Georgia State University
ScholarWorks @ Georgia State University

Nutrition Theses

Department of Nutrition

Summer 6-23-2015

The Efficacy of a Screening Tool to Assess Malnutrition in Adults Admitted to a Large Urban University Hospital

Alexandra Moshier

AUTHOR'S STATEMENT

NOTICE TO BORROWERS

All theses deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this thesis is:

Alexandra Moshier

Address

Atlanta, GA 30342

The director of this thesis is:

Anita M. Nucci, PhD, RD, LD

Associate Professor

Department of Nutrition

Byrdine F. Lewis School of Nursing and Health Professions

Georgia State University

Atlanta, Georgia 30302

Vita
Alexandra Moshier
Canton, GA

EDUCATION

- **Georgia State University,** *Atlanta, GA* 06/09/2014 – 08/2015
  Master of Science in Health Sciences, Concentration in Nutrition
  Coordinated Program

- **Georgia State University**, *Atlanta, GA* 01/09/2012 – 05/09/2014
  Bachelor of Science in Nutrition, *Summa Cum Laude*
  Didactic Program in Dietetics

PROFESSIONAL EXPERIENCE

- **Graduate Assistant at Georgia State University** 2014/2015
  Atlanta, GA
- **Human Resources Intern, The HoneyBaked Ham Company of Georgia,** *Alpharetta, GA* Summer 2012

SUPERVISED PRACTICE June 2014 – present

Completing an ACEND accredited Coordinated Program consisting of 1200-hours of supervised practice with an urban health emphasis completing competencies in the following areas: Nutrition Assessment, Nutrition Intervention; Nutrition Counseling Skills; Medical Nutrition Therapy; Trends Affecting Health Policies Practices, and Laws; and Nutrition, Culture, and Lifecycle and development of a Business Plan. Rotations occurred in the Georgia State University Nutrition Clinics; Grady Memorial Hospital; Head Start; Project Open Hand; Children's Healthcare of Atlanta; and School Nutrition

MEMBERSHIPS/CERTIFICATIONS

- Academy of Nutrition and Dietetics 2012 – present
- Georgia Academy of Nutrition and Dietetics 2012 – present
- Certified Food Safety Manager 2012 – present
- The National Registry of Food Safety Professionals
  - TAPS Completion/Certification
- Nutrition Student Network, Georgia State University 2012 - 2014
  - President (2013 – 2014)

AWARDS/PUBLICATIONS

- Lettie Pate Whitehead Scholarship Spring 2015, Fall 2013
- Georgia State University Outstanding Didactic Program in Dietetics Undergraduate Student Award Spring 2014

- Georgia State University’s Nutrition and Dietetics Scholarship — Spring 2014
- HOPE Scholarship — 2009 – 2014

ABSTRACT

THE EFFICACY OF A SCREENING TOOL TO ASSESS MALNUTRITION IN ADULTS ADMITTED TO A LARGE URBAN UNIVERSITY HOSPITAL

by

Alexandra N. Moshier

Background: The increasing use of electronic health records (EHR) provides a novel opportunity to evaluate hospital-based nutritional outcomes, such as malnutrition. There is no universally accepted screening tool for the detection of malnutrition. However, assessment for malnutrition should be made early, be simple, based on scientific evidence, and include data on age, gender, and disease severity. The malnutrition screening tool (MST) used in this study is a two question tool that assesses two parameters commonly seen when diagnosing malnutrition (weight loss and loss of appetite).

Objective: The purpose of this study is to determine the ability of the MST used at a tertiary or quaternary hospital to accurately identify patients with malnutrition by comparing it against the Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition criteria for malnutrition.

Participants/setting: A descriptive cohort study was conducted that included 167 patients admitted to Emory University Hospital between October 1 - 14, 2014. MST score, malnutrition diagnostic criteria, and demographic and anthropometric characteristics were obtained to describe and assess the study population.

Statistical Analysis: Frequency statistics were used to describe the demographic and anthropometric characteristics and MST score results. Normality statistics were used to determine the distribution of continuous variables. A Chi Square table was used to determine the significance of the association between the MST score and diagnosis of malnutrition made by the Registered Dietitian (RD) as well as the sensitivity and specificity of the MST.

Results: A total of 167 patients (48.5% male, 51.5% Caucasian, non-Hispanic) were admitted during the study period. The vast majority of the patient population with malnutrition (79%), as diagnosed by the RD, was identified as such by the MST ($p < 0.01$). The sensitivity and specificity of the MST was 79% and 62%, respectively.

Conclusion: The MST is a useful screening tool for malnutrition in adults admitted to a large urban university hospital. There is a lack of research validating the MST in the adult

outpatient population. Therefore, future studies are necessary to evaluate the effectiveness of the MST in this population.

THE EFFICACY OF A SCREENING TOOL TO ASSESS MALNUTRITION IN ADULTS ADMITTED TO A LARGE URBAN UNIVERSITY HOSPITAL

by

Alexandra N. Moshier

A Thesis

Presented in Partial Fulfillment of Requirements for the Degree of

Master of Science in Health Sciences

The Byrdine F. Lewis School of Nursing and Health Professions

Department of Nutrition

Atlanta, GA

2015

ACKNOWLEDGMENTS

I am truly thankful for the work, patience, and support that Dr. Anita Nucci has offered me throughout this entire process. I also thank her for all of her wise words and for sharing her expertise in research with me. I have learned so many invaluable things for the future. I would like to also extend my gratitude to Barbara Hopkins and Dr. Jessica Alvarez for their assistance in writing this thesis and their willingness to help when an opinion or an idea was needed. In addition, I want to thank Liz Kustin, Michelle Gooden, and Chad Robichaux at Emory University Hospital for their help with collecting data and their willingness to answer any questions I had along the way. And last, I would like to thank my family and friends for the love and support they have given me throughout this process. I could not have done it without you all!

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

ARRA	American Recovery and Reinvestment Act
AND	Academy of Nutrition and Dietetics
ASPEN	American Society for Parenteral and Enteral Nutrition
AUC	area under the curve
BMI	Body mass index
CDC	Centers for Disease Control
EBHRS	electronic-based health record systems
EHR	electronic health records
ICD	International Classification of Diseases
MNA-SF	Mini-Nutritional Assessment Short Form
MST	malnutrition screening tool
MUST	Malnutrition Universal Screening Tool
NCP	nutrition care process
NPV	negative predictive value
NRS-2002	Nutritional Risk Screening 2002
PHR	Personal Health Record
PPV	positive predictive value
RD	Registered Dietitian
RMNST	Royal Marsden Nutrition Screening Tool

ROC	receiver operating characteristics
SGA	Subjective Global Assessment
SNAQ	Short Nutritional Assessment Questionnaire

CHAPTER I

INTRODUCTION

The Health Information Technology for Economic and Clinical Health (HITECH) Act was created as part of the American Recovery and Reinvestment Act (ARRA) of 2009. The HITECH Act is an economic stimulus package to encourage providers to move from paper-based health record systems to electronic-based health record systems (EBHRS) and to promote the meaningful use of these systems.[1] The rationale was EBHRS would offer a more efficient system with enhanced productivity without compromising patient outcomes.[2] In addition, EBHRS provide networks for information exchange and are convenient, time-savings, and improve outcomes.[2]

