How Can We Improve Functional Outcomes?

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Which Outcomes?

Health has multiple dimensions. In a broad sense, health can be considered in terms of physical, mental and social well-being, but this may be difficult to measure, particularly in whole populations. The earliest population indices of health were based on readily available and unambiguous indicators, such as mortality; and these were applied to particular age groups, such as the first year of life (infant mortality). The legal requirement in many societies to record mortality meant that generally complete data could be obtained. However, although such information has been of considerable value, this may change over time as societies evolve. Health indicators are often specifically chosen to reflect current problems within societies, especially those requiring improvement. Mortality statistics may reveal new layers of concerns, which may lead to the development of new indicators of health outcome to reflect these new concerns. For example, in low income countries, where infant mortality is high (or mortality from specific treatable diseases are high) appropriate policies may produce improvements in outcome relatively easily. In developed countries, where this mortality has already been reduced to very low levels, the cost of reducing it to an even lower level may be disproportionately high and unacceptable to policy makers. Therefore, new policies are established so that resources can be redirected to address other more important health problems in the general population. For example, as survival from a particular condition or groups of conditions improves, a range of persisting disabilities may develop, e.g. increasing life expectancy in countries with well-developed economies is associated with greater disability and dependency in older life, and a poorer quality of life. As a consequence, indicators of these health outcomes have become increasingly more prominent in
developed countries. Furthermore, new indicators may not only be used as markers of health, but they may also become incorporated into clinical and public health policies, and even concepts and definitions of health.

Societies in different parts of the world are in various stages of economic and industrial development, which means that health outcomes that are a high priority in one society may be much less important in another society. Global, national, regional, local, and individual perspectives of health outcomes may vary considerably, with consequent variation in the choice of health outcomes. A global perspective on nutritional problems [1] reveals that iron deficiency anemia (~2,000 million people worldwide) and iodine deficiency (~740 million) affects more individuals than protein-energy malnutrition (~150 million), but the latter has a greater impact on mortality. The trends also differ, with iodine deficiency decreasing, obesity rapidly increasing, and protein-energy malnutrition showing relatively little overall change in absolute prevalence. Therefore, health outcome measures used by the WHO to assess global health may be different from those used in particular countries where, for example, iodine deficiency is a trivial public health problem. Another example concerns malnutrition and mortality due to AIDS, which is continuing to increase in many parts of the developing world, and decreasing in developed parts of the world [2]. Health inequalities [3], including those involving malnutrition, also occur within developed countries. For example, a secondary analysis of the National Diet and Nutrition Survey (UK) on individuals aged 65 years and over [4] revealed that the risk of malnutrition (medium and high risk, using criteria similar to those used in the ‘Malnutrition Universal Screening Tool’ [5]) was greater in the north of England (19.4%) than central (12.3%) and south England (11.3%). There is a north–south divide with respect to other health inequalities which the government is keen to eliminate [6]. The commitment to reduce health inequalities (nutritional and non-nutritional) within and between countries varies according to geography.

Individual health professionals may also have different perspectives about outcome measures. A clinical perspective involving treatment of individual patients with established disease may be very different from a public health perspective which involves prevention of disease in the entire population. Economic issues are relevant to both clinical and public health outcome measures. However, improved survival as a result of medical advances may leave large numbers of people debilitated and dependent on the community for financial and social support. Furthermore, in clinical practice improvement in economic outcome in one health care setting does not necessarily mean improved outcomes in another setting. For example, in some health care systems emphasis is placed on the length of hospital stay because of its high cost. A reduction in the length of hospital stay may be interpreted as a success for the hospital setting, but this could be detrimental to the community if hospitalized patients are discharged prematurely and ill advisedly,
so that a heavier burden of care and cost fall on the community and to society as a whole. At the same time, policies in the community may influence the type of patients admitted to hospital. Unified health and economic policies across all care settings may yield different results from those involving individual health care settings. Here I will consider both public health strategies during the lifecourse, which may have cumulative beneficial effects in old age, and to clinical strategies which deal with acute and chronic conditions once they have arisen. A nutritional focus will be maintained throughout.

