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Are energy and protein requirements met in hospital?

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Abstract

Background: Malnutrition is a problem within hospitals, which impacts on clinical outcomes. This audit assesses whether a hospital menu meets the energy and protein standards recommended by the British Dietetic Association's (BDA) Nutrition and Hydration Digest and determines the contribution of oral nutrition supplements (ONS), and additional snacks.

Methods: Patients in a UK South West hospital were categorised as 'nutritionally well' or 'nutritionally vulnerable' according to their Malnutrition Universal Screening Tool score. Energy and protein content of food selected from the menu ('menu choice'), menu food consumed ('hospital intake') and total food consumed including snacks ('overall intake') were calculated and compared to the standards.

Results: In total 93 patients were included. For 'nutritionally well' patients (n=81) energy and protein standards were met by 11.1% and 33.3% ('menu choice'), 7.4% and 22.2% ('hospital intake') and 14.8% and 28.4% ('overall intake'). For 'nutritionally vulnerable' patients (n=12) energy and protein standards were met by 0% and 8.3% ('menu choice'), 0% and 8.3% ('hospital intake') and 8.3% and 16.7% ('overall intake'). Ten percent of patients consumed ONS. Patients who consumed hospital snacks (34%) were more likely to meet the nutrient standards ($p \leq 0.001$).

Conclusions: This audit demonstrated that the majority of patients are not meeting the nutrient standards recommended by the BDA Nutrition and Hydration Digest. Recommendations include provision of energy/protein-dense snacks and menu, offering ONS where clinically indicated, and training for staff. A food services dietitian is ideally placed to lead this, forming a vital link between patients, caterers and clinical teams.

Introduction

Nutritional problems in hospital patients are complex, resulting from both the consequences of disease and an altered food intake [1]. '*Malnutrition is a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects on tissue / body form (body shape, size and composition) and function and clinical outcome*' [2]. Consequences include increased infections and hospital admissions, prolonged recovery and increased mortality [3]. Previous research revealed that 29% of patients admitted to hospitals in the United Kingdom (UK) were at risk of malnutrition [4], with hospitalisation potentially leading to further deterioration of nutritional status [5] . Due to its widespread health consequences, malnutrition is estimated to cost up to £19.6 billion annually in England [6]. Unfortunately, it is often an unrecognised and untreated problem within hospitals [6]. Consequently, the National Institute for Health and Clinical Excelence (NICE) identified that improved nutritional care could be one of the largest potential sources of cost saving to the NHS [7].

The provision of food is integral to the prevention of malnutrition [8] and hospital menus should provide suitable food choices for all patients [9]. Energy and protein intakes are frequently insufficient to meet patients' nutritional requirements [10] and as a result, the British Dietetic Association (BDA) published The Nutrition and Hydration Digest (The Digest) [9] , an evidence-based document applicable to all NHS hospitals [11]. The Digest provides information for best practice and auditable standards [12] . The nutrient standards which categorise inpatients into 'nutritionally well' and 'nutritionally vulnerable' (Table 1) are based on the Dietary Reference Values (DRVs) and British Association for Enteral and Parenteral Nutrition (BAPEN) recommendations [13].

Although reasons for malnutrition are multifactorial, inadequate dietary intake is a principal factor in its development [14] . Barriers to an adequate dietary intake include interrupted meals, unwanted food, poor appetite, nausea and fatigue [15]. Patients often have higher nutritional requirements due to increased gluconeogenesis, muscle catabolism, and decreased absorption [16]. The development of validated screening tools, such as the Malnutrition Universal Screening Tool (MUST) [17], has allowed for early detection and effective treatment [18].

Clinical audit is an effective way of assessing and improving nutritional care within hospitals [19]. A systematic review highlighted the need for more effective evaluations and auditing of dietary intake within hospitals [20]. Although audits have been conducted, generalisability is often limited due to the assessment of specific patient populations and a lack of detail within dietary recall [21]. Furthermore, as well as concern about the adequacy of food intake, questions remain as to whether

patients make appropriate food choices. Assessing the nutritional content of patients' menu choices is important so that menus can be reviewed and updated as required [22]. BAPEN [17] recommends that audit measures include the nutritional content of the menu in addition to food intake.

Food fortification, hospital snacks and oral nutritional supplements (ONS) have been shown to positively impact on a patient's nutritional status [23]. However, it has been argued that both energy and protein requirements should be met through hospital meals alone due to the low protein content of many snacks [24] and to prevent reliance on ONS as a substitute for adequate food provision [25]. It is therefore important to understand to what extent hospital meals meet the nutrient standards, in order to assess the need and contribution of additional food items [25]. Research suggests that up to 63% of patients consume non-hospital foods during their admission, which could have a significant impact on their nutritional status [26]. The potential for their contribution to reducing malnutrition highlights the importance of assessing the nutritional content of these non-hospital foods.