Since the recent adoption of these systems, few studies have evaluated the perceived efficacy of electronic health records (EHRs). However, the Office of the National Coordinator for Healthy Information Technology has reported on a few statistics regarding the use of EHRs in hospital based systems.[3] The use of EHRs in acute care hospitals has been steadily increasing since 2008. The adoption of these systems in hospitals across the United States varies. Nonetheless, in 2013, fifty-nine percent of acute care hospitals had adopted a basic EHR system, which increased from the previous year by thirty-four percent and a five-fold increase since 2008. Lastly, the adoption of a comprehensive EHR systems in hospitals has increased eight-fold from 2009 to 2013 and continues to increase.[3]

The increased use of EHRs provides a unique opportunity to evaluate hospital-based nutritional outcomes, such as malnutrition. There is no universally accepted tool for the detection of malnutrition. However, the prevalence of adult malnutrition is estimated to be 15% to 60% depending on the patient population and diagnostic criteria.[4] The American Society for Parenteral and Enteral Nutrition (ASPEN) and the Academy of Nutrition and Dietetics (AND) have collaborated to standardize the diagnostic criteria used to identify adult malnutrition in the United States. Since there is no single parameter to define adult malnutrition, ASPEN and AND recommend identification of two or more of six characteristics for diagnosis of malnutrition: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized fluid accumulation that may sometimes mask weight loss, and diminished functional status as measured by hand grip strength.[4]

Emory University Hospital (Emory) is a medical and surgical facility specializing in the care of the acutely ill adult, and is classified as a tertiary or quaternary care facility. In June 2014, Emory began using the Malnutrition Screening Tool (MST) designed by Ferguson M et al. (1999) to screen for malnutrition in patients at the time of admission (Appendix B).[5] The purpose of this study was to determine the ability of the MST used at Emory to accurately identify patients with malnutrition by comparing it against the AND and ASPEN criteria for malnutrition. We examined the medical records of all patients who were admitted to Emory from October 1, 2014 to October 14, 2014 to determine the sensitivity and specificity of the MST against the AND/ASPEN criteria for a diagnosis of malnutrition. Based on previous validation studies of the MST, we hypothesized that 90%

of patients with a positive malnutrition screen would meet the AND/ASPEN criteria for diagnosis of malnutrition. We also hypothesized that the malnutrition screen would be positive in 90% of patients with an admission diagnosis of malnutrition.[4]

CHAPTER II

LITERATURE REVIEW

ELECTRONIC HEALTH RECORDS

An EHR is defined as a digital version of a patient's personal medical chart. The EHR is a real-time, patient-centered record that is instantly and securely available to authorized users. The record includes the medical and treatment histories of patients, the patient's medical history, diagnoses, medication, treatment plans, immunization dates, allergies, and laboratory and test results. The EHR allows access to evidence-based tools that are useful to providers in patient care, and EHRs improve provider workflow. A benefit of an EHR is the ability for health information to be created and managed by authorized providers and shared with other providers across health care organizations. These organizations include, but are not limited to, laboratories, specialists, medical imaging facilities, pharmacies, emergency facilities, and school and workplace clinics.[6]

There are well over 600 EHR vendors in the United States, and RDs have been advocating for the implementation of the nutrition care process (NCP) in EHRs for quite some time. In practice, RDs use many different formats of medical record documentation, including medically screening for the risk and/or presence of malnutrition. The use of nutritional screening tools within the EHR at hospital admission should be used routinely to help identify patients at risk for malnutrition and to offer proper nutrition care.[7]

Malnutrition is often not identified in hospitalized patients and can unfortunately lead to increased risk for complications such as morbidity, increased length of stay, increased mortality, functional impairment, and economic implications.[8, 4, 9] In a review conducted by Norman, K. et al. (2007), the prognostic implications of disease related malnutrition were investigated. The researchers found that the prevalence of malnutrition has not changed since 1990, and studies conducted in Europe and the U.S. report that 31% of all hospitalized patients are considered to be malnourished or at nutritional risk.[10] The common causes of increased morbidity in those with malnutrition are impaired immune function and delayed wound healing.[10] The economic implications related to malnutrition are due to the longer length of stay and intensive hospital treatment. Assessment of malnutrition should be early, simple, based on the best scientific evidence, and include data on age, gender, and disease severity.[8] EHRs are conduits for timely referrals for nutrition assessment and intervention for patients identified at risk for malnutrition. Hopefully, the complications associated with malnutrition would be reduced or even avoided with early identification.[11]

Malnutrition Screening Tools

Previous studies have evaluated the effectiveness of malnutrition screening tools with various populations and in a variety of locations (Appendix A). Ferguson et al. (1999) aimed to validate a new malnutrition screening tool (MST) in cancer patients who were undergoing radiotherapy. Nutrition status from 106 patients was assessed on the basis of weight change, dietary intake change, gastrointestinal symptoms that persisted more than two weeks, changes in functional capacity, loss of subcutaneous fat, muscle wasting, ankle/sacral edema, and ascites. The study was conducted over a 5-day period. The new screening tool assessed patients for recent unintended weight loss, the amount of weight lost, and poor eating habits due to anorexia. The Subjective Global Assessment (SGA) was used for comparison to validate the new screening tool. Data analysis involved a contingency table to determine the sensitivity, specificity, and predictive value of the MST. In addition, analysis of variance and chi-squared tests were used to determine the associations between gender, age, number of radiotherapy treatments, and nutrition status. The results of this study found that the MST has a sensitivity of 100% and a specificity of 81%. The positive predictive value was 0.4 and the negative predictive value was 1.0.[12] Similar to the Ferguson study, J Bauer and S Capra sought to assess the sensitivity and specificity of a nutrition screening tool created by the Malnutrition Advisory Group (MAG) used in a tertiary private hospital by comparing it to the SGA. This cross sectional study included patients who were 18 years of age or older; data were collected over a three month period. Variables included in the study were weight change, dietary intake change, gastrointestinal symptoms that persisted more than two weeks, changes in functional capacity, loss of subcutaneous fat, muscle wasting, ankle/sacral edema, and ascites. The statistical analyses used in this study were a contingency table to determine the sensitivity, specificity, and the predictive value of the MAG screening tool compared to the SGA and a linear regression to examine the linear trend between age, BMI, and percentage weight loss in the previous six months for each SGA classification. In this study, the MAG screening tool has a sensitivity of 59% and a specificity of 75%. The positive predictive value was 88% and the negative predictive value was 38%. The researchers concluded that this tool was not suitable for detecting risk of malnutrition in hospitalized patients with cancer.[13]