**Interventions during the Lifecourse**

The increase in mass and change in structure of tissues during growth are associated with improved functional capacity, such as the strength of muscular contraction, the strength of bones, ability to work, and development of reproductive competence. Such functional capabilities typically peak during early adult life and then gradually decline [7, 8] (fig. 1). If function falls below the threshold of disability, quality of life decreases and the person may become dependent on carers, either in their own home or long care facilities such as residential care homes. The fall below the threshold of disability may be permanent, and develop either acutely, for example following a stroke, or more slowly during the course of a chronic debilitating illness such as arthritis, motor neuron disease or Parkinson's disease. The fall below this threshold may also occur transiently during the course of a treatable acute or subacute

![Fig. 1. A lifecourse perspective of functional outcomes (see text for details).](image-url)
illness. The period of time spent below the threshold of disability is greater for an individual already close to the threshold of disability than for a healthier fitter person with better initial functional capacity. No time may be spent below the threshold of disability for a fit young adult with a high initial functional capability (fig. 1). Therefore, one way of improving outcome is to implement policies that ensure that functional capability is maintained at a high level, well above the disability threshold. This can be achieved by: (1) establishing a high peak functional capacity in young adult life; (2) reducing the rate of loss of functional capacity after the peak level has been reached, and (3) lowering the threshold of disability through modification of the environment.

There is biological variability in functional capability, which is partly genetic and partly environmental, with a contribution of nutritional factors to the environmental component. These nutritional factors influence the first two strategies. The example given below, involving bone mineralization, illustrates how all these three components might be modified during the lifecourse to prevent osteoporotic fractures and disability in later life. However, the impact of osteoporotic fractures on clinical outcome also depends on equitable access to quality health care. Therefore, following the lifecourse example, which is described below, consideration is given about how nutritional interventions in patients with fractures can affect clinical outcome during a journey of clinical care. This journey frequently spans more than one health care setting, and therefore an integrated strategy that takes all these settings into consideration would have obvious advantages.

**A Lifecourse Example**

Although the strength of bone and the likelihood of fracture depends on its microarchitecture, it is also strongly influenced by the extent of mineralization. Individuals with a low bone mineral (osteoporosis) are more likely to develop fractures either spontaneously or following accidents. Reducing the frequency and severity of trauma in the elderly is one way of avoiding fracture development. Another strategy is to slow down the rate of bone mineral loss in adult life. Yet another strategy, which has received less attention, is to increase the peak bone mass, so that loss of mineral in later life would take longer to produce osteoporosis and to predispose to fractures.

**Fetus.** One of the earliest environmental factors that may influence bone mineralization in adults is the intrauterine environment [9–11]. The growth and mineral content of bones are related to birth weight, which is influenced by the nutritional status of the pregnant mother as well as the function of the placenta which delivers nutrients to the fetus. Low birth weight infants become shorter adults. In the case of monozygotic twins [12, 13], in which the same relationship applies, it is reasonable to suggest that the effect is due to environmental and not genetic factors. Of further interest is the relationship between birth weight and adult bone mineral content, which remains
statistically significant after adjustment for adult height and a variety of other variables, such as age, sex, cigarette smoking, intake of alcohol and calcium and physical inactivity [9]. These observations may be mediated through growth hormone/insulin like growth factor and the hypothalamic-pituitary-adrenal axes [10]. Twin studies have also shown an association between birth weight and intestinal calcium absorption in adults (using strontium as a marker), which is partly explained by a lower circulating 1,25-hydroxy-vitamin D concentration [14]. It has been suggested that the intrauterine environment programs the postnatal accretion of bone mineral, potentially influencing the peak bone mineral mass during early adult life. It has also been suggested that optimization of maternal nutrition during intrauterine growth is a potential strategy for preventing osteoporotic fractures in the future generation. However, direct evidence that interventions before or during pregnancy can alter peak bone mass and reduce the risk of fractures in the human offspring is lacking. This is an area that is currently being investigated.

**Childhood and Adolescence.** The rate and extent of bone mineral accretion during childhood and adolescence, as well as loss during most of adult life depends on many factors including physical activity and intake of calcium and vitamin D.

