Improving the Nutritional Intake of Hospital Patients - How far have we come? A Re-audit

Abstract

Background: Malnutrition affects up to 33.6% of hospitalised patients, with consequences detrimental for both patients and healthcare providers. In 2015, an audit demonstrated inadequate nutritional provision and consumption by hospitalised patients; a major risk factor for malnutrition. This re-audit evaluates whether patients are meeting recommended energy and protein standards and estimated individual requirements, subsequent to food service improvements since 2015.

Methods: Patients (n=111) were included from a South West hospital, and Malnutrition Universal Screening Tool scores (MUST) categorised patients as 'nutritionally well' (MUST 0) or 'nutritionally vulnerable' (MUST ≥1). Individual energy and protein requirements were estimated using weight-based equations. Nutritional intakes were assessed via 24-hour dietary recall and compared against the British Dietetic Association's *Nutrition and Hydration Digest* standards, and estimated individual requirements.

Results: In total, *the Digest* standards for energy and protein were met by 35% and 63% of patients respectively; an increase of 19% and 36% since 2015. 'Nutritionally well' patients were more likely to meet nutrient standards for protein (62%), than estimated individual requirements (30%) ($p \leq <0.001$). 'Nutritionally vulnerable' patients were more likely to meet estimated individual requirements for energy (60%), than *the Digest* standards (30%) ($p=0.047$).

Conclusions: The proportion of patients meeting *the Digest* standards has increased considerably following numerous food service changes. Nutritional training for housekeepers, energy/protein-dense snacks and drinks, and fortified dietary items may further increase nutritional intakes. Additionally, due to discrepancies between Digest standards and individual estimated requirements, more research is required to identify the most appropriate auditing standards that reflect best practice.

Key Words: Energy, Protein, Hospital, Nutrition, Malnutrition, Intake

Introduction

Malnutrition is a highly prevalent, costly and growing burden amongst hospitalised patients and the National Health Service (NHS), affecting up to 33.6% of adults aged 65 and over, and costing an estimated £19.6 billion annually [(1)]. Malnutrition refers to under-nutrition in the present context. The consequences of malnutrition are associated with increased risk of infection, mortality and impaired wound healing, resulting in longer hospital stays, higher treatment costs, frequent re-admissions and reduced quality of life [(2,3)].

Causes of malnutrition are often multifactorial [(4)] and may be disease-related or as a result of inadequate dietary intake [(5)]. Hospitalisation itself is identified as a major risk factor for inadequate dietary intake, often due to inadequate nutritional screening, nil by mouth status, missed meals for medical procedures, poor appetite, food waste, limited dietary selection or nutritional inadequacy of hospital meals [(6,7)]. Malnutrition is largely manageable and often preventable however, and has been identified as the fourth largest potential cost saving to the NHS [(1)].

With reduced dietary intake being identified as the main modifiable cause of malnutrition [(7)], provision of adequate nutrition has formed an integral part of the care process [(8)]. Furthermore, hospitals have a regulatory requirement to ensure patients meet their nutritional needs [(9)] and in response the British Dietetic Association (BDA) developed the *Nutrition and Hydration Digest* (the Digest) [(10)]; most recently updated in 2017 [(11)]. The Digest provides evidence-based guidelines for best practice for nutritional provision in hospitals. Additionally, the Digest provides auditable nutrient standards for 'nutritionally well' and 'nutritionally vulnerable' patients. Derived from Department of Health (DOH) [(12)] Dietary Reference Values and British Association for Enteral and Parental Nutrition (BAPEN) recommendations [(13)], these standards are defined in Table 1.

Clinical audits play a key role in effectively reducing hospital malnutrition by enabling measurement of care delivery against explicit standards for best practice [(14,15,16)]. Consensus of previous audits implies dietary provision in hospitals is inadequate for meeting patients' energy and protein requirements, and consequently nutritional intakes are below recommended values [(7,17,18,)]. It must be noted however, that these studies use different

auditing standards [19, 20] and as nutritional adequacy is determined by the auditing standards used, these findings are not directly comparable so generalisation is therefore limited.

In 2015, an audit was conducted in a South West hospital comparing patients' nutritional intakes against the Digest standards [10]; Pullen *et al.* [21] were the first to publish literature using these auditing standards in 2017 and will be referred to as 'the baseline audit' herein. Their results were consistent with similar studies [22,23], concluding that provision and intake of energy and protein were significantly lower than recommended standards. Following these findings, the hospital implemented major changes to food services and nutritional care including a new patient menu, ward staff training, increased snack provision and the appointment of a Food Services Dietitian (post re-audit) (Table 2).

Having critiqued the use of population averages to formulate the Digest standards, Pullen *et al.* suggest that estimating patients' individual energy and protein requirements would allow for a more valid assessment of nutritional adequacy [21]. The Digest standards are not individualised to patients and do not take into consideration age, gender, weight and clinical condition; all of which can impact on nutritional requirements. Digest standards may not always be appropriate therefore, as they may overestimate or underestimate the needs of some patients. Although there is no one optimal method, the Scientific Advisory Committee on Nutrition report increased accuracy using the Henry equation [24, 25] and recommend its' use within the UK and Europe for healthy individuals. The Henry equation is also used at an individual level when appropriate stress and activity factors are applied [26].