A retrospective study by Miyata et al. (2013) aimed to determine if there were any relationships between the nutrition status using Malnutrition Universal Screening Tool (MUST) and the mortality of patients with pulmonary tuberculosis. Fifty-seven patients were assessed using MUST. Gender, age, BMI, and underlying disease were examined as well as scores for unintentional weight loss, BMI and acute disease effect. Each patient's malnutrition risk was based on the sum of the scores and categorized as low, medium, or high risk. Statistical analyses of this study included the Cox proportional hazard model to assess the ability of the MUST to predict malnutrition, operating characteristic curve analysis to assess the MUST score as a prognostic indicator, and the Kaplan-Meier method with the log rank test to calculate survival. The optimal cut-off value for MUST score was 3.5 when predicting the risk of mortality. In addition, a MUST score $\geq$ 4 and age were identified as significant independent prognostic factors for survival.[14] In an observational, cross sectional study by Isenring et al. (2006) patients greater than 18 years old were included in an 8 week study to determine the validity of the MST compared to the SGA. Two researchers interviewed study subjects. The first researcher used the MST, which is based on appetite and recent unintentional weight loss and provides a score between zero and five. A score of 2 or higher elicits a notification of possible malnutrition. The second researcher used the patient generated subjective global assessment (PG-SGA) tool to assess the nutritional status of all subjects according the standard guidelines. Statistical analyses in this study included a contingency table to determine the sensitivity, specificity, and predictive value of the MST to identify patients at risk for malnutrition compared to the SGA as well as the adjusted Wald method to calculate confidence intervals. The researchers found that the MST was able to detect nutritional risk relative to the PG-SGA (100% sensitivity, 92% specificity, 0.8 positive predictive value, 1.0 negative predictive value). In addition, the MST showed agreement with 18/20 cases administered by staff/nursing, staff/patient, and the dietitian.[15]

A prospective study audited data from 100 patients admitted to a hip fracture unit in a public tertiary hospital over a 5-month period. The study aimed to determine whether the malnutrition screening tool or anthropometric parameters adequately detected malnutrition in patients who were admitted to a hip fracture unit. MST screening was performed independently. Patients with a score above 2 or more, as related to recent weight loss and poor eating habits due to anorexia, indicated a risk for malnutrition. Dietitians using the International Classification of Diseases (ICD) 10-AM coding for malnutrition evaluated nutritional status. Scores from each assessment were compared. The statistical analyses used in this study were a contingency table to determine the sensitivity, specificity, positive and negative predictive values, and tool accuracy for the screening tools and objective measures compared with the ICD10-AM criteria for malnutrition. This results of this study determined that BMI was the most valid predictor of malnutrition (sensitivity 75%; specificity 93%; positive predictive value 73%; negative predictive value 84%) whereas the nursing MST screening was the least valid (sensitivity 73%; specificity 55%; positive predictive value 50%; negative predictive value 77%).[16]

In another study conducted by Moriana et al. (2014), the researchers aimed to validate the SGA as a screening tool for malnutrition in a tertiary hospital. This was a cross-sectional study conducted with 197 patients. These patients were evaluated using the SGA and a nutritional assessment protocol. Measurements included weight, height, tricipital fold, arm circumference, calculated BMI, and percent weight loss. The recruitment period was three months. The SGA assessed weight loss, changes in oral intake, gastrointestinal symptoms, functional capacity, loss of muscle and fat mass, ankle and sacral edema, and ascites. The Chi-square test was used to compare qualitative variables, and the Spearman's correlation assessed coefficient the correlation between SGA and biochemical and anthropometric parameters of malnutrition. Quantitative variables were compared using an analysis of variance. This study found that SGA was negatively correlated with anthropometric and biochemical malnutrition parameters ($P < 0.012$).[8]

In an observational study conducted by Shaw et al. (2014), 126 oncology patients underwent a full nutritional screening and assessment, and the MST, SGA and Royal Marsden Nutrition Screening Tool (RMNST) were compared. Validation of these tools was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), receiver operating characteristics (ROC), and the area under the curve (AUC). The results of this study showed that the SGA tool identified 90 (71%) patients as malnourished or at risk of malnutrition. In addition, the RMNST had a sensitivity of 93% and a specificity of 53%; the MST had a sensitivity of 66% and a specificity of 83%.[17] Similar to the previous study, Lawson et al. (2012) conducted a cross-sectional study to determine the validity and reliability of the MUST and the MST in 276 hospital inpatients with renal disease. Sensitivity, specificity, PPV, and NPV were used to determine the validity of these screening tools. In this study, the MUST had a sensitivity of 53.8% and specificity of 78.3% when compared with the SGA. The MST had a sensitivity of 48.7% and a specificity of 85.5% when compared with the SGA.[18] Neelemaat et al. (2010) conducted a cross sectional study of 275 patients that aimed to compare more simplistic screening tools such as the MST, Short Nutritional Assessment Questionnaire (SNAQ), and Mini-Nutritional Assessment Short Form (MNA-SF), and more comprehensive malnutrition screening tools such as the MUST and Nutritional Risk Screening 2002 (NRS-2002). Sensitivity, specificity, PPV, and NPV were used to test the validity of these tools. A sensitivity and specificity of $\geq$ 70% was set as an adequate performance of a screening tool; the MUST, NRS-2002, MST, and SNAQ showed sensitivities and specificities of $\geq$ 70%.[19]

CHAPTER III

THE EFFICACY OF A SCREENING TOOL TO ASSESS MALNUTRITION IN ADULTS ADMITTED TO A LARGE URBAN UNIVERSITY HOSPITAL

METHODS

SAMPLE POPULATION

This study population included all patients admitted to Emory University Hospital (Emory) between October 1, 2014 and October 14, 2014. De-identified patient data were extracted from the Emory patient database and recorded onto a Microsoft Excel spreadsheet. Each patient was assigned a numeric identification code chosen at random. An expedited approval from the IRB at Georgia State University was approved for this study; IRB approval from Emory was exempt from this study because it does not meet the applicable federal definition of research for IRB purposes and instead can be classified as quality assurance and improvement.

STUDY DESIGN

The design of this study is a descriptive cohort study. Existing EHRs were reviewed to collect demographic variables (age in years, gender, BMI, and race), anthropometric measures (admission weight in kg, height in cm, and usual body weight), and malnutrition screening data, including the response to questions 1 and 2 of the MST used to derive the total malnutrition screening score.[5] Other variables that were collected include admission diagnosis, chief complaint on admission, length of stay, admission diet order, 30-day readmission, and RD consult notes. All variables were extracted by the Emory University Data Extraction Warehouse and supported by the Data Analytics and Biostatistics (DAB) Core at Emory University School of Medicine.

MALNUTRITION SCREENING TOOL

The malnutrition screening tool used at Emory assigns a score to patients based on their answers to the following questions: 1) Have you/the patient lost weight recently (within the last 6 months) without trying and 2) Have you/the patient been eating poorly because of a decreased appetite (Appendix B). The first question is scored as follows: no (0 points), unsure (2 points), yes - 1 – 5 kg (1 point), yes – 6 – 10 kg (2 points), yes – 11 – 15 kg (3 points), >15 kg (4 points), unsure (2 points). The second question is scored based on whether the answer is no (0 points) or yes (1 point). The scores to each question are summed to give the total patient malnutrition score (Appendix C). A total malnutrition score of $\geq$2 results in an automatic nutrition consult.[5]

DATA ANALYSIS

The demographic, anthropometric, the MST results, and malnutrition diagnosis criteria as determined by an RD were described using frequency statistics. Normality statistics were conducted on continuous variables (age, weight, height, length of stay) to determine the appropriate descriptive measure of central tendency. A 2 x 2 table was created with the results of the Emory malnutrition screening tool (positive or negative) and the AND/ASPEN criteria determination for malnutrition (positive or negative) for the purpose of conducting chi-square analysis and determining sensitivity and specificity. The sensitivity of the Emory malnutrition screening tool was assessed by calculating the percent of patients who were determined to have malnutrition by the Emory tool (malnutrition score ≥ 2) divided by the total number of patients who have malnutrition as determined using the AND/ASPEN criteria. The specificity of the MST used at Emory was assessed by calculating the percent of patients who were determined not to have malnutrition by the Emory tool (malnutrition score <2) divided by the total number of patients who are not malnourished as determined using the AND/ASPEN criteria. In addition, statistics were conducted for the total population by gender. The Mann Whitney U test was used to determine if there was a significant difference in patients' length of stay and MST score category. In addition, Chi-square tests were used to determine if there was a significant difference between MST score category and 30-day readmission as well as for the top five admitting diagnoses and those diagnosed with malnutrition. A p-value of <0.05 was established for statistical significance. Statistical analyses were performed using SPSS (version 20.0, SPSS, Inc., Chicago, IL.).