**Adults.** A series of comprehensive reviews and meta-analyses have been carried out to establish the role of nutrients and drugs in reducing the rate of bone demineralization and risk of fractures. Administration of calcium and vitamin D in combination to individuals with postmenopausal osteoporosis for a period of 1.5 years decreased femoral neck bone mineral density relative to a placebo [15]. The effect is less than that produced by other treatments, such as drug therapy for 3 years (e.g. risendronate or etidronate), but hormone replacement therapy was greater. Calcium and vitamin D in combination were also found to reduce the risk of hip fractures. Since bone mineral density is an important determinant of bone strength, accounting for more than 60% of the variance in breaking strength according to some reports [16, 17], changes in bone mineral density is frequently used as an outcome variable of intervention studies. However, fluoride supplementation appears to produce a major increase in bone mineral density without an effect on the incidence of hip fracture [15], possibly because of effects on the microarchitecture of bone. Other reviews have concluded that large supplements of calcium are efficacious in populations with a low intake of calcium, and vitamin D with calcium is efficacious in deficient populations [18]. Yet another meta-analysis on the use of vitamin D, with or without calcium, for a period of at least 1 year (9 studies, 1,130 postmenopausal women) concluded that there was a reduction in the risk of vertebral fractures and possibly in non-vertebral fractures [19]. Another meta-analysis in postmenopausal women concluded that calcium supplementation alone has a small positive effect on bone mineral density, and a trend (which was not significant) in reducing vertebral fractures [20]. There have also been summaries of several
meta-analyses or systematic reviews. One such article [20], which summarized 7 systematic reviews, reported that calcium and vitamin D have positive effects on bone mineral density of the hip, forearm and total body, and that vitamin D significantly reduced the incidence of vertebral fractures.

In summary, a variety of nutritional and non-nutritional interventions could potentially be used (some are already being used) to prevent osteoporotic fractures. These mainly aim to increase peak bone mineral mass and decrease the demineralization after the peak mass has been achieved (although some also aim to increase bone turnover). However, controversy still exists about the role of routine screening for osteopenia, the long-term administration of drugs that affect bone mineral density, and the optimal time of initiating prescription. Few women have major fractures before the age of 65, probably because they do not tend to fall. Therefore programs that aim to reduce the frequency of falls later in life are important (see below). In the meantime a lifecourse perspective which involves optimizing pregnancy outcomes, implementing a healthy diet, exposure to sunlight, and increasing physical activity in those who are inactive should be strongly encouraged.

**Decreasing the Disability Threshold**

An alternative strategy to improve outcome is to reduce the disability threshold through environmental modification. For example, introduction of special cutlery, plates, and cups to patients with arthritis, fractures/deformities, or certain neuromuscular problems, who would otherwise depend on others to feed them, may allow them to become independent and increase their self-esteem. Providing supportive rails may allow patients who are unstable on their feet to get around the house and prevent falls before, during or after showering or bathing. Removal of slippery, uneven surfaces and providing adequate light in certain areas (either inside or outside the house) can also help lower the disability threshold. Such modifications may also help to reduce falls and the risk of fractures in vulnerable individuals (table 1) [21].

**Intervention by Health Care Services and Their Effects on the Patient Journey**

**Community Interventions to Prevent Falls and Bone Fractures**

Here I deal with the theme of bone fractures in the elderly by considering interventions that may reduce the frequency of falls and fractures and damage produced by such events. Falls in the elderly are an important cause of morbidity, such as fractures (they may also lead to a variety of other injuries and to hypothermia). Fractures of the proximal femur (hip fractures) in the elderly also cause a high mortality, ranging from 12 to 37% in the first year and 11% during the first few months after fracture [22]. Interventions for reducing falls in the community can be divided into those that involve the
health of individuals/populations, the environment, or a combination of both. Table 1 provides examples of the types of interventions that have been assessed, and identifies those in which a significant benefit has been reported, often through meta-analyses. Muscle strength and balance-retraining programs, home hazard modification and drug therapy modification, such as withdrawal of psychotropic drugs, are the main interventions that have shown benefit. Malnutrition could potentially predispose to falls and worsen their outcome in a number of ways: poor strength and inability to adequately compensate for abnormal movements, such as those induced by ‘accidents’; reduction in the amount of subcutaneous fat, resulting in a smaller cushioning effect, which increases the risk of fracture, such as hip fracture; osteoporosis resulting in weaker bones which are more likely to fracture. Despite these possibilities, two types of nutritional interventions have failed to demonstrate a reduction in the number of falls. The first type involved vitamin D supplementation, with or without calcium [for a meta-analysis of 5 such studies, see 21]. The second type, involving administration of oral energy-dense multinutrient supplementation over a period of 12 weeks, was examined by only one small randomized controlled trial involving 50 frail elderly women (low body mass index or a history of weight loss). However, the number of subjects was small and therefore larger studies are required [23]. Furthermore, since multiple factors predispose to falls and affect their outcome, interactions between these factors, including nutritional factors, could be important. Multifactorial and multidisciplinary intervention studies,