Unfortunately the baseline audit highlights how little appears to have changed in over a decade, with a key audit in 2000 demonstrating low nutritional intakes in a hospital failing to meet dietary recommendations [27]. In light of these findings from the baseline audit, a re-audit is essential following implementation of nutrition interventions (Table 2) to promote continuous care improvements [28]. The primary aim of this re-audit was to identify whether there have been improvements in the number of patients meeting the Digest standards [10] since 2015. The secondary aim was to determine whether patients were also meeting their estimated individual requirements for energy and protein in order to assess nutritional adequacy in the same South West hospital.

Methods

Audit data was collected in May 2017 and the methodology used was based upon that of the baseline audit to allow for comparable results [21]. This audit was compliant with the Data Protection Act [29] and was registered and approved by the NHS Hospital Trust Ethics Committee.

Participants

Participants were recruited from a convenience sample across 25 inpatient wards including care of the elderly, renal, medical, surgical, orthopaedic, stroke, gastroenterology, oncology, respiratory, gynaecology and neurology. Every 4th patient was systematically selected from a ward list to reduce selection bias and provide similar numbers to the baseline audit for comparative results. 'Malnutrition Universal Screening Tool' (MUST) [30] scores were calculated by trained ward staff and used to categorise patients as nutritionally well (MUST 0) or nutritionally vulnerable (MUST ≥1); MUST 0 indicating low risk of malnutrition and MUST ≥1 implying medium to high risk. To avoid unnecessary distress and obtain complete 24-hour recalls, patients were excluded when meeting any of the following criteria: receiving care on maternity, paediatric or critical care wards; terminally ill; barrier nursed; prescribed a special/ therapeutic diet (e.g. vegan, texture modified, gluten-free, renal); receiving enteral or parental nutrition; inpatient for less than 24-hours; incomplete MUST score; had not received three hospital meals in the previous 24-hours. Patients were also excluded if they were unable to recall a diet history for example if they were unconscious or confused (this was highlighted by nursing staff). Verbal consent was gained from all participants.

Dietary Assessment

Nutritional intakes were assessed via 24-hour dietary recall; a validated method of assessing short term energy and protein intakes [31]. For the purpose of this audit, a dietary assessment tool (Appendix 1) was developed for conducting 24-hour recalls. This was adapted from a validated tool by Budiningsari *et al.* [32] and piloted among five inpatients on a renal ward one week prior to data collection to ensure ease of use for interviewers. As the piloted tool remained unchanged, these patients were also included.

Patients were asked about consumption of breakfast that morning, lunch and evening-meal from the previous day, hospital snacks, drinks and non-hospital dietary items in the past 24

hours. Dietary intakes were then recorded as fractions of a whole portion (0, ¼, ½, ¾, all). Additionally, patients were also asked to answer 'Yes' or 'No' to being offered mid-morning, afternoon and night-time snacks and to receiving oral nutrition supplements (ONS), which was checked against fluid and drug charts. Dietary intake was also checked against food charts where available and patients receiving fortified foods were identified by housekeeping staff.

The nutritional content of hospital items was determined from a pre-analysed menu provided by the catering department, and used to estimate energy and protein intakes. Nutritional content of ONS and non-hospital items were identified from manufacturer packaging and websites. Overall intake was considered adequate if patients met 100% of the Digest standards or individual requirements (using the minimum figure were the standards specified a range).

Estimated Individual Requirements

Individual requirements were estimated using the Parental and Enteral Nutrition Group guidelines (ESPEN) [33]. Energy requirements were calculated using the Henry equation [24], with the addition of appropriate stress and activity factors. A 10% stress factor was given for infection in the absence of pneumonia and septicaemia [34] to reduce overestimation. Protein requirements were calculated from estimated nitrogen requirements [33]. In obese patients (Body Mass Index (BMI) ≥30kg/m^2) requirements were adjusted to 25% of additional body weight [33, 10] to avoid overestimation. Medical notes, nursing notes, drug and observation charts were used to identify age, sex, weight, height, temperature, blood C-reactive protein level and presenting clinical condition to determine appropriate stress factors.

Statistical Analysis

Coded data was analysed using the Statistical Package for the Social Sciences (SPSS) version 23 (IBM Corp., Armonk, NY, USA). The Digest standards [10] and individual requirements were compared against different dietary measurements including 'menu choice', 'hospital intake' and 'overall intake' (Table 3). Dietary measurements of the participants were categorised into binary variables ('Yes'/ 'No') for patients meeting the minimum Digest nutrient standards and individual requirements, and were compared against baseline audit results. Available energy and protein from snacks were compared against the Digest snack

standards, and that from supplementary items were compared with baseline audit results. Additionally, individual requirements were compared with the Digest standards [10].

Data was assessed for normality using the Shapiro-Wilk test and analysed using a one-sample t-test, to identify significant differences between dietary intake and nutrient standards. For non-normally distributed data, the non-parametric, one-sample Wilcoxon signed rank test was applied. This test was also used to analyse data for nutritionally vulnerable patients due to the small sample size (n=10) and median values were used to describe central tendency. Pearson's Chi-squared test was used to evaluate significant differences between the number of snacks consumed and the number of participants meeting the Digest standards and individual requirement. All tests were two-tailed and statistical significance was set at $P \leq 0.05$.

Results

Overall 127 participants were recruited, 16 of which were excluded for not ordering all three hospital meals, allowing for direct comparison with the baseline audit. The remaining 111 participants had a median age of 72 years (range 22-98 years) and 101 (91%) patients were considered nutritionally well and 10 (9%) nutritionally vulnerable. In total 35% (n=39) of patients met the minimum Digest energy standards and 63% (n=70) met minimum Digest protein standards, based on overall nutritional intake including ONS.