CHAPTER IV

THE EFFICACY OF A SCREENING TOOL TO ASSESS MALNUTRITION IN ADULTS ADMITTED TO A LARGE URBAN UNIVERSITY HOSPITAL

RESULTS

The clinical characteristics of the total population and by gender are shown in Table 1. The study population included an even distribution of males (48.5%) and females (51.5%) and was primarily Caucasian, Non-Hispanic (53%) (Figure 1). The age range of the population was 20 to 98 years. Median hospital stay of the population was less than two weeks, and the average time between patient admission and the first note written by an RD was 25.8 hours. Approximately one quarter (27%) of patients were readmitted to the hospital within 30 days of discharge. Table 2 summarizes the anthropometric characteristics of the total population and by gender. The median BMI of the population was 22.8 kg/m^2, which is within a normal BMI range. Twenty-four percent of the population was obese (BMI $\geq$ 30 kg/m^2). The top five admitting diagnoses for the patient population and by gender are shown in Figures 2 - 4. For the total population, the majority of patients were admitted with pulmonary disorders. However, gastrointestinal disorders were the most common admitting diagnosis for patients diagnosed with malnutrition by an RD.

Figure 1. Race Distribution of the Total Patient Population (N = 167)

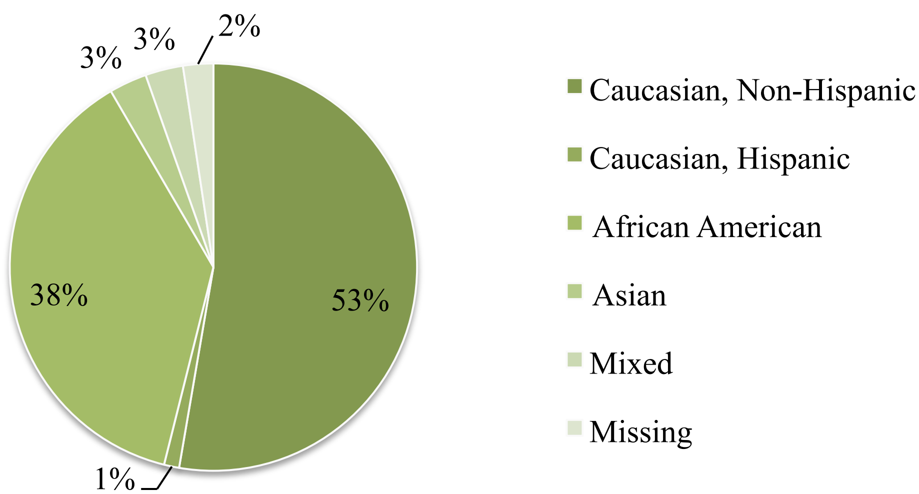


Table 1. Demographic and clinical characteristics of the total population and by gender

	Total Population (N = 167)	Males (n = 81)	Females (n = 86)
Mean Age ± SD (years)	62.04 ± 15.995	62.12 ± 16.1	61.97 ± 16.013
Length of Stay (days)*	11 (7, 18)	11 (7, 17.5)	11 (6, 19.25)
Time to RD Note (hours)*	25.8 (18.1, 71.1)	27.7 (19.6, 94.9)	24.4 (16.3, 38.5)
Patients readmitted within 30 days n (%)	44 (26.3)	20 (24.7)	24 (27.9)

*Median (25%, 75%)
SD – standard deviation; RD – registered dietitian
Time to RD Note – time between patient admission and the first note written by an RD
Length of Stay – the number of days hospitalized (admission to discharge) at Emory University Hospital
Patients Readmitted within 30 Days – the percentage of patients that were readmitted to Emory University Hospital within 30 days of leaving the hospital

Table 2. Anthropometric characteristics of the total population and by gender

	Total Population (N = 167)	Males (n = 81)	Females (n= 86)
Weight (kg)*	67.7 (53.1, 86.4)	74.6 (65.9, 92.9)	54.3 (49.3, 72.2)
Height (cm)*	170.1 (160, 180.3)	180.3 (173.8, 185.4)	161.3 (154.9, 165.1)
BMI (kg/m^2)*	22.8 (19.4, 29.5)	23 (20.5, 28.9)	22.6 (18.8, 30.1)

