My Meal Intake Tool (MMIT) and the Mealtime Audit Tool (MAT) – Criterion Validity and Inter-rater Reliability Testing of two Novel Tools for Improving Food Intake in Acute Care

by

James McCullough

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Science
in
Kinesiology

Waterloo, Ontario, Canada, 2016

AUTHOR'S DECLARATION

This thesis consists of material all of which I authored or co-authored: see STATEMENT OF CONTRIBUTIONS included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

STATEMENT OF CONTRIBUTIONS

All aspects of this thesis have been solely authored by me, with the following exceptions:

Chapter 4 was co-authored by myself and Dr. Heather Keller. The study was designed by Dr. Heather Keller. Data collection was conducted by dietitian site coordinators at the four participant hospital sites. This data was compiled and analyzed by James McCullough. Dr. Heather Keller contributed to the review of drafts, editing, and support for analysis for this chapter in preparation for submission for publication.

Chapter 5 was co-authored by myself, Dr. Heather Keller, and Hannah Marcus. The studies involved in this chapter were designed by Dr. Heather Keller and James McCullough. Data collection was conducted and/or coordinated by dietitian site coordinators at the participant hospital site(s) for the two studies. This data was compiled and analyzed by James McCullough. Dr. Heather Keller and Hannah Marcus contributed to the review of drafts and editing, and Dr. Heather Keller provided support for analysis for this chapter in preparation for submission for publication.

Dr. Heather Keller also contributed to the review of drafts of the other chapters within this thesis. Celia Laur contributed to the review of drafts of Chapter 6.

Abstract

BACKGROUND: Forty-five percent of patients in Canada are admitted to hospital already malnourished. Compared to well-nourished patients, those with diminished nutritional status are at an increased risk of in-hospital mortality and several medical complications. As a result, malnourished patients take longer to recover, stay hospitalized longer, and are more likely to be readmitted to hospital after discharge, costing the healthcare system more to care for them. Improving nutritional status in hospital can improve recovery and shorten length of stay. Insufficient food intake (FI) is common in hospital and has also been associated with longer lengths of stay (LOS), leading to further declines in nutritional status. Thus, ensuring sufficient patient FI could improve patient outcomes and reduce costs of care by reducing nutritional decline. However, current FI monitoring practices in hospital are generally ad hoc. Most hospitals don't have the resource capacity to have staff monitor every patient's FI, so monitoring practices are sparsely or inaccurately completed for only a portion of patients. There are also barriers to FI that occur in hospital, which include a range of potential mealtime issues patients could experience that further prevent them from consuming enough food. These barriers are simple issues that can easily go unrecognized by staff and their existence isn't formally assessed or monitored in current practice. Creating practices that allow 1) the accurate monitoring of all patients' FI, and 2) the identification and removal of FI barriers, could increase the efficacy of hospitals to provide sufficient nutrition care and fight the prevalence of malnutrition through increased patient FI.

PURPOSE: The purpose of this thesis was to complete key steps in the development and testing of two novel hospital nutrition care tools. The My Meal Intake Tool (M-MIT), a patient-completed FI monitoring tool, was tested for feasibility and criterion validity in a clinical setting. The Mealtime Audit Tool (MAT), a hospital staff-completed tool for the identification of FI barriers, was tested for feasibility and inter-rater reliability in a clinical setting.

METHODS & MAJOR FINDINGS: Two studies were conducted as part of this thesis work.

Study 1: Patients from four Canadian hospitals (n=120) were recruited to participate in the feasibility testing of both the M-MIT and the MAT, as well as the criterion validation of the M-MIT. Participants estimated their food and fluid intake using the M-MIT at one mealtime. M-MIT results were validated against dietitian visual estimations of their FI for the same meal. At a separate mealtime, a dietitian completed the MAT with the participants, identifying the barriers that they

experienced at that mealtime. 78% of participants were able to estimate their FI on the M-MIT without error. Sensitivity and specificity of M-MIT's ability to identify participants who consumed < 50% of their meal were 76.2% and 74.0% ($p < 0.001$) respectively, indicating sufficient criterion validity; sensitivity analyses including those who did not complete the tool resulted in a range of sensitivity from 53.3% to 83.3% and specificity from 60.0% to 78.9%. The results of the validity analyses, in combination with patient follow-up interviews and clinician feedback, were used to make revisions to the tool to improve the feasibility and ease of use of M-MIT. Descriptive analyses were conducted to characterize barriers experienced by participants according to the MAT, and clinician feedback was used to make revisions to the MAT before Study 2.

Study 2: Ninety patients from multiple medical and surgical units in a Canadian hospital were recruited to participate in the inter-rater reliability testing of the MAT across 30 different mealtimes. Two auditors completed the MAT with each of the 90 participants within a few minutes of each other after the participants had completed their meals. The MAT tabulates a total score of the number of barriers (out of 18) experienced at a mealtime. Total MAT scores between the two auditors showed good agreement, with an intra-class correlation coefficient (ICC) of 0.68 (0.52-0.79). About two-thirds of the 18 barrier items listed on the MAT showed good to excellent agreement between the two auditors, according to calculated kappa statistics. The inter-rater reliability analyses, descriptive analyses, and clinician feedback from Study 1 and Study 2 were used to make revisions to improve functionality and ease of use of the MAT.

OVERALL CONCLUSIONS: The studies within this thesis have shown the M-MIT and MAT have good potential for use in clinical practice. If implemented into use, the tools have the potential to play a role in improving nutrition care. These tools could help standardize processes (FI monitoring, assessment of FI barriers) that are currently ad hoc or non-existent. However, changing existing care practices is an extremely complex task. There is still work to be done to further test and refine the tools, as well as to determine whether these tools can feasibly be integrated into routine practices, and if their use leads to improvement in patient outcomes.

Acknowledgements

To my parents, thank you so much for supporting me and staying patient through my post-secondary education journey, even though I didn't know where it was leading at times and has taken a little longer than expected. I don't say it enough, so thank you.

To my supervisor, Heather, thank you for *also* staying patient with me through this journey. Thank you for seeing something in my work with you as an undergraduate student that I probably didn't see in myself and giving me this opportunity to contribute in some small way to the meaningful work you are doing. Thank you for all of help, guidance and support. Your passion and ability to balance everything on your plate are inspiring.

To the lab team, Celia, Vanessa, Renata, Tara, Sabrina, and Sarah: thank you guys for the support, critiques, and advice you've provided along the way; I wish you all the best in your continued studies. And mostly thank you for letting me monopolize the computer lab, it's all yours now! To former lab members as well, Kaylen, Ivy, and Kate: thanks for the advice and support you've all provided as I've been coming close to the finish line.

Finally, to people who have been friends, confidantes, roommates, and support systems for me: JF, MD, JN, BK, ST, JH, SF, KB, PC, MJ, and probably many more: Thank you for listening to topics you might not know anything about, thank you for advice on topics you know a lot about, thanks for keeping me company during long days or nights reading, writing, or marking, and thank you for taking my mind off those long days and nights.

Table of Contents

AUTHOR'S DECLARATION ii
STATEMENT OF CONTRIBUTIONS iii
Abstract iv
Acknowledgements vi
Table of Contents vii
List of Tables x
List of Abbreviations xi
Chapter 1 Introduction 1
Chapter 2 Background 5
2.1 Malnutrition in Hospital 6
2.2 Insufficient Food Intake in Hospital 7
2.2.1 Monitoring food intake in hospital – The need for a tool to monitor all patients 9
2.3 Barriers to Food Intake in Hospital 11
2.3.1 How can we remove barriers to food intake in hospital? – The need for a barrier assessment tool 13
2.4 The Integrated Nutrition Pathway for Acute Care (INPAC) 15
2.5 Developing and Testing New Clinical Tools 15
2.6 Summary 17
Chapter 3 Research Questions 19
3.1 Study 1: My Meal Intake Tool (M-MIT) – Validation of a novel food intake monitoring tool for acute care hospital patients against dietitian visual estimations 20
3.2 Study 2: The Mealtime Audit Tool (MAT) – Inter-rater reliability testing of a novel tool for the monitoring and assessment of food intake barriers in acute care hospital patients 21
Chapter 4 My Meal Intake Tool (M-MIT) – Validation of a novel food intake monitoring tool for acute care hospital patients against dietitian visual estimations 23
4.1 Abstract 23
4.2 Introduction 24
4.3 Methods 26
4.3.1 My Meal Intake Tool (M-MIT) 26
4.3.2 Subjects 27
4.3.3 Data Collection 28

4.3.4 Analysis 29
4.4 Results 32
4.4.1 Patient Characteristics 32
4.4.2 M-MIT Completion & Errors in Completion 33
4.4.3 Validation of M-MIT 34
4.4.4 Descriptive Analyses of Reasons for Low Appetite and Challenges 38
4.4.5 Revisions Made to M-MIT 39
4.5 Discussion 41
4.5.1 M-MIT as a Tool for Change in Nutrition Care 41
4.5.2 Strengths and Limitations 44
4.5.3 Next Steps 46
4.6 Conclusions 48
4.7 Data Tables 49
Chapter 5 The Mealtime Audit Tool (MAT) – Inter-rater reliability testing of a novel tool for the monitoring and assessment of food intake barriers in acute care hospital patients 55
5.1 Abstract 55
5.2 Introduction 56
5.3 Methods 58
5.3.1 Subjects and Hospitals 58
5.3.2 Mealtime Audit Tool (MAT) 59
5.3.3 Data Collection 61
5.3.4 Analysis 62
5.4 Results 64
5.4.1 Patient Characteristics 64
5.4.2 Descriptive Analysis of Mealtime Barriers 64
5.4.3 Inter-rater Reliability 67
5.4.4 Revisions Made to MAT 67
5.5 Discussion 68
5.5.1 MAT as a Feasible Tool for Change in Nutrition Care 68
5.5.2 Prevalence of Mealtime Barriers in Hospital Patients 70
5.5.3 Strengths and Limitations 71
5.5.4 Next Steps 73

5.6 Conclusions 73
5.7 Data Tables 75
Chapter 6 Discussion 81
6.1 M-MIT and MAT – Implications for Practice 82
6.1.1 My Meal Intake Tool within the Integrated Nutrition Pathway for Acute Care (INPAC) 82
6.1.2 Mealtime Audit Tool within the Integrated Nutrition Pathway for Acute Care (INPAC) 86
6.2 Implementing Changes in Nutrition Care Practices 88
6.2.1 Value of M-MIT and MAT Outside of INPAC 88
6.2.2 Improving Nutrition Care Requires a Multidisciplinary Approach 89
6.3 Next Steps 91
6.4 Concluding Remarks 92
Bibliography 93
Appendix A The Integrated Nutrition Pathway for Acute Care 103
Appendix B My Meal Intake Tool – Tested Version 105
Appendix C M-MIT & MAT Feasibility Studies – Ethics Approval 107
Appendix D My Meal Intake Tool – Published Version 108
Appendix E My Meal Intake Tool – Guidance Document 110
Appendix F Mealtime Audit Tool – Version 1 112
Appendix G Mealtime Audit Tool – Version 2 115
Appendix H MAT Inter-rater Reliability Testing – Ethics Approval 117
Appendix I Mealtime Audit Tool – Published Version 118
Appendix J Mealtime Audit Tool – Guidance Document 120

