Investigating the Nutrition Dashboard's ability to identify malnutrition in a large rural hospital

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Abbreviations

LHD – Local Health District

ACI – Agency for Clinical Innovation

MFC – My Food Choice

LOS – Length of Stay

FSS – Food Service Suite

ARRH – Armidale Rural Referral Hospital

MST – Malnutrition Screening Tool

LNV – Low Nutritive Value

BMI – Body Mass Index

PG-SGA – Scored Patient Generated Subjective Global Assessment

Table of Contents

Abstract

Background and Aims: Malnutrition is a highly prevalent, burdensome, and costly health issue that is under identified and therefore under managed, especially in the acute health care setting. Furthermore, even though rural populations experience poorer health and healthcare access, research on malnutrition in rural inpatient settings is limited. The Nutrition Dashboard is a unique interactive nutrition technology platform that presents comprehensive food provision and intake data from patients admitted in at least 48 NSW Health inpatient sites. The Nutrition Dashboard utilises this data to categorise patients' nutrition risk. To the authors knowledge the Nutrition Dashboard has not been researched to date. This study aims to identify the ability of the Nutrition Dashboard to identify malnutrition compared to the validated Malnutrition Screening Tool (MST).

Methods: A retrospective observational study (June 2020 to August 2020) was conducted at the 99-bed Armidale Rural Referral Hospital, utilising demographic and clinical data extracted from medical notes and food intake data presented via the Nutrition Dashboard. The Inter-Rater Reliability (IRR) of food intake estimation (proportion consumed) was assessed. Default nutritional adequacy thresholds of 4500kJ and 50g protein were applied for daily food intake. Generalised estimating equation regression models were used to identify the association between the Nutrition Dashboard risk categories and the MST, with and without controlling for patient demographics.

Results: The pre-audit IRR assessment showed there was good agreement between raters across 912 meal items for the amount of food consumed ($\kappa = 0.69$, 95% CI .65-.72, $p < 0.001$). Analyses of data from 216 individuals for 1783 hospital admission days found that those in the highest risk Nutrition Dashboard Category were 1.93 times more likely to have a MST score indicating malnutrition risk compared to the lowest risk Nutrition Dashboard Category (unadjusted odds ratio 1.93, 95% CI, 1.17-3.19, $p<0.01$). However, when patient weight was added to the model, the relationship between Nutrition Dashboard and MST malnutrition risk categories was no longer significant. A higher body weight reduced the likelihood of malnutrition risk as measured by the MST (adjusted OR 0.97, 95% CI 0.96-0.99, $p = 0.006$).

Challenges: This preliminary investigation of the Nutrition Dashboard confirms the complexity of investigating a nutrition intake technology but suggests that it can play a role in improving malnutrition identification.

Implications: The Nutrition Dashboard has potential clinical applications that extend beyond food service scope. Further adaptions could improve the use of the Nutrition Dashboard to support identification of malnutrition and therefore improve the care of patients within NSW Health Facilities.

Keywords: hospital malnutrition; technology; food intake monitoring; informatics; health information technology

Executive Summary

Malnutrition is experienced by around 40% of people admitted to Australian hospitals, it negatively impacts on all aspects of an individual's health and has very costly implications to Health Services. Malnutrition Screening is recommended in all NSW Health facilities but is completed poorly due to time constraints.

The Nutrition Dashboard is a new nutrition technology developed by HealthShare NSW in collaboration with NSW Health dietitians. It provides unprecedented amounts of nutrition data to dietitians, the health professionals who are most responsible for managing malnutrition. The clinical use of the Nutrition Dashboard had not previously been investigated.

This research found that the Nutrition Dashboard can play a role in the identification of Malnutrition. Ongoing investment in the development and adaptation of the Nutrition Dashboard technology could improve the identification and management of Malnutrition in NSW Health facilities in accordance with the NSW Health Nutrition Care Policy. The implications of this research include improvements to clinical care, efficiencies in food service, and associated cost savings

Introduction

Malnutrition is a serious, burdensome and costly health problem. Research shows that individuals at risk of or experiencing malnutrition in the hospital setting is around 40% (1). Malnutrition in hospitals results in significant negative health outcomes for individuals including increased length of stay (LOS) complications and morbidity and mortality (1).

Malnutrition also has serious financial implications for hospitals. Coding for diagnosed pre-existing malnutrition has the potential to provide activity-based funding. Many hospitals are missing out on funding due to the inadequate detection and diagnosis of malnutrition (2). Hospitals are penalised for malnutrition that occurs during a hospital admission. Patients experiencing hospital-acquired malnutrition remain in hospital for 21.3 days longer on average than those without this hospital-acquired complication (3). The national average cost per admitted acute overnight stay is $2,074.6 each hospitalisation with hospital acquired malnutrition may therefore be associated with approximately $44,176 in extra costs (3).

The delivery of adequate and appropriate food in hospital settings is a primary strategy to avoid hospital acquired malnutrition. Timely access to accurate food intake data in the clinical setting allows for the identification of inadequate nutrition provision and therefore increased risk of malnutrition.

Situation

In 2017 NSW Health in association with the Agency for Clinical Innovation (ACI) and HealthShare NSW directed the implementation of the My Food Choice food service model. The My Food Choice project aimed to 'reimagine' the provision of food to patients in NSW Health hospitals and inpatient facilities. The project aimed to reduce costs and improve the functionality of food service in NSW Health

hospitals as well as improving nutrition outcomes. It was hypothesised that enabling meal ordering closer to meal delivery time would improve food intake. A feature of the My Food Choice model is the collection of comprehensive food intake data at the end of meal times by food service staff.

The food intake data collected by food service staff as a part of the My Food Choice project is currently presented to dietitians through the Nutrition Dashboard at 47 NSW Health facilities with a total 8 230 beds. The Nutrition Dashboard is a health information technology that was developed by HealthShare NSW in collaboration with NSW Health Clinical Dietitians. The Nutrition Dashboard visualises trends in patient ordering and intake, and categorises patients according to nutrition risk.

Background

Investigations into the role of the Nutrition Dashboard in the clinical setting are limited and have been explored mostly in local health facility quality assurance projects. This research project was designed to determine the Nutrition Dashboard's ability to accurately predict malnutrition risk. The findings of the research were intended to inform future practice in order to improve the health outcomes of NSW Health patients.

Assessment

Research conducted at Armidale Rural Referral Hospital audited 216 patient admissions for a total of 1783 (1775 with complete data) days. Statistical analyses of this data found that the highest risk Nutrition Dashboard Category (Category one) was almost twice as likely as the lowest risk Nutrition Dashboard Category (category four) to be associated with an increased risk of malnutrition ($p<0.01$).

Recommendations

For the ongoing development of the Nutrition Dashboard:

- Consider streamlining the data collection process by removing food items which contribute only minimal nutritional value (appendix four)
- Investigate the feasibility of the inclusion of appetite and weight trend questions in the data collection process
- Evaluate the efficacy and safety of routine high energy, high protein diets for those identified at risk by the Nutrition Dashboard

Clinical implications for dietitians:

- Consider the Nutrition Dashboard in triaging referrals
- Utilise data included in the Nutrition Dashboard, alongside clinical judgement of dietitians in the nutrition care of patients admitted at relevant sites
- Reconsider requesting food intake charts (burdensome to nursing staff) at sites with access to the Nutrition Dashboard

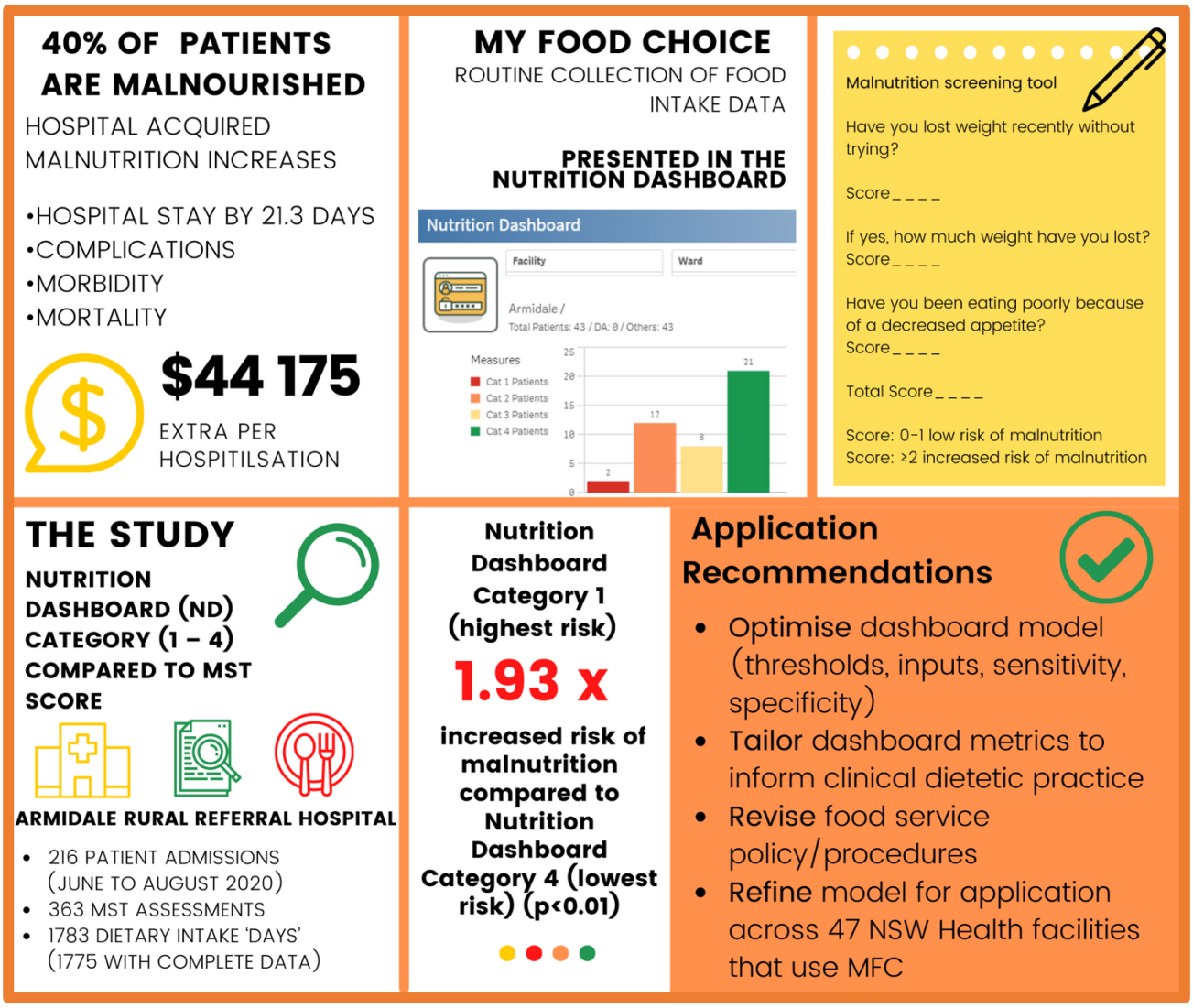
For the executive of NSW Health:

- Compare the cost of inadequate malnutrition screening and identification, as well as the Activity Based Funding implications of Hospital acquired malnutrition and investment in an enhanced nutrition workforce (dietitians, allied health assistants and nutrition focussed food service hours)

- Liaise with HealthShare NSW and the ACI regarding collaborative research project with data from 47 MFC hospitals
- Investigate the Nutrition Dashboard's alignment and role within the Nutrition Care Policy

For researchers:

- Disseminate findings of this study through publication and presentations to increase awareness of the functions and applications of the Nutrition Dashboard
- Further investigation into the accuracy and clinical application of the Nutrition Dashboard using increased datasets and additional thresholds



Introduction

The provision of appropriate food to people admitted to hospitals is a primary strategy to prevent and manage malnutrition in the acute care setting. HealthShare NSW in collaboration with NSW Health has undertaken the transformation of meals provided in many of its hospitals, multipurpose services and mental health facilities (excluding Far West LHD). My Food Choice (MFC) is the result of a NSW Health Agency for Clinical Innovation (ACI) project to 'reimagine the provision of food to patients in public hospitals' (4). The MFC project aims to centre the provision of meals on the patient and their nutrition needs (4). MFC utilises new foodservice ordering and preparation technology to enable the ordering of food closer to the time of delivery, therefore delivering food choices that are 'more suited to the patient's immediate levels of wellness and hunger' (4). As well as significantly decreasing the time from ordering to delivering meals to hospital patients, the MFC project also aims to increase the variety of meals available to patients receiving care in NSW health facilities. Across NSW Health, 47 sites with a total of 8 230 hospital beds have implemented the MFC project, including Armidale Rural Referral Hospital (ARRH) which 'went live' with MFC in late 2018.

An important outcome of the MFC project is increased availability of nutrition intake data of patients admitted to hospital. As a result of the increased technology that MFC utilises, dietitians working at MFC sites can access comprehensive food consumption data for patients staying at NSW Health MFC sites for three days or longer. The data is collected at the end of each mealtime by trained food service staff who visually estimate the amount of food eaten by each patient and record this on food service software (appendix one for further detail). The data is accessible to MFC site dietitians via the Nutrition Dashboard web-based program. The Nutrition Dashboard, 'a world first in nutrition analytics', (5) provides dietitian users with detailed nutrition data which was unavailable under previous food service models.

Nutrition Dashboard data includes, but is not limited to, daily intake of key nutrients, trends in consumption and food and ordering preferences in an easily accessible, interactive format. The ordering and delivery of food in NSW Health Hospitals is coordinated through CBORD Food Service Suite (FSS) software (appendix two). The Nutrition Dashboard interfaces with CBORD FSS data to present ordering and consumption data. The Nutrition Dashboard has a system for categorising patients according to nutrition risk by comparing their consumed energy and protein with an adjustable threshold (appendix three). The aim of the Nutrition Dashboard is to increase the amount of accurate information available to dietitians to improve the care of clients admitted to their facilities. Whilst it is important to acknowledge that the data does have limitations, it presents an opportunity for dietitians working in MFC sites to transform their nutrition care of NSW Health patients to improve nutrition outcomes and patient health.

It is well established that individuals living in regional, rural and remote locations experience poorer health than their city counterparts (6). Research that compares the prevalence of malnutrition in rural Australia compared to metropolitan areas is limited (7). A 2020 study found that 70.4% of people seen by a rural dietitian were diagnosed with malnutrition (7). The Armidale Regional Referral Hospital is a 99-bed facility which includes medical, surgical, high dependency unit, maternity, paediatric wards as well as day surgery, oncology and haemodialysis units. Investigating the Nutrition Dashboard at ARRH allows a broad representation of relevant patient groups in a hospital where MFC and the Nutrition Dashboard are embedded as standard process. The findings of this research will be used to make

recommendations to inform health service practice, with a broader goal of improving the management of malnutrition in NSW Health hospitals, including rural hospitals which have reduced access to dietitian (allied health) assistants and dietitians in general.

Background

Malnutrition has no universally accepted definition but is regularly used to describe a state of undernutrition, which is a major contributor to poor health (8). Malnutrition is highly prevalent in health care settings (1, 9-11). Australian studies indicate that the prevalence of malnutrition in acute hospital settings is around 40%, this is also mirrored in international studies (1, 11). Malnutrition is associated with several adverse outcomes including decreased immunity, compromised wound healing, loss of muscle mass, longer lengths of hospital stay, increased treatment costs and increased mortality (12). Research indicates that patients experiencing malnutrition have increased rates of morbidity and mortality, a study of 469 individuals found a 27% increase in complications and more than two and a half times increased mortality rate for the malnourished when compared to well-nourished individuals (13). Despite the significance of malnutrition on the patient and health care system it remains inadequately identified, diagnosed and managed.

Malnutrition screening

As well as being a serious health issue, malnutrition is under-identified, which contributes to poorer health outcomes for the individual and increased costs to health care intuitions (1, 8). Universal malnutrition screening is commonly recommended as best practice for acute care settings (3, 14). Validated malnutrition screening tools have been developed to identify people suffering or at risk of malnutrition. These tools are largely designed to be quick and simple to use with minimal training. A systematic review of existing malnutrition (undernutrition) screening tools for adults found that of six validated tools to screen for malnutrition, none of the tools had high validity, agreement, and reliability supported by Grade I evidence (14). The systematic review recommended the Malnutrition Screening Tool (MST) be implemented in healthcare settings as it exhibited moderate validity, agreement, and reliability based on *Good/Strong* (Grade I) evidence (14). The MST (Figure 1) is a three-question tool which has been designed to be simple and timely to complete (15). A MST score of two or more indicates an increased risk of malnutrition and

Malnutrition Screening Tool

- Have you lost weight recently without trying?
  - No 0
  - Unsure 2 Score____
- If yes, how much weight (kg) have you lost?
  - 1-5 1
  - 6-10 2
  - 11-15 3
  - >15 4
  - Unsure 2 Score____
- Have you been eating poorly because of a decreased appetite?
  - No 0
  - Yes 1 Score____

Total Score____

Score: 0-1 low risk of malnutrition

Score: ≥2 increased risk of malnutrition

Figure 1: Questions and scoring of The Malnutrition Screening Tool – a validated screening tool for malnutrition

recommends referral for further investigation. NSW Health's Nutrition Care Policy mandates the compulsory screening of all individuals admitted to NSW Health facilities, the policy recommends the use of MST for all adult patients admitted to acute, rehabilitation, residential and mental health facilities (16).

Impact of inadequate identification of malnutrition

Best practice guidelines recommend the routine screening of malnutrition in all hospitals using a validated screening tool however evidence shows that this is not routinely implemented due to factors including time restraints and decreased awareness and education (10). Research has shown that in populations where as many as 40% of people were malnourished and a further 21% were at risk of malnutrition only around 20% of this population were adequately identified (1).

The effective identification of malnutrition is important in improving health outcomes for individuals, it also poses considerable financial implications for hospitals. The diagnosis and subsequent documentation of malnutrition in the acute care setting has the potential to attract funding through an activity-based model (2). A study in an Australian tertiary hospital that averaged 1938 separations per month found that in a sample of 189 patients, 52% of them were diagnosed with malnutrition according to the Scored Patient Generated Subjective Global Assessment tool (PG-SGA). Coding data and extrapolated funding data found that in this hospital inadequate screening and documentation of malnutrition had contributed to an estimated missed $8.5 million annually for their hospital population (2). Additionally, malnutrition that develops during a hospital admission poses financial implications. During 2015 the rate of hospital-acquired malnutrition in Australian hospitals was 12 per 10,000 hospitalisations (3). Patients experiencing hospital-acquired malnutrition remain in hospital for 21.3 days longer on average than those without this hospital-acquired complication (3). The national average cost per admitted acute overnight stay is $2,074.6 each hospitalisation with hospital acquired malnutrition may therefore be associated with approximately $44,176 in extra costs (3).