Nutritional intake and the Digest standards

Nutritional values for the different dietary measurements are shown in Table 4. Energy provision from 'menu choice' was significantly lower than the Digest standards for nutritionally well and vulnerable patients. Consequently 'hospital intake' was also significantly lower. No significant differences were observed however between overall energy intakes and the Digest standards. For protein, overall intakes of nutritionally well males and females were significantly higher than standards. The percentage of participants meeting the Digest standards within the different dietary measurements are shown in Figure 1.

Compared with the baseline audit, the number of participants meeting energy standards increased by 0.3%, 16% and 19.3% for menu choice, hospital intake and overall intake respectively. The number of participants meeting the Digest protein standards increased for menu choice by 13%, hospital intake by 28.2% and overall intake by 36%.

Nutritional intake and individual requirements

Individual energy requirements as shown in Table 5 were significantly lower (p=0.047) than the Digest standard for nutritionally vulnerable patients. For nutritionally well patients, individual protein requirements were significantly higher (p<0.001) than Digest standards. More patients (n=12) met their individual energy requirements than the Digest standards, whereas more patients (n=33) met the Digest standards for protein than their individual requirements (Figure 2). Additionally, minimum Digest standards were adequate to meet minimum individual energy requirements for 40% (n=44) participants (41% nutritionally well, 30% nutritionally vulnerable) and minimum protein requirements for 8% (n=9) participants (3% nutritionally well, 60% nutritionally vulnerable).

Overall nutritional intake

Contributions from ONS, hospital snacks, drinks and non-hospital dietary items to overall energy and protein intakes are displayed in Table 6. No patients in this cohort were ordered fortified foods by a Dietitian. For participants receiving ONS (n=7), 43% (n=3) met the Digest energy standards and 100% (n=7) met the Digest protein standards. There was no significant difference between participants receiving and not receiving ONS and meeting the Digest standards for energy (χ^2 <0.001, p=0.988) or protein (χ^2 = 1.975, p=0.160).

Snacks were offered to 91% (n=101) of patients and 74% (n=75) were offered a minimum of two snacks, as per Digest standards [10]. Of those offered snacks, 59% (n=60) consumed them and they were more likely to meet the Digest standards than those who didn't consume snacks, with 48.3% (n=29) meeting energy standards and 66.7% (n=40) meeting protein standards. Likewise, more patients met their individual energy (55%, n=33) and protein requirements (38.3%, n=23), when consuming snacks.

A significant difference was found between the number of snacks consumed and the number of patients meeting Digest energy standards ($X^2(1)=8.181$; $p=0.042$). No significant differences however were observed between the number of snacks consumed and the number of patients meeting Digest protein standards ($X^2(1)=1.568$; $p=0.667$), individual energy ($X^2(1)=2.857$; $p=0.414$) or protein requirements ($X^2(1)=0.875$; $p=0.831$).

Discussion

This re-audit demonstrates considerable increases in the proportion of patients meeting the Digest standards for energy (19.3%) and protein (36%) since the baseline audit in 2015. Contributions from ONS and snacks to overall intakes are similar to the baseline audit, whilst non-hospital items are contributing more, especially for nutritionally vulnerable patients (30% and 20% for energy and protein respectively, compared to 24% and 10% and on average providing an 83kcal and 7.2g protein compared to the baseline audit). Building on previous research, the present audit shows more patients are meeting individual energy requirements (46%) than Digest standards (35%), whereas for protein, patients are more likely to meet Digest standards (63%) than individual requirements (33%).

Overall, the findings suggest that food services improvements at this South West hospital (Table 2), in particular increased snack provision, have been effective in improving nutritional intakes and helping patients meet their nutritional requirements. Efficacy and usefulness of these interventions were not specifically measured however. With non-hospital items providing twice as much energy and protein compared with the baseline audit, it could be suggested that improvements are related to increased consumption of non-hospital items, rather than as a result of meal improvements. Although specific reasons for poor dietary intake in hospital were not explored in this audit, participants reported that consumption of non-hospital food and drink is sometimes preferred due to poor menu choice and this similar to findings by the Soil Association [(35)]. Qualitative research to explore factors affecting food choices and dietary consumption is therefore recommended to help develop a more suitable hospital menu that caters for a wider range of tastes [(36)].

The two-fold increase in patients consuming snacks may also account for the improvements seen, as statistical significance was observed between the number of snacks consumed and the percentage of patients meeting Digest energy standards. This supports the Digest recommendations for offering snacks at least twice a day to optimise intake. On average

however, snacks consumed were often low in protein (mean 4.5g ± 5.7 standard deviation) as patients tended to choose items including biscuits and cake. This could explain why no significant difference was found between increased snack consumption and patients meeting Digest standards and individual requirements for protein. Despite the implementation of higher protein snack options, participants reported that these products were not promoted or routinely offered and consequently not consumed by patients. To maximise nutrient intakes and benefits from snacks, specific training for housekeepers may be beneficial, given their responsibility for delivering snacks and drinks on the wards. Increasing the visibility/prominence of higher protein items on the snack trolleys should also be considered. In line with BAPEN recommendations [37], the dedicated Food Services Dietitian would ideally provide nutrition education and training for housekeepers to help them inform and influence patients' food choices when ordering from the menu and choosing snacks. Furthermore, this comprehensive approach may enhance self-efficacy and ownership amongst housekeepers, potentially resulting in successful implementation of nutrition interventions amongst ward staff [38,39].