Although previous audits have investigated the provision of nutrition within hospitals [27] the extent to which hospitals are meeting the nutrient standards set by The Digest and the contribution of supplementary food items to nutritional intake have yet to be explored. This audit aimed to determine whether patients' choice and consumption of food from a South West Hospital menu, met nutrient standards for adults recommended by The Digest [9]. The secondary aim was to evaluate the contribution made by supplementary food items (hospital snacks, non-hospital food & drinks and prescribed ONS) to patients' overall intake of energy and protein.

Methods

Participants:

This audit recruited patients from a South West hospital in the UK in April-May 2015. Patients were selected from 24 inpatient wards across the hospital, excluding critical care, admission and maternity wards where a complete 24-hour dietary recall would be difficult to obtain. To eliminate human bias in selection, a systematic method including selecting from the 5th, 10th, 15th and 20th patients from a list, in line with previous Trust audits, was used on all the eligible wards.

Participants were excluded if they selected from a special diet menu (e.g gluten free, renal, modified consistency), did not receive all daily meals, were terminally ill, cognitively impaired, barrier nursed or had an incomplete MUST screning. Due to limited access to medical notes to assess appetite, oral intake prior to data collection and specific nutritional requirements, categorisation of

participants by MUST score allowed appropriate target nutrient levels, as outlined by the BDA (Table 1), to be identified. MUST scores, which had been calculated by the ward staff, were used to categorise patients as nutritionally well (MUST 0) or vulnerable (MUST ≥1) (Table 1).

The audit was registered with and approved by the Plymouth Hospitals NHS Trust and compliant with the Data Protection Act [28].

Dietary Assessment:

A 24-hour dietary recall was conducted with each patient, using an audit tool developed for this audit (Appendix 1) and visual prompts for more accurate recall. The audit tool was adapted from a validated dietary assessment tool [29] and piloted with six patients who were asked to give feedback following the use of the audit tool on the format/questions, and whether it was clear and understandable. The pilot study did not highlight any areas that needed to be adapted, therefore their data was included in the final results. In addition to the adapted validated dietary assessment tool, patients were asked to provide as much detail as possible about the food and drink they had consumed over the past 24 hours and were provided with the hospital menu and visual aids (pictures showing a ¼, ½, ¾ and full plate of food) for the amount they consumed. Patients were asked if they were taking any nutritional supplement drinks (Options: Yes or No. If yes, how many per day?) and pictures of ONS were shown as a prompt for recall. Consumption was checked against the fluid charts. This recall included the breakfast selection on the morning of data collection, lunch and dinner from the previous day, as well as snacks provided by the hospital (e.g. biscuits, cheese and biscuits) and non-hospital food & drinks (e.g. any food brought in by the patient, friends and/or family). Additional questions included: 'Was the portion size correct?' (Options: Too Big, Plenty, Acceptable or Too Small) and 'Did you eat any food apart from hospital food?' Energy and protein intakes were estimated using a pre-analysed hospital menu provided by the catering company Apetito, McCance and Widdowson's 'The Composition of Foods' [30] and photographs of food portion sizes [31]. Where brands were specified, manufacturers' websites were used to determine the nutritional content. Three different dietary measurements: 'menu choice', 'hospital intake' and 'overall intake' (Table 2) were compared against the nutrient standards (Table 1).

Statistical Analysis

Anonymised data were analysed using the Statistical Package for the Social Sciences (SPSS), version 21(IBM Corp., Armonk, NY, USA). Descriptive statsistics were used to describe the demographic characteristics of the participants. All tests were two-tailed and independent. As data from nutritionally well patients were normally distributed, a one-sample t-test was used to determine any significant differences between the energy and protein content of the nutritional

standards and ‘menu choice’, ‘hospital intake’ or ‘overall intake’ (Table 3). ONS were not included in overall intake so as to assess the adequacy of a food first approach, but their contribution to nutritional intake was assessed separately (Table 4). Due to low numbers in the nutritionally vulnerable category, the non-parametric one-sample Wilcoxon signed rank test was used to analyse this data. A Pearson’s chi squared test was used to compare the number of patients meeting the nutrient standards for energy and protein in those who did and did not receive hospital snacks and non hospital food & drink respectively. Additionally, an independent–samples t-test was used to demonstrate any differences between energy and protein intakes in those who did and did not receive non-hospital food & drinks.

Results

One hundred and twelve patients were reviewed, 19 of whom were excluded for having an incomplete MUST or an incomplete dietary recall. The median age was 70 years, with a range of 23-97 years. Of the 93 patients included, 81 were classified as nutritionally well (87%) and 12 were classified as nutritionally vulnerable (13%). Average nutritional values for ‘menu choice’, ‘hospital intake’ and ‘overall intake’ are shown in Table 3.