Best practice guidelines identify dietitians as the health professional's best equipped to manage malnutrition. In the acute care setting the referral of a patient at risk of or experiencing malnutrition to a dietitian relies usually on other health professionals identifying the patient at risk and then initiating the referral. The suboptimal screening of malnutrition and reliance on third parties for referrals for dietetic management of malnutrition all contribute to an increased risk of poor management of malnutrition (17, 18).

Food intake records and malnutrition screening

The Nutrition Dashboard presents food and dietary intake data, which provides important insights into the nutrition status of people admitted to hospital. Food intake is traditionally assessed in hospitals using patient recall or food intake records completed by healthcare staff. These methods are prone to substantial error through inaccurate reporting (19-21). Plate waste audits are regularly used in nutrition research in the acute care hospital setting. Plate waste studies have identified important associations between plate waste and health outcomes. A 2017 study discovered a link between increased plate waste in the hospital setting and an increased risk of hospital acquired malnutrition (22). A 2014 study also found a positive association between increased plate waste and increased length of hospital stay (23). A study utilising a plate waste audit identified a link between decreased

intakes in people prescribed therapeutic diets (24). Plate waste studies are usually conducted by weighing the remaining food from patients' meals. Alternative methods for estimating plate waste that have been trialled in the hospital setting including visual estimation, photography and patient reported intake (25-28). Each of these alternative methods for estimating intake and plate waste were acceptably accurate, with one study reporting 90% accuracy and another a 1.5g discrepancy for each component of a meal (27, 29).

Technology, dietary assessment and malnutrition

The use of technology in the healthcare setting is becoming increasingly commonplace. This growth in technology has occurred in many aspects of health care including, but not limited to, electronic medical records, patient journey boards, biochemistry monitoring and support services such as food service. These technologies have large scale data sets with the potential to cultivate evidence and inform practice (30). Research indicates that health professionals, including dietitians, routinely access data to complete daily tasks and are comfortable in doing so (30, 31). Australian research found that dietitians agree to strongly agree that they utilise data and technology to problem solve and to inform decision making (31). The same research found that dietitians believe that technology can improve time management and access to data however they were less likely to report that technology could positively impact patient safety, quality of care and lead to a reduction in medical errors (30, 31).

The exponential increase in available and accessible data has seen the emergence of healthcare dashboards (32, 33). Healthcare dashboards aim to visualise patient data in order to improve care and outcomes (32, 33). Healthcare dashboards can be utilised at a facility level for patient care, at a public health level for monitoring of specific health conditions or complications or for more global surveillance (34). A study of the implementation of a health dashboard in the nutrition care of head and neck cancer patients in combination with weekly multi-disciplinary team meetings demonstrated improved process and clinical outcomes (35). The dashboard detailed in the study did not include food intake data but used a traffic light colour coded system to highlight weight loss and nutrition status change, as measured by the Scored Patient Generated Subjective Global Assessment (PG-SGA) (a validated malnutrition diagnostic tool for cancer patients). An unpublished Quality Assurance project undertaken at Belmont Hospital investigated malnutrition and the NSW Health, Health Share Nutrition Dashboard. The project found that a higher risk Nutrition Dashboard Category (categories one and two) was associated with a MST score greater than two, 77% of the time in geriatric, acute medical and sub-acute areas, but only in 8-37% of acute surgical patients across a total of 406 patients (36).

The assessment of food intake is a primary component of the assessment of malnutrition risk. There is increasing research regarding innovative technologies to assess food intake. To date, research indicates that these novel diet assessment technologies are valid at the population but not at an individual level (19). Research pertaining to the use of technology in the identification of malnutrition in hospitals is limited, however, initial studies indicate that the use of technology can assist in the identification and management of malnutrition (37). Evidence surrounding nutrition intake monitoring tool technology (such as the Nutrition Dashboard) is particularly limited due to the need for hospital expenditure and infrastructure to implement them.

Rationale

The Nutrition Dashboard and malnutrition

Malnutrition is highly prevalent, burdensome, and costly health issue that is under identified and therefore under managed especially in the acute health care setting. Global malnutrition screening using a validated tool (such as the MST) can reliably identify malnutrition risk (14). Despite best practice guidelines, policy review and ongoing research and education routine malnutrition screening and identification remains inadequate (8, 10, 38). Research demonstrates that inadequate food intake is associated with increased malnutrition risk (19). Traditionally, food intake records are completed by nursing staff and are frequently inaccurate due to them being incomplete. The Nutrition Dashboard presents detailed food intake data. The Nutrition Dashboard presents this data to dietitians who have been identified as the key health professionals for the management of malnutrition. By validating the Nutrition Dashboards accuracy in identifying patients at risk or experiencing malnutrition it presents an opportunity for dietitians to recognise individuals requiring nutrition intervention without reliance on third parties for referral.

We hypothesise that providing dietitians directly with information regarding the risk of malnutrition of the patients admitted to their facilities will improve the identification and management of malnutrition therefore improving the health outcomes of both the individual and health care setting. The Nutrition Dashboard has been described as 'a world first in nutrition analytics', it is a novel health and nutrition technology that has not been researched to date, recommendations regarding its clinical implementation are also limited. Findings from this research project will contribute to the evidence base regarding this novel nutrition technology, the study has the potential to inform recommendations regarding the Nutrition Dashboard's clinical use as well as providing evidence for further developments of the program with the ultimate aim being the improved management of malnutrition and improved health outcomes.

Research aim

The aim of this study is to establish the accuracy of the Nutrition Dashboard in identifying clients at risk of or experiencing malnutrition when compared to the Malnutrition Screening Tool.

Research question

Can the Nutrition Dashboard risk categories accurately predict the risk of malnutrition as determined by the weekly validated MST score?

Method

Study Design

A retrospective observational study was conducted at Armidale Rural Referral Hospital utilising data collected as a part of standard process through inpatient medical notes and food intake data collected and recorded via CBORD FSS.

IRR audit of the Nutrition Dashboard data collection process

A pre-audit of the inter-rater reliability (IRR) of the nutrition dashboard data collection process was undertaken before completing the data collection for the primary research project. The Nutrition Dashboard uses food intake data collected by food service staff. At the end of mealtimes, food service staff estimate how much a person has consumed of each component of the meal in 25% increments (appendix one) or select not applicable (NA) for items they are unable to visualise. The IRR audit involved the dietitian researcher (EF) visually estimating and recording the amount consumed for each individual food item or selecting NA for a total of 119 meals including 912 individual food items. Attempts were made to ensure that the dietitian researcher completed the intake estimations in the same manner and at the same time as food service staff (n = 5). The dietitian researcher recorded intake estimations on printed order slips from CBORD FSS tray monitor, the intake estimates recorded by food service staff were obtained from the CBORD FSS tray monitor program as per standard process. Both dietitian researcher and food service staff intake estimations were transcribed to a excel spreadsheet. Fleiss' kappa was used to measure inter-rater agreement on a nominal scale (separate categories which included 0%, 25%, 50%, 75%, 100% and NA) for all 912 ratings. Further investigation of IRR was then undertaken by removing food items deemed of low nutritional value (LNV) (that is <41kJ/item) (appendix four), which resulted in analysis of 591 individual food items. The interpretation of agreement for the Kappa analysis is presented in Figure 2.

κ	Interpretation of agreement
<0	Poor
0.01-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Good
0.81-1.00	Very Good

Figure 2: Interpretation of Fleiss Kappa analysis

Data completeness

To ensure that an appropriate data set was available to undertake the proposed study a student dietitian (JF) assisted with the completion and documentation of patient's MST scores and weight measurement where it was deemed clinically appropriate as per NSW Health standard process. The study period of June to August 2020 was selected to ensure MST data was available for all patients.

Sampling

A census approach to sampling was utilised to retrospectively audit 309 patient medical files. This involved obtaining a medical records list of people aged ≥18 admitted to ARRH medical, surgical and HDU wards from June to August 2020 for three or more days. Patients receiving end of life care and or enteral/parenteral nutrition support were excluded.

Medical file audit

Data extracted from inpatient files included age, gender, reason for admission, length of stay (LOS), MST score on admission, weekly MST score thereafter, whether or not they were referred to a dietitian, date of referral to dietitian, and the date of dietitian assessment. This data was collected manually and entered into the data collection tool using MS excel.

CBORD FSS data collection

The Nutrition Dashboard presents data that is collected and stored in CBORD FSS software. A request was made to NSW Health clinical support services to obtain a food ordering and intake report from CBORD FSS for all patients included in the medical file audit for the study period. The data requested included daily provided and consumed energy and protein as well as unaccounted intake data for each patient, for each day of admission. The report containing this data was provided as an excel spreadsheet. The provided report had 32 missing patients, these files were excluded (Figure 3). The functionality of CBORD FSS means that every food item provided to the patient was listed in the report individually for all meals for each day. In order to investigate the data provided through CBORD FSS, aggregates of provided and consumed energy and protein were created for each meal of each day of admission these were then aggregated to daily energy and protein provision and consumption. For analysis, only files which included three or more days of CBORD FSS data were included as per Nutrition Dashboard process (Figure 3).