*Median (25%, 75%)
cm – centimeters; kg – kilograms; BMI – body mass index

Figure 2. Top five admitting diagnoses of the total patient population

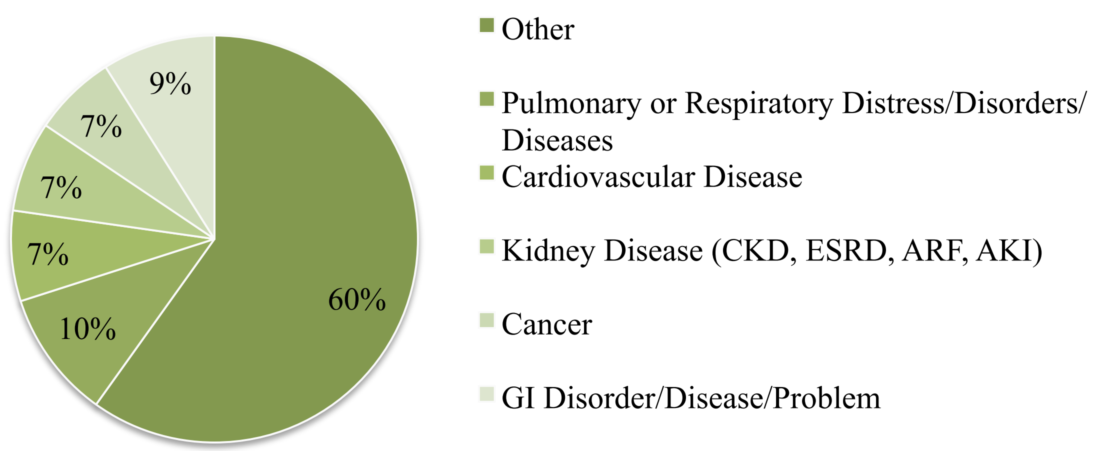


Figure 3. Top five admitting diagnoses of the male patient population

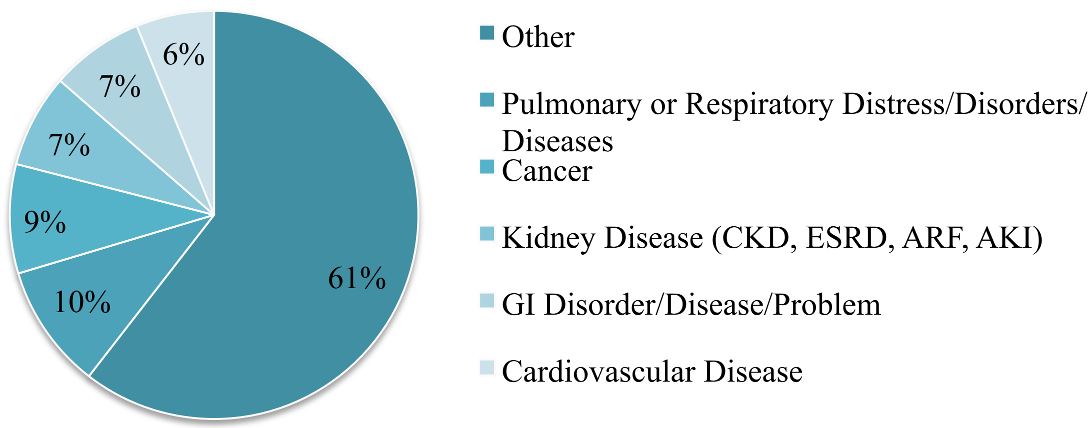
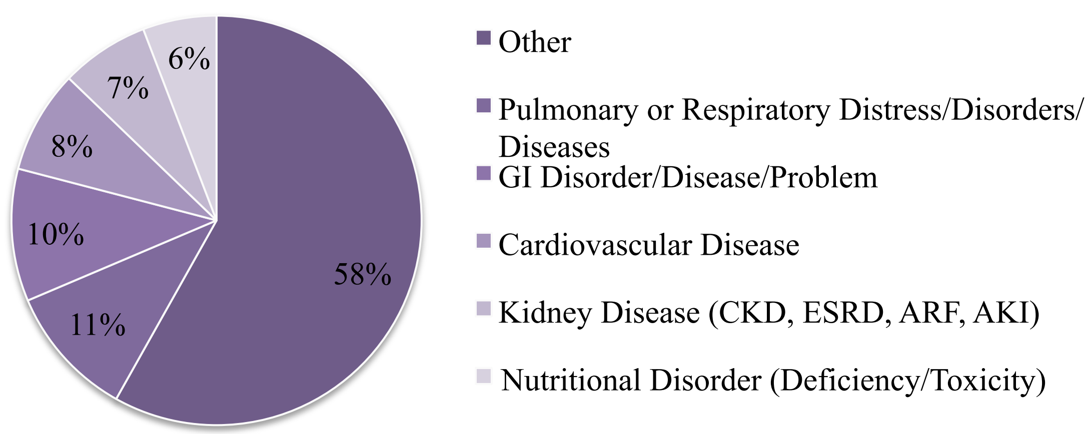
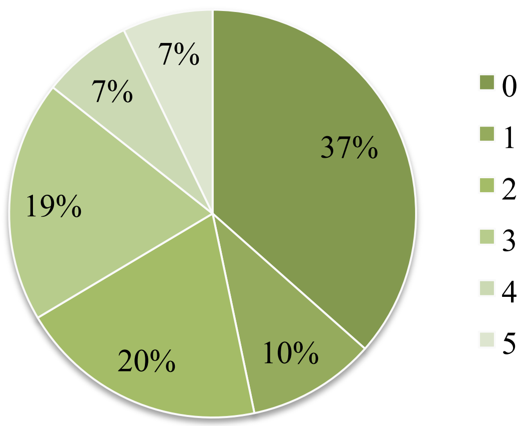


Figure 4. Top five admitting diagnoses of the female patient population



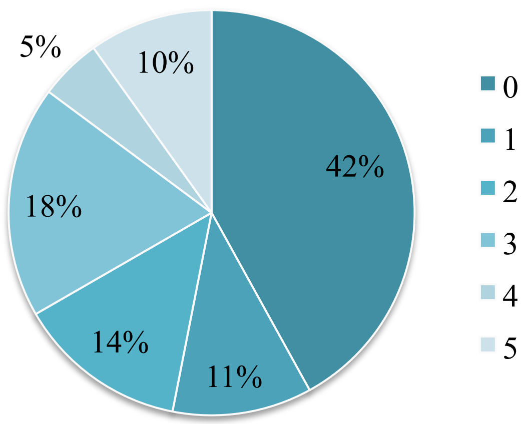
The MST score percentages of the total population and by gender are shown in Figures 5-7. Approximately half (53.3%) of patients were determined by the MST to be at high risk for malnutrition (MST score ≥2; Table 3). Of those patients, 38 (46.9%) were male and 51 (59%) were female.

Figure 5. MST score percentages of the total population



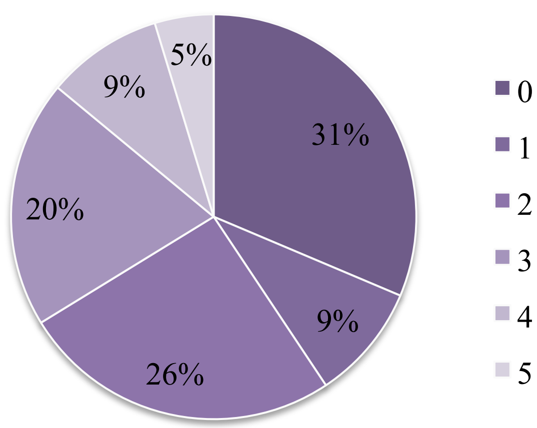
MST – Malnutrition Nutrition Screening Tool
Score ≥ 2 – patients at risk for malnutrition; automatic Registered Dietitian consults

Figure 6. MST score percentages of the male patient population



MST – Malnutrition Nutrition Screening Tool
Score ≥ 2 – patients at risk for malnutrition; automatic Registered Dietitian consults

Figure 7. MST score percentages of the female patient population



MST – Malnutrition Nutrition Screening Tool
Score ≥ 2 – patients at risk for malnutrition; automatic Registered Dietitian consults

Table 3. Summary of MST score for the total population and by gender

	Total Population (N = 167)	Males (n = 81)	Females (n = 86)
MST Score < 2 n (%)	78 (46.7)	43 (53.1)	35 (41)
MST Score ≥ 2 n (%)	89 (53.3)	38 (46.9)	51 (59)

MST – Malnutrition Screening Tool

The MST score category (<2 vs. ≥2) by diagnosis of malnutrition by the RD (yes vs. no) and accompanying Pearson Chi-square analysis for the total population and for each gender are shown in appendices D-I. A significant association between the MST score category and RD diagnosis of malnutrition was observed (p <0.01). Length of stay did not differ significantly by MST score category (p = 0.25). Tables 4 – 6 show the sensitivity and specificity of the MST for the total population and by gender. In the total population, the MST identified 79% of patients who met the AND/ASPEN criteria for malnutrition as determined by the RD. The specificity statistic evaluated whether the MST was as likely as the RD to identify patients who did not meet the AND/ASPEN criteria for malnutrition. In the total population, the MST identified 62% of patients who did not meet the AND/ASPEN criteria for malnutrition as determined by the RD. These percentages were consistent after subdivision by gender. The number of patients readmitted within 30 days of discharge did not differ statistically between those screened to be at risk of malnutrition when compared to those not at risk (41% vs. 59%, respectively, p = 0.06).