Significantly lower values for energy provision ($p \leq 0.001$) were observed in ‘menu choice’, ‘hospital intake’ and ‘overall intake’ when compared to the lower end of the energy standards for nutritionally well patients (n=81). For protein, nutritionally well male patients’ ‘menu choice’, ‘hospital intake’ and ‘overall intake’ were significantly lower ($p \leq 0.001$) than the nutrient standards. In females, in whom the standard for protein intake is lower than that for males, a significant difference was found between the standards and ‘hospital intake’ ($p=0.002$). For nutritionally vulnerable patients energy and protein intakes were significantly lower than the standards in all three dietary categories (n=12) (Table 3).

The proportion of patients meeting the nutrient standards is demonstrated in Figure 1. The percentages of patients receiving ONS, hospital snacks and non-hospital foods/drinks were compared, as well as their average nutritional contents (Table 4).

Hospital Snacks

Although 39 patients were offered hospital snacks, only 32 of these patients consumed them. An additional 2 patients had to ask for hospital snacks in order to receive them. Of those who consumed hospital snacks (n=34), 15% (n = 5) met the energy standards compared to 2% (n=1) of those who

did not consume snacks (n=60) (p=0.011). Of patients who consumed hospital snacks, 41% (n = 14) met the protein nutrient standards compared to 9% (n=5) of those who did not ($p \leq 0.001$).

Non-hospital food & drink

A significant difference was found in energy intake between those who did and did not receive non-hospital food & drinks. Those who received non-hospital food & drink consumed a mean (SD) daily energy intake of 1375 kcal/5753 kJ (509 kcal/2131 kJ), as compared to those who did not who consumed a mean (SD) daily energy intake of 1102 kcal/4611 kJ (520 kcal/2176 kJ); t(85.18)=-2.53; p= 0.013). No significant difference was found in protein intake between those who consumed non-hospital food & drink and those who did not (p=0.322). Consumption of non hospital food & drink did not result in any significant difference in the numbers of participants meeting the nutrient standards for energy ($X^2(1)= 1.09$; p=0.297) or protein ($X^2(1)= 0.212$; p=0.645).

Portion size and content

Patients rated portion sizes as 'acceptable/plenty' (nutritionally well 81%, nutritionally vulnerable 75%), 'too big' (nutritionally well 15%, nutritionally vulnerable 8%) or 'too small' (nutritionally well 4%, nutritionally vulnerable 17%). Based on the menu dietary coding 15% of patients chose energy dense main dishes (≥350 kcal/≥1464 kJ) and 25% chose energy-dense desserts (≥250 kcal/≥1046 kJ).

Discussion

In a move towards addressing malnutrition in hospitals, the Hospital Foods Standards Panel identified The Digest as being highly relevant to improving hospital food provision [(11)]. Providing guidelines to facilitate the adequate delivery of food services within hospitals, The Digest offers the opportunity for a positive change. In identifying aspects of the standards not being met, and factors contributing to this, it is possible to implement change to address the ongoing problem of malnutrition in hospitals. This audit investigated whether the energy and protein provided by the hospital menu met guidelines and builds on previous audits to develop a more detailed account of patients' intake, including the contribution of ONS, hospital snacks and non-hospital food & drinks.

The results demonstrate that the mean energy and protein content of the 'hospital foods consumed' was significantly lower than that recommended by The Digest (Table 3). This audit supports the findings from a comparative study in Switzerland [32], which indicates consistent rates of inadequate intake of more than 70% over the past 15 years. A previous hospital survey found that patients consumed an average of 1536kcal/6427kJ and 58g protein [10] and only 41% of older patients met their energy requirements [33]. Nutritional intakes observed in this audit were considerably lower. The use of generic requirements as opposed to individual calculated requirements based on body weight may have contributed to the differences observed in the percentage of patients that met the recommendations. The lower end of The Digests' standards used within this audit are based on the Estimated Average Requirements (EARs), which are meant for groups of healthy free-living people, who are likely to have significantly higher activity levels than that of hospitalised patients. In contrast, the lower end of the standards used are also based on the nutritional needs of a 75+ year old woman. Although some patients' requirements may be higher than this, perhaps resulting in an overestimation of patients that met the nutrient standards, it must also be considered that patients' requirements may also be reduced due to a reduction in energy expenditure during hospitalisation. Considering gender, age and weight when determining nutrient standards may help provide a more accurate number of patients meeting their nutritional requirements.

Furthermore, the use of self-reported dietary intakes, as opposed to observations, could have affected the result [10] [33]. Although the use of self-reported estimations have been validated against direct weighing methods and observation [34] , Førli et al. reported that patients significantly under-reported their intake when compared to recalls of trained observers [29]. It is important to note that the dietary assessment tool used in this audit was adapted from a previous study and did not go through a formal validation process itself. An alternative validated method that could have increased the accuracy of dietary estimation would be incorporating technology. For example weighing foods and photographic documentation to allow more detailed analysis [35].