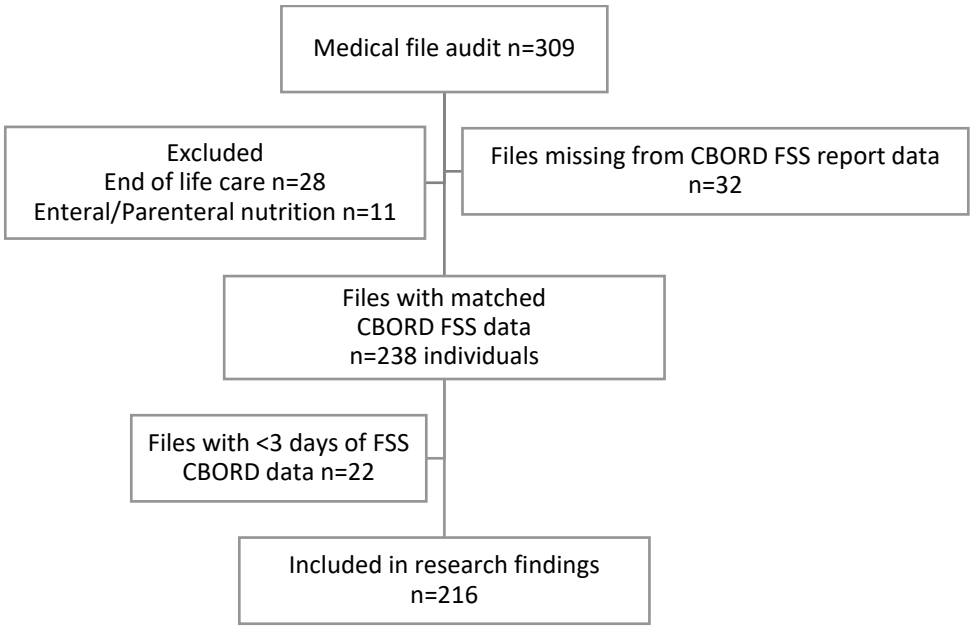


Figure 3: Flowchart detailing files included for data analysis

Nutrition Dashboard categorisation

The daily Nutrition Dashboard category for energy and then protein was calculated for each individual admission using the standard Nutrition Dashboard process (Table 1) by the dietitian researcher (EF) and biostatistician (GL). As per standard Nutrition Dashboard process the individuals daily risk category was selected as the most severe out of energy and protein. The Nutrition Dashboard utilises an adjustable threshold for energy and protein in order to determine nutrition risk category, for the purposes of analysis, the energy threshold was set at 4500kj and 50 grams for protein. These thresholds were selected as they are the default thresholds presented by the Nutrition Dashboard.

Weight and MST measures were recorded weekly for each patient, whereas Nutrition Dashboard food provision and intake data and category was recorded daily for each file. Corresponding weekly weight and MST measures were matched to daily Nutrition Dashboard category for each individual file. Only

files with a MST score on admission were included in data analysis, for those with admissions greater than one week, where a weekly MST score was missing, that week of data was excluded from analysis.

Table 1: Nutrition Dashboard categorisation – Nutrition risk category as determined by the Nutrition Dashboard using daily provided and consumed energy and protein data stored in CBORD Food Service Suite software

Severity	Nutrition Dashboard Category	Condition
●	Category 1 – Definitive Low Supply	IF provided daily average energy or protein < energy or protein threshold
●	Category 2 – Definite Low Intake	IF not Category 1, AND consumed daily average energy or protein < energy or protein threshold OR consumed daily average energy or protein + unaccounted energy or protein < energy or protein threshold
●	Category 3 – Possible Low Intake	IF not category 2, AND consumed daily average energy or protein < energy or protein threshold AND consumed daily average energy or protein + unaccounted energy or protein > energy or protein threshold
●	Category 4 – No Issue Noted	IF not category 3

Data comparison

Data from the medical file audit and CBORD FSS were collated in SPSS (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). The audit included individuals who had multiple admissions throughout the study period. Each individual was assigned a unique identifier, individuals who were admitted multiple times were assigned unique admission identifiers also.

Data analysis

After files were excluded for missing or incomplete data 216 individuals were included in the study for a total of 237 admissions and 1783 days. Descriptive statistics were undertaken to explore the demographic profile of the study group as well as the characteristics of the admission. Means and standard deviations (SD) were calculated for continuous data (weight), where this data was not normally distributed it was presented as median and inter quartile range (IQR) (age and LOS).

For the purpose of analysis MST score was dichotomised as <2 (low risk) and ≥2 (increased risk). The univariate association between MST score and Nutrition Dashboard risk category (category 1-4) was explored using a chi-square test. A regression model was applied to determine whether or not Nutrition Dashboard category (1 to 4) is a good predictor of MST score. The generalised estimating equation (GEE) regression was used to model the relationship between dichotomised MST score and Nutrition Dashboard Category to account for potential correlations between repeated longitudinal measurements. The GEE was used to investigate the hypothesis that the Nutrition Dashboard has the

ability to predict increased risk of malnutrition (as measured by MST≥2). Use of the GEE allowed for multi variate analysis of repeated data measures across individuals with unevenly distributed amounts of data. The uneven distribution of data was a result of varying lengths of stay, as well as multiple admissions for some patients. Further modelling was developed including age, gender, LOS and weekly weight (including weight on admission) as additional variables. The modelling developed by the GEE was presented as unadjusted odds ratio (OR) with a 95% confidence interval (CI). Analysis plan was developed by the dietitian researcher with a biostatistician, who then conducted analysis. All analyses were conducted using appropriate statistical software (IBM SPSS version 25) and the p value of significance set at 0.05.

Ethics

Approval for the study was obtained from Hunter New England Human Research Ethics Committee on 18 December 2019 (2019/ETH13100) and site-specific approval (2019/STE17325) 14 January 2020

Funding

The Health Education and Training Institute provided funding for 60 days of clinical backfill through the Rural Research Capacity Building Program in order for this project to be undertaken.

Results

Pre-audit of Nutrition Dashboard accuracy

The IRR pre-audit found overall agreement between the dietitian researcher and food service staff for the proportion of items consumed and 'NA' classification for all nominal categories was 0.86. Across the 912 ratings, there was good overall agreement (κ = 0.69, 95% CI, .65 to .72, $p < 0.001$). Agreement was better (very good) for ratings of '100' and 'n/a' (the most common categories). Analysis was then undertaken excluding all food items deemed of low nutritive value (LNV), that is foods that provide <41kJ/item (n=312). There were 591 paired ratings and kappa agreement was higher (κ = 0.77, 95% CI, .72 to .82, $p < 0.001$); and again, agreement was very good for ratings of 0, 100 and n/a (Table 2).

Table 2: Kappa analysis of inter-rater reliability for all individual food items (n=912) and all food items >41 kilojoules (kJ)/serve (n=591) for each measurement between dietitian researcher and food service staff

Rating Category	Kappa	P Value	Lower 95% Asymptotic CI Bound	Upper 95% Asymptotic CI Bound
All	.686	<.001	.647	.724
Excluding LNV[a] items	.771	<.001	.724	.818

[a] LNV items are those that provide <41kJ per serve, CI: confidence interval

Demographics

In total 216 files were included in the study, 56.9% of included files were from males, the mean LOS was 8.85 days (SD 8.54). Thirty nine percent (n=140/363) of files included in the study were identified at risk of malnutrition via the MST (Table 3).

Table 3: Characteristics of patients in a study investigating the Nutrition Dashboard's ability to identify malnutrition

Age on admission (years)	
Median (IQR)	74 (23)
Minimum-maximum	18-104
Gender	
Male (%)	123 (56.9)
Length of stay	
Median (IQR)	6 (5)
Minimum-Maximum	3-58
Weight on admission (kg) n=181	
Mean (SD)	80.8 (22.7)
Minimum-maximum	36.7-163.4
MST≥2, %, (n)[a]	38.6(140/363)

[a] MST ≥ 2 proportion is based on the number of MSTs collected for 216 patients across a total of 298 weeks of admissions
IQR: Interquartile range; kg: kilograms; n: number; SD: standard deviation, MST: Malnutrition Screening Tool

Risk of malnutrition and the Nutrition Dashboard

Analyses indicated that when measured using 4500kJ and 50g protein thresholds, the Nutrition Dashboard category 4 (no issue noted) was most frequently represented with 61.3% of daily measures, Nutrition Dashboard category 2 (definite low intake) was the least represented at 10.4%.

Table 4: Distribution of Nutrition Dashboard Categories for 216 patients across a total of 1775 days

Nutrition Dashboard Category	Number of days	Percent
● **1 –** Definite low supply	237	13.4
● **2 –** Definite low intake	184	10.4
● **3 –** Possible low intake	266	15.0
● **4 –** No issue noted	1088	61.3

Weekly malnutrition risk as measured through MST (risk ≥2 and low risk 0-1) was correlated with the daily Nutrition Dashboard categories one to four. A low risk MST (0-1) was more likely to be a low risk Nutrition Dashboard category (category 4) than a higher risk MST (≥2).

Table 5: Comparison of MST score and Nutrition Dashboard category for total 1775 days of data collection

	Nutrition Dashboard Category							
	● 1	%	● 2	%	● 3	%	● 4	%
MST 0-1	121	51	106	57	148	56	727	67
MST≥2	116	49	78	42	118	44	361	33

A statistically significant model was developed using the generalised estimating equation (GEE) (Wald χ^2= 10.89, df = 3, p<0.05). The model found that Nutrition Dashboard categories 1 (OR 1.93, 95% CI 1.17-3.19) and 3 (OR 1.61, 95% CI 1.12-2.30) were significant predictors of a MST≥2 (p<0.01 for both) but not category 2 (p=0.059) when compared to Nutrition Dashboard Category 4 (see Table 6).

Table 6: Multivariable generalised estimating equation model: association between MST≥2 and Nutrition Dashboard category

Nutrition Dashboard Category	Unadjusted OR	95% CI	p-value
● **1 –** Definite low supply	1.93	1.17-3.19	0.010[a]
● **2 –** Definite low intake	1.48	0.99-2.23	0.059
● **3 –** Possible low intake	1.61	1.12-2.30	0.010[a]
● **4 –** No issue noted	reference category		

[a] p-value below 0.05; OR odds ratio.