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<th>Environment</th>
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<td>Hazards in the home</td>
<td>Muscle strength/balance retraining</td>
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<td>e.g. Irregular slippery surface</td>
<td>Optimizing drug therapy</td>
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<td>No supportive hand rails</td>
<td>Correction of poor sight/other disabilities</td>
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<td>Poor lighting</td>
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<td>Other features detrimental to the activities of daily living</td>
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<td>Loss of cushioning effect of subcutaneous fat</td>
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*aEvidence of benefit from meta-analyses.
in which health and environmental hazard modification have been combined, have generally yielded positive results [21]. However, such studies with complex designs have not included a nutritional intervention. Another general finding is that studies involving unselected populations (chosen on the basis of age or risk factors) have been found to be less likely to show benefit than those that have been selected on the basis of a previous history of falls [21]. A larger number of subjects would normally be required if unselected populations are to be studied. By analogy, nutritional interventions are more likely to demonstrate benefit in patients who are already malnourished or likely to become malnourished than those who are not malnourished and unlikely to become malnourished.

**Hospital interventions with Nutrition: Effect on Longer Term Outcomes**

Several studies have been undertaken to examine the effect of nutritional supplementation in hospitalized patients with fractured femurs. Four randomized control trials also examined outcome at 6 or 7 months after the patients were discharged from the acute hospital. All these involved multinutrient supplements containing protein energy, trace elements and vitamins. Two of these trials reported a better overall clinical course [24, 25]. Another reported a significantly lower mortality at 6 months [26] and the fourth reported a higher femoral bone mineral density compared to control patients [27]. These studies suggest that nutritional treatment started in an acute hospital could have longer term effects, which are apparent after the transfer of patients to a rehabilitation hospital or the community. In one of the studies [27] in which supplementation was continued for 6 months, it is obviously not possible to ascribe the benefit entirely to the early period of supplementation.

**Targeting Nutritional Interventions in the Community**

The aim of nutritional support is to treat patient groups that are likely to show benefit and not to treat those that are unlikely to show benefit. In the community, response to oral nutritional supplements was found to depend on the initial body mass index (BMI). Randomized controlled trials in which the mean BMI was <20 kg/m² showed the following differences with those in which the BMI was >20 kg/m², involving a variety of patient groups including orthopedic patients [28].

Suppression of food intake was less in those with a BMI of <20 kg/m² so that the net effect was that 83% of the supplemental energy added to the food intake (11 studies) compared to only 45% in those with a BMI of >20 kg/m² (10 studies; Fisher’s exact test, p < 0.024).

Changes in body weight in patients receiving oral nutritional supplements in randomized controlled trials was greater in those with a mean BMI of <20 kg/m² (+4.6%, 12 trials) than those with a BMI of >20 kg/m² (1.74%, 11 trials), although the difference did not quite reach statistical significance.
(p < 0.054, unpaired t test). The difference between supplemented and unsupplemented patients was also greater in those in with a BMI of <20 kg/m² (3.1 vs. 1.3%; p < 0.09). Improvements in body function were more likely to occur in patient groups with a BMI of <20 kg/m² than >20 kg/m². Functional benefits were found in 13 of 16 (81%) of randomized controlled trials when the BMI was <20 kg/m² (81%), and in only 2 of 9 (22%) in those with a mean BMI of >20 kg/m² (Fisher’s exact test, p < 0.009). Similarly, in non-randomized trials functional improvements were likely to occur in those with a BMI of <20 kg/m² (12/16 trials; 75%).

The mean changes in weight were variable with no overall difference between those showing benefit and those who did not. However, in underweight patients with chronic obstructive airways disease and in the elderly, significant functional benefits were only found in trials in which more than 2 kg in weight had been gained (~4% body weight).

**Interventions to Improve Equity and Quality of Healthcare Services**

Health inequalities and inequitable access to health care has been of increasing concern to national and international agencies [29] and governments of both high and low income countries. Although many examples exist, the following concerns data on home artificial nutritional support produced by the British Artificial Nutrition Survey, which is the largest ongoing survey of its kind worldwide.