Proven both clinically effective and cost effective in a hospital setting [40], ONS are widely recommended for supporting patients at risk of malnutrition [8], hence they must be utilised appropriately in nutritionally vulnerable patients. Although energy and protein content of snacks remain incomparable to that of ONS [10] the Digest emphasises the importance of using a 'food first' approach, turning the focus to other nutritional interventions. The present audit highlights the considerable contribution of hospital drinks to overall intake, with drinks (such as milk and Ovaltine in particular) providing more protein on average than snacks (additional 2.6g and 2.2g protein for nutritionally well and nutritionally vulnerable participants respectively). Increased promotion and provision of nourishing drinks could therefore be an effective 'food first' approach to improving energy and protein intakes, and in accordance with the Digest standards [10] nutritionally vulnerable patients should receive whole milk as standard.

Elsewhere in a move towards tackling hospital malnutrition, food fortification has been widely employed to increase energy and protein density of meals [40,41]. Despite the enhancements made to food services in this South West hospital, no participants were receiving fortified meals. Given that reduced appetite can result in poor meal consumption among hospitalised patients [42], research denotes that food fortification significantly

increases energy intakes without increasing food volume [43]. It could be recommended therefore that nutritionally vulnerable patients receive fortified items and high energy, high protein menu options as standard, and is implemented as part of the Trusts first line nutrition support pathway for the management of malnutrition.

Whilst overall protein intakes were compliant with Digest standards, when compared against individual protein requirements, intakes were significantly lower for nutritionally well patients; only 33% (n=37) met their individual protein requirements. Adequate protein is essential for maintaining lean body mass, muscle function and wound healing in order to improve clinical outcomes and quality of life [44, 45]. Considering this, significant differences between estimated individual protein requirements and Digest standards could suggest that the Digest standards are too low for ensuring sufficient protein nutritional status. Recent ESPEN guidelines recommend increased protein requirements of 1.0-1.2g/kg body weight/day for nutritionally well older adults and 1.2-1.5g/kg body weight/day for nutritionally vulnerable older adults [46]. It may also be considered, that use of the DOH Reference Nutrient Intake (RNI) (56g and 45g per day for males and females respectively) [12] as the Digest protein standard for nutritionally well patients, is too low for the general hospital population and that Digest protein standards for nutritionally vulnerable patients (60-75g/day) are more applicable. Following revision of the BDA Digest in 2017 [11], protein targets for nutritionally vulnerable individuals are based on PENG recommendations [33] using at least 1.1g/kg body weight/day (equating to a minimum of 66-83g), however protein standards for nutritionally well patients remain unchanged (based on 0.75g/kg body weight/day) [11].

Comparing nutritional intake against individual requirements in addition to Digest standards increases the strength of the present audit by providing a more thorough assessment of nutritional adequacy in hospitals [21]. Building on previous evidence [28], the Digest energy standard for nutritionally well patients seems appropriate for this population, seeing there was no significant difference between the standard and individual requirements. Given median individual energy requirement was significantly lower than the Digest standard for nutritionally vulnerable patients, it could be implied that the Digest standard is too high and therefore, 100% achievement is unrealistic and unnecessary to achieve nutritional adequacy. With a small sample of nutritionally vulnerable patients (n=10) however, generalisation of these findings to the rest of this population and other NHS hospitals is limited. Due to the

discrepancies found between the Digest standards and estimated individual requirements, it is recommended that further research is required to identify the most appropriate auditing standards for hospital patients.

Although improvements are apparent, in this audit only half of the sample population are met their individual requirements and so further improvements are required. Literature denotes however, that improved nutritional care does not always translate into improved nutritional intake, as patients frequently fail to consume hospital meals, snacks or ONS due to the multifactorial nature of malnutrition [47, 48]. To further enhance nutritional care, a qualitative exploration of factors impeding nutritional intake would be beneficial for addressing malnutrition in this South West hospital. A service evaluation is also recommended to explore patient satisfaction and evaluate effectiveness of the new patient menu and changes to food services, for improving clinical outcomes including weight, BMI, length of hospital stay and grip strength [49,50].

The limitations of this audit should be highlighted; nutritional assessment via 24-hour dietary recall has been linked with under-reporting of energy [51] and rarely represents typical hospital intakes [52]. Ideally meal times would have been observed however this was not practical within the time constraints of this audit; reliability and validity of overall intakes and the proportion of patients meeting both Digest standards and individual requirements are therefore reduced. This could be improved using repeat 24-hour recalls [52] although weighed food intakes would provide the most accurate results for patients meeting their nutritional requirements [7].

Whilst this audit included a large sample size, the strict exclusion criteria resulted in limited representation of the acute care population. Patients were excluded if they did not order all three hospital meals which likely impacts on the validity of the results, given this is a frequent occurrence within hospital settings. Many nutritionally vulnerable patients were also excluded for receiving therapeutic diets. This is a major limitation, as evidence shows that these diets are often nutritionally inadequate [11] and it was recently observed that only 20% of these patients were meeting energy and protein requirements [7]. To obtain a more accurate representation of patients meeting Digest standards and individual requirements, it is important for future audits to also assess the nutritional adequacy of therapeutic/special diets as a further development for addressing hospital malnutrition.