List of Tables

Table 1 - Participant Hospital Characteristics 49
Table 2 - Patient Demographics (n=120) 50
Table 3 - Contingency Table for Solid Intake Calculation Method 1 51
Table 4 - Contingency Table for Solid Intake Calculation Method 2 51
Table 5 - Contingency Table for Solid Intake Calculation Method 3 51
Table 6 - Contingency Table for Fluid Intake Calculation Method 1 51
Table 7 - Contingency Table for Fluid Intake Calculation Method 2 51
Table 8 - Contingency Table for Fluid Intake Calculation Method 3 52
Table 9 - Sensitivity and specificity of M-MIT fluids section and of most common individual fluid items 52
Table 10 - Overall Agreement, Sensitivity & Specificity stratified by demographics/appetite for solid food intake 52
Table 11 - Overall Agreement, Sensitivity & Specificity stratified by demographics/appetite for total fluid intake 53
Table 12 - Low food and fluid intake (50% or less) for dietitian and M-MIT estimations across hospital sites 53
Table 13 - "How was your appetite at this meal?" – % of participants with low appetite & reasons for low appetite across hospital sites 54
Table 14 - "Did you have any challenges at this meal?" – Number of challenges experienced by participants across hospital sites 54
Table 15 - Participant Hospital Characteristics 75
Table 16 - Patient Demographics for Study 1 and 2 76
Table 17 - Descriptive analysis for barriers experienced by patients across hospital sites and studies 77
Table 18 - Comparison of number of barriers experienced by selected patient characteristics 77
Table 19 - Proportion of each food intake barrier experienced in study 1 (MAT Version 1) 78
Table 20 - Proportion experiencing mealtime barriers and reliability testing for study 2 (MAT Version 2) (n=90) 79

List of Abbreviations

AD: Alzheimer's disease

ANOVA: Analysis of variance

ASPEN: American Society for Parenteral and Enteral Nutrition

BMI: Body mass index

CI: Confidence interval

CMTF: Canadian Malnutrition Task Force

CNST: Canadian Nutrition Screening Tool

DV: Dietitian visual

EER: Estimated energy requirements

ESPEN: European Society for Clinical Nutrition and Metabolism

FFM: Fat-free mass

FFMI: Fat-free mass index

FI: Food intake

ICC: Intra-class correlation coefficient

INPAC: Integrated Nutrition Pathway for Acute Care

LOS: Length of stay

M2E: More-2-Eat

MAT: Mealtime Audit Tool

M-MIT: My Meal Intake Tool

MP: Meal portion

NCCH: Nutrition Care in Canadian Hospitals

NPT: Normalization process theory

PDSA: Plan-Do-Study-Act

PM: Protected Mealtimes

REE: Resting energy expenditure

Se: Sensitivity

SGA: Subjective Global Assessment

Sp: Specificity

TEE: Total energy expenditure

VE: Visual estimation

Chapter 1
Introduction

In acute care hospital wards malnutrition, or undernutrition, is a prevalent threat that is under-recognized and undertreated[1] especially among elderly patients (65+ years)[2,3]. Malnutrition prevalence data varies greatly in the literature due to a lack of consensus around a clinical definition of 'malnutrition' and due to the numerous diagnostic tools and methods used to measure nutritional status that exist.[4,5] However, with 45% of patients in Canada being admitted to hospital already malnourished[6] and other prevalence rates quoted in existing literature as ranging from approximately 10-70%[7-20], malnutrition in hospitalized patients is a significant issue. Furthermore, nutritional status tends to deteriorate in hospital due to the combined effects of insufficient nutritional intake and the patient's medical condition.[18] Being malnourished while in hospital is associated with adverse clinical outcomes such as increased risk of morbidity[5,17], mortality[5,17,21,22], and medical complications[18,23], and increased lengths of stay (LOS)[17,21,22] and readmission rates[21,22], when compared to well-nourished patients. Undernutrition is associated with impairments in every system in the body[18], resulting in declines in functional status, immune function, muscle function, bone mass, cognitive function, wound healing, and delayed recovery from surgery.[18,23] The consequence is that malnourished patients require more care and take longer to recover, resulting in increased costs of care for malnourished patients.[17,22]

Food intake (FI), a primary determinant of nutrition status[6], is generally insufficient to meet daily needs while in hospital[3,24-26]. Insufficient FI is also an independent predictor of in-hospital mortality[21,24,27] and LOS[6,21]. Thus, FI is considered an essential indicator of nutrition status that should be monitored in hospital patients.[28,29] However, current FI and nutrition status monitoring practices are generally not standardized[30], are completed inaccurately or not at all due to their reliance on busy nursing staff[31,32], and due to resource constraints cannot be completed for all patients[30].

Food intake is also impacted by barriers that exist in the hospital setting. These barriers are issues faced by patients that further prevent them from consuming enough food. Barriers can be physical (e.g. unable to cut food, open packages, or reach their meal tray, or being positioned uncomfortably) or organizational (e.g. food served at inconvenient times, missing food items, food not served hot, being disturbed or interrupted during the meal) in nature, or can simply be caused by poor food quality or foods that don't meet the preferences of patients.[33,34] The occurrence of these barriers can vary from hospital to hospital or between units within a hospital due to the physical and cognitive capabilities of the patients and the quality of nutrition care provided. Though knowledge of the occurrence of these barriers exists, little is done in practice to identify and remove barriers in order to improve the quality of nutrition care.

The Integrated Nutrition Pathway for Acute Care (INPAC) is a recently-developed evidence-based and consensus-derived algorithm that was created as a set of best practice recommendations for nutrition care in acute care hospital patients.[35] The aim of following INPAC's care practices is to better detect, monitor, and treat malnutrition in this vulnerable population. During INPAC development, two needs were identified in order to facilitate the proposed improved nutrition care processes: 1) a standard way to accurately assess all patients' FI, and 2) a tool that hospital staff could use to easily identify FI barriers. Thus, two novel tools were created in an attempt to meet these needs. To address the first need, the My Meal Intake Tool (M-MIT) was created. The M-MIT is a patient self-completed form that allows the patient to estimate their food and fluid intake for a single meal. It also allows patients to note any issues or challenges they had with the meal. To address the second need, the Mealtime Audit Tool (MAT) was created. The MAT is an interview-based questionnaire completed by hospital staff that allows them to identify barriers to FI that individual patients may have experienced during a mealtime. The MAT also allows the auditor to note any potential issues across the unit that may have impacted the mealtime environment.

This thesis includes two studies that aimed to: 1) conduct criterion validity testing of the M-MIT, and 2) conduct inter-rater reliability testing of the MAT, in real-life clinical settings. The main objective of these studies was to determine if the tools had sufficient measures of validity and reliability, respectively, to be deemed acceptable for use in clinical practice. The M-MIT was tested for validity by comparing patient M-MIT estimations of their food and fluid intake against the criterion measure of visual estimation of patient intake by trained dietitians. The MAT was tested for inter-rater reliability by having two dietetic interns complete the tool with each patient involved in the study and comparing results between the two raters. Another aim in both studies was to use the quantitative data collected as well as qualitative comments and feedback from participants and staff to make revisions to the tools to improve their ease of use.

The M-MIT and MAT were created as potential tools that could be feasible for clinical use and if adopted into routine practices, could facilitate improvements to nutrition care in hospitals. Providing statistical evidence of their validity and reliability would enhance the rationale for hospitals to adopt these tools, within or outside of INPAC, into their standard care practices. The M-MIT and MAT are meant to be used for regular monitoring of FI and FI barriers. Regular monitoring practices are a common element of successful nutrition interventions.[36] Developing tools and providing evidence for their use will not make a difference on their own, however. Making changes to care processes, even small changes, can be incredibly complex. Further research would need to uncover whether these tools can be implemented into routine care practices, the steps necessary to successfully implement them, and whether they contribute to producing a change in malnutrition-related outcomes. First and foremost, an acknowledgement is needed – that current practices in detecting, monitoring, and treating malnutrition in hospital are not up to par. This acknowledgement needs to be multi-level and start from hospital management, who must recognize that a culture change is needed towards promoting and improving nutrition.[37] The culture change needs to extend to all levels – from the organizational, to the staff, to the patient-family level – to increase

awareness of the prevalence of malnutrition and why it is a problem.[37] Only then can tools such as the M-MIT and MAT, and care processes such as the INPAC, be implemented effectively and real changes be made.

Chapter 2
Background

Malnutrition is a broad term that encompasses either a deficiency or an excess of energy, protein, and/or other nutrients. In clinical practice, deficiency or undernutrition, is the main concern.[38] Undernutrition is defined as a pathological state caused by the inadequate intake of energy, protein, and/or nutrients that affects body composition, functional ability, and overall health[38,39], leading to impaired clinical outcomes from disease.[4] From this point the term *malnutrition* will be considered synonymous with *undernutrition*. The causes of malnutrition are multi-factorial in nature. In disease, injury, or aging, malnutrition can be caused or exacerbated by inadequate intake, increased nutritional requirements (i.e. due to medical condition), impaired nutrient absorption, transport or utilization, or by any combination of these.[5]

Though the definition of malnutrition is well-accepted, there is yet to be a universally accepted set of diagnostic criteria for the condition. Both the American Society for Parenteral and Enteral Nutrition (ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) have recently published consensus statements[4,5] attempting to standardize the definition. ASPEN (2009) suggested a diagnosis of malnutrition should have two or more of the following criteria: insufficient FI, recent weight loss, loss of muscle mass, loss of subcutaneous fat, localized or generalized inflammation, and diminished handgrip strength (as a measure of diminished functional status), with differential designations for 'mild/moderate' and 'severe' malnutrition for each of the six criteria.[5] ESPEN's suggested diagnostic framework (2015) contains fewer criteria and more objective cut-off values for diagnosis. According to ESPEN, unintentional weight loss (>5% over the last three months for acute illness or >10% of habitual weight indefinite of time for chronic conditions) combined with one of either: low BMI (<20 kg/m^2 for <70 years of age; <22 kg/m^2 for 70 years and older) or low fat free mass index (FFMI) (females: <15 kg/m^2; males: <17 kg/m^2) is enough for a malnutrition diagnosis. They also suggest that immediate diagnosis of malnutrition is warranted for any patient with BMI <18.5 kg/m^2.[4] Although these attempts to

standardize diagnosis have been made, there is still no universally accepted definition, set of diagnostic criteria, nor a standardized measurement method or tool to diagnose malnutrition.

2.1 Malnutrition in Hospital

Malnutrition is a prevalent issue in the hospital patient population that is under-recognized and undertreated.[1] This is especially true when it comes to elderly hospital patients.[2,3] In Canada, 45% of patients are admitted to hospital already malnourished according to Subjective Global Assessment (SGA) (either moderate or severe malnutrition).[6] Other studies in various settings and hospital populations have reported the prevalence of malnutrition to be anywhere from 11-71%.[7-20] The wide range of reported prevalence rates could be due to the different populations studied, but also due to the lack of agreed upon diagnostic criteria and therefore the variety of diagnostic methods used in these studies. Regardless the fact remains that a large portion of the hospitalized population is affected by a diminished nutritional state.