A GEE that included gender, age and LOS as possible confounders found that the Nutrition Dashboard category remains a significant predictor of MST≥2 (Wald χ^2= 10.78, df = 3, p<0.05; Table 7).

Table 7: Multivariable generalised estimating equation model: association between MST≥2, Nutrition Dashboard Category and possible confounders (for 216 patients)

	Unadjusted OR	95% CI	p-value
● **1 –** Definite low supply	1.89	1.15-3.11	0.012[a]
● **2 –** Definite low intake	1.43	0.97-2.11	0.074
● **3 –** Possible low intake	1.63	1.13-2.34	0.009[b]
● **4 –** No issue noted	reference category		
Sex, female	1.01	0.54-1.89	0.977
Age	1.01	0.99-1.03	0.448
Length of stay	0.997	0.97-1.02	0.809

[a] p-value below 0.05; OR odds ratio. [b] p-value below 0.01

The median weight for those with an 'at risk' (MST ≥2) was 73 (IQR 28.1; range 41.8-151kg) and for those not at risk (MST 0 or 1) was 84 (IQR 24.0; range 36.4 – 163.4kg). Weight was included as a confounder for the above model. There were 185 patients with complete data for analysis, the GEE found that weight was the only significant predictor of MST≥2 (p<0.01; Table 8).

Table 8: Multivariable generalised estimating equation model: association between MST≥2, Nutrition Dashboard Category and possible confounders including weight (for 185 patients)

	Unadjusted OR	95% CI	p-value
● **1 –** Definite low supply	1.78	0.98-3.22	0.057
● **2 –** Definite low intake	1.53	0.91-2.58	0.110
● **3 –** Possible low intake	1.35	0.86-2.13	0.189
● **4 –** No issue noted	reference category		
Sex, female	0.77	0.36-1.62	0.488
Age	1.01	0.99-1.03	0.318
LOS	0.98	0.96-1.01	0.223
Weight	**0.97**	**0.96-0.99**	**0.006[a]**

[a] p-value below 0.01; OR odds ratio

Referral to dietitian

During the study period, 95 admissions (38.6%) had at least one MST score greater than two, and across 363 weekly measures, 140 MST scores were greater than two, which should prompt a dietitian referral. Of the 87 individuals identified in medical records as being at risk of malnutrition only 43 (45.3%) were referred to a dietitian.

Discussion

To the authors' knowledge there has been no published research into the use of the Nutrition Dashboard to identify malnutrition, and limited research into the Nutrition Dashboard at all. This study of 216 individuals with a total of 1775 days of included data found that the Nutrition Dashboard does have the potential to identify those at increased risk of malnutrition. A MST score indicating increased risk of malnutrition (MST≥2) was found in 38.6% of the study population which is consistent with published prevalence of malnutrition in the hospital setting (1, 2, 11). The findings indicate that when investigated as a base model (that is without confounding factors) a modest, but statistically significant association between Nutrition Dashboard categories 1 and 3 as a predictor of increased risk of malnutrition (identified via MST score ≥2) when compared to category 4. Category 2 (person consumed less than 4500Kj or 50g protein across the day) did not have a statistically significant finding, this result may have been impacted on by a smaller sample size in category 2 (4.4% of total population with a MST ≥2 and category 2, vs 6.5% and 6.6% in categories 1 and 3). Nutrition Dashboard category 1 (supply was less than 4500Kj or 50g protein per day) was shown to be the most likely to predict an increased risk of malnutrition when compared to category 4 (OR 1.93, $p<0.05$).

Nutrition Dashboard category 3 includes individuals who have unaccounted food intake data. This means that when food service staff were collecting the meal tray at the end of a meal, they identified that they were unable to accurately estimate intake for one or more food items provided. Reasons for this may include that the item had been disposed of, a family member may have eaten then item or the patient requested to keep the food item for later. People in category 3 received energy and protein above the defined threshold (for this study 4500kJ and 50g protein) but their consumed and unaccounted food intake data were below the defined threshold. This study found that Nutrition Dashboard category 3 was also a modest but statistically significant predictor of increased risk of malnutrition when compared to Nutrition Dashboard Category 4 (OR 1.63, $p<0.01$). These findings suggest that the nutrition dashboard maintains some value in predicting risk of malnutrition, even for individuals with unaccounted food intake data.

The model developed remained statistically significant when gender, length of stay and age were included as possible confounding factors. Increasing age and LOS have been found to be associated with an increased risk of malnutrition (1-3, 10), but findings from this study indicate that Nutrition Dashboard Categories 1 and 3 were better predictors of malnutrition than age and LOS. When patient weight was included in the model in addition to age and LOS, the relationship between Nutrition Dashboard Categories and MST was no longer significant. The model found that as a static measure, a higher weight was associated with a modest, but lower risk of a MST score≥2 (OR 0.97). Although lower body weight is commonly associated with an increased risk of malnutrition it is important to consider that malnutrition, especially in the acute care setting, is not exclusive to those with a low body weight. Studies have found that within a population identified at increased risk of malnutrition 9-15% of individuals had a BMI>30kg/m^2 (39-41).

The IRR audit was completed to investigate the accuracy and reliability of the Nutrition Dashboard data before undertaking this research. Good agreement was found between raters across all food items (K=0.69, p<0.01), this was increased when foods with low nutritive value were removed (K=0.77, p<0.01). It is important to acknowledge the potential for observer bias to have impacted on this process, however it does indicate that the data contained within the Nutrition Dashboard has the potential for high reliability. When compared to other methods of food intake monitoring, such as food charts, which is common standard process in hospital settings, the findings of this audit indicate better agreement for the Nutrition Dashboard (20, 21). This finding is also suggestive that food service staff are adequately trained and able to estimate food intake through MFC standard process.

This study found that referrals to dietitian for the management of malnutrition were inadequate when compared to best practice (1-3, 16). Of 95 admissions identified 'at risk' of malnutrition according to MST only 45% were referred to a dietitian. Inadequate dietitian referral rates for malnutrition management are well documented in both Australian and International literature (8-12, 18). The findings of this research are consistent with a recent international study of 8405 patients admitted across 45 hospitals, this study found that 49.5% of the population were screened for malnutrition (18). In this study 37% of people at risk of malnutrition were referred to a dietitian (18). Similarly, an Australian study found that only 45% of individuals at risk of malnutrition were being managed by a dietitian (10).

Malnutrition screening in NSW Health facilities and in many Australian hospitals is most frequently assigned to nursing staff (10, 16). The process of malnutrition screening requires nursing staff to complete the screening tool, document the screening tool and also complete steps to refer those identified 'at risk' to a dietitian. Despite education and attempts to improve this process, the time demands have previously been associated with the under detection and inadequate management of malnutrition in the acute care setting (9, 10, 14, 39). Identifying and managing malnutrition is a time sensitive issue. Late referrals to a dietitian for the management of malnutrition have been shown to result in poorer outcomes for the individual (18). The findings of this research indicate that the Nutrition Dashboard could be used to improve the identification and management of malnutrition as directed by the NSW Health Nutrition Care Policy (16). Utilising the Nutrition Dashboard alongside the current MST process could improve the time frame for management of malnutrition by decreasing the need for third party referrals to a dietitian.

The findings of this research suggest that using the Nutrition Dashboard to assist in the identification of malnutrition may improve the detection and diagnosis of malnutrition. With additional data analysis and system refinement the Nutrition Dashboard may improve malnutrition identification by providing dietitians, the key health professionals in malnutrition management with important, accurate nutrition data. The Nutrition Dashboard monitors food intake for patients, as estimated by trained food service staff. Research into this specific or similar models is limited (37). Traditionally dietitians have relied on patient recall or food intake charts to monitor and evaluate the nutritional adequacy of an individual's diet whilst admitted to hospital (19-21). Both of these approaches have substantial limitations. Food charts are commonly utilised in reviewing the adequacy of a person's intake in the hospital setting (21). The completion of food charts has commonly been the responsibility of nursing staff. Research indicates that food charts are regularly incomplete (up to 97%) and inaccurate (21). The findings of this research suggest that the Nutrition Dashboard can provide

meaningful food intake information directly to dietitians, thus reducing the responsibility of other time poor health professionals (namely nursing staff).

It has previously been established that health professionals, including dietitians, are comfortable with and willing to utilise technology in their day-to-day practice (30, 31, 33). In Australia, increasingly accessible patient generated data to inform care is emerging as is healthcare professionals understanding and acceptance of it (31). The research undertaken in this study indicates that the Nutrition Dashboard is positioned to provide dietitians with access to meaningful data to identify individuals requiring nutrition intervention. The Nutrition Dashboard allows access to this information as current standard process in NSW Health MFC sites and does not rely on other health professionals initiating transfer of this information. This is supported by Australian research of another health dashboard focussing on nutrition data which improved care of head and neck patients (35), this research found that the dashboard being investigated was identified as valuable and useful by health professionals utilising it.

It has been established that the diagnosis of malnutrition and subsequent coding in the medical file attracts activity-based funding (2, 10, 11). Dietitians are primarily responsible for the diagnosis of malnutrition using a validated assessment tool. This research further contributes to the knowledge base regarding the inadequate identification of malnutrition in the acute care setting. This study found that although 38.6% were identified at risk of malnutrition only 45% of this at-risk population were referred to a dietitian, thus contributing to the under diagnosis of malnutrition in the study setting. The inadequate referral of patients at risk of malnutrition to dietitians in resulting in poor nutrition care and outcomes as well as a substantial shortfall in funding for acute care settings.