*Inequity in Home Artificial Nutrition Support*

A survey within the Trent Region (population 5.5. million) revealed that there was an up to threefold variation in the point prevalence of home tube feeding [30]. A larger survey in 1998 involving 38 health authorities (total population 17.3 million or ~0.46 million/health authority) revealed that the point prevalence of home parenteral nutrition varied from zero/million (several health authorities) to about 30/million [31]. Since this was unlikely to occur by chance as a result of random variation (p < 0.001; Poisson distribution), at least two alternative possibilities exist: large geographic variation in the conditions requiring home artificial nutrition, and inequity in access to nutritional support. Although there are some geographic variations in the prevalence of conditions requiring nutritional support, it is hard to envisage that they are responsible for the magnitude of observed variations. It is more likely that attitudes to nutritional support vary across geographic locations within the UK. Indeed there is evidence that regions close to the two national intestinal failure units are more likely to receive home artificial nutritional support than those who are not. Furthermore, in Scotland, where there is an organized national network for home parenteral nutrition, the prevalence of
home parenteral nutrition (~14/million) is generally greater than in England, but similar to the northwest region of England [30], which is served by one of the national intestinal failure units. Selection of patients for home nutritional support is a complex issue and depends on the availability of expertise (e.g. only about 40% of British hospitals have a nutrition support team), ethical issues, and nutritional training and education of health professionals, which needs improvement.

**Quality of Home Nutritional Support**

Annual surveys by the British Artificial Nutrition Survey involving reports from over 200 centers/year suggests that up to a fifth of the centers do not allocate sufficient time to training the patient and caregiver for home enteral tube feeding before discharge from hospital. Furthermore, patient records are not kept in 24–31% of centers. Financial arrangements are also a problem, although these have tended to decrease with time. Surprisingly, patients are not followed up in 13–20% of centers and this could have detrimental effects on outcome. A possible example concerns patients receiving home enteral tube feeding following a cerebrovascular accident [32]. At 1 year, 13% had returned to full oral feeding. One of the concerns is that if patients are instructed to continue on tube feeding as the sole source of nutritional support, without follow-up to check whether swallowing function has improved (a not uncommon situation), patients may be receiving tube feeding unnecessarily. Therefore, simple changes in the home care service could produce improvements in clinical outcome.

**Interventions to Provide Better Nutrition Education and Training to Health Professionals**

Much malnutrition in developed countries is under-recognized and undertreated in hospitals (inpatients and outpatients), nursing homes and in the community [5]. Without recognition it is difficult to provide effective treatment. Among the factors responsible for poor recognition are the following: diffuseness of responsibility; lack of an integrated infrastructure for dealing with nutritional problems within and between different health care settings; lack of consistent criteria to identify and treat malnutrition, and inadequate education and training. Since there is a nutritional component to most diseases, education should benefit from multi-professional input. In the UK, the Nutrition Task Force Project Team on Nutrition Education and Training [33] has provided specific guidelines for areas of nutritional competence that should be acquired by various health professionals, including doctors, nurses, dentists, pharmacists, physiotherapists, and speech and language therapists. Health professionals should appreciate the importance of nutrition in both prevention and treatment of disease. Professional organizations,
the Department of Health and cross-governmental agencies, all have a role to play. Each initiative should be undertaken as part of a coordinated strategy.

References

Discussion

Dr. Powell-Tuck: At the beginning of this workshop we talked about indexes of undernutrition: on the one hand we talked about anthropometric measurements, and on the other hand we talked about measurements of the acute phase response and effect by looking at low albumin for example. Even though we know that low albumin and things like that in hospital may have prognostic significance, wouldn't you agree that when you look over the patient's whole journey, the pre-hospital period, that whole curve you showed rather than the acute illness blips, that it becomes very important that we assess nutrition anthropometrically or by direct nutritionally significant things rather than concentrating on the acute phase response? Wouldn't you also agree therefore that screening tools such as MVST, which under your guidance has recently been introduced into the UK, become something that we all ought to be pressing for very much more than the use of these nutritional indexes which only have prognostic significance in the context of acute illness?