Being malnourished in hospital carries with it significant clinical and economic implications. Malnourished patients have an increased risk of morbidity[5,17] and mortality[5,17,21,22], are more likely to be readmitted[21,22] and are more likely to be hospitalized longer[17,21,22] than well-nourished patients. Undernutrition is associated with impairments in every system in the body[18], resulting in declines in functional status, impaired muscle function, decreased bone mass, immune dysfunction, anemia, reduced cognitive function, poor wound healing, and delayed recovery/increased risk of infection after surgery, among other potential complications.[18,23] Thus, malnourished patients require more care and take longer to recover, resulting in increased costs of care for malnourished patients.[17,22] In Canada, the cost of care for a malnourished patient was found to be approximately $2000 more per patient per stay than for a well-nourished patient.[40] Furthermore, nutritional status tends to deteriorate while hospitalized due to the combined effect of insufficient intake and the patient's medical condition, which can result in increased metabolic demands, impaired nutrient utilization and/or increased nutrient losses.[18] Preventing nutritional

decline and improving nutritional status can play a significant role in improving patient outcomes. The Nutrition Care in Canadian Hospitals (NCCH) study found that patients who were admitted already malnourished and improved their nutritional status while in hospital had shorter lengths of stay than those who did not improve.[6] Elderly hospital patients are especially susceptible to weight loss and malnutrition due to age-related reductions in appetite, sense of taste and smell, and oral health.[41] Older patients are also more likely to be co-morbid[41-43], and thus more likely susceptible to the nutritional effects of their multiple medical conditions and medications. Certain age-related conditions, such as dementia and Alzheimer's disease (AD), can increase risk of malnutrition as well by impairing the desire or ability to eat.[41]

Weight loss, a classic sign of malnutrition, can develop through numerous mechanisms in hospital patients as a result of insufficient FI, injury or illness, and/or a lack of physical activity. Insufficient nutritional intake is the most obvious mechanism and can lead to wasting, which is an involuntary loss of weight due to a negative energy balance[41], and eventually malnutrition. Many acute illness or injury states can lead to the development of cachexia, an involuntary loss of fat-free mass (FFM). Cachexia can develop in the presence of an acute immune response, in which pro-inflammatory cytokines are released to deal with the metabolic stress. Such a response results in an increase in resting energy expenditure (REE), causing a rapid disease-related loss of FFM.[41] Weight loss caused by cachexia does not respond to feeding.[44] Sarcopenia is an involuntary loss of muscle mass due to physical inactivity and the age-related increase in concentration of pro-inflammatory cytokines.[41,45] Sarcopenic muscle loss improves in response to resistance exercise but evidence is inconsistent for a response to re-feeding.[45,46]

2.2 Insufficient Food Intake in Hospital

Food intake is a primary determinant of nutrition status. Both the ASPEN and ESPEN diagnostic recommendations for malnutrition considered FI within their criteria. As one of six possible criteria, ASPEN defined intake of < 75% of one's estimated energy requirements (EER) for > 7 days as a sign of

mild malnutrition and intake of ≤ 50% of EER for ≥ 7 days as a sign of severe malnutrition.[4] ESPEN did not recommend an assessment of FI specifically as a diagnostic criteria; however they rationalized that low intake would be captured under the 'unintentional weight loss' component of their criteria.[5] Similar to malnutrition, low FI is also an independent predictor of in-hospital mortality[21,24,27] and LOS[6,21], as low intake can lead to nutritional decline in patients hospitalized over extended periods of time.[47] Thus, ensuring sufficient FI for hospital patients would be a logical step in reducing the occurrence or perpetuation of malnutrition and negative clinical outcomes. Of course, this solution is not simple as the issue of malnutrition is much more complex. A number of interacting factors can affect nutrition status and influence the likelihood of patient outcomes, including FI, along with gastrointestinal status, disease effects on nutritional requirements, and the current direction of change in the patient's nutrition status.[48]

Food intake is generally decreased compared to normal levels when in hospital. Appetite is the primary determinant of FI and is a major cause of insufficient intake leading to wasting and malnutrition.[41] Appetite can be depressed due to the patient's medical condition, their medications or treatments and their side effects[49], the lack of physical activity that occurs in hospital, or simply due to the stress of hospitalization[41]. Combined with the aforementioned increase in metabolic demands and nutrient losses caused by the medical condition that further increase the patient's nutritional requirements, meeting nutritional needs in hospital can be especially challenging.

The significant prevalence of insufficient intake in hospital patients is well-documented. Thibault et al.[49] found that approximately 70% of patients in a Swiss hospital did not meet their recommended energy and/or protein needs over a 24 hour period. Dupertuis et al.[25] also reported that 70% of patients consumed below their daily recommended energy and/or protein needs, while 43% of patients consumed below their *minimum* daily needs. In fact, some patients that consumed all of the food they were provided still fell below their recommended needs in the study. Furthermore, Mudge et al.[3] reported that 59% of hospitalized older adults did not even consume enough energy to meet their REE requirements, and 92%

did not consume enough to meet their estimated total energy expenditure (TEE) requirements. Finally, analysis of approximately 21,000 cross-sectional surveys from the 2007 & 2008 nutritionDay™ questionnaires across Europe and Israel found that almost half (47%) of patients consumed fewer calories than their estimated requirements.[26] The prevalence of insufficient food and nutrient intake can be quite variable from hospital to hospital due to differences in food and nutrition care quality (e.g. food delivery systems, support for eating, etc.) and patient populations; yet the fact remains that many patients do not meet their nutritional needs, placing patients at risk of nutritional declines and impaired recovery.

2.2.1 Monitoring food intake in hospital – The need for a tool to monitor all patients

The practice of regular monitoring of nutritional status indicators is a common element of successful nutritional interventions.[36] FI is considered an essential indicator of nutritional status in hospital patients[28,29]; an insufficient intake indicates the need for further nutritional intervention. Body weight is also commonly monitored as an indicator of nutritional status[28,29], however it is not as reflective of nutrition as FI, as body weight in acutely ill patients is often influenced by fluid shifts and systematic inflammation and therefore is not specific enough to a patient's nutritional status.[48,50] Plasma levels of acute phase proteins such as serum albumin and prealbumin have also previously been used as indicators of nutrition status, but it has been demonstrated that these blood markers do not predictably change with weight loss or calorie restriction and thus are also not valid nor meaningful for predicting changes in nutrition status.[5,48,50]

Weighed food records are generally considered the gold standard method for monitoring FI with pre- and post-meal food weighing.[31,51,52] This method involves weighing the remaining waste of each food item after the meal and comparing it to the weight of the food provided in order to determine the proportion of the meal consumed. The proportions are then used to calculate intake of energy/protein/nutrients, etc. Food weighing, while highly accurate, is also very expensive, time-consuming, and disruptive,[51-53] and thus generally only used in a research context. Visual estimation (VE)

of plate waste is a less intrusive method that has been validated against the weighing method in a number of research settings[51,53,54], including in elderly hospital patients[55]. VE uses a meal portion (MP) method of estimation, in which the proportion of the meal consumed (i.e. <25%, 25%, 50%, 75%, >75%) is estimated and used to calculate energy/protein/nutrient intake.[55]

Current clinical practice commonly uses calorie counts to estimate patients' food intake. A calorie count is a monitoring method that uses VE of tray waste to calculate energy and protein intake.[56] The calorie counts are usually completed by the nursing staff, who are typically untrained on proper estimation methods; they must also complete these calorie counts on top of their numerous other responsibilities.[30] Thus it is not surprising that calories counts are often inconsistent and inaccurate[32], and often are not completed at all.[31] Furthermore due to the time constraints of the nursing staff, calorie counts are only assigned to certain patients; most hospitals simply do not have the resources nor time to provide this detailed assessment of FI for every patient.[30,31]

Time and resource constraints make it impossible for all patients to have their FI monitored using current methods. As a result, FI is often missed as a 'vital statistic' for monitoring the recovery of the patient, despite being considered an influential indicator.[28,29] To be useful for monitoring on all patients, a potential tool needs to be simple and efficient, and would likely need to be completed by the patient/family or health care/dietary aid, therefore requiring minimal skill. The patient food intake questionnaire used in the annual nutritionDay™ survey[24,49] is a self-completed FI monitoring tool that uses a MP estimation method. While most commonly used in research for the aforementioned nutritionDay™ survey, the self-completed tool does allow the monitoring of all patients to be possible. However, no validation or reliability testing of this tool has been reported. If criterion validity[57] were to be determined for a similar patient self-completed tool, this would present the possibility of a useful monitoring tool for all patients that could be used in clinical practice.

A food intake self-monitoring tool validated against accurate FI estimation methods would be greatly beneficial to improving nutrition care in hospitals. Such a tool could standardize a currently unstandardized practice and could help improve the process of identifying patients that may need nutritional support or a dietitian consult. Early involvement of dietitians and individualized nutrition treatment for malnourished patients improves FI and body weight[58,59], reduces complications[59], mortality[60], readmissions[59], and length of stay[61,62]. However, current identification practices often result in an inefficient use of dietitian resources. Currently, inefficient practices are employed to identify patients in need of consultation, such as by dietitians reviewing admissions for diagnosis and diet order or attending rounds[32,52] to subjectively determine who may benefit from consultation. These practices are time-consuming for dietitians, whose services are already a limited resource in many hospitals.[30] A study by Keller et al.[30] of medical and surgical ward patients across 18 Canadian hospitals found that 44% of patients who received a dietitian consult over the course of their hospital stay were well-nourished (i.e. likely did not need nutritional support). The study also found that approximately 75% of moderately malnourished and 60% of severely malnourished patients were not assessed or treated by dietitians, underlining the fact that malnutrition in hospital is severely under-recognized and under-treated. Current practices do not support the idea of 'ethical screening', as monitoring of all patients does not occur and assessments are not targeted at the patients who need them.[30] Improving FI monitoring practices would go a long way in bridging the gaps that exist.

2.3 Barriers to Food Intake in Hospital

Within the past decade, research has emerged[33,34,63-71] identifying the existence of FI barriers in hospitals, which can be thought of as any issues faced by patients that further prevent them from achieving sufficient nutritional intake. These barriers can be physical[33,34]; for example if patients are unable to cut their food or open packages, are positioned uncomfortably to eat, or cannot reach their meal tray, they would have difficulty being physically able to consume enough of their meals to meet their needs without

assistance. Organizational barriers can include: food being served at inappropriate or inconvenient times for the patient, patients not being offered flexible menu choices, missing food items, or hot foods not being served hot.[33,34] Organizational barriers can also be environmental, resulting in distracting eating environments due to excessive noise, unpleasant smells, or being interrupted during meals for tests, medications, physicians visits, etc.[33,34] Poor food quality[33,34] or food that doesn't meet the preferences of the patient can act as barriers as well. If appetite is low patients will more likely eat preferred foods if they are going to eat anything at all. In turn desserts, which generally have lower protein and micronutrient content, can often become the most likely part of the meal to be consumed by patients.[72] People of different ethnic backgrounds may be dissatisfied with hospital food if their cultural preferences are not met by the food options[73], leading to decreased FI.