A higher percentage of patients met the nutrient standards for protein than for energy (Figure 1). When energy intake is inadequate, the body will find an alternative metabolic fuel, in this case protein, preventing its use for tissue protein synthesis [36]. In those deficient in both energy and protein the body will break down healthy muscle and tissue, leading to decreased muscle mass, disruption of vital organ systems, poor wound healing, and prolonged rehabilitation [37].

The majority of patients in this audit would not have meet the nutrient standards for energy and protein even if they had consumed all of the chosen food provided by the hospital (Figure 1). This suggests that in addition to the menu that provides coded information for high energy options,

patients would benefit from further support in making the most appropriate dietary choices. It is possible that patients are not always offered the full choice available, including snacks and that there is a lack of nutritional guidance for food choice, particularly for those at nutritional risk [35]. Naithani et al. reported 3% of patients had difficulty completing the menu order form, and 30% found it difficult to choose the right foods because of a lack of information [38]. Health-care professionals have the responsibility to facilitate patients in making appropriate food choices [39]. In order for this to happen, staff should receive dietitian-led training to help patients make appropriate food choices.

The vast majority of patients rated portions sizes as 'acceptable/plenty', however some evaluated that they were either 'too big' or 'too small'. Elderly orthopaedic patients have been found to consume more energy and protein when offered larger portions [40], however providing too large portions can limit patients' ability to consume the food [41]. Conflicting research into the effectiveness of increasing portion size on energy and protein intake limits its application in a hospital setting [42]. Food fortification has been suggested as an alternative to larger portions, although some argue that the addition of calorie-dense foods compromises protein and micronutrient intake through suppression of appetite, and budgetary constraints are often considered to be a barrier [43]. It has been argued that budgeting for quality food and openness to new approaches, would demonstrate a patient-centred approach to address malnutrition [44].

Food fortification has been found to successfully increase dietary intake [45] [46] but longer term interventions are needed to determine the impact on clinical outcomes. ONS may be a suitable alternatives to food fortification since they are nutritionally complete in sufficient quantities, and have been shown not to suppress appetite [43]. It has been demonstrated that those receiving ONS exceeded their estimated requirements, leading to positive changes in nutritional status [46]. Due to the low numbers of patients receiving ONS, the significance of their impact on meeting nutrient standards was not explored within this audit. However in those who consumed them, ONS contributed to over 30% of patients' energy and protein intake, and provided substantially more energy and protein than hospital snacks or non-hospital food & drinks (Table 4). Where clinically indicated, ONS can be very effective [17] however, the potential for future increases in costs and poor compliance, are both barriers to ONS use.

The BDA supports a 'food first' approach [25], recommending the improvement of nutritional status via ordinary food as a first step in providing nutritional support [47]. The provision of hospital snacks could be beneficial for patients who prefer to eat little and often [24]. However, in this audit, a number of patients were not offered hospital snacks although the reasons for this were not explored.

A lack of hospital snack provision has been identified as an inhibitory factor of optimal nutrition [48] and although snacks are often available some studies have found this is not always communicated adequately to patients [49], which appeared to be the case in this audit. The Digest emphasises that patients should be offered hospital snacks twice daily, rather than relying on patient's requests [9]. However, this audit highlighted that energy and protein provided by additional snacks did not compare to that of ONS. This is important to reflect upon when considering nutritional goals of snack provision and how their nutritional contribution could be improved.

Over 50% of nutritionally well patients and over 80% of nutritionally vulnerable patients within this audit received non-hospital food & drinks (Table 4). Whilst reasons for their consumption were not investigated in this audit, one study highlighted that it is often due to hunger [38]. Although the majority of patients audited were satisfied with the portion size allocated, inconsistent snack provision and long gaps between meals may have resulted in hunger. This audit demonstrated that non-hospital food & drink choices were often low in protein. Patients, as well as their visitors, could benefit from education and guidance in making appropriate food choices [5]. Although patients who received non-hospital foods had a higher-energy intake, they were not significantly more likely to meet the nutrient standards and inequalities of care between those who do and do not have the money and/or resources to access food from outside the hospital requires ethical consideration. The Department of Health [11] state that patients' nutritional needs should be catered for by the hospital, implying that non-hospital food and drink should not be relied upon to meet the nutrient standards.

Limitations for this audit are the use of a single 24-hour recall although within a larger population one 24-hour recall can provide sufficient data to assess nutritional intake [50]. Furthermore, nutritional analysis was based on estimations of portion size using visual aids, menu prompts and household measures. Estimations were likely to cause inaccuracies, especially for non-hospital food. Finally, the calculation of each patients' individual nutritional requirements would have provided a more accurate representation of how many patients received adequate energy and protein.