Dr. Elia: I fully agree. One needs to have a simple procedure that can be readily undertaken by a wide range of health professionals. Screening is usually undertaken by nurses or health care assistants, but it could be done by other health care workers. By thinking about nutrition, screening is a first step in the management of nutritional problems. Most screening tools in hospital include an acute disease effect, which can take different forms. I am concerned about the use of some of the biochemical indexes. Albumin has been mentioned, but people dying of anorexia nervosa may have a near normal albumin concentration. People who starve for several weeks (water only) may have a normal albumin concentration. In the seminal Keys semi-starvation study, where individuals lost 25% of their body weight over 6 months, the albumin concentration was within the normal range. But as indicated earlier, hypoalbuminemia can develop rapidly as a result of disease. There are also practical points. Results of blood tests can take time to be processed and communicated, and routine blood tests may be impractical in all patients in all care settings. Therefore there is a need for a simple, reliable, reproducible and valid tool that can be readily used in the different health care settings. I full agree with your comments.

Dr. Morley: I really enjoyed the talk. I think it was a wonderful global view and I particularly like your emphasis on neonatal and postnatal care because I think we

References

have really done a terrible job. When we look at old people we forget that muscle mass and bone mass develop by the age of 15–20 years, and if they haven’t developed until then there are going to be problems when the subject is 80, it is very simple. What I care most about are the screening questionnaires because I think that is the secret. In the United States we introduced the determined screen which was a very unsuccessful screen because it had neither sensitivity nor specificity. It was basically a disease screen and aging screen, and while it increased awareness of nutrition, it finished up having almost everybody thinking that every older person should take a caloric supplement because they were at risk. I think that is a terrible approach. Keller [1] has developed a screen which is slowly being introduced throughout Canada that is the final approach that they are tending to use and it is an excellent outpatient screen. The Council on Nutrition has come up with an appetite questionnaire in the United States which will very nicely predict weight loss 6 months afterwards, just based on people’s appetite at the time that they are screened. The nutritional assessment has been extraordinarily successful as a secondary screen, not as a primary screen. We have to have those different screens and put them in place, but all of this leaves us with virtually no really good screening in children. We tend to look at growth development and so on, but we don’t really look at malnutrition in children. So when we have done all of this we are still left with the fact that we will let a child eat inadequately and not exercise, which I think should be a part of the nutrition screening in a child, and in the end we will say now they are 70, let’s try and fix something that we should be fixing now for our grandchildren or children.

Dr. Elia: I agree with all that you have said. When we first started to try and get a screening tool, we were a bit over ambitious in thinking we could also tackle children at the same time. We could not get too much agreement about what cutoff points should be used. Unless we have that agreement between professionals, it will be difficult to implement national policies.

Dr. Lochs: You put some emphasis on screening of nutritional status, but this is only one part. Wouldn’t the documentation of intake be as important? I recently heard a talk by McFee in which he showed a patient chart from 1905 and one could clearly see what the bowel habits of these patients were in the hospital 100 years ago. But one could not see whether the patients eat or what they got to eat, and I think this situation has not changed yet. So do you have any proposals as to how we could improve on that?

Dr. Elia: I can tell you what applies to the ‘Malnutrition Universal Screening Tool’ (‘MUST’), which is ‘an acute disease effect’ that can result in no dietary intake for more than 5 days. The problem is not just a matter of identifying individuals who have not been eating, but also those who are unlikely to eat, such as unconscious individuals or those who develop a severe swallowing difficulty after a stroke. A screening tool is likely to be of little value unless it is linked to a care plan. This plan may vary from one care setting to another, and also according to local resources and policies. High risk patients typically require treatment, low risk patients routine clinical care, and medium risk patients, observation. In hospitals or nursing homes, this observation includes keeping a food chart of dietary intake. The screening procedure can be repeated at intervals, which may be one week in hospital, one month in nursing homes, and even longer in the community.

Dr. DeLegge: I have a story to tell you and I would appreciate your feedback. I live in South Carolina, it is one of the poorest states in the US; it is mostly rural. On a survey 5 years ago in various hospitals across the state, we realized there were close to 20 different nutrition assessment programs which made little sense to one another, and then the standardized patient follow-up varied from institution to institution. Most of the nutrition care depended upon how the clinicians felt that they should
treat their particular patients. In response to this we put together a formalized nutrition-based survey at 5 sites. We were able to correlate the patient's nutrition status to days of re-hospitalization in the next year. We caught the attention of the hospitals because suddenly we were talking dollars. We were also able to focus on patients with chronic disease. This included a lot of patients who were uninsured and used the emergency room as their primary physician. The hospital provided free care. The financial burden of the care of this group of patients falls directly onto the hospitals. The hospitals are searching for any method to prevent re-hospitalization. The interesting part is that we found that current nutrition screening surveys done by nurses were incorrect for identifying at-risk patients 30% of the time. This was even worse when left up to the physicians. We finally realized that we needed to have someone whose total job was to do nothing but nutrition screening in order to impact outcomes. This could not be the regular dieticians as they are responsible for many other tasks, including following up on the patients who are at nutritional risk. Do you think that in order for us to correctly address this problem we have to put the finances behind what we are talking about and not make another duty for the nurse, not make another duty for the physician, but in fact have the personnel specifically trained and designed to do nothing but identify these patients?