Understanding on the importance of FI barriers is generally poor as this literature is only recently emerging, but studies that have been conducted seem to show that their existence is prevalent while the types of barriers observed can vary. For example, in a study of 764 British hospital patients, the most common barriers reported were: not wanting what was ordered once it arrived (67%), not receiving the food that was ordered (48%), being disturbed while eating by activities, noises, etc. (40%), dissatisfaction with taste (34%), and difficulty opening packets/unwrapping food (33%).[34] In a study of 890 Canadian hospital patients across 18 hospitals[71], the most common barriers reported by patients were: not receiving food when a meal was missed (69.2%), not wanting what was ordered once it arrived (58.0%), not getting help to eat meals when needed (42.2%), meals interrupted by staff (41.8%), and being disturbed while eating by activities, noises, or smells (38.9%). Additionally in the Canadian study, patients who were severely malnourished upon hospital admission were more likely to have experienced certain barriers (e.g. more likely to have: had eating difficulties; been disturbed or interrupted during meals; missed meals because of tests; not been able to choose foods they liked) compared to those who were well-nourished. Patients 65 years or older were more likely to have experienced eating difficulties (physical barriers) and

more reported that they were not able to choose foods that they liked.[71] Older patients are also more likely to be comorbid[42,43], which may further increase the risk of experiencing physical barriers[70]. Thus, older malnourished patients, who enter the hospital in greater need of sufficient FI to support their recovery, are more likely to experience challenges in actually receiving it.

2.3.1 How can we remove barriers to food intake in hospital? – The need for a barrier assessment tool

Although it is more challenging to remove illness effects (e.g. impaired appetite)[71] that lead to reduced intake, removing physical and organizational barriers is a feasible goal. Nutritional interventions, such as oral nutritional supplementation or nutritional support (aka artificial feeding) have been extensively studied, however very little research exists on interventions that focus on improving FI and removing barriers to food access in hospitals.[36] 'Protected Mealtimes' (PM) is an initiative that was created with the aim of preventing these FI barriers from occurring. PM aims to protect mealtimes from unnecessary interruptions, provide an environment conducive to eating, allow staff to provide patients with support and assistance during meals, and place food first at mealtimes.[67] With PM, effort is made to ensure that no non-urgent clinical activity is scheduled during mealtimes, and unit staff are encouraged to focus solely on the patients' mealtime.[74] In the few PM intervention studies that have been conducted to date, results have been mixed when it comes to reducing mealtime interruptions and increasing the provision of eating assistance; thus evidence that PM increases rates of protein/energy intake or nutritional status remains elusive.[74-78] The one study that was able to show improved nutritional intake after PM implementation[78] reported that the proportion of patients classified as consuming 'adequate' energy was increased. However the increase in adequate energy intake was only associated with a decrease in patients who were consuming 'borderline' adequate energy intakes, while the proportion of patients with 'poor' intake was unchanged. A common reason cited for these inconsistent results, other than small sample size, was the irregularity in implementation of all aspects of PM – not all hospital wards fully complied with all of the

PM policies.[74,77] The lack of evidence of the success of PM interventions could be misleading and is likely more reflective of the incredible difficulty in changing care processes, which requires widespread multi-level (organizational, staff, and patient-level) action in order to facilitate change.[37]

The existence of FI barriers combined with the difficulty of changing care processes underlines the necessity for a way to assess the existence of these barriers that could track whether improvements in care are being made. Although changing clinical practice can be difficult and complex, it has been shown to be possible; Dickinson et al.[68] were able to make improvements to mealtime practices in a hospital ward through an 'action learning' process that focused on education of hospital staff involved in mealtimes and auditing the ward afterwards to support this change in practice. Regular auditing of mealtime barriers with an assessment tool (i.e. a questionnaire) could help to ensure that changes in practice are being implemented effectively. Such a practice, implemented in combination with multi-disciplinary and multi-level strategies (e.g. educating management, staff, and patients themselves of the importance of nutrition, well-defined roles within the nutrition care process), can be effective in improving nutrition care and changing clinical practices.[79,80] Developing a reliable mealtime assessment tool for clinical use would be the first step in making this possible, as regular auditing can be effective in improving clinical practice, especially when adherence to recommended practices is low.[81] While a similar questionnaire for the assessment of patient food access issues was developed by Naithani et al.[34] that demonstrated some elements of validity and consistency, this questionnaire was designed mainly for research purposes and characterizes barriers experienced by patients throughout their hospital stay, as opposed to a single mealtime. A need exists for an assessment tool of mealtime barriers that can be applied in routine clinical practice and be used as a regular monitoring tool that can help to change practice.

2.4 The Integrated Nutrition Pathway for Acute Care (INPAC)

The Integrated Nutrition Pathway for Acute Care (INPAC) is a recently-developed algorithm that was created as a best practice guideline for the nutrition care of acute care hospital patients.[35] The aim of following INPAC's guidelines is to instill processes that better detect, monitor, and treat malnutrition in this vulnerable population.[35] The INPAC is evidence and consensus-based. The algorithm was developed based on existing literature of best nutrition care practice, and consensus among clinician experts was reached using a modified Delphi process to determine whether these practices were feasible in clinical settings and to come to agreement on certain aspects that were not covered in existing literature (such as timing of assessment and monitoring practices).[35] The resulting INPAC details the specific care processes and suggested timing of these processes that should occur from the time a patient is admitted to hospital to the time that they are discharged, including planning of nutrition care steps that patients should take after they are discharged. The published INPAC pathway and guidelines are displayed in **Appendix A**.

Within INPAC, it was determined that FI should be the primary indicator used to drive a change in the nutrition care a patient receives.[35] The INPAC also recommends the assessment of FI barriers for patients receiving an oral diet.[35] Yet, no valid and reliable tools were available at the time of INPAC's development to monitor these aspects of care. Thus, there was a need for: 1) a tool that could be used to accurately assess all patients' FI, and 2) a tool that hospital staff could use to assess and identify barriers to FI while in hospital. As INPAC's success is dependent on FI monitoring and assessment of barriers to intake, these tools are required for feasible implementation of INPAC. This thesis is focused on the development and initial testing of two tools in clinical settings; My Meal Intake Tool (M-MIT) and the Mealtime Audit Tool (MAT).

2.5 Developing and Testing New Clinical Tools

A number of steps need to be taken when developing and testing novel clinical tools.[82] The first step is determining what needs to be measured and what are the criteria that the tool(s) needs to meet.[82] Based on

the processes described in INPAC[35], it was determined that a self-administered FI monitoring tool, and a staff-completed assessment of FI barriers in acute care hospital patients were needed. The next step would be to confirm the need to develop novel tools by examining and critiquing existing tools.[82,83] In terms of FI monitoring, the only existing tool that was found that was patient self-completed (and therefore able to be completed for all patients) was the nutritionDAY™ FI questionnaire, which had not been validated in the literature and had deficiencies identified with it during its use in the NCCH study. Thus, development of a new tool, the M-MIT, was justified.[83] The MAT was developed to meet the need for a tool to assess FI barriers, as existing tools (e.g. Naithani et al.'s questionnaire[34]) did not focus on barriers encountered at a single mealtime and were designed mainly for research purposes.

After determining that existing tools would not support the implementation of INPAC, the M-MIT and MAT were both developed using expert clinician input that was gathered during development of the tools and helped determine what was to be included on them.[82] Initial proforma drafts of the tools were also given to clinician experts for face validation[82] and they were iteratively revised. The research conducted for the purposes of this thesis aimed to cover in-depth steps six through nine of Keller et al.'s "steps for developing an effective health measurement tool" (p.68)[82]. Specifically, this thesis aimed to revise M-MIT and MAT to optimize readability, clarity, and ease of use (step 6), determine what items should be kept, removed, or added to the tools (step 7), validate (step 8), and ensure test-retest reliability (step 9) of the tools.[82] The latter two steps are especially imperative as evidence of reliability and validity are essential for a tool to be deemed useful.[83] Reliability assesses the accuracy or repeatability of the results of the tool[84] and validity indicates whether the tool actually measures what it is supposed to[85].

The MAT was tested for inter-rater reliability, which measures the agreement between assessments when multiple raters assess the same subject.[84] High inter-rater reliability indicates that a tool is reliable and is relevant when the tool is designed to be completed by various assessors.[84] High inter-rater reliability ensures test-retest reliability, as a valuable tool should result in respondents interpreting

the questions the same way across multiple administrations of the tool[82] regardless of who is conducting the assessment. Only reliability was assessed for the MAT, as encountering FI barriers is a subjective experience for the patient with no known criterion for validation. However, MAT was based on the NCCH results and other empirical evidence, as well as face validated by content experts on the research team.

The M-MIT was tested for criterion validity, which measures how a tool compares to the gold standard assessment procedure.[85] However, the gold standard measure of FI (pre- and post-meal food weighing)[31,51,52] was impractical to use in the study setting. Besides being time-consuming and expensive, food weighing is disruptive to the normal eating routine.[51-53] It is important to carry out validity studies in the setting in which the tool will be used[85], so disrupting patients' mealtime routines would have affected the legitimacy of the study's results. Thus, dietitian visual estimation, which has been validated against food weighing[51,53,54], was chosen as the criterion measure to validate the M-MIT against. Inter-rater reliability testing of the M-MIT could not be readily conducted as it was designed to be a self-completed tool. In the future if staff are involved in assessing FI using M-MIT, a further study to assess this reliability would be required. As FI is variable within each patient from meal to meal, reliability testing (aka test-retest reliability) across meals would not be feasible either. Therefore, only criterion validity testing occurred for the M-MIT. Following a systematic process for development and testing of these clinical tools promoted rigor and confidence in their utility for their designed purpose.

2.6 Summary

Being malnourished in hospital impairs recovery and leads to extra resources being spent on caring for those patients affected. Malnutrition's prevalence is significant yet commonly goes unrecognized and unacknowledged as an issue, with already limited dietitian resources being misallocated. Insufficient FI, extremely common in the hospitalized population, exacerbates declines in nutrition status and contributes to malnutrition. FI barriers exist that make it more difficult than it already is for patients to eat enough

food. Current FI monitoring procedures are lacking in their accuracy and ability to monitor all patients. Assessment of FI barriers doesn't normally occur in practice. The M-MIT and MAT are novel tools that have been developed as support tools for INPAC in an attempt to address these deficiencies in current nutrition care practice. The rationale for improving nutrition care is strong, as patients who improved their nutritional status in hospital have been shown to have had shorter lengths of stay than those who did not.[6] The research conducted for this thesis has attempted to validate the M-MIT, determine inter-rater reliability of the MAT, and make revisions to both tools to promote their acceptability for clinical use.

Chapter 3
Research Questions

For newly-developed screening, assessment, or monitoring tools to have true value, validity and reliability testing should be conducted in the clinical setting.[84,85] The My Meal Intake Tool (M-MIT) and Mealtime Audit Tool (MAT), two novel nutrition care monitoring tools, were tested for criterion validity and inter-rater reliability respectively, in two separate studies. The two studies involved in this thesis will be presented as manuscripts.