Whilst it is essential to optimise the referral of people at risk of malnutrition to dietitians, it is also important to acknowledge the limitations. Health professionals face increasing workloads which are not being supported by proportionate increases in funding, especially in rural clinical practice and health research (42). Therefore, adequate, accurate malnutrition screening could further increase workload for an already stretched dietetics workforce. The findings of this research indicate that adequate referral of people identified at risk of malnutrition would result in more than double the number of referrals for malnutrition risk to a dietitian in the study setting. Innovative approaches to increased malnutrition referrals could help to manage this. These could include automatic provision of high energy, high protein diets for those identified at risk of malnutrition (by either the Nutrition Dashboard or MST).

Strengths and Limitations

This study was completed using retrospectively collected data, in an attempt to manage bias in a hospital where MFC and the Nutrition Dashboard have been embedded as standard practice for more than 18 months. MST data (which can have low rates of completion) was complete because it was collected by a student dietitian for the audit period.

The data utilised in this study is collected as standard process across 47 NSW Health sites. The methods of this project are generalisable and could therefore be utilised to collect and analyse data across multiple centres to strengthen the findings of this study and clinical application of the Nutrition Dashboard.

The Nutrition Dashboard utilises data stored within the CBORD FSS program, this data is available for three months and is then removed. Functionality of the Nutrition Dashboard limited the amount of data available for the research project. Of 309 medical files audited, 22 had less than three complete days of CBORD FSS data, a further 28 were not included in the CBORD FSS data report, these files were unable to be obtained at the time of data analysis. The reduced sample size may have impacted the statistical significance of the findings.

The Nutrition Dashboard utilises adjustable thresholds for protein and energy to determine the Nutrition Dashboard Category. Due to time constraints only one threshold for energy and protein (the defaults) were investigated.

It is also important to acknowledge that the data collected to inform this research was obtained across June to August 2020, this time frame was affected by the Covid-19 pandemic, it was a time where elective surgeries were not being performed and presentations to hospital were lower than average.

Conclusion

The findings of this research support the role of the Nutrition Dashboard in the identification and management of malnutrition. The study has established that people within Nutrition Dashboard Category 1 are almost twice as likely to be at risk of malnutrition (as measured by MST≥2) than those in Nutrition Dashboard Category 4. The research identified that Nutrition Dashboard Category alone was not a good predictor of an at-risk MST score. The role of weight on malnutrition risk is multifactorial but was found in this study to impact on the Nutrition Dashboards ability to predict malnutrition. This research confirms the complex, multifactorial nature of investigating a nutrition intake technology and its ability to predict malnutrition in the acute care setting. The Nutrition Dashboard presents detailed nutrition intake data which has been shown to be associated with nutrition risk directly to dietitians, and this research confirms that it has the potential to play a role in improving nutrition care.

Recommendations

For researchers:

- Further analyses of data collected for this research project, including analyses of the GEE model to determine optimal energy and protein thresholds
- Further explore the relationship between weight status and malnutrition screening in the clinical setting, particularly the relationship between obesity and malnutrition
- The data used to undertake this research is already collected as a part of standard practice in all NSW Health MFC sites. The ACI to investigate the feasibility of repeating this research at all MFC sites to increase the strength of these findings and recommendations.
- Disseminate findings of this study through publication and presentations to increase awareness of the functions and applications of the Nutrition Dashboard

For the ongoing development of the Nutrition Dashboard:

- Consider the role and importance of including low nutritive value (<41kJ/serve) items (appendix four) in the food intake process for the Nutrition Dashboard. Excluding these items could improve time demands and the burden of data collection for food service staff without impacting the value of Nutrition Dashboard data
- Investigate the feasibility of the inclusion of malnutrition screening style questions (appetite, weight trend) as a component of the nutrition dashboard data collection process to further improve the accuracy and role of the Nutrition Dashboard in identifying malnutrition
- Explore potential for improved ease of access to retrospective Nutrition Dashboard data, including risk category, for the purpose of ongoing analysis and interpretation

For dietitians:

- Consider using the Nutrition Dashboard in triaging referrals
- Utilise data included in the Nutrition Dashboard, alongside clinical judgement in the nutrition care of patients admitted at relevant sites
- Reconsider requesting food intake charts at sites with access to the Nutrition Dashboard
- Evaluate the efficacy and safety of routine high energy, high protein diets for those identified at risk by the Nutrition Dashboard (particularly category 1 – inadequate supply)

For the Local Health District Executive:

- Compare the cost of inadequate malnutrition screening and identification, as well as the Activity Based Funding implications of Hospital acquired malnutrition and investment in an enhanced nutrition workforce (dietitians, allied health assistants and nutrition focussed food service hours)
- Liaise with HealthShare NSW and the ACI regarding collaborative research project with data from 47 MFC hospitals

Contributions

Research question and protocol design by dietitian researcher Erin Fisher with contributions from Dr. Kerith Duncanson, Assoc. Prof. Georgina Luscombe and Assoc. Prof. Leanne Brown. Planning discussions regarding data collection for IRR pre-audit with Cate Cannon. Planning discussions for data analysis with David Schmidt. Statistical analysis completed by biostatistician Assoc. Prof. Georgina Luscombe. Report authored by Erin Fisher with review from Dr. Kerith Duncanson, Assoc. Prof. Georgina Luscombe and Assoc. Prof. Leanne Brown.

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Appendices

One: Explanation of the data collection process for the Nutrition Dashboard

Two: Integration of CBORD software for food service

Three: Images of the Nutrition Dashboard platform

Four: List of low nutritive value food items

Appendix one: Explanation of data collection and presentation in Nutrition Dashboard

The 'My Food Choice' (MFC) model includes as a part of its standard practice, the monitoring and collection of food consumption data which is presented through the Nutrition Dashboard. All staff members working at MFC sites have received training in the estimation and collection of food intake data. Compliance and accuracy of this data collection by staff has been undertaken as a component of the MFC model. Staff identified as requiring further training through this quality assurance project receive further training.

The images below have been included to explain the Nutrition Dashboard and its data further.

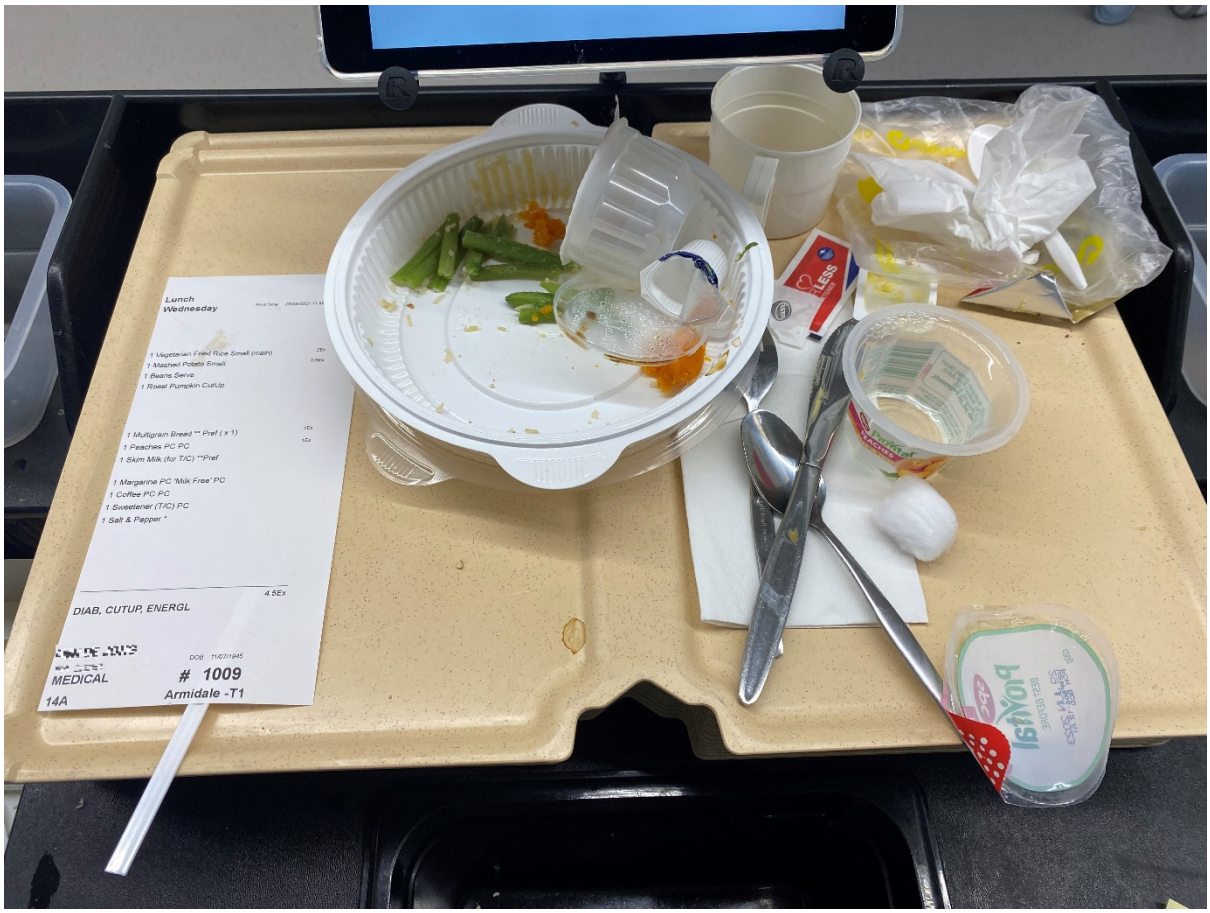

Image one: At the end of a designated meal period, patient meal trays are collected by food service staff. The food service staff member selects the patient's bed number from the tablet which uses 'tray monitor' software. This software is linked to the CBORD database which is used for the ordering and preparation of meals.