Conclusion

Considerable efforts have been made to improve food services and nutritional care at this hospital and as a result, the present audit demonstrates significant improvements in the proportion of patients meeting the Digest standards since 2015. Despite this there is still need for further improvement and consideration must be given to optimising nutritional intakes including nutritional education, training for housekeepers and providing fortified foods and high energy high protein menus as standard for nutritionally vulnerable patients. Further qualitative research is required to explore factors affecting nutritional intakes in hospital and to identify appropriate auditing standards. Finally, as a crucial part of the audit cycle, another re-audit is recommended following commencement of the Food Services Dietitian, to ensure performance improvements and enhance nutritional care quality.

Transparency Declaration

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

Tables and Figures

Table 1. BDA Nutrition and Hydration Digest definitions and standards [(11)].

	Energy	**Protein**
Nutritionally Well	**1810-2550kcal** (7573-10669 kJ)	**56g** (Male), **45g** (Female)
Normal nutritional requirements and normal appetite, OR those with a condition requiring a diet that follows healthy eating principles.	Lowest energy target based on the estimated average requirement (EAR) for women aged ≥75 years. Highest energy target based on EAR for men aged 19-59 years [(12)]	Based on reference nutrient intakes (RNI) for males and females aged 19-50 years [(12)]
Nutritionally Vulnerable	**2250-2625kcal** (9414-10983 kJ)	**60-75g**
Normal nutritional requirements but with poor appetite and/or unable to eat normal quantities at mealtimes, OR with increased nutritional needs.	Based on 1.3 to 1.5 times resting energy expenditure, for a 75kg individual [(13)]	Based on 1g/kg body weight/day, for a 60-75kg individual [(13)]

Table 2. Food service changes at a South West hospital since 2015.

- New menu with main meal at lunchtime and a lighter, bistro-style evening meal consisting of a soup, sandwich, salad, jacket potato and a hot dessert.
- Increased number of choices at lunch time, with more hot options including a roast dinner option every day.
- A new sandwich supplier providing a wider range of fillings.
- Provision of more energy-dense options
- Increased range of snacks available including cakes, scones, thick and creamy and low-fat yoghurts, biscuits, fruit pots, cheese and crackers.
- New printed menu folders displaying dietary coding including energy-dense options and information about accessing food outside of mealtimes
- Increased engagement of ward staff at mealtimes to help with meal service and assist patients
- Reinforcement of protected meal times.
- Annual 'Making Mealtimes matter' campaigns to promote quality food service and provision.
- Secured funding for a Food Services Dietitian to act as a link between dietitians, catering staff and ward teams (appointed August 2017).

Table 3. Definitions of dietary measurements [21].

Dietary Measurement	Definition
Menu Choice	Amount of energy and protein provided by hospital meals as chosen by patients, and assuming 100% consumption.
Hospital Intake	Actual consumption of energy and protein provided by hospital meals, snacks and drinks. Not including ONS.
Overall Intake	Total consumption of energy and protein from hospital meals, snacks, drinks and non-hospital dietary items. Not including ONS.
Non-hospital dietary items	Any dietary items not provided by hospital meals/drinks/snacks on inpatient wards. Includes items at the hospital accessible to the general public including shops, restaurants and cafeterias.

Table 4. Comparison of energy and protein consumption against minimum Digest standards

	Digest Standard	Menu Choice	Hospital Intake	Overall Intake
Energy (kcal/kJ)				
Nutritionally Well (n=101) (Male and Female)				
Mean (SD)	1810	1359 (379)	1453 (549)	1704 (745)
Min to Max		599 to 2630	403 to 4050	542 to 5237
p-value		<0.001	<0.001	0.269
Nutritionally Vulnerable (n=10) (Male and Female)				
Median	2250	1147	1280	1792
Min to Max		437 to 1950	777 to 1981	1272 to 2911
p-value		0.005	0.007	0.093
Protein (g)				
Nutritionally Well (n=43) (Male)				
Mean (SD)	56.0	52.4 (16.6)	55.8 (19.9)	63.0 (26)
Min to Max		16.7 to 106.4	19.8 to 130	22.6 to 152
p-value		0.497	0.365	0.021
Nutritionally Well (n=58) (Female)				
Mean (SD)	45.0	47.6 (15)	46.5 (18)	50.6 (20)
Min to Max		19.0 to 102.5	11.9 to 113.6	11.9 to 114.6
p-value		0.079	0.139	0.006
Nutritionally Vulnerable (n=10)(Male and Female)				
Median	60.0	42.9	43.4	52.5
Min to Max		6.9 to 58.9	12.9 to 70.8	25.9 to 78.1
p-value		0.009	0.047	0.333

Note. SD = standard deviation, (g) = grams, (kcal) = kilocalories, (kJ) = kilojoules, *P* = probability, n = number

Figure 1. Percentage of participants meeting Digest standards for energy and protein: a comparison with the baseline audit [(21)].