The M-MIT is a novel patient self-completed tool that has been developed to measure the intake of a patient at a single meal. The aim of the first study was to assess criterion validity for the M-MIT – that is, whether the M-MIT correlates well with accepted measures[86] – in order to determine if it was acceptable for clinical use. In this study, a meal portion VE method[55] where a trained dietitian visually estimated the proportion of food and fluids consumed was deemed to be the most feasible and valid criterion measure to use for comparison. As the M-MIT is a patient self-completed tool and FI is variable within each patient from meal to meal, it was decided that measures of reliability could not readily be established.

The MAT is a novel clinician-completed tool to assess barriers to FI experienced by patients at a single mealtime. The aim of the second study was to determine measures of inter-rater reliability of the MAT between two raters for each participant – that is, to determine whether MAT completion produced similar results between the two raters upon repeat administrations[87] for each patient – in order to determine if it was acceptable for clinical use. As experiencing FI barriers is based on the subjective opinion of the patient with no known criterion to validate against, it was determined that validation testing could not be readily conducted for the MAT. A secondary aim in this study was to conduct descriptive analyses to characterize the barriers to FI observed in the elderly patient participants across the hospitals involved in the study to determine if barriers observed differed between hospitals.

Finally, for both studies, secondary aims included using both the quantitative data and qualitative feedback to make revisions to both tools to improve feasibility, functionality, and ease of use. Thus, the two studies aimed to answer the following research questions:

3.1 Study 1: My Meal Intake Tool (M-MIT) – Validation of a novel food intake monitoring tool for acute care hospital patients against dietitian visual estimations

Primary Research Questions:

1) What is the M-MIT's ability to accurately identify patients who consumed ≤ 50% vs. > 50% of the solid food provided when compared to a trained dietitian's estimation of solid food intake for a single meal?

   Hypothesis: It was hypothesized that M-MIT estimation of solid food intake would be able to identify patients who ate ≤ 50% vs. > 50% with sensitivity and specificity values of at least 70% when compared to dietitian visual estimations. Thus, it would be deemed acceptable for clinical use.

2) What is the M-MIT's ability to accurately identify patients who consumed ≤ 50% vs. > 50% of the fluids provided when compared to a trained dietitian's estimation of fluid intake for a single meal?

   Hypothesis: It was hypothesized that M-MIT estimation of fluid intake would be able to identify patients who drank ≤ 50% vs. > 50% with sensitivity and specificity values of at least 70% when compared to dietitian visual estimations. Thus, it would be acceptable for clinical use.

Secondary Research Questions:

1) Does patient age (< 80 years vs. ≥ 80 years) affect the sensitivity and specificity of both the solids and fluids sections of the M-MIT?

2) Does patient gender affect the sensitivity and specificity of both the solids and fluids sections of the M-MIT?
3) Does patient education level (less than high school vs. greater than high school education) affect the sensitivity and specificity of both the solids and fluids sections of the M-MIT?
4) Does patient appetite at the mealtime (very good/good vs. fair/poor according to M-MIT completion) affect the sensitivity and specificity of both the solids and fluids section of the M-MIT?
5) What improvements/revisions can be made to the M-MIT based on the quantitative validity analyses and qualitative feedback and suggestions from participants and hospital staff to improve its feasibility and ease of use?

3.2 Study 2: The Mealtime Audit Tool (MAT) – Inter-rater reliability testing of a novel tool for the monitoring and assessment of food intake barriers in acute care hospital patients

Primary Research Questions:

1) What is the reliability between raters for the total MAT score (out of 18) of barriers experienced?

   Hypothesis: It was hypothesized that the intra-class correlation (ICC) statistic would be acceptable for clinical use, with an ICC rating of at least good (0.60-0.75) to excellent (> 0.75)[88] between raters.
2) What is the reliability between raters for each of the 18 barrier items listed on the MAT?

   Hypothesis: It was hypothesized that the kappa statistics calculated for each patient-level barrier listed on the MAT (n=18) would be acceptable for clinical use, with kappa statistics calculated between raters ranging from fair/good (0.40-0.75) to excellent (> 0.75).[89]

Secondary Research Questions:

1) What were common barriers observed among the patient participants? Was there a difference in the mean number of barriers experienced across the hospitals?
2) What improvements/revisions can be made to the MAT based on the quantitative analyses and qualitative feedback and suggestions from hospital staff to improve its feasibility and ease of use?

Chapter 4

My Meal Intake Tool (M-MIT) – Validation of a novel food intake monitoring tool for acute care hospital patients against dietitian visual estimations

4.1 Abstract

Background: Malnutrition, while prevalent in hospital patients, is generally under-recognized and undertreated and associated with adverse outcomes, like prolonged length of stay (LOS). Food intake (FI) is a useful indicator of changes in nutritional status in hospital and is also independently associated with LOS. Current FI monitoring practices completed by nursing staff are impractical for all patients and existing self-completed tools have not been tested for validity.

Objectives: To determine whether the patient completed My Meal Intake Tool (M-MIT), can accurately represent food and fluid intake at a single meal in medical and surgical hospital patients.

Methods: 120 patients over the age of 65 from four Canadian hospitals with adequate cognition completed M-MIT for a single meal. Food and fluid waste was visually estimated by a dietitian at each hospital site. Sensitivity (Se), specificity (Sp) and overall agreement were calculated for both solid food and fluid intake by comparing M-MIT and dietitian estimations to determine criterion validity of M-MIT; two different cut-off points for low intake ($\leq$ 50, and $\leq$ 75%) were used. Sensitivity analyses were completed for those with missing data on M-MIT. Descriptive and bivariate analyses were also performed to explore the data and any differences in accuracy due to patient characteristics. Patient and dietitian comments on the tool were used to make revisions.

Results: Using the cut-point of $\leq$ 50% Se was 76.2% and 61.9% and Sp was 74.0% and 80.5% for solid and fluids respectively ($p < 0.001$). Se increased for both solids (81.8%) and fluids (79.1%) using the $\leq$ 75% cut-point; sensitivity analyses increased and decreased Se and Sp depending on assumptions with respect to intake made for patients who did not complete the M-MIT (~20%). M-MIT identified a greater

proportion of participants (37.2%) as having low FI (≤ 50%) than dietitians (25.0%), as well as a greater proportion identified with low fluid intake (28.3% vs. 24.6%).

Conclusion: M-MIT is valid for use in older medical and surgical patients based on the SE and SP results for those with complete data. Modest revisions were made to M-MIT to improve functionality. M-MIT provides a practical tool for monitoring FI in hospital.

4.2 Introduction

In acute care hospital wards malnutrition is a prevalent threat that is under-recognized and undertreated[1,2,39,90], especially among older patients (65+ years)[2,3,41,90]. The Canadian Malnutrition Task Force (CMTF) found that 45% of patients across 18 hospitals were malnourished according to Subjective Global Assessment (SGA) upon admission to hospital[6]; other studies have found the prevalence of malnutrition to be anywhere from approximately 10-70%[7-20]. Hospital malnutrition is associated with adverse outcomes such as increased morbidity[5,17] and mortality[5,17,21,22] rates, and malnourished patients can increase strain on limited resources due to increased readmission rates[21,22] and lengths of stay (LOS)[17,21,22]. This results in a greater cost of care for a malnourished patient compared to a well-nourished patient.[17,22,40] Insufficient food intake (FI) is commonplace while in hospital with anywhere from 40-90% of patients reported as not having consumed enough to meet their daily energy or protein requirements[3,25,26,49,91], even when the nutritional content of meals provided was sufficient for meeting daily needs.[25,91] Low intake puts patients at further risk of declines in nutritional status when intake is low for extended periods of time[47]. Additionally, insufficient FI is an independent predictor of malnutrition-related outcomes such as in-hospital mortality[21,24,27] and LOS[6,21].

Patient FI is commonly monitored as an indicator of nutritional status[28,29] due to their direct relationship[47]. It may be a more useful monitoring measure in acute care than body weight, which can be challenging to collect and may be affected by other factors such as inflammation and fluid shifts, making it less specific to nutritional status.[48,50] Blood markers (e.g. serum albumin, prealbumin) have previously

been used as indicators of nutritional status, but these may also be influenced by systemic inflammation and thus levels of these markers also tend to lack specificity.[5,48,50]

Current practice in FI monitoring includes the use of calorie counts on nursing flow sheets that variably report on intake and may not be linked to consequent interventions when intake is poor.[30] Calorie counts are prescribed when a detailed data collection is required, taking precious time of nursing staff, and are thus reserved for monitoring intake only for a select number of patients who have been identified for follow-up.[30] Additionally, Palmer et al. (2014) reported that FI assessments completed by nursing staff, who are generally untrained in estimating FI, are not accurate and often are not done at all due to time constraints.[31] There is a need for a patient-completed tool as most hospitals have neither the time nor the resources to have staff (e.g. nursing) accurately monitor the intake of every patient. Such a tool would not be a panacea, as it may not be feasible for those with low literacy, delirium, or dementia. But for many patients, this could be a mechanism for readily obtaining sufficient detail on intake to determine the necessity of further nutrition intervention. Self-completed tools exist, such as the food intake questionnaire used in the annual nutritionDAY™ survey[24]; however, none have been validated in the existing literature nor are they widely used outside of clinical research.

The My Meal Intake Tool (M-MIT) is a patient self-completed form that aims to provide an estimate of the patient's food and fluid intake for a single meal. The tool was created to support the recently-developed Integrated Nutrition Pathway for Acute Care (INPAC), an evidence and consensus-based nutrition care algorithm that is meant to be a set of best practice guidelines for nutrition care of acute care hospital patients.[35] The aim of following the care practices outlined in INPAC is to better detect, monitor, and treat hospital malnutrition.[35] Based on previous work that identified that poor FI was associated with adverse malnutrition-related outcomes (LOS[6,21], mortality[21,24,27]), regular FI monitoring of all patients was recommended in INPAC to serve as the primary driver for determining when changes in nutrition care were necessary.[35] Specifically, FI of < 50% within the first week of stay has been

independently associated with LOS[6], so within INPAC it was recommended that increased nutrition care is necessary if patients are identified as eating less than half of their food[35].

The primary aim of this study was to determine whether the M-MIT was valid and thus sufficiently accurate to be deemed suitable for use with hospital patients in acute care hospital wards. Criterion validity[57] of the M-MIT was determined with visual estimations of patient intake by trained dietitians serving as the criterion measure for comparison. An additional objective was to combine the results of the validity analyses with qualitative comments and suggestions from patient participants and hospital staff in order to make improvements to M-MIT's to promote clarity and ease of use.

4.3 Methods

4.3.1 My Meal Intake Tool (M-MIT)

My Meal Intake Tool (M-MIT) is a patient self-completed form that aims to provide an estimate of the patient's food and fluid intake for a single meal. M-MIT's template was based on the aforementioned nutritionDAY™ patient food intake questionnaire, which had been used in the Nutrition Care in Canadian Hospitals (NCCH) study conducted by the CMTF.[6] Based on that experience with this tool, a variety of adaptations were made. For example, the M-MIT was streamlined to include only the relevant information that was contained on the nutritionDAY™ questionnaire, clear instructions were written, and font was enlarged. The plate rating method was retained (e.g. 25%, 50%, etc. consumed), and a similar rating was developed for each fluid on the tray. Additionally, reasons for low consumption and barriers to FI were streamlined based on the NCCH survey results.[71] The draft M-MIT underwent several revisions made by a small group of investigators (n=4), and was then taken to five clinician experts for face validation[57] and further revisions.

