is also needed to decide doses of

certain drugs, e.g. some cytotoxic drugs, antibiotics, muscle relaxants and possibly some anti-epileptic drugs. Short-term changes in weight can also be used as an accurate measure of fluid balance. Much of the emphasis in this paper has been on detecting malnutrition. However, measurement of weight status and changes in weight is also of value to the management of patients who are overweight and obese. It is an advantage to use the same tool for the detection and management of both malnutrition and over-nutrition.[3]

Alternatives to nutritional screening

The alternatives to routine universal screening for malnutrition are not to screen at all or to screen only selected populations. In a health care setting where it is recognised that most or all of the population is likely to be malnourished or at high risk of developing malnutrition, screening is likely to be of limited value (Fig. 2). Some studies have shown benefits of supplementing all patients in a health care setting, where malnutrition is very common or likely to develop in a large proportion of patients. For example, Larsson et al.[85] randomised 501 geriatric patients (initially well nourished and malnourished) with a range of diagnoses to either receive an ONS (400 kcal and 16 g protein per day) or no ONS. Similarly, Delmi et al.[86] randomised patients with fractured femur ($n = 59$) to receive an ONS (254 kcal and 20.4 g protein per day) or no ONS. Another study involving oncology outpatients receiving radiotherapy to the gastrointestinal tract or head and neck area[87] randomised patients to receive dietetic counselling or routine care. All these studies reported some benefits in favour of the intervention. On the other hand, other studies in which nutritional intervention has been provided to a wider range of patients, with a smaller likelihood of malnutrition, have not demonstrated clinical benefits. For example, one of the largest supplementation studies involving various types of patients in medical, surgical and orthopaedic wards, after excluding those with a body mass index $<18\,kg/m^2$ or $>10\%$ weight loss, showed no significant changes in LOS.[88] In such studies better clinical results may have been achieved at lower cost by undertaking nutritional screening so that only those already malnourished or at risk of becoming malnourished during the course of their illness could be targeted in a more specific or individualised way. The approach may vary depending on the resources, local policies, and prevalence of malnutrition.

The value of nutritional screening in populations or settings, where the prevalence of malnutrition is very small, has been questioned. If substantial resources are used to identify a very small proportion of patients with a true positive test, whilst identifying a much larger proportion of patients with a false positive test (low overall positive predictive validity), the value of the screening programme needs to be re-considered in relation to its priority in health care. The same resources could be used for detecting and treating other health problems. Sometimes relatively inexpensive interventions are applied to an entire population, without specifically targeting those at risk of developing a condition, which may be rare. An example is fortification of food with folic acid to prevent or reduce births of babies with neural tube defects in the general population (e.g. in the USA and some other countries).

Concluding remarks and clinical guidelines

There is substantial evidence that treatable malnutrition is under-recognised and under-treated. This is unacceptable to professional organisations, governments (Table 1), and international agencies such as the Council of Europe[8,9] and the World Health Organisation.[89] There is widespread demand for nutritional screening in high-risk populations and environments (Table 1), such as hospitals, especially where the gap between routine care and desired care is large or variable (Fig. 1). Such a policy is reasonable, especially since societal values to abolish or minimise suffering from severe malnutrition appear to be strong. Indeed, screening has been elevated to an essential standard of care for all patients admitted to hospitals in some countries,[6] specific regions within countries, and specific Hospital Trusts. In some countries it is also a criterion for assessing the performance of hospitals. It is difficult to make universal recommendations about nutritional screening, and care plans linked to the screening process, since the prevalence and types of nutritional problems vary according to country, health care setting, local resources, and adequacy of the infrastructure necessary for the nutritional management of the patient. Nevertheless, some guidelines about nutritional screening are provided below as the basis for discussion in different health care settings in different countries. It is understood that screening refers to a simple, rapid and general test that is undertaken by nursing, medical and other staff,

often at first contact with patients, in order to identify those at the risk of malnutrition. This differs from the detailed and specific nutritional evaluation that is undertaken by specialists in nutrition (e.g. dietitian, or specialist nutrition nurse or doctor with an interest in nutrition), often for complex problems, and often following nutritional screening.

Screening in all health care settings

- Nutritional screening would be most effective if deployed in a health care system that prioritised nutrition strategies, training and implementation. A screening test should be linked to a care plan and an adequate infrastructure for implementing such a plan.
- All health care settings should have a policy for nutritional screening. Results of screening, especially when action is required, should be communicated from one care setting to another.
- Nutritional screening should be undertaken using a valid, reliable and practical tool that is quick and easy to use, and acceptable to both the patient and health care worker.
- The screening tool should consider current weight status (e.g. underweight or obesity), as well as past and likely future change in weight, both of which are linked to food intake/appetite and disease severity.
- Other things being equal, it is recommended that the same tool (i) can be used in different care settings, so as to encourage continuity of care from one setting to another (the use of multiple tools in different tools in different care settings, or different phases of an illness can cause confusion and be counterproductive) (ii) can be used for detecting both under- and over-nutrition (iii) is capable of establishing nutritional risk in all types of patients, including those with fluid disturbances, and those in whom weight and height cannot be easily measured (iv) the care plan can be modified according to local resources and policy (e.g. availability of a nutrition support team in a hospital).
- The screening tool should be regarded as an aid rather than a replacement to clinical judgement.

Screening in specific health care settings

Hospitals

Inpatients

- It is recommended that all patients admitted to hospital should be screened, unless there is a rational and transparent local policy to exclude certain groups of patients, who are unlikely to benefit from such screening. There should also be a policy about repeating the screening process, e.g. typically at weekly intervals or earlier if there is clinical concern (it may be longer in long-stay hospitals).

Outpatients

- Hospital outpatients should be screened, unless there is a rational and transparent local policy for excluding certain types of clinics or types of patients, who are unlikely to benefit from screening in the local setting. Repeat screening can vary from a week to several months or even longer depending on the patient.

Care homes

- It is recommended that all patients admitted to care homes should be nutritionally screened. Repeat screening is recommended, e.g. at monthly intervals, but may be shorter when there is clinical concern or longer (e.g. every three months) when there is little or no clinical concern. (This may vary according to type of care home.)

Primary care (General Practice (GP))

- All new patients registering with a GP should have nutritional screening, and the baseline result recorded for future reference. In countries where national policies exist for annual health check ups for elderly patients, e.g. those over 75 years, the check up should include nutritional screening. Nutritional screening should also be undertaken in groups that are at risk of malnutrition (e.g. with severe disease/disabilities likely to cause poor nutrition, socially isolated) and when there is clinical concern. Repeat opportunistic screening can vary from a week to a year or longer, depending on the patient (some patients are not seen by their GP for years so the opportunity does not arise).

Finally, it is recognised that direct RCT evidence of benefits from nutritional interventions and nutritional screening in specific groups of patients and in specific settings is incomplete. (This is analogous to the lack of RCT evidence that routine screening of patients by testing pulse, blood pressure, and temperature alters the outcome of the whole population of patients who are electively admitted to hospital.) This does not mean that real benefits do not exist and that nutritional screening is an unimportant procedure to undertake in groups

of patients, where such evidence is lacking. Whilst gaps in knowledge need to be pursued in a structured way, policies need to be established based on general nutritional and clinical principles, evidence from a variety of other more indirect sources, societal values, and other factors indicated in Fig. 2.

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