As the literature indicates that 29% of patients are classified as at risk of malnutrition on admission to hospital [4], 13% identified in this audit is comparatively lower. This may have been influenced by the study exclusion criteria including a number of patients at high risk of malnutrition, making the sample less representative of the hospital population. Furthermore people at low risk of malnutrition as defined by MUST may not necessarily fit the 'nutritionally well' definition provided by The Digest [9] (Table 1). In considering the definition of nutritional vulnerability provided by The

Digest, the use of disease type and appetite status could result in more accurate assessment of vulnerability and is an area to consider in future audits.

Qualitative reasons as to why patients were not consuming all of their food were not explored in this audit. Future audits would benefit from assessing factors effecting oral intake in order to tailor any dietary interventions accordingly. For example, providing more energy-dense options may not be beneficial if people are not receiving adequate support whilst eating, and providing snacks more consistently would be counterproductive if patients do not like the snacks that are available. Additionally the duration of admission may have an impact on oral intake and could be an important factor to consider in future audits.

Conclusion

The results of this audit demonstrate that most patients' energy and protein intakes failed to meet the nutrient standards recommended by The Digest. It is likely that this problem is not unique to this hospital. Organisations must provide assurance of high quality nutritional care if they are to meet the national standards set by the Care Quality Commission (CQC); provision of food which meets patients' requirements forms a central part of this. A publication by NHS England [51] has recently urged commissioners to view nutrition and hydration as a priority; providing guidance on ways of tackling malnutrition at a national and local level. This audit has highlighted a number of areas hospital trusts should focus on when trying to improve the nutritional intake of hospitalised patients. These include the provision of more energy-dense menu options, improving systems for provision of hospital snacks, supporting patients in making appropriate choices and providing ONS where clinically indicated. However, in order to tailor these changes in a patient-centred approach it would be important to explore reasons as to why patients are not consuming adequate nutrients. In addition to energy and protein intake, future research may also benefit from assessing micronutrient intake to gain a broader understanding of the true extent of malnutrition in hospitalised patients. A dedicated food services dietitian is ideally placed to lead this work, forming a vital link between patients, ward staff, caterers and clinical teams. Clear leadership and management support is required to engage staff at all levels and ongoing audits should demonstrate consistent compliance with the hospital food standards.

References

1) Schuetz P, Blaser Yildirim P.Z, Gloy V.L et al. Early nutritional therapy for malnourished or nutritionally at-risk adult medical inpatients. *The Cochrane Library.* 2014;1-21.

2) Elia M. Screening for malnutrition: a multidisciplinary responsibility. Development and use of the 'Malnutrition Universal Screening Tool' ('MUST') for adults. MAG, a Standing Committee of BAPEN. Redditch: BAPEN; 2003.

3) Agarwal E, Ferguson M & Banks M. Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmissions, and greater in-hospital mortality: results from the nutrition care day survey 2010. *Clin Nutr*. 2013; 32: 737-745.

4) Russell C & Elia M. *Nutrition screening surveys in hospitals in the UK, 2007-2011*. Redditch: BAPEN; 2014

5) Laur C, McCullough J & Keller H. Becoming Food Aware in Hospital: A Narrative Review of Best Practices for a Multi-level Approach to Improve the Culture of Nutrition in Hospital. *Healthcare*. 2015; 29: 393-407.

6) Elia M. The cost of malnutrition in England and potential cost savings from nutritional interventions (full report). Southhampton: BAPEN and NICE; 2015.

7) NICE (2009) Cost saving guidance: http://www.nice.org.uk/usingguidance/benefitsofimplementation/costsavingguidance.jsp (accessed November 2016)

8) Webster-Gandy J, Madden A, Holdsworth M. *Oxford Handbook of Nutrition and Dietetics.* Oxford: Oxford University Press; 2012.

9) British Dietetic Association (2012) *The Nutrition and Hydration Digest: improving outcomes through food and beverage services:* https://www.bda.uk.com/publications/professional/NutritionHydrationDigest.pdf (accessed October 2014)

10) Dupertuis Y, Kossovsky M, Kyle U et al. Food intake in 1707 inpatients: a prospective comprehensive hospital survey. *Clin Nutr*, 2003; 22: 115-123.

11) Department of Health (2014) *New rules to serve up better food for NHS patients and staff*: https://www.gov.uk/government/news/new-rules-to-serve-up-better-food-for-nhs-patients-and-staff (accessed June 2014)

12) Cartz M (2013). *The Nutrition and Hydration Digest One Year On*: http://www.thenacc.co.uk/assets/downloads/396/Nutrition%20&%20Hydration%20Digest%20-%20Food%20Counts.ppt (accessed July 2016)

13) Allison S. Hospital food as a treatment, *Clin Nutr*, 2003: 22; 113-114.