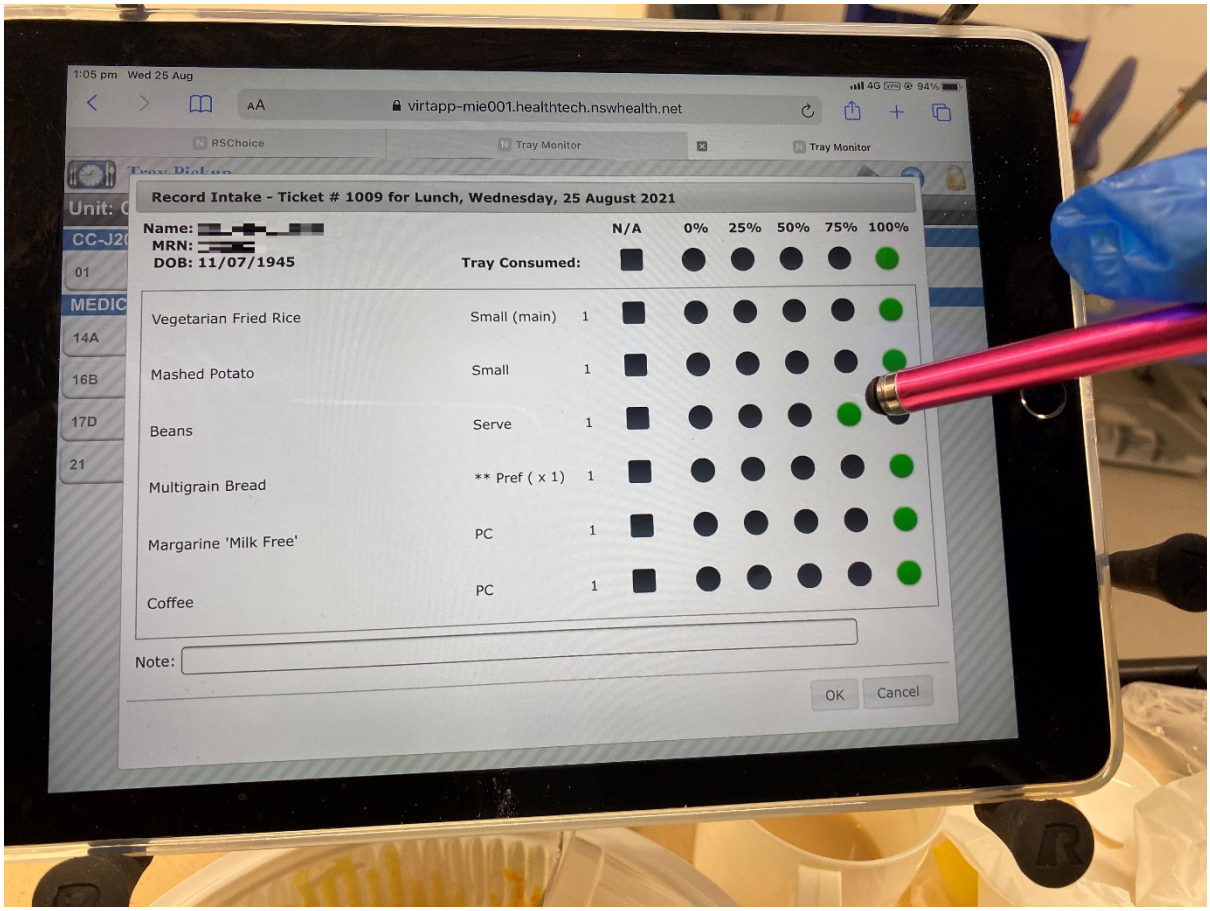

Image two: Whilst the tray is being cleared and sorted the amount of food eaten is visually estimated by food service staff and entered into a tablet that is mounted on the trolley. Each component of a patient's ordered meal is pre-populated on the tablet when the patient's bed is selected. If the food service member feels that they are unable to accurately estimate patient intake (for example, if the patient keeps a food item, or the food service staff member feels a visitor ate some of the meal)- the food service member is able to select this option from the tablet. The food intake data collected through this process is linked to the CBORD database which includes the nutrition profile of the foods including (energy, protein and micronutrient content). The information collected at the end of each meal is presented through the Nutrition Dashboard which is accessible to dietitians working at MFC site

Appendix two: Integration of CBORD software for food service

CBORD Food Service Suite

Collection of integrated software for the stocktaking, ordering, preparation and delivery of food in an institutional setting, including hospitals. NSW Health has their own specific design of this software.

CBORD Nutrition Service Suite

Collection of integrated software specific to the nutrition needs of patients in hospital

CBORD Diet office

- Database which stores patient information including diet codes, past and future meal orders, allergies and notes regarding preferences
- Used by dietitians and food service supervisor role (team leader)
- Used to order supplements or specific foods by dietitians or food service supervisors, can also be used to set nutrition goals (eg minimum daily protein, maximum carbohydrate serves per meal)
- Includes database of the nutrient profile of food items provided at site

CBORD Room Service Choice

- Software used on a tablet style device
- Used for ordering meals at the bedside by food service staff
- Includes prompts regarding specified meal patterns
- Has built in warnings and restrictions according to patients specified diet code

CBORD Tray Monitor

- Software used on a tablet when collecting meal trays at the end of a meal
- Where food service staff enter amount of each food item consumed
- Integrates with diet office
- Data from tray monitor is presented in the Nutrition Dashboard

Appendix three: Images of the Nutrition Dashboard platform

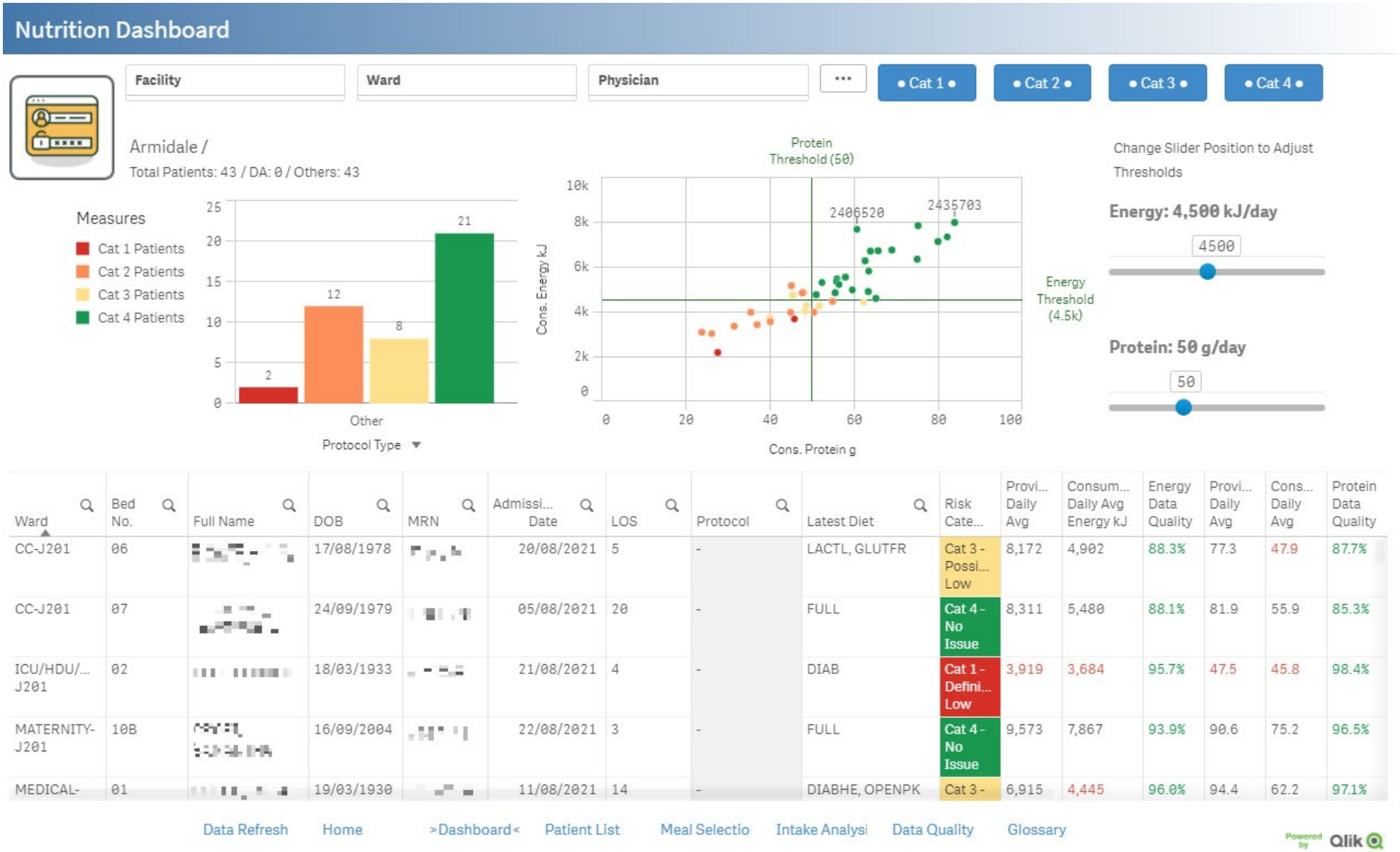

Image three: Homepage of the Nutrition Dashboard and overview of patients admitted to Armidale Rural Referral Hospital