Table 4. Diagnostic test results of the total patient population

Total Population			
	Diagnosis +	**Diagnosis -**	**Total**
MST Score ≥ 2	49	40	89
MST Score < 2	13	65	78
Total	62	105	167
Sensitivity = a / (a + c) = 0.79 **Specificity = d / (b + d) = 0.62**			

Table 5. Diagnostic test results of the male patient population

Male Population			
	Diagnosis +	**Diagnosis -**	**Total**
MST Score ≥ 2	26	12	38
MST Score < 2	7	36	43
Total	33	48	81
Sensitivity = a / (a + c) = 0.79 **Specificity = d / (b + d) = 0.75**			

Table 6. Diagnostic test results of the female patient population

Female Population			
	Diagnosis +	**Diagnosis -**	**Total**
MST Score ≥ 2	23	28	51
MST Score < 2	6	29	35
Total	29	57	86
Sensitivity = a / (a + c) = 0.79 **Specificity = d / (b + d) = 0.51**			

CHAPTER V

THE EFFICACY OF A SCREENING TOOL TO ASSESS MALNUTRITION IN ADULTS ADMITTED TO A LARGE URBAN UNIVERSITY HOSPITAL

DISCUSSION

Over half of our patient population was found to be at risk for malnutrition using the MST. Of those found to be at risk for malnutrition upon admission, more than half were diagnosed with malnutrition by an RD, which illustrates the importance of performing a nutrition screening in an acute care setting. The top five admitting diagnoses for patients who were at risk for malnutrition were pulmonary disorders, cardiovascular disease, kidney disease, cancer, and gastrointestinal disorders. The sensitivity of the MST was moderate (79%) and consistent after subdivision by gender. Sensitivity of a screening tool is important to ensure that all or most of the patients with a particular condition or disease is recognized and that resources are utilized appropriately and in a timely manner. Therefore, the MST is an acceptable method of identifying patients with a true diagnosis of malnutrition in this patient population. The specificity of the MST was lower (62%) than the sensitivity for the total population and varied for males and females (75% and 51%, respectively). This indicates that the tool identified patients without malnutrition in the male population better than in the female population in our patient group. The specificity of a screening tool is important to rule out patients that do not have malnutrition so that resources can be used for those who do.

The MST has been tested in many populations with varying results. In an observational study performed at a single tertiary cancer center consisting of 126 oncology patients, the researchers aimed to determine the sensitivity and specificity of the MST and the Royal Marsden Nutrition Screening Tool against the SGA. In this study, the MST had a sensitivity of 66% and a specificity of 83%.[17] In contrast, an observational cross-sectional study of 50 outpatient oncology patients receiving chemotherapy aimed to determine the validity of the MST against a full nutrition assessment in an outpatient chemotherapy unit at a public hospital. In this study, the MST had a sensitivity of 100% and specificity of 92%.[15] In another study performed in 106 outpatient oncology patients receiving radiotherapy, the researchers aimed to determine the validity of the MST. They found that the MST had a sensitivity of 100% and a specificity of 81%.[12] In a cross-sectional study performed in three dedicated renal inpatient wards in a large tertiary hospital, 276 patients with renal disease were examined to determine the validity of the MST in the renal population. The MST was found to have a sensitivity of 48.7% and a specificity of 85.5%.[18]

These studies illustrate the varying results of validation studies using the MST. Although this tool has shown to be a good predictor of malnutrition risk in an outpatient oncology setting, both for chemotherapy and radiotherapy patients and in the general acute care setting, it might not be appropriate for all adult populations. The results of the current study are not consistent with previous studies that were conducted in the acute care setting. For instance, Ferguson et al. (1999) found that in 408 adult acute hospital patients, the MST, when compared to the SGA, had a sensitivity and specificity of 93%, which is higher than what was found in the current study.[5] In another study, Neelemaat et al. (2011) compared the MST with the SNAQ, the MNA-SF, the MUST, and the NRS-2002 to determine its validity. The MST in this study of 275 inpatients had a sensitivity of 75% and a specificity of 90%.[19] The sensitivity of the MST in this study is consistent with the current study, but the specificity of the MST is higher than the current study. Possible explanations for these inconsistent results may include the differences in sample size and length of the study. Both the Ferguson and the Neelemaat studies had larger sample sizes and longer study lengths than the current study. In addition, the reference tool used to validate the MST was different for each study.

We looked at the difference between malnutrition score and length of stay and the difference between malnutrition score and 30-day readmission. However, we did not find any significant difference in either. In contrast, the Ferguson et al. (1999) study, found that the length of stay of patients at risk for malnutrition was significantly higher than those who were not at risk ($p < 0.05$).[5]

There were a few limitations to this study. The first was the use of data extraction instead of reviewing actual patient charts. Although the data extraction conveniently organized the patient data, it converted the data into an excel document, which made interpretation of RD notes difficult. In addition, the data collection period was a limited to two weeks resulting in a small patient population. Also, as this was a retrospective study, we were inherently limited by the available information that was recorded in to the EHR.

Furthermore, the RDs often used the same criteria, such as weight loss and energy intake, to diagnose patients with malnutrition as the screening tool did; evaluation of muscle and fat losses or functional assessment may have provided different results. The identification of patient weight loss and anorexia were based on subjective data with both methods of malnutrition identification, which may have falsely identified malnutrition in this patient population. Previous documentation of weight in medical records to assess the severity of weight loss and a standardized predictive formula to determine inadequacy of energy intake should be used to ensure that patients meet the specific AND/ASPEN criteria for diagnosis of malnutrition.

Although the MST did not identify all of the patients at risk for malnutrition (21%), the tool proved to be a useful method for early identification of malnutrition in adults admitted to a large urban university hospital. The MST is most commonly studied in inpatients and outpatients with cancer, but there is a lack of validation studies of the tool in outpatient adults with other conditions. Therefore, future studies are necessary to evaluate the effectiveness of the MST in various adult outpatient populations.

References

1. Peregrin T. Personal and electronic health records: sharing nutrition information across the health care community. *J Am Diet Assoc*. 2009;109(12):1988-1991.

2. Handel DA, Hackman JL. Implementing electronic health records in the emergency department. *J Emerg Med*. 2010;38(2):257-263.

3. Charles, MPH D, Gabriel, PhD M, Furukawa, PhD MF. Adoption of electronic health record systems among U.S. non-federal acute care hospitals: 2008-2013. *Healthit.gov*. May 2014. http://healthit.gov/sites/default/files/oncdatabrief16.pdf.

4. White JV, Guenter P, Jensen G, et al. Consensus statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). *J Acad Nutr Diet*. 2012;112(5):730-738.

5. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. *Nutr Burbank Los Angel Cty Calif*. 1999;15(6):458-464.

6. What is an electronic health record (EHR)? http://www.healthit.gov/providers-professionals/faqs/what-electronic-health-record-ehr. Accessed July 12, 2014.

7. Milani S, Wright C, Purcell O, Macleod I, Gerasimidis K. Acquisition and utilisation of anthropometric measurements on admission in a paediatric hospital before and after the introduction of a malnutrition screening tool. *J Hum Nutr Diet Off J Br Diet Assoc*. 2013;26(3):294-297.