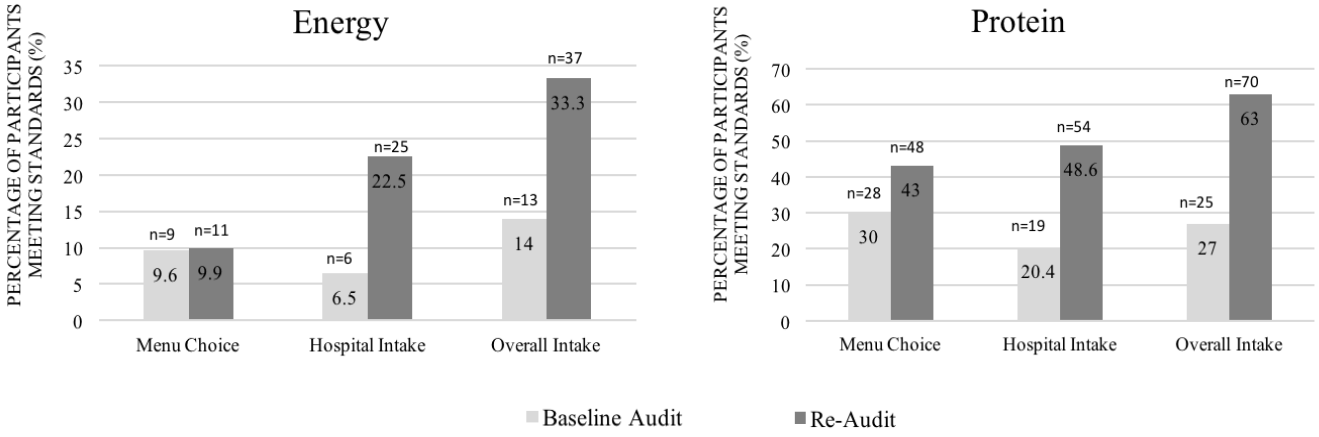

Table 5. Proportion of participants meeting Digest standards for energy and protein compared with individual requirements (based on overall intakes including ONS).

	ENERGY (kcal)			PROTEIN (g)		
	Estimated individual requirements ***Mean (SD) / Digest Standards***	**Meeting Digest Standards** ***n (%)***	**Meeting Estimated Individual Requirements** ***n (%)***	**Estimated individual requirements** ***Mean (SD) / Digest Standards***	**Meeting Digest Standards** ***n* (%)**	**Meeting Estimated Individual Requirements** ***n (%)***
Nutritionally Well (n=101)	1821 (321) / 1810 - 2250	36 (36)	45 (45)	72.4** (14) / 45 – 56	63 (62)	30 (30)
Nutritionally Vulnerable (n=10)	1848* (455) / 2250 - 2625	6 (60)	3 (30)	63.4 (19) / 60 - 75	7 (70)	7 (70)
Total Patients (n=111)	1823 (332)	39 (35)	51 (46)	71.6 (15)	70 (63)	37 (33)
Note. Significance (*p*-value) when estimated individual requirements were compared against the Digest standards: *p=0.047 **p<0.001						

Figure 2. Percentage of participants meeting the Digest standards compared to estimated individual requirements.

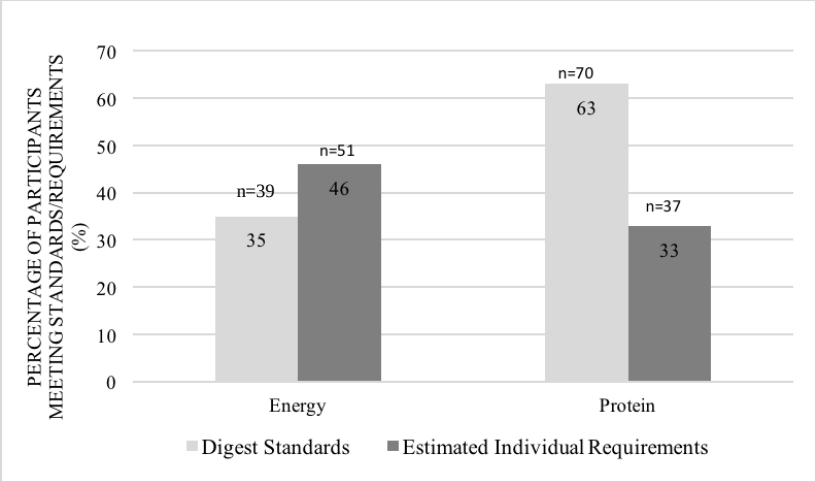

Table 6. Percentage of patients receiving supplementary items, mean nutrient content of items consumed and their contribution to overall intake.

	Patients receiving dietary items *n (%)*	**Mean nutrient content**	**Contribution to overall intake *(%)***
Nutritionally Well (n=101)			
ONS	4 (4)	394kcal 13.7g Protein	28% 27%
Hospital Snacks	52 (51)	283kcal 4.5g Protein	15% 7%
Hospital Drinks	100 (99)	171kcal 7.1g Protein	10% 13%
Hospital Snacks (including Drinks)	100 (99)	327kcal 9.6g Protein	18% 17%
Non-hospital Food/Drinks	62 (61)	409kcal 9.0g Protein	19% 12%
Nutritionally Vulnerable (n=10)			
ONS	3 (30)	700kcal 31.0g Protein	37% 67%
Hospital Snacks	8 (80)	194kcal 4.5g Protein	10% 7%
Hospital Drinks	9 (90)	274kcal 6.7g Protein	12% 11%
Hospital Snacks (including Drinks)	8 (80)	402kcal 9.6g Protein	20% 15%
Non-hospital Food/Drinks	8 (80)	640kcal 11.4g protein	30% 20%

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Appendices

Appendix 1. Example of the Dietary Assessment Tool, including PENG guidelines (2011) and the equations for calculating estimated individual requirements.