14) Young AM, Mudge AM, Banks MD et al. Encouraging, assisting and time to EAT : improved nutritional intake for older medical patients receiving Protected Mealtimes and/or additional nursing feeding assistance, *Clin Nutr*, 2013: 32; 543-549.

15) Keller H, Allard J, Vesnaver E et al. Barriers to food intake in acute care hospitals: a report of the Canadian Malnutrition Task Force. *J Hum Nutr Diet*, 2015: 1-12.

16) Grodner M, Roth SL & Walkingshaw BC. Nutrition an metabolic stress. In Nutritional Foundations and Clinical Applications: A nursing approach. [Internet]. Missouri: Elsevier; 2012: 341-356.

17) BAPEN (2013). Introducing ‘‘MUST’’: http://www.bapen.org.uk/screening-for-malnutrition/’MUST’/introducing-’MUST’(accessed November 2014)

18) Elia M, Zellipour L, Stratton RJ. To screen or not to screen for adult malnutrition. *Clin Nutr*, 2005: 24; 867-884.

19) Benjamin, A. Audit: how to do it in practice, *Br Med J*, 2008: 336; 1241-1245.

20) Mitchell H & Porter J. The cost-effectiveness of identifying and treating malnutrition in hospitals: a systematic review. *J Hum Nutr Diet*, 2015: 1-9.

21) Hamilton K, Spalding D, Steele C et al. An audit of nutritional care delivered to elderly inpatients in community hospitals, *J Hum Nutr Diet*, 2002: 15; 49-58.

22) The Scottish Government. *Food in Hospitals: National catering and nutrition specification for food and fluid provision in hospitals in Scotland*. Edinburgh: The Scottish Government; 2008

23) Elia M, Normand C, Norman K et al. A systematic review of the cost and cost-effectiveness of standard oral nutritional supplements in the hospital setting. *Clin Nutr*, 2015: 1-11.

24) Iff S, Leuenberger M, Rösch S et al. Meeting the nutritional requirements of hospitalized patients: An interdisciplinary approach to hospital catering. *Clin Nutr*, 2008: 27; 800-805.

25) Baldwin C & Weekes C. Dietary advice with or without oral nutritional supplements for disease-related malnutrition in adults, *Cochrane Database Syst Rev*, 2012: 9; 1-138.

26) The Soil Association. *First Aid for Food*. Bristol: Soil Association; 2011.

27) Ord H & Steele C. A baseline audit to evaluate the quality of nutritional provision delivered to fractured neck of femur inpatients, *J Hum Nutr Diet*, 2011: 24; 375-407.

28) Data Protection Act (1998). Schedule 1 – The Data Protection Principles: http://www.legislation.gov.uk/ukpga/1998/29/schedule/1 (accessed December 2014)

29) Førli L, Oppedal B, Skjelle K et al. Validation of a self-administered form for recording food intake in hospital patients, *Eur J Clin Nutr*, 1998: 52; 929-933.

30) Food Standards Agency. *McCance and Widdowson’s The Composition of Foods: Sixth Summary Edition.* Cambridge: The Royal Society of Chemistry; 2002.

31) Diabetes UK. *Carbs & Cals*. London: Chello Publishing Ltd; 2010

32) Thibault R., Chikhi M, Clerc A et al. Assessment of food intake in hospitalised patients: a 10-year comparative study of a prospective hospital survey. *Clin Nutr*, 2011: 30; 289-296.

33) Mudge AM, Ross LJ, Young AM et al. Helping understand nutritional gaps in the elderly (HUNGER): a prospective study of patient factors associated with inadequate nutritional intake in older medical inpatients. *Clin Nutr*, 2011; 30; 320-325.

34) Berrutt G, Favreau A, Dizo E et al. Estimation of calorie and protein intake in aged patients validation of a method based on meal portions consumed. *J Geronto A Biol Sci Med Sci*, 2002: 57; 52-56.

35) Ofei KT, Holst M, Rasmussen HH et al. Effect of meal portion size choice on plate waste generation among patients with different nutritional status. An investigation using Dietary Intake Monitoring System (DIMS). *Appetite*, 2015: 91; 157-164.

36) Bender DA. *Introduction to Nutrition and Metabolism*, Boca Raton: CRC Press; 2008

37) Barker L, Gout B & Crowe T. Hospital malnutrition: prevalence, identification and impact on patients and the healthcare system', *Int J Environ Res Public Health*, 2011: 8; 514-527.

38) Naithani S, Thomas JE, Whelan K et al. Experiences of food access in hospital. A new questionnaire measure. *Clin Nutr*, 2009: 28; 625-630.