The tested version of M-MIT (**Appendix B**) instructed patients to estimate the total proportion consumed of all solid foods they were provided at that meal, by marking the corresponding checkbox: <

25%; 25%; 50%; 75%; > 75%. The proportions were accompanied by visual diagrams of plates that used shading to indicate how much food was remaining. To estimate fluid consumption, patients were instructed to list each fluid provided at the meal (e.g. milk, juice, coffee, supplement, etc.) and to choose the corresponding proportion (< 25%, 25%, 50%, 75%, > 75% consumed) for each fluid provided. Again, each proportion was accompanied by a visual diagram of cups with different levels of shading that indicated how much liquid was left. The reverse side of the form contained two questions. The first asked how the patient's appetite was at that meal ("Very Good/Good" or "Fair/Poor") and asked the patient to identify the reason for having a fair/poor appetite ("I was not interested in eating", "I had nausea/vomiting", "I was tired", "I had pain", "I ate outside foods and was not hungry", "Other"). The second question asked the patient about challenges they may have had during the meal. Seven options were provided: "I did not like the food"; "I needed assistance to eat my meal"; "I have problems chewing/swallowing"; "I was not allowed to eat"; "I did not get what I ordered"; "The environment was not appetizing"; and "Other". Finally, a comment box was provided for the patient to indicate anything else they felt was relevant. A French translation version was also created.

4.3.2 Subjects

Recruited participants (n=120) were over the age of 65. This data collection was part of a multi-component study focused on frail older adults admitted to hospital; three components were collected for an initial assessment of their feasibility, including the M-MIT, an assessment tool of mealtime barriers, as well as post hospital follow up on nutrition services in the community. To be included in the study, participants needed to be: admitted from home; likely to be discharged home; admitted to a medical or surgical unit; able to speak and read English or French; not cognitively impaired; and likely to be admitted for 2-5 days. Participants were recruited from multiple units in four Canadian hospitals (30 patients/hospital). The participating hospitals were diverse in terms of region, type, size, and primary language (**Table 1**). Patients illiterate in English or French, those who had poor cognitive capacity (e.g.

unable to understand consent process), and those who did not provide consent were excluded. In all hospitals, nursing staff who were part of the patients' circle of care made the initial approach to prospective participants to garner their interest in being part of the study and their consent to have the site dietitian approach the patient with more information about the study. Nursing staff determined which patients had sufficient cognitive abilities based on their admission assessments. Once prospective participants were identified, they were approached by the dietitian at each hospital site, who provided them with detail about the study and gathered their written consent to participate. The following demographic information was collected at the time of consent based on the patients' charts and self-report: gender, year of birth, reason for admission, highest level of education, and living situation in the community (lives alone, lives with spouse, lives with spouse and other family, lives with other family/friends).

4.3.3 Data Collection

Data collected consisted of patient-completed M-MIT forms and dietitian visual estimations of each participant's consumption of a single meal. Participants identified on the M-MIT form which meal was being assessed (breakfast, lunch, dinner). Each hospital had one designated dietitian complete the visual estimations and interact with the patients. The meals that were chosen for monitoring were based on the dietitians' discretion. Training for the study procedures was conducted by teleconference and where considered necessary, the dietitians were encouraged to practice estimating fluid and food portions consumed prior to the conduct of the study.

Before the selected meal to be estimated, the dietitian provided participants with the M-MIT form and gave no verbal instructions, other than to complete the form after the meal and to place the M-MIT in the provided envelope when complete. Participants completed M-MIT independently to the best of their ability after the designated meal, by estimating the proportion (%) of total meal tray solids they consumed, the proportion consumed of each fluid provided at that meal, completing the questions on the

reverse side regarding appetite and eating challenges, and providing any other comments they had about the meal. If participants were physically unable to complete the form themselves, family members/visitors/staff were allowed to complete it with them. However, proxies were instructed not to make the estimations themselves, but to verbally ask the participant the questions on the M-MIT and record their answers without influencing them.

Upon participant completion of the meal, dietitians retrieved the meal tray and visually estimated the proportion of each food and each fluid item consumed by estimating the amount of waste/leftovers based on the items that were listed on the patient meal tickets. They were blinded to the patients' M-MIT results when this visual estimation was completed. The dietitians' visual estimations (VE) served as the criterion and the M-MIT estimations were compared to these reference values. The dietitians then conducted a brief follow-up interview using standardized questions with the participants, which asked them to describe whether the instructions were easy to follow, whether they understood how to identify how much food and fluids were consumed, whether the appetite and eating challenges questions were easy to understand, and if participants would make any changes to the form. Dietitians wrote detailed responses for these open-ended questions. Ethics clearance for the data collection was obtained through a University of Waterloo Research Ethics Committee (**Appendix C**), as well as through the ethics board of each individual hospital involved.

4.3.4 Analysis

Descriptive analyses (mean, s.d., proportions) were performed for patient demographics, food and fluid intake according to VE and M-MIT, reasons for low appetite, and challenges experienced. M-MIT forms were reviewed to qualitatively determine challenges and errors made by participants with completion of the M-MIT (e.g. multiple checkmarks made, incomplete forms etc.). Chi square, ANOVA, and z-tests were used to determine significant differences among these descriptive statistics, where applicable.

To determine criterion validity of solid food consumption according to the M-MIT, sensitivity (Se), specificity (Sp), and overall agreement with dietitian VEs were calculated. As the M-MIT only provided one overall proportion of solids consumed at the meal, while dietitians visually estimated proportions consumed for each solid food item, the dietitian VEs were averaged to determine the overall proportion of total food consumed. Both the M-MIT and VE estimations were dichotomized to either ≤ 50% or > 50% consumed for this analysis. The 50% cut-point was chosen to represent low intake as an association has been demonstrated between eating less than half of the food provided at one meal and length of hospital stay.[6] Additionally, 50% is the suggested cut point used to define low intake within INPAC.[35] Overall agreement represented the proportion of M-MIT and VE estimations that corresponded according to the dichotomized intake results. Se represented the proportion of M-MIT estimations of ≤ 50% consumption that corresponded with VE of ≤ 50% consumption. Sp represented the proportion of M-MIT estimations of > 50% that corresponded with VE of > 50%. VE was considered the 'true' criterion measure of patient intake. To calculate Se and Sp, two-by-two Chi square analysis was used to provide raw counts of how many VE and M-MIT estimations corresponded (top left: VE ≤50%/M-MIT ≤ 50%; top right: VE ≤ 50%/M-MIT > 50%; bottom left: VE > 50%/M-MIT ≤ 50%; bottom right: VE > 50%, M-MIT > 50%). Se and Sp were then calculated by hand. Se and Sp analyses were also stratified by gender, age (< / ≥ 80 years), education level (less than high school vs. graduated high school), and appetite (very good/good vs. fair/poor) to determine if these characteristics affected the accuracy of M-MIT completion. Where possible, z-tests were performed to determine significant differences between Se, Sp, and overall agreement for these characteristics.

Similarly, overall agreement, Se and Sp analyses were also performed to determine the criterion validity of fluid consumption according to the M-MIT. Since both the M-MIT and VE estimations listed each individual fluid, both estimations were averaged to determine the proportion of total fluids consumed. Similar to the analysis of solid food intake, both the M-MIT and VE estimations were

dichotomized to ≤ 50% or > 50% consumed, with the dietitian estimations representing the 'true' intake of the patient. Se and Sp analyses were also conducted individually for juice, coffee/tea, and milk, which were the most commonly provided fluids. Finally, Se and Sp analyses for total fluids were stratified for the same demographic characteristics (gender, age, education level) and appetite level with z-tests for significant differences between proportions, as in the analysis for solid consumption.

Overall agreement, Se, and Sp for both solids and liquids were also calculated using ≤ 75% and > 75% as an alternative cut-off point. This was done in order to achieve more even cell counts within the Chi squares than with the ≤ 50%/> 50% cut-point. Sensitivity analyses were also completed to determine the effect of missing data on Se, Sp and overall agreement assuming incomplete or incorrectly completed M-MIT forms represented 1) "low" (≤ 50%) intake, or 2) "sufficient" (> 50%) intake.

4.3.4.1 Determination of acceptable Se/Sp and sample size

A priori, it was determined that Se/Sp values greater than 70% would be considered sufficiently valid as compared to the criterion, especially considering that the M-MIT is an 'untrained' patient self-assessment. However, a lower Sp value (i.e. greater chance for false negatives) was also considered a priori to be acceptable as a greater chance of false positives (which occurs with a higher Se and lower Sp)[92] was of less concern; in practice, it would be preferred to over-identify patients as 'low intake' who may need further investigation or intervention rather than under-identify.[57] Within the INPAC, patients with low intake based on monitoring with M-MIT are recommended to be followed-up to determine why low intake occurred.[35] For those already identified to have some level of malnutrition, those with low intake are to receive a full nutrition assessment to determine specialized interventions.[35] Thus, misidentifying patients as having low intake would be a conservative approach to ensuring that a greater proportion of individuals with poor intake are followed-up with to determine cause of low intake (e.g. dislike of food vs. inability to eat) and subsequent interventions needed. The questions on reasons for poor intake

provide support to identifying potential causes for low intake and support the follow-up process with patients.

With a sample size of 120, it was determined that if levels of agreement (Se/Sp) between M-MIT and VE were calculated to be 70%, the 95%CI for the true value would be within +/- 7.5%. If levels of agreement were calculated to be 90%, the true value would lie within +/- 5.5% (p.81)[86]. It was determined that these estimated CI's would be deemed acceptable for the calculated Se/Sp. If Se/Sp were determined to be less than 70% for completed tools, it was decided that the M-MIT would not be recommended as being sufficient for clinical use.

The results of the analyses as well as comments from dietitian coordinators and patients on follow-up questionnaires on ease of use and feasibility facilitated revisions with any issues that arose with the use and completion of the M-MIT. Errors made by patients in M-MIT completion were qualitatively noted during data entry and were also taken into consideration when making revisions to the tool.

4.4 Results

4.4.1 Patient Characteristics

The demographic characteristics of the 120 participants enrolled in the study across the four hospitals are displayed in **Table 2**. The sample contained 43.3% male and 56.7% female participants. There were no significant differences among the sites for the distribution of genders ($X^2 = 1.90$, $p = 0.59$). Almost half (47.5%) of the participants were 80 years of age or older. ANOVA and Tukey analyses found that site 1 had a significantly older participant population (mean = 85.0 years, $F = 10.16$, $p < 0.05$) than the other three sites (mean 75.8-76.7 years). A majority of participants (62.5%) had at least a high school education, while the most common living situations were alone (41.7%) or with their spouse (40.0%). While inclusion criteria for the study was to recruit only patients who were admitted from home, there were three participants included who were admitted from long term residences. Chi square analysis found

that there was a difference in education level (less than high school vs. at least high school education) among the hospital sites ($X^2 = 10.06$, $p < 0.05$). Sites 1 and 3 had higher proportions of participants with at least a high school education than sites 2 and 4. Chi square analysis for living situation could not be performed due to low cell counts. Most participants (77.5%) were recruited from medical wards, with sites 1 and 2 recruiting exclusively from medical wards ($X^2 = 33.11$, $p < 0.001$). Participants had a wide range of reasons for admission, with orthopedic conditions (22.5%) being the most common.