8. Moriana M, Civera M, Artero A, et al. Validity of subjective global assessment as a screening method for hospital malnutrition. prevalence of malnutrition in a tertiary hospital. *Endocrinol Nutr Engl Ed*. 2014;61(4):184-189.

9. Wong S, Graham A, Hirani SP, Grimble G, Forbes A. Validation of the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP) in patients with spinal cord injuries (SCIs). *Spinal Cord*. 2013;51(5):424-429.

10. Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr Edinb Scotl*. 2008;27(1):5-15.

11. Malone, M.S., R.D., C.N.S.C., L.D. A. Dietitians critical role in leading nutrition intervention in the hospital. October 2013. http://malnutrition.com/commentary/ainsley. Accessed June 17, 2015

12. Ferguson ML, Bauer J, Gallagher B, Capra S, Christie DR, Mason BR. Validation of a malnutrition screening tool for patients receiving radiotherapy. *Australas Radiol*. 1999;43(3):325-327.

13. Bauer J, Capra S. Comparison of a malnutrition screening tool with subjective global assessment in hospitalised patients with cancer--sensitivity and specificity. *Asia Pac J Clin Nutr*. 2003;12(3):257-260.

14. Miyata S, Tanaka M, Ihaku D. The prognostic significance of nutritional status using malnutrition universal screening tool in patients with pulmonary tuberculosis. *Nutr J*. 2013;12:42-42.

15. Isenring E, Cross G, Daniels L, Kellett E, Koczwara B. Validity of the malnutrition screening tool as an effective predictor of nutritional risk in oncology outpatients receiving chemotherapy. *Support Care Cancer*. 2006;14(11):1152-1156.

16. Bell JJ, Bauer JD, Capra S. The Malnutrition Screening Tool versus objective measures to detect malnutrition in hip fracture. *J Hum Nutr Diet*. 2013;26(6):519-526.

17. Shaw C, Fleuret C, Pickard JM, Mohammed K, Black G, Wedlake L. Comparison of a novel, simple nutrition screening tool for adult oncology inpatients and the Malnutrition Screening Tool (MST) against the Patient-Generated Subjective Global Assessment (PG-SGA). *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2015;23(1):47-54.

18. Lawson CS, Campbell KL, Dimakopoulos I, Dockrell MEC. Assessing the validity and reliability of the MUST and MST nutrition screening tools in renal inpatients. *J Ren Nutr Off J Counc Ren Nutr Natl Kidney Found*. 2012;22(5):499-506.

19. Neelemaat F, Meijers J, Kruizenga H, van Ballegooijen H, van Bokhorst-de van der Schueren M. Comparison of five malnutrition screening tools in one hospital inpatient sample. *J Clin Nurs*. 2011;20(15-16):2144-2152.

20. Validated Malnutrition Screening and Assessment Tools: Comparison Guide. September 2014. http://www.health.qld.gov.au/nutrition/resources/hphe_scrn_tools.pdf. Accessed June 17, 2014.

APPENDICES

APPENDIX A

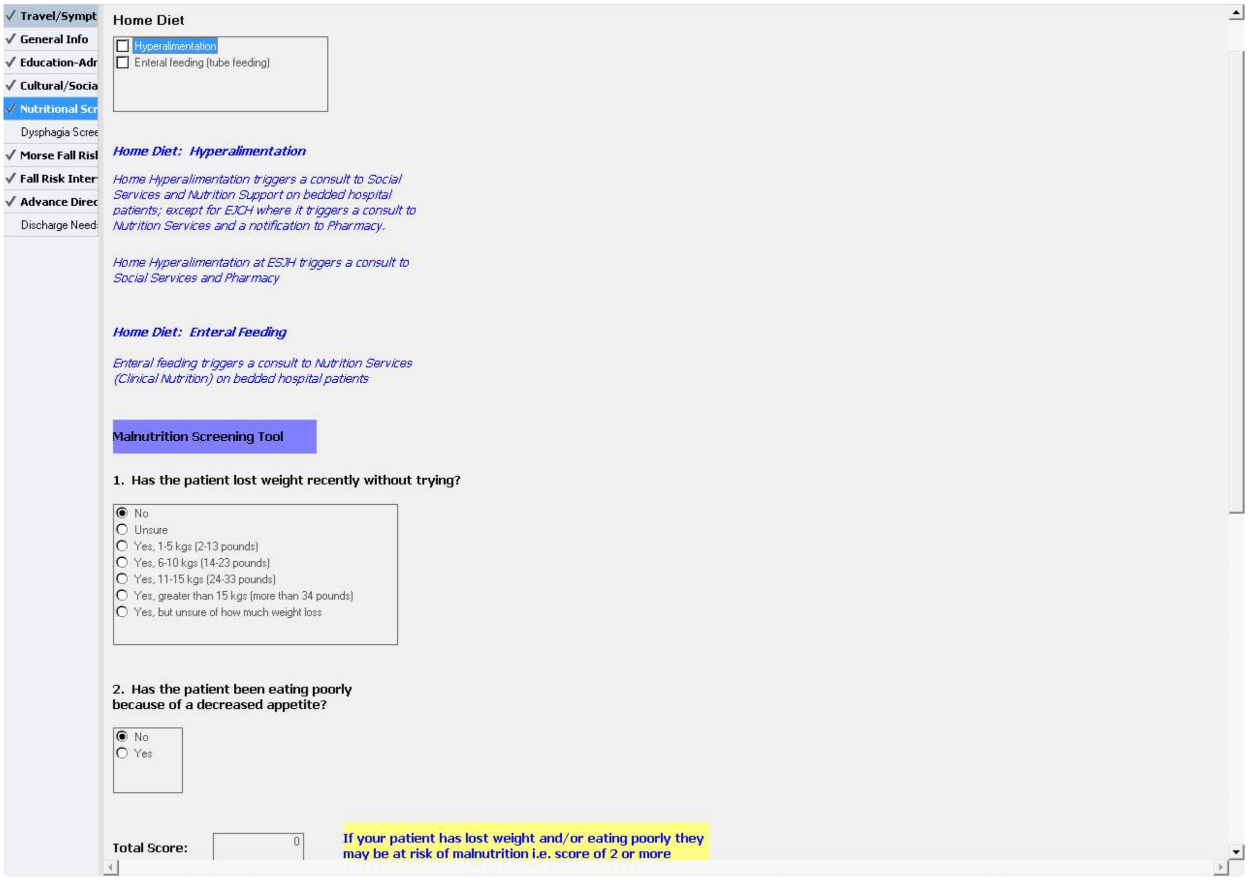
MALNUTRITION SCREENING TOOLS [20]