39) Savage J & Scott C. *Patients' nutritional care in hospitals: An ethnographic study of nurses' role and patients' experience*. London: Royal College of Nursing Institute; 2005

40) Bannerman E, Cantwell L, Gaff L et al. Dietary intakes in geriatric orthopaedic rehabilitation patients: Need to look at food consumption not just provision. *Clin Nutr*. 2016: 35; 892-899.

41) Johns N, Edwards JS, Hartwell HJ. Hungry in hospital, well-fed in prison? A comparative analysis of food service systems. *Appetite*. 2013: 68; 45-50.

42) Munk T, Seidelin W, Rosenbom E et al. A 24-h a la carte food service as support for patients at nutritional risk: a pilot study. *J Hum Nutr Diet*, 2013: 26; 268-275.

43) Saunders J, Smith T & Stroud M. Malnutrition and undernutrition. *Medicine*, 2011: 39; 45-50.

44) Keller HH, Vesnaver E, Davidson B et al. Providing quality nutrition care in acute care hospitals: perspectives of nutrition care personnel. *J Hum Nutr Diet.* 2014: 27; 192-202.

45) Leslie WS, Woodward M, Lean MEJ et al. Improving the dietary intake of under nourished older people in residential care homes using an energy-enriching food approach: a cluster randomised controlled study. *J Human Nutr and Diet*, 2013: 26; 387-394.

46) Collins J & Porter J. The effect of interventions to prevent and treat malnutrition in patients admitted for rehabilitation: a systematic review with meta-analysis. *J Hum Nutr Diet,* 2015: 28; 1-15.

47) Gandy J. *Manual of Dietetic Practice*. 5th edn. Chichester: John Wiley & Sons Ltd; 2014

48) Lassen KO, Olsen J, Grinderslev E et al. Nutritional care of medical inpatients: a health technology assessment. *BMC Health Serv Res*, 2006: 6; 7.

49) Walton K, Williams P, Tapsell L et al. Observations of mealtimes in hospital aged care rehabilitation wards. *Appetite*, 2013: 67;16-21.

50) Biro G, Hulshof KF, Ovesen L et al. Selection of methodology to assess food intake. *Eur J Clin Nutr*, 2002: 56; 25-32.

51) NHS England (2015). Guidence- Commissioning Excellent Nutrition and Hydration 2015-2018: https://www.england.nhs.uk/wp-content/uploads/2015/10/nut-hyd-guid.pdf (Accessed July 2016)

Transparency Declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted and that any discrepancies from the study as planned (and registered with) have been explained. The reporting of this work is compliant with CONSORT/STROBE guidelines.

Table 1: Nutrition and hydration digest standards and definitions [12]

	Energy	Protein
Nutritionally Well Normal nutritional requirements and normal appetite OR those with a condition requiring a diet that follows healthier eating principles. The lowest energy target is based on the Estimated Average Requirement (EAR) for women aged 75+ years and the highest target based on the EAR for men aged 19-59 years.	1810-2550 kcal 7573-10669 kJ	56g*
Nutritionally Vulnerable Normal nutritional requirements but with poor appetite and/or unable to eat normal quantities at mealtimes OR those with increased nutritional needs. The energy target range is based on requirements of 1.3 to 1.5 times resting energy expenditure for a 75kg individual.	2250-2625 kcal 9414-10983 kJ	60-75g

* For females of the same age bracket the RNI is 45g.

Table 2: Definitions of dietary terms

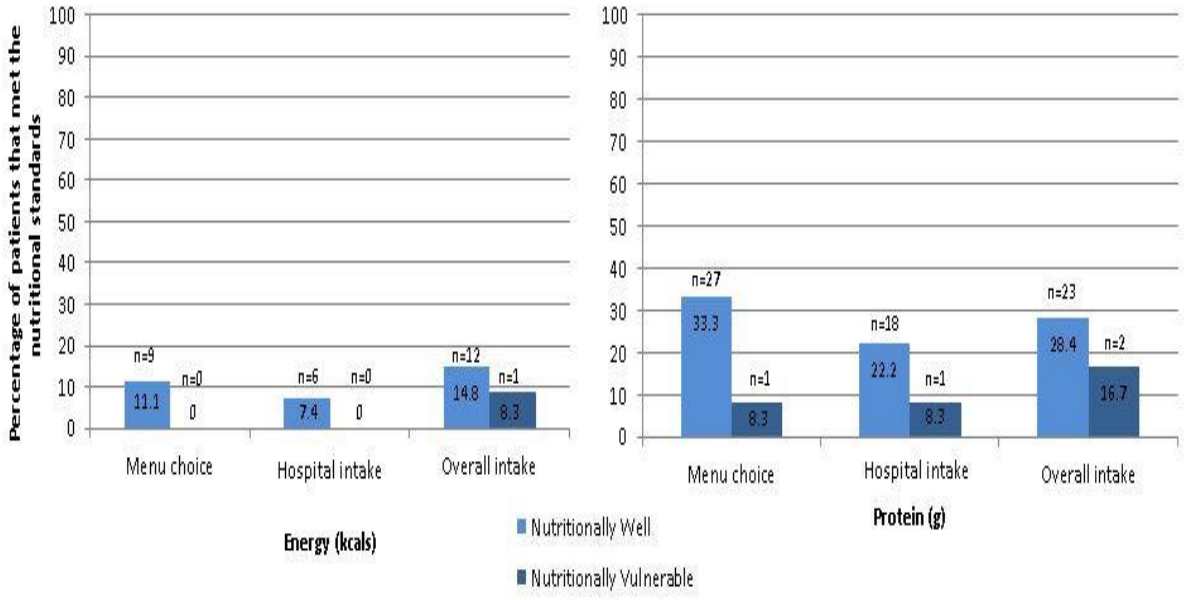
Dietary Term	Definition
Menu Choice	Amount of energy or protein provided by meals chosen by patients from the hospital main menu, assuming 100% consumption.
Hospital Intake	Amount of energy or protein provided by hospital meals and snacks, based on actual consumption. Not including ONS.
Overall Intake	Total amount of energy or protein provided by hospital meals and snacks plus non-hospital food and drinks consumed, based on actual consumption. Not including ONS.