**Dr. Elia:** The more resources that are available for implementing a program, the better. However, resources vary of course from place to place and from one health care setting to another. But the extent to which screening tools and procedures agree or disagree depends on the criteria used. The more objective the criteria, usually the less likelihood of disagreement. Let me give you an example. With the ‘MUST’ we undertook 10 reproducibility studies on the same patients. These were between nurses/nurses, doctors/nurses, students/nurses, and other combinations of health workers. The agreement was between 92 and 100%, and in 5 of the 10 studies the agreement was almost perfect (98–100%). This is because the observers were appropriately trained and the ideal tool involves simple and objective criteria. The more complex and subjective the criteria, the less likely the consistency, especially if there has been no training. I don't know details of your specific tool, but these general comments might be relevant.

**Dr. Labadarios:** In relation to the point being discussed, in South Africa we are actually developing middle level workers in nutrition for the purpose of doing exactly what you said, screening on understanding that the screen has to be simple in order to be reproducible. We are interested in the ‘MUST’ screening tool that you were talking about. Thank you for elegantly pointing out the tremendous complexity of interventions and looking at one parameter only is really a problem. The first question from Dr. Powell-Tuck was on the necessity for simplicity in assessing nutritional status. Assuming that one does that as step one if you like, do you see the need for routinely available or in selective cases more specialized chemical investigations being done among those patients who are actually identified as being at risk, or would you use the ‘MUST’ alone?

**Dr. Elia:** I think the ‘MUST’ is an aid to clinical judgment, it is not a replacement, and it aims to detect mainly protein energy malnutrition. But we know very well that other specific nutrient deficiencies such as iron deficiency may occur in subjects with a normal protein-energy status and even in those who are overweight or obese. However, there is a strong relationship between ‘MUST’ scores and the status of many nutrients.

**Dr. Morley:** Coming back to screening and who should do it. I may not get this totally right because I have only heard Keller [1] who I think has tried harder than anyone to actually look at what happens when you screen and understanding the process and outcomes. She found that if a physician screened there was far more chance that the patient would actually get follow through, which sort of makes some
sense, but in addition to that the patient would follow through themselves with what they were told to do. As you went through the health professionals the outcome was a less good, so that when you got to the volunteers who screened, they actually appear in many cases to do a little better than the physician at doing the screening, but the outcomes were not nearly as good because then you had to refer to the physician, the physician had to do something, the physician didn’t know what to do. I think until we can actually manage to teach physicians about nutrition we are wasting our time. There are some of us who clearly care about it but we are a minority of physicians. The average physician cardiologists would care about cholesterol but would be quite happy if the cholesterol was very low even though that most probably suggests severe cytokine disease, as Rauchhaus et al. [2] have shown, and impeding death in the patients. They would say, well that is great, your cholesterol is nothing we have really succeeded. I think adequate treatment about nutrition and education is absolutely the key. We have been trying to do this for years with medical students and about the only people who pay any attention are the doctors in the nursing home because they see a lot of it and understand, but the rest say it is not important. So what is your solution to make it important?

Dr. Elia: It is a difficult problem and I think it is going to take years to overcome because at the heart of all this lack of appreciation of nutrition as a problem, and lack of education, which needs to come more and more to the forefront. I fully agree with you that there is little point in identifying someone who is malnourished unless there is a pathway at the other end, preferably a consistent pathway, to manage the patients. This is the difference between a screening test, which is the procedure in the first initial step and may subsequently lead to assessment, and a screening program, which involves the remainder of the management, including treatment, and may operate between health care settings. There is little point in having a test without a program. At the same time it is necessary to take into account local policies, initiatives and resources. A screening test or program that is absolutely rigid probably won’t work.

References