4.4.2 M-MIT Completion & Errors in Completion

Of the 120 participants assessed, 44 had reported their intake at breakfast (36.7%), 52 at lunch (43.3%), and 17 at supper (14.2); seven participants did not identify on the M-MIT what meal was being assessed. It is likely that a lower proportion of meals were assessed at supper, as dietitians tend to work normal daytime hours. Seven M-MIT forms contained notes stating that patients were unable to complete the form themselves and needed help from proxies (usually from nursing or another dietitian). There was nowhere on this version of the M-MIT or on the follow-up questionnaire that captured whether the patient or a proxy completed the form, so the exact number of proxy respondents is not known.

Over 78% (94/120 participants) completed the solid food section of M-MIT without error. The 26 incomplete/improperly filled out forms were not included in the initial validity analysis of the solids section. In sensitivity analyses, this missing data was imputed as either ≤ 50% or > 50% consumed. Of these 26 M-MIT forms, some were left completely blank (n=4), or no mark was made in the solids estimation section (n=13), while the other nine forms were filled out incorrectly. Most of these errors (n=7) involved making multiple checkmarks in the solids estimation section. It's possible that some participants were confused and made marks based on each individual food item, rather than an aggregate estimation of all food provided. One participant listed some food items under the instructions of the solids section and did not check a proportion consumed. Finally, another participant checked "breakfast" and

listed breakfast food items, while according to the dietitian it was lunch that was observed. Therefore, this patient's M-MIT form was excluded from analysis.

About 81% (98/120 participants) completed the fluid intake estimation without error. Nine of the 22 forms were left completely blank (n=4) or had fluid sections that were not filled out (n=5), and thirteen forms had the fluid sections incorrectly filled out. The 22 incomplete or incorrect forms were not included in the initial validity analysis and were imputed as ≤ 50% or > 50% for sensitivity analyses as with the solid intake estimation. The most common error made (n=7) was listing fluids provided without checking proportions consumed. Other errors included: checking a proportion on the "Example" line of the fluids section but not next to the fluids listed (n=2); listing all fluids on one line but making proportion selections on different lines (n=2); and checking off multiple proportions on the same line (n=1). There were also some errors made in filling out the fluids section on M-MIT forms but these estimations were included in the validity analysis of the fluids section, as it was apparent what these participants meant. The most common error (n=20) was that patients made a checkmark on the "Example - Milk" line in the fluids section. This was either because participants drank milk and did not write 'milk' again on another line, or because all of their checkmarks were shifted up one line due to making a checkmark on the "Example" line. Some participants also included fluids provided for the whole day and not just the single meal, or included certain food items in the fluids section (e.g. soup, pudding, gravy, etc.). These forms were also included in the validity analysis, as long as items were listed and proportion consumed was selected.

4.4.3 Validation of M-MIT

Out of the 94 participants who properly completed the solid food intake section of the M-MIT, 21 were identified by the dietitians as having consumed 50% or less of the food provided. Sixteen of these 21 participants also estimated on the M-MIT that they had consumed 50% or less of their meal (Se = 76.2%; $p < 0.001$). Of the 73 patients identified by the dietitian as having consumed more than 50% of their meal,

54 also estimated on the M-MIT that their consumption was greater than 50% for their meal (Sp = 74.0%; $p < 0.001$). Overall agreement (concordance) between M-MIT and VE for solid food intake was 74.5% (**Table 3**). Sensitivity analyses that included incomplete forms resulted in changes in Se and Sp. Where intake was assumed to be ≤ 50% intake the results were: Se = 83.3%, Sp = 60.0%, and overall agreement = 65.8% ($p < 0.001$) (**Table 4**). Where intake was assumed to be >50% intake the results were: Se = 53.3%, Sp = 78.9%, and overall agreement = 72.5% ($p < 0.001$) (**Table 5**). When ≤ 75% was used at the cut-point for "low" intake, Se increased to 81.8%, while overall agreement decreased to 69.1% and Sp decreased to 58.0% ($p < 0.001$). Of participants who correctly completed the solid intake estimation, 22.3% (21/94) had low (≤ 50%) intake according to VE, and 37.2% had low intake according to M-MIT. When the entire sample (n=120) was considered, low solid intake according to VE increased to 25.0%, as over a third (9/26) of participants who did not correctly complete M-MIT had low intake as per VE.

Out of the 98 participants who properly completed the fluid intake section of the M-MIT, 21 were identified by the dietitians as having consumed 50% or less of the fluids provided. Thirteen of the 21 participants also estimated that they consumed 50% or less (Se = 61.9%; $p < 0.001$). Of the 77 participants identified by the dietitians as having consumed greater than 50%, 62 also estimated that they consumed more than half (Sp = 80.5%; $p < 0.001$). Overall agreement between both estimations for fluid intake was 76.5% (**Table 6**). Sensitivity analyses assuming that participants with incomplete M-MIT consumed ≤ 50% intake resulted in Se = 71.0%, Sp = 69.7%, and overall agreement = 70.0% ($p < 0.001$) (**Table 7),** whereas assuming these missing cases had >50% intake resulted in Se = 41.9%, Sp = 83.1%, and overall agreement = 72.5% ($p < 0.001$) (**Table 8**). Additionally, when ≤ 75% was used as the cut-point, Se increased to 79.1%, overall agreement increased to 77.6%, and Sp decreased to 76.4% ($p < 0.001$) for the aggregate estimation of all fluids. Of participants who completed the fluid intake estimation correctly, 21.4% had low (≤ 50%) intake according to VE, and 28.6% had low intake according to M-MIT. When the entire sample (n=120) was considered, low fluid intake according to VE increased to

25.8%, as almost half (10/22) of participants who did not correctly complete the M-MIT fluid estimation had low fluid intake as per VE.

There was a concern that the lower sensitivity of fluid estimations based on the complete forms may have resulted from beverage additions or removals from the tray. For example, 24 patients listed 'water' on the M-MIT, while only four dietitians listed water in their estimations. Water isn't commonly listed on hospital meal tickets even if it is provided, which could have caused overestimations on the self-completed M-MIT, as dietitians based their estimations of intake only on the items listed on the tickets. Errors such as including beverages from other meals and including certain food items in the fluids section could have affected these results as well. These errors would have led to inaccuracies on the M-MIT, thus lowering the overall Se and Sp for the fluids section. As a result, individual fluids which were concordant between the VE and M-MIT estimations for complete forms were compared to determine if sensitivity improved for the most common fluids listed: coffee/tea (listed on 51.0% of completed M-MIT forms), juice (50.0%), and milk (44.9%). When Se/Sp analyses were performed on these individual fluids, the accuracy of M-MIT improved compared to when fluids were aggregated (**Table 9**).

When participants were stratified by gender, age, and education, there were a few patterns found in the accuracy of M-MIT completion (**Table 10** & **Table 11**). Based on a qualitative comparison, male participants had higher overall agreement (88.1% and 81.6% for solids and fluids, respectively) and Sp (88.6% solids, 86.8% fluids) for both solids and fluids than females. However, males had a higher Se for solids (85.7% vs. 71.4%), and females a higher Se for fluids (66.7% vs. 50%). Participants under the age of 80 had higher overall agreement (76.6% solids, 82.7% fluids) and Sp (78.9% solids, 85.7% fluids) for both solids and fluids, and higher Se for fluid intake (70.0% vs. 54.5%) as compared to those $\geq$ 80 years of age. Those that had less than a high school education had higher overall agreement (80.6%), Se (85.7%), and Sp (79.2%) for solids, and higher Se (83.3%) for fluids compared to those with at least a high school education. Z-tests could not be performed to determine statistical significance of these

qualitative differences in Se/Sp for any of the demographic characteristics due to small cell size for some categories of characteristics. The only statistically significant difference in overall agreement was identified between males and females for solid intake ($z = 2.723$, $p < 0.01$) (**Table 10**). There was no difference in completion rate of the M-MIT for any of these demographic characteristics.

When stratifying by appetite level, it is possible that participants who had a lower than normal ("Fair/Poor") appetite were less accurate than those who had a "Very Good/Good" appetite, in response to the question "How was your appetite at this meal?" on page 2 of the M-MIT. However, z-tests also could not be completed for Se/Sp due to small expected cell count for some categories. Qualitatively, those with lower appetite had lower overall agreement and Sp for solids (**Table 10**), and lower overall agreement, Se, and Sp for fluids (**Table 11**). Unexpectedly, those with lower appetite had a higher Se for solids intake (85.7% vs. 66.7%), but again significance could not be determined due to low cell count (**Table 10**). It also appears that participants with lower appetite were more likely to have low intake (≤ 50%); 45.1% (14/31) of participants who identified as low appetite had low solid food intake compared to 6.4% (3/47) of those with good appetite. Over a third (11/30 = 36.7%) of participants with low appetite had low fluid intake compared to 7.8% (4/51) of those with good appetite. Z-tests could not be completed for significant differences between these ratios due to small expected cell count for some categories. Further evaluation on larger samples would be worthwhile to test these associations to determine statistical significance. There was no difference in completion rate of the solid intake estimation for appetite level. There was however a significant difference in completion rate of the fluid intake estimation for appetite level; only 7.1% of participants with a "Very Good/Good" appetite did not complete their fluid intake estimation, while 23.1% of participants with a lower than normal appetite did not complete the fluid intake estimation ($X^2 = 4.942$, $p = 0.026$). The fluid intake estimation requires the patient to list out all of their beverages and estimate how much of each was consumed, so it's possible that participants with a

lower appetite (who were likely not feeling well) did not bother to complete the fluid estimation, which required more writing than the solid intake section.

4.4.4 Descriptive Analyses of Reasons for Low Appetite and Challenges

When considering all participants regardless of M-MIT completion, dietitians estimated that 25.0% and 25.8% of participants had low intake (50% or less consumed) for solids and fluids, respectively. M-MIT estimated 37.2% and 28.3% low intake for solids and fluids, respectively. According to z-tests these differences between M-MIT and VE were not statistically significant. **Table 12** shows the estimated proportions of low intake across the four hospitals.

On the second page of the M-MIT, 46.7% of participants responded "Very Good/Good", 32.5% responded "Fair/Poor", and 20.8% of participants did not respond/incorrectly responded to the question, "How was your appetite at this meal?" Of the 39 participants who responded "Fair/Poor", their reasons for having low appetite were: "I was not interested in eating" (33.3%); "I had nausea/vomiting" (20.5%); "I was tired" (35.9%); "I had pain" (28.2%); and "I ate outside foods and was not hungry" (2.6%). Multiple responses were allowed, resulting in a total greater than 100%. The proportions of participants with low ("Fair/Poor") appetite and reasons for low appetite across the four hospital sites are shown in **Table 13**.