Table 3: Energy and protein provision and consumption compared to the BDA (2012) nutrient standards

	Nutrient Standard	Menu choice	Hospital intake	Overall intake
Energy (kJ)				
Nutritionally well (Male and Female) (n = 81)				
Mean (SD) **p value**	7573	5356 (1900) <0.001	4573 (1900) <0.001	5205 (2092) <0.001
Nutritionally Vulnerable (Male and female) (n = 12)				
Median (Range) **p value**	9414	4987 (5899) 0.002	4707 (7468) 0.002	5485 (9971) 0.005
Protein (g)				
Nutritionally well (Male) (n = 42)				
Mean (SD) **p value**	56	49.0 (15.7) <0.001	41.8 (18.4) <0.001	44.4 (17.9) <0.001
Nutritionally well (Female) (n = 39)				
Mean (SD) **p value**	45	45.7 (12.9) 0.727	36.5 (15.8) 0.002	39.8 (18.6) 0.819
Nutritionally Vulnerable (Male and Female) (n = 12)				
Median (Range) **p value**	60	44.2 (54.2) 0.034	40.9 (61.3) 0.005	45.8 (65.3) 0.015

Table 4: Patients receiving ONS, hospital snacks and non-hospital food & drink

Nutritionally Well n = 81	No. of patients: n (%)	Energy and Protein Contribution	Contribution to overall intake (%)
ONS	8 (10)	1891 kJ	36
		17.8g protein	42
Hospital Snacks	29 (36)	937 kJ	18
		6.1g protein	14
Non-hospital Food & Drinks	42 (52)	1034 kJ	20
		3.6g protein	9
Nutritionally Vulnerable n = 12	No. of patients: n (%)	Energy and Protein Contribution	Contribution to overall intake (%)
ONS	3 (25)	2092 kJ	38
		15.7g protein	37
Hospital Snacks	5 (42)	875 kJ	16
		7.8g protein	18
Non-hospital Food & Drinks	10 (83)	1335 kJ	24
		4.2g protein	10



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492 **Figure 1: Percentage of patients meeting the BDA (2012) nutrient standards for energy and**
493 **protein.**

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507 **Appendix 1: Example of the 24 hour recall section of the audit tool**

Patient Number: **MUST:** **Age:**

Ward: **Gender:**

Tuesday	Patient Selection	Amount consumed				
		0%	25%	50%	75%	100%
Breakfast						
Cereal						
Fruit Juice						
Prunes in Juice						
Toast						
Preserve						
Lunch						
Steak and Mushroom Pie						
Gammon and Pineapple						
Pasta Provencale						
Plain Omelette						
Roast Pork Salad						
Egg and Cress Salad						
Sandwich of the Day						
Cut Green Beans						
Sweetcorn						
Croquette Potatoes						
Ceamed Potatoes						
Raspberry Pudding						
Rice Pudding with Nutmeg						
Jelly						
Ice Cream Dessert						
Cheese and Biscuits						
Peaches in Natural Juice						
Fresh Fruit						
Diet Yogurt						
Supper						
Fruit Juice						
Home-made Pea and Ham Soup						
Wholemeal Bread Roll						
Chicken Cheese and Bacon Bake						
Cheese and Tomato Omelette						
Plain Omelette						
Sandwich of the Day						
Mixed Bean Salad						
Peas						
Potato Wedges						
Creamed Potatoes						
Chocolate Mousse						
Jelly						
Fruit Juice						
Cheese and Biscuits						
Ice Cream Dessert						
Diet Yogurt						

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