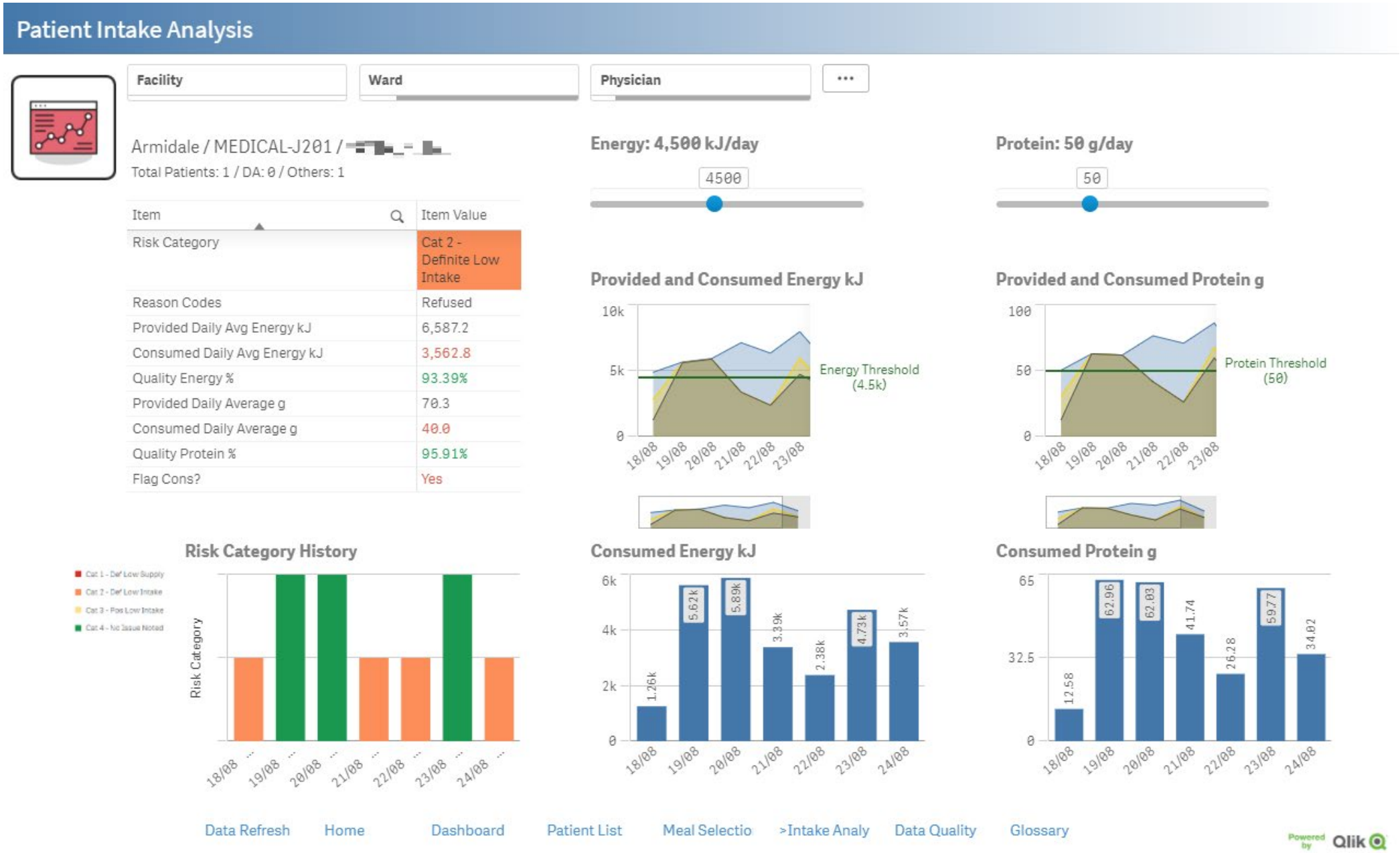

Image four: The data collected at meal times is then presented through the Nutrition dashboard. Image three is an example of an individual patient's intake analysis as presented by the Nutrition Dashboard. This section of the Nutrition Dashboard summarises total provided and consumed energy and protein for each day. It also summarises the patient's daily nutrition risk category.

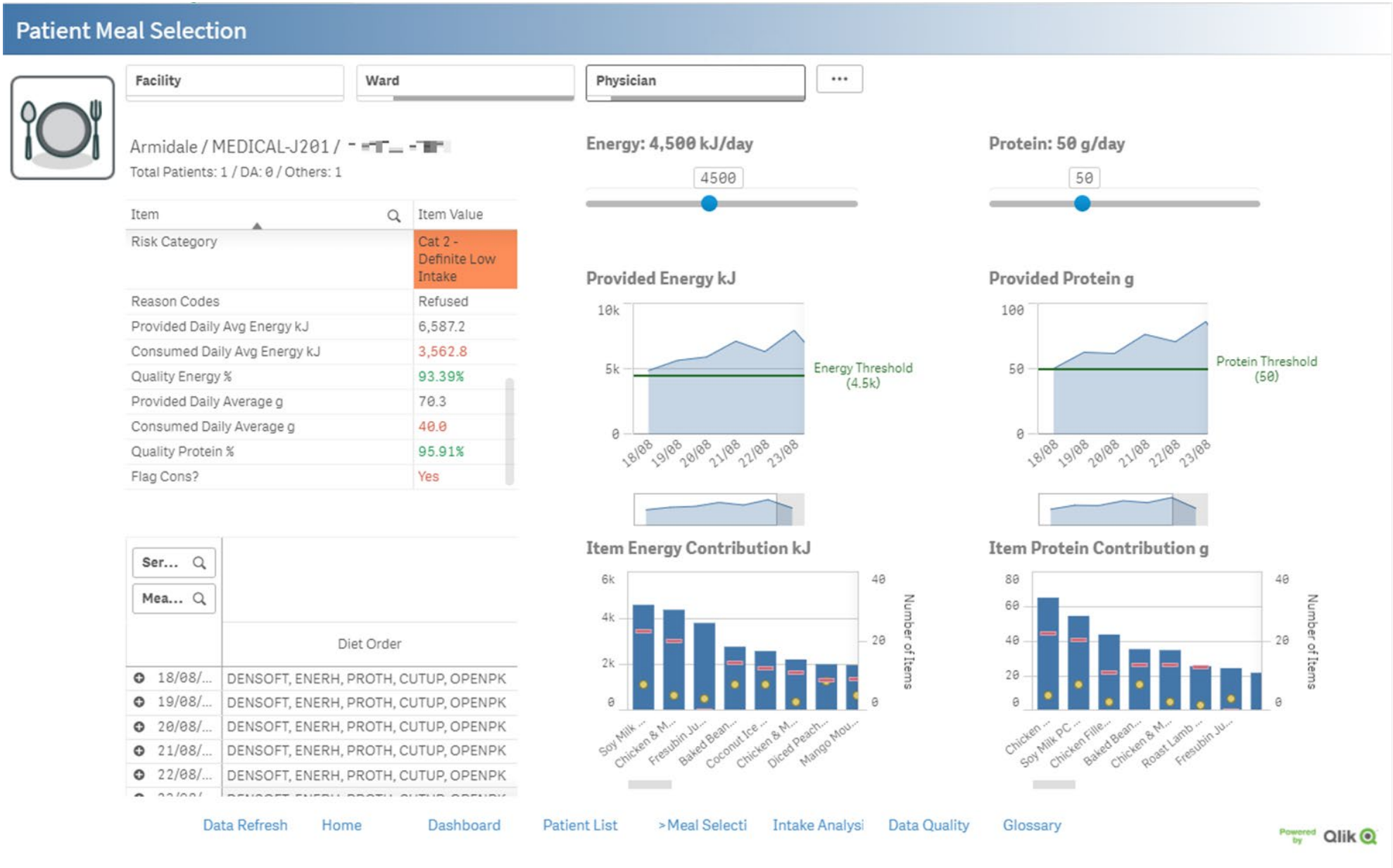

Image five: The Nutrition Dashboard also presents a summary of the individual patient's daily provided energy and protein and which food items are most frequently ordered and consumed.

Patient Data Quality

Facility | Ward | Physician | ...

Armidale / MEDICAL-J201 / [redacted]

Total Patients: 1 / DA: 0 / Others: 1

Patient Record

Item	Item Value
Length of Stay	62.0
Latest Diet	DENSOFT, ENERH, PROTH,
Protocol Type	Other
Protocol	-
Risk Category	Cat 2 - Definite Low Intake
Reason Codes	Refused
Provided Daily Avg Energy kJ	6,587.2
Consumed Daily Avg Energy kJ	3,562.8
Quality Energy %	93.39%
Provided Daily Average g	70.3
Consumed Daily Average g	40.0
Quality Protein %	95.91%
Flag Cons?	Yes

Reason Code Heatmap

Service Date	Breakfast	Lunch	Dinner
18/08/2021			
19/08/2021			
20/08/2021			
21/08/2021			
22/08/2021			
23/08/2021			
24/08/2021			

Data Quality < 70%
Data Quality <= 85%
Data Quality > 85%

Item Selected Yes/No

Service Date	Breakfast	Lunch	Dinner
18/08/2021			
19/08/2021			
20/08/2021			
21/08/2021			
22/08/2021			
23/08/2021			
24/08/2021			

Not Selected
Selected

Data Refresh | Home | Dashboard | Patient List | Meal Selectio | Intake Analysi | >Data Quality | Glossary

Powered by Qlik

Image six: Summary of food intake data quality, as presented by the Nutrition Dashboard. For the purposes of the study, patients with total data quality below 85%

Appendix four List of low nutritive value food items

The following food items were classified as low nutritive value (<41kJ or 10kcal/serve)

- Salt and pepper sachet
- 15ml serve of milk for tea or coffee
- Sugar sachet
- Artificial sweetener sachet
- Tea bag
- Coffee sachet