24 HOUR RECALL SHEET - MONDAY pm TUESDAY am

Pt Code _____ Ward _____ Sex: M / F Age: _____

MUST: _____ Weight: _____ kg Height: _____ m BMI: _____kg/m^2

Henry Equation (Henry, 2005)

Gender	Age	kcal/day	Gender	Age	kcal/day
Male	18-30	16.0W + 545	Female	18-30	13.1W + 558
	30-60	14.2W + 593		30-60	9.74W + 694
	60-70	13.0W + 567		60-70	10.2W + 572
	70+	13.7W + 481		70+	10.0W + 577

Est. BMR: (_____ x _____kg) + (_____ x _____m) + _____ = _____kcal

Protein Requirements

		Nitrogen g/kg/day
Normal (no stress factor)		0.14 – 0.20
Stress Factor	5 – 25%	0.17 – 0.25
	25 – 50%	0.20 – 0.30
	> 50%	0.25 – 0.35
Liver	Comp.	0.19 – 0.20
	Decomp	0.20 – 0.25
	Post-transplant	0.20 - 0.25
Renal	CKD St 4-5 (no RRT)	0.75-1.0g protein/kg
	CKD St. 4-5 (HD/PD)	1.2g protein/kg
	AKI (no RRT)	1g protein/kg
	AKI (on HD)	1.2g protein/kg

Activity/DIT factor: Sedated and ventilated 0% Bed bound immobile 10% Bed bound mobile/sitting 15-20% Mobile on ward 25%

Stress factors: Stroke: Haemorrhagic 30% Ischaemic 5% COPD: 15 - 20% _____ Infection: 10% Sepsis 25% IBD: 0 - 10% _____

Brain Injury – Recovery 5 - 50% _____ Solid tumour: 0- 20%_____ Lymphoma: 0 – 25% _____ Surgery – uncomplicated 5 – 20% _____

Liver disease: Compensated. 0 – 20% ____Decompensated. 30 – 40% ____ Post-transplant 30%

Est. Energy Req: BMR _____ x (AF/DIT_____ + SF_____) = _____ **kcal/day**

Est. Protein Req: _____N_2 x _____kg X 6.25 = _____ **g/day**

Food Record Chart YES/NO
Fortified Menu YES/NO

	None	¼		½		¾		All		TOTALS	
		kcal	protein	kcal	protein	kcal	protein	kcal	protein	kcals	protein
BREAKFAST											
Fruit Juice	-	15	-	30	-	45	-	60	1		
Fresh Fruit Pot	-	19	-	37	-	56	-	75	0		
Prunes	-	24	-	48	-	72	-	95	0.8		
Fruit Yoghurt (low fat)	-	24	0.7	47	1.3	71	2	94	2.6		
Cereal with milk:											
Cornflakes	-	38	1.0	75	2.0	113	3.0	150	5.0		
Shredded Wheat	-	32	1.0	65	2.0	97	3.0	130	6.0		
Fruit & Fibre	-	48	1.0	95	2.0	143	4.0	190	7.0		
Ready Brek	-	42	2.0	83	3.0	125	5.0	165	6.0		
1 Weetabix (+67kcal + 2.3g for 2)	-	28	1.0	57	2.5	85	3.5	113	5.0		
Toast with Butter	-	25	0.8	50	1.5	75	2.3	100	3.0		
Toast with Butter & Jam	-	31	0.8	63	1.5	94	2.3	125	3.0		
MID-MORNING SNACK	Offered YES / NO										
Fruit: Banana	-	20	-	40	0.5	60	0.8	80	1.0		
Apple	-	15	-	30	0.5	45	0.8	60	1.0		
Biscuits	-	45	-	90	1.0	135	2.0	180	3.0		
Cake: Madeira	-	58	0.8	115	1.6	173	2.4	230	3.2		
Lemon	-	73	0.8	145	1.3	218	2.1	290	2.6		