Name Author, Year, Country	Patient Population of Tool Validation	Nutrition Screening Parameters	Criteria for Risk of Malnutrition
Malnutrition Screening Tool (MST) *Ferguson et al. (1999) Australia*	Acute adults: inpatients & outpatients including elderly Residential aged care facilities	Recent weight loss Recent poor intake	Score 0-1 for recent intake Score 0-4 for recent weight loss Total score: >2 = at risk of malnutrition
Malnutrition Universal Screening Tool (MUST) *Malnutrition Advisory Group, BAPEN (2003) UK*	Adults – acute and community	BMI, Weight loss (%) Acute disease effect score	Score 0 – 3 for each parameter. Total score: >2 = high risk; 1 = medium risk; 0 = low risk
Mini Nutritional Assessment – Short Form (MNA-SF) *Rubenstein et al. (2001) United States*	Elderly May be best used in community, sub-acute or residential aged care settings, rather than acute care	Recent intake, Recent weight loss Mobility: Recent acute disease or psychological stress, Neuropsychological problem, BMI	Score 0-3 for each parameter Total score: < 11 = at risk, continue with MNA
Nutrition Risk Screening (NRS-2002) *Kondrup et al. (2003) Denmark*	Acute adult	Recent weight loss (%), Recent poor intake (%) BMI Severity of disease Elderly	Score 0-3 for each parameter Total score:> 3 = start nutritional support

Nutrition Assessments		
Name Author, Year, Country	**Patient Population of Tool Validation**	**Criteria for Risk of Malnutrition**
Subjective Global Assessment (SGA) Detsky, A.S. et al. 1987	Setting: Acute, Rehab, Community, Residential Aged Care Patient group: Surgery, Geriatric, Oncology, Renal	Includes medical history (weight, intake, GI symptoms, functional capacity) and physical examination Categorizes patients as: SGA A (well nourished), SGA B (mild-moderate malnutrition) or SGA C (severe malnutrition)
Patent Generated Subjective Global Assessment (PG-SGA) Ottery, F. 2005	Setting: Acute, Patient group, Renal, Oncology, Stroke	Includes medical history (weight, intake, symptoms, functional capacity, metabolic demand) and physical examination Categorizes patients into SGA categories (A, B or C) as well as providing a numerical score for triaging. Global categories should be assessed as per SGA.

Appendix B

Malnutrition Screening Tool



APPENDIX C

MALNUTRITION SCREENING TOOL SCORING

Nursing Nutrition Screen

- Change from previous multiple nutrition screening questions to two questions
- Quick and simple
- Answers to the two questions are given a score
- Total score of 2 or more result in an automatic nutrition consult

Malnutrition Screening Tool:

1. Have you/the patient lost weight recently without trying?

Applies to the last 6 months

No	0
Unsure	2
Yes, how much?	
1 – 5 kg (2 – 13 pounds)	1
6 – 10 kg (14 – 23 pounds)	2
11 – 15 kg (24 – 33 pounds)	3
>15 kg (> or = 34 pounds)	4
Unsure	2

If the patient is unsure if he/she has lost weight, ask if he/she thinks his/her clothes are looser, does face appear thinner?

2. Have you/the patient been eating poorly because of a decreased appetite?

No	0
Yes	1

Example: eating less than 75% of normal eating habits

A total score of 2 or greater will result in an automatic nutrition consult. The dietitian will assess the patient within 48 hours of the consult being initiated.

APPENDIX D

Table 7. Cross tabulation of MST Score and RD Diagnosis of the total patient population

MST SCORE * RD Diagnosis Cross Tabulation of the Total Patient Population					
			RDDX		Total
			1	2	
MST Score	1	Count	49	40	89
		Expected Count	33.0	56.0	89.0
		% within MST Score	55.1%	44.9%	100.0%
		% within RDDX	79.0%	38.1%	53.3%
		% of Total	29.3%	24.0%	53.3%
	2	Count	13	65	78
		Expected Count	29.0	49.0	78.0
		% within MST Score	16.7%	83.3%	100.0%
		% within RDDX	21.0%	61.9%	46.7%
		% of Total	7.8%	38.9%	46.7%
Total		Count	62	105	167
		Expected Count	62.0	105.0	167.0
		% within MST Score	37.1%	62.9%	100.0%
		% within RDDX	100.0%	100.0%	100.0%
		% of Total	37.1%	62.9%	100.0%

MST – Malnutrition Screening Tool; RD – Registered Dietitian; RDDX – RD Diagnosis

APPENDIX E

Table 8. Chi-square tests of the total patient population

Chi-Square Tests of the Total Patient Population					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	26.245[a]	1	.000		
Continuity Correction[b]	24.626	1	.000		
Likelihood Ratio	27.558	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	26.088	1	.000		
N of Valid Cases	167				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 28.96.

b. Computed only for a 2x2 table

APPENDIX F

Table 9. Cross tabulation of MST score and RD Diagnosis of the male patient population

MST SCORE * RD Diagnosis Cross Tabulation of the Male Patient Population					
			RDDX		
			1	2	Total
MST Score	1	Count	26	12	38
		Expected Count	15.5	22.5	38.0
		% within MST Score	68.4%	31.6%	100.0%
		% within RDDX	78.8%	25.0%	46.9%
		% of Total	32.1%	14.8%	46.9%
	2	Count	7	36	43
		Expected Count	17.5	25.5	43.0
		% within MST Score	16.3%	83.7%	100.0%
		% within RDDX	21.2%	75.0%	53.1%
		% of Total	8.6%	44.4%	53.1%
Total		Count	33	48	81
		Expected Count	33.0	48.0	81.0
		% within MST Score	40.7%	59.3%	100.0%
		% within RDDX	100.0%	100.0%	100.0%
		% of Total	40.7%	59.3%	100.0%

MST – Malnutrition Screening Tool; RD – Registered Dietitian; RDDX – RD Diagnosis

APPENDIX G

Table 10. Chi-Square test of the male patient population

Chi-Square Tests of the Male Patient Population					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	22.717[a]	1	.000		
Continuity Correction[b]	20.609	1	.000		
Likelihood Ratio	23.891	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	22.437	1	.000		
N of Valid Cases	81				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.48.
b. Computed only for a 2x2 table

APPENDIX H

Table 11. Cross tabulation of MST Score and RD Diagnosis for the female patient population

MST SCORE * RD Diagnosis Cross Tabulation of the Female Patient Population					
			RDDX		
			1	2	Total
MALSCORECHI	1	Count	23	28	51
		Expected Count	17.2	33.8	51.0
		% within MALSCORECHI	45.1%	54.9%	100.0%
		% within RDDX	79.3%	49.1%	59.3%
		% of Total	26.7%	32.6%	59.3%
	2	Count	6	29	35
		Expected Count	11.8	23.2	35.0
		% within MALSCORECHI	17.1%	82.9%	100.0%
		% within RDDX	20.7%	50.9%	40.7%
		% of Total	7.0%	33.7%	40.7%
Total		Count	29	57	86
		Expected Count	29.0	57.0	86.0
		% within MALSCORECHI	33.7%	66.3%	100.0%
		% within RDDX	100.0%	100.0%	100.0%
		% of Total	33.7%	66.3%	100.0%

MST – Malnutrition Screening Tool; RD – Registered Dietitian; RDDX – RD Diagnosis

APPENDIX I

Table 12. Chi-square tests for the female patient population

Chi-Square Tests of the Female Patient Population					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.258[a]	1	.007		
Continuity Correction[b]	6.061	1	.014		
Likelihood Ratio	7.657	1	.006		
Fisher's Exact Test				.010	.006
Linear-by-Linear Association	7.173	1	.007		
N of Valid Cases	86				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.80.

b. Computed only for a 2x2 table