Scone	-	54	1.1	108	2.1	162	3.3	215	4.1		
and Butter	-	13	0	26	0	39	0	52	0		
Yoghurt:											
Thick and Creamy	-	55	0.9	110	1.8	165	2.6	220	3.5		
Low fat	-	24	0.7	47	1.3	71	2	94	2.6		
Cheese and Crackers	-	47	1.5	93	2.9	140	4.2	185	5.7		
LUNCH											
Steak & Mushroom Pie	-	120	4.3	240	8.5	360	12.8	479	17		
Chicken & Gravy	-	40	6.3	79	12.5	119	18.8	158	25		
Sausage Casserole	-	90	4.3	180	8.5	270	12.8	359	17		
Cauliflower Cheese	-	73	3.0	146	6.0	218	9.0	291	12		
Tuna Pasta Bake	-	74	3.8	149	7.5	223	11.3	297	15		
Omelette	-	47	2.7	94	5.3	141	8.0	188	10.5		
Veg: Green beans	-	5	-	10	-	15	-	20	1.3		
Vegetable Mash and Swede	-	10	-	19	0.5	29	0.8	38	1.0		
Potatoes:											
Roast	-	32	-	63	1.2	95	1.8	126	2.3		
Creamed	-	30	-	59	0.9	89	1.3	118	1.7		
Salad:											
Ham	-	25	2.8	50	5.5	75	5.3	99	10.9		
Cheese	-	65	3.9	129	7.8	194	11.7	258	15.5		
Chicken	-	40	7.2	79	14.3	119	21.5	158	28.5		
Turkey	-	22	2.3	43	4.6	65	6.9	86	9.2		
LUNCH - DESSERT											
Fruit salad	-	19	-	37	-	56	-	75	0		
Raspberry Dessert	-	38	0.8	76	1.6	114	2.4	152	3.2		
Jelly	-	25	-	50	-	75	-	100	-		
Ice cream	-	20	-	40	0.7	60	1.0	80	1.5		
Cheese and crackers	-	47	1.5	93	2.9	140	4.2	185	5.7		
Yoghurt:	-										
Thick & Creamy		55	0.9	110	1.8	165	2.6	220	3.5		
Low Fat		24	0.7	47	1.3	71	2	94	2.6		
	None	**¼**		**½**		**¾**		**ALL**		**TOTALS**	
		kcals	**protein**	**kcals**	**protein**	**kcals**	protein	kcals	**protein**	**kcals**	**protein**
MID-AFTERNOON SNACK	Offered YES/NO										
Fruit: Banana	-	20	-	40	0.5	60	0.8	80	1.0		
Apple	-	15	-	30	0.5	45	0.8	60	1.0		
Biscuits	-	45	-	90	1.0	135	2.0	180	3.0		
Cake: Madeira	-	58	0.8	115	1.6	173	2.4	230	3.2		
Lemon	-	73	0.8	145	1.3	218	2.1	290	2.6		
Scone	-	54	1.1	108	2.1	162	3.3	215	4.1		
and Butter	-	13	0	26	0	39	0	52	0		
Yoghurt: Thick and Creamy	-	55	0.9	110	1.8	165	2.6	220	3.5		
Low fat	-	24	0.7	47	1.3	71	2	94	2.6		
Cheese and Crackers	-	47	1.5	93	2.9	140	4.2	185	5.7		
EVENING MEAL											
Soup: Pea and Ham	-	23	1.0	47	1.8	70	2.7	93	3.6		
Tomato	-	18	-	36	0.7	54	1.0	72	1.4		
Roll	-	20	0.5	40	1.0	60	1.5	80	2		
Butter	-	13	-	26	-	39	-	52	-		
Sandwich: Ham Salad	-	72	4.0	144	8.0	216	12.0	287	16.1		
Tuna Mayonnaise	-	86	4.5	171	9.0	257	13.5	342	17.9		
Chicken Mayonnaise	-	85	4.0	170	8.0	255	12.0	339	15.9		
Egg Mayonnaise	-	86	3.4	171	6.8	257	9.2	342	13.5		
Cheese and Pickle	-	100	4.0	200	8.0	300	12.0	399	15.9		
Salad: Ham	-	25	2.8	50	5.5	75	5.3	99	10.9		
Cheese		65	3.9	129	7.8	194	11.7	258	15.5		
Tuna		40	7.2	79	14.3	119	21.5	158	28.5		
Turkey		22	2.3	43	4.6	65	6.9	86	9.2		
Jacket Potato: Plain	-	83	2.3	165	4.5	248	6.8	330	9		
Coronation chicken	-	44	1.3	88	2.5	132	3.8	176	5		
Cheese	-	73	4.5	145	9.0	218	13.5	290	18		
Cottage Cheese	-	28	3.3	55	6.5	83	9.8	110	13		
Tuna	-	31	7.5	62	15	93	22.5	124	30		
+ Butter		13	-	26	-	39	-	52	-		
EVENING MEAL - DESSERT											
Rhubarb Crumble	-	64	1.0	129	1.9	193	2.9	257	3.8		
and custard	-	38	1.0	75	2.0	113	3.0	150	4.0		
Rice Pudding	-	40	1.1	80	2.1	120	3.2	160	4.2		
Pears in natural juice	-	15	-	30	-	45	-	60	-		
and custard		38	1.0	75	2.0	113	3.0	150	4.0		
Jelly	-	25	-	50	-	75	-	100	-		
Ice cream	-	20	-	40	0.7	60	1.0	80	1.5		

Cheese and crackers	-	47	1.5	93	2.9	140	4.2	185	5.7		
NIGHT TIME SNACK	Offered YES / NO										
Sandwich from EM (fill above)	-										
Fruit: Banana	-	20	-	40	0.5	60	0.8	80	1.0		
Apple	-	15	-	30	0.5	45	0.8	60	1.0		
Biscuits	-	45	-	90	1.0	135	2.0	180	3.0		
Cake: Madeira	-	58	0.8	115	1.6	173	2.4	230	3.2		
Lemon	-	73	0.8	145	1.3	218	2.1	290	2.6		
Scone	-	54	1.1	108	2.1	162	3.3	215	4.1		
+ Butter	-	13	0	26	0	39	0	52	0		
Yoghurt: Thick and Creamy	-	55	0.9	110	1.8	165	2.6	220	3.5		
Low fat	-	24	0.7	47	1.3	71	2	94	2.6		
Cheese and Crackers	-	47	1.5	93	2.9	140	4.2	185	5.7		
Drinks											
Fruit Juice x _____	-	15	-	30	-	45	-	60	1		
Glass of Milk (s/s) x _____	-	18	1.0	35	2.0	53	3.0	70	5		
Tea/Coffee with milk x _____	-	5	-	10	-	15	0.8	20	1		
Ovaltine x _____	-	54	3.0	109	6.0	163	9.0	218	11		
Hot Chocolate with s/s x _____	-	45	2.0	90	4.0	135	6.0	180	8		
Total sugars x _____ tspns	-	16 (1)	-	32 (2)	-	48 (3)	-	64 (4)	-		

ONS **YES/NO**. If yes, type _____ Prescribed: OD / BD / TDS / QDS Amount taken _____

Non-hospital foods/other:_____
_____
_____
_____
_____

TOTALS	**Available Energy (kcals)**	**Available Protein (g)**	**Actual Energy Intake (kcals)**	**Actual Protein Intake (g)**
Hospital menu/meal choices				
Hospital snacks provided				
Hospital drinks				
ONS prescribed				
Non-hospital food/drink	----------	----------		