For the second question on page 2, "Did you have other challenges at this meal?", proportions of responses were as follows (n=120): "I did not like the food" (15.8%); "I have problems chewing/swallowing" (3.3%); "I did not get what I ordered" (3.3%); "The environment was not appetizing" (1.7%); and "I was not allowed to eat" (0.8%). Similarly, participants could check off multiple challenges. No participants indicated that they needed help to eat the meal. Half (50%) of the participants did not check off one of the challenge options. About one third (35.8%) of participants had one challenge during their meal. Four participants (3.3%) had two challenges during their meal. **Table 14**

shows the proportion of participants at each hospital who responded on the M-MIT that they had challenges at that meal.

4.4.5 Revisions Made to M-MIT

Revisions were made to the M-MIT based on the errors observed on the forms during data entry and on other sources of confusion and erroneous completion with the form that were identified through the follow-up interviews with participants after completing the M-MIT. The majority of revisions aimed to minimize the incorrect completion of the solids and fluids sections. The follow-up questions identified issues with: the "<25%" and ">75%" options in both the solids and fluids sections; the shading in the solids and fluids visual diagrams; confusion as to how to deal with items being saved for later; and the "Fair/Poor" option on the appetite question on page two.

First, a clearer set of step-by-step instructions for proper completion of the M-MIT was further detailed at the top of the form. The new instructions use more specific language on how to properly fill out the fluids and solids sections than what the tested version of M-MIT contained (e.g. specifying that patients should list all drinks provided on their tray and giving examples of fluids, and specifying that solids should be an overall estimation of all other foods included on the tray including main dishes, side dishes, desserts, etc.). The instructions also specify that the form is for "this meal" only.

The most frequent comment given by participants in the follow-up interviews was that the 'greater than' and 'less than' symbols were confusing and many suggested that "0%" and "100%" should be options instead. Many patients simply wrote in "0%" or "100%" instead of checking the corresponding "< 25%" or "> 75%" options in both the solid and fluid estimation sections, or simply skipped these sections altogether because they were confused. On the revised version, the "< 25%" and "> 75%" options were changed and a word descriptor was added: "0% - I ate none" (or "I drank none") and "100% - I ate all" (or "I drank all").

Some participants found that both the solid and fluid visual diagrams were confusing. They were unsure as to whether the shading in the diagrams represented how much was consumed or whether it represented how much was remaining on the plate or in the fluid container. This confusion could have affected the accuracy of the patients' estimations and also resulted in some patients skipping these sections on the M-MIT altogether. On the revised version, the diagrams were changed so that the shaded portions looked more like actual fluids remaining in a glass or actual particles of food remaining on a plate. This should result in the diagrams being more intuitive for users. Additionally, the "Example" line in the fluids section of the revised version was more distinctly separated from the rest of the space patients have to fill in their fluids, in order to avoid patients making a checkmark on that line.

Other participants mentioned that they did not know how to estimate intake for food or drink items they were planning to save for later. Ideally, these items would not have been recorded as consumed on M-MIT, because even if patients planned to eat items later, there was no guarantee that these items would be consumed. However, this was not addressed within M-MIT's instructions so participants recorded items saved for later under their own discretion. In addition to clearer instructions, a section was added in the revised version that allows patients to list food items that they are saving for later so that they don't include these items in their estimations.

On page two of M-MIT, there was confusion caused by the question, "How was your appetite at this meal?" The two response options were "Very Good/Good" and "Fair/Poor". Anglophone and Francophone participants noted that they had issues with the "Fair/Poor" option. Some interpreted the term "fair" as meaning a normal or average appetite. However, the true essence of the option was to identify patients who had a poor, or lower than usual, appetite. On the revised version, "Fair/Poor" was changed to "Less than usual" to avoid this confusion. "No specific reason" was also added as an option to the follow-up question "Why was your appetite less than usual?" Additionally, more options were added to the question "Did you have any challenges at this meal?" including an "I had no challenges" option.

Finally, at the end of page two, the question, "Who completed this form?" was added (patient, family/friend/volunteer, or staff member).

The M-MIT has been developed clinimetrically, in that it has been developed and revised through evidence in the existing literature, clinician face validation, as well as through the quantitative validity testing conducted in this study.[82] The final version of the M-MIT (**Appendix D**) along with a clinician guidance document (**Appendix E**) for its use are available at: www.nutritioncareincanada.ca/resources.

4.5 Discussion

4.5.1 M-MIT as a Tool for Change in Nutrition Care

The M-MIT, a patient-completed assessment of food and fluid intake, has shown sufficient sensitivity and specificity for those participants who were able to correctly complete the tool. The correct completion by approximately 80% of participants suggests that for many cognitively able elderly patients, M-MIT would be feasible. Se and Sp for solid intake were both at least 74% and while Se for fluid intake was lower than desired (61.9%), this value improved when fluids were individually itemized and compared. Se was increased (83.3% for solids, 71.0% for fluids) when incomplete or erroneous forms were imputed as ≤ 50% consumed, and decreased (53.3% solids, 41.9% fluids) when they were imputed as > 50% consumed. When all participants (complete and incomplete M-MIT) were included, the proportion of low intake participants according to VE increased compared to when only complete M-MITs were included (25.0% vs. 22.3% for solids, 25.8% vs. 21.4% for fluids), which explains the increase in Se observed.

The tool has been deemed sufficient because M-MIT is not a diagnostic tool. Instead, routine FI monitoring with M-MIT would act more as an ongoing screening process, identifying those patients who may require a nutrition assessment or intervention. Additionally, the solid intake estimation was considered more relevant to clinical use since it would be the solid food estimation that would drive changes in nutrition care within INPAC[35], so the lower Se for fluids observed and the lower completion

rate of this section for those with low appetite were less of a concern. Revisions that were made to the tool are anticipated to reduce confusion with the M-MIT, and the fluid intake section specifically, and should hopefully improve completion rates as well as the accuracy of completion. In practice, it may be clinically more beneficial to consider incomplete or erroneous M-MIT forms as having low intake, as this greatly increased the tool's sensitivity in this study; however this will result in more false positives. Alternatively, training staff who remove trays to estimate intake is a way to ensure this data is collected. Future work should determine if proxy respondents of family, staff or volunteers can also accurately complete the M-MIT when compared to VE.

M-MIT is not meant to be an objective measure of intake in which an overall intake of < 50% would automatically result in nutrition intervention. In practice, the intake estimations on page one would be taken in combination with the appetite and eating challenges questions, as well as the patient comments on page two. In practice, staff (e.g. a dietitian) could then review the completed M-MIT and make a subjective judgement based on all of this information as to whether a patient needs a change in nutrition care. For example if a patient did not consume any of their meal, but on page two they stated that their appetite was less than usual because they had nausea and vomiting, a dietitian reviewing the M-MIT could judge that the nausea was not a regular occurrence for the patient and would not necessarily have to recommend a change in nutrition care. The M-MIT could be used as a regular intake monitoring tool (e.g. three times/week), and if a patient's intake was consistently below 50%, this could result in nutritional intervention or a comprehensive dietitian assessment, which is how M-MIT is designed to be used within INPAC; patients would be screened and/or diagnosed for malnutrition (using the CNST and/or SGA)[35] upon admission. Patients' intakes would then be monitored regularly using M-MIT, and those with low intakes could be moved between the different nutrition care levels within INPAC based on their level of nutrition risk.[35]

The M-MIT is a basic monitoring tool designed to stimulate changes in staff behaviour in terms of nutrition care. Subgroup analysis based on appetite demonstrated that sensitivity was highest for those with limited to no intake, though significance could not be determined. This is an interesting potential finding as those with low intake would need staff follow up and potentially further intervention. The increase in sensitivity of the M-MIT observed when the cut-point was increased to 75% consumption shows that a higher proportion of patients would be identified as 'low-intake' with this cut-off. Though specificity would be decreased using a higher cut-point[57,92] as observed in this study (i.e. greater incidence of false positives), subsequent assessments such as reviewing the reasons for low intake (e.g. did not like the food) and determining an appropriate course of action would address these false positives. There is potentially minimal harm in over-identifying low-intake patients excepting the increased workload and resource use of following up with these patients. However, many hospitals may not have the resource capacity to be able to use a higher cut-point, as dietitians are often a limited specialist resource.[30] Overall for those that were able to complete it, M-MIT identified more participants (37.2%) as having low FI than dietitians did (22.3%), as well as identifying more participants with low fluid intake (28.3%) than dietitian VE (21.4%). The differences in low intake as identified by M-MIT vs. dietitians were not statistically significant, however. Thus in this study, M-MIT was not under-identifying patients with low intake, which would be of concern for its use in practice if this were the case. The decision on what intake level leads to a change in care (e.g. < 50% or < 75%) could be tailored by the hospital or unit depending on patient population, resource capacity to follow up on patient results, etc.

It is worthwhile to note the contextual nature of M-MIT results as evidenced by the differences among hospital sites observed in the descriptive analyses. Hospital units differed greatly in size, staffing, resources, specialization, patient demographics, etc. It can be hypothesized that FI will therefore vary as well. This variability in FI can be affected by the quality of food and nutrition care provided in specific hospitals.[47] When validity analyses were stratified by demographics and appetite level, Se values

remained acceptable (> 65%) for solid food intake, which helps to show that M-MIT could be useful for a wide range of patient types.

4.5.2 Strengths and Limitations

Until this study was completed there were no patient self-completed FI monitoring tools that had been validated. The major strength of this study is that it is the first to attempt to create and validate a feasible tool. Criterion validation usually is conducted by comparing a new method with a gold standard measure.[85] In the case of FI, pre- and post-meal weighing of food items is generally considered the gold standard[31,51,52], allowing a precise estimation of proportions consumed. However, food weighing is expensive, time-consuming, and disruptive to the normal eating routine.[51-53] Since validation studies should be conducted in the setting in which the new tool will be used[85], dietitian visual estimations, which were not resource-intensive nor disruptive to patients, were chosen as the criterion measure. Although likely less accurate than weighing, the dichotomization of intake for analysis and comparison to patient estimation justified this less precise method, as did the relatively large sample size. Visual estimation (VE) of FI has also been validated against the food weighing method in various clinical settings[51,53-55], so it was decided that VE by trained dietitians would be acceptable as a criterion for this study. The inclusion of four dietitians (one at each participant hospital), with their potential differences in estimation skill could be considered a limitation. Training was provided, but inter-rater reliability of these dietitians was not assessed.[84] When reliability of a criterion is unknown, using multiple raters would help to dilute the effect of differing estimations.[85] For example, two dietitians could have reviewed the same meal leftovers and the average of their estimation used as the criterion. However, dietitians involved in the study were experienced in estimating FI and also received training specifically for the protocols within the study in an attempt to standardize their estimations.

Additionally in this investigation dietitians estimated the proportion consumed of each food and fluid item provided. These estimations were then averaged to come up with crude estimations of overall

solid food intake and overall fluid intake. In essence, each food item was treated equally, so if a participant ate 0% of their main dish, 100% of their appetizer, and 100% of their dessert, the resulting estimation was 67% of their food consumed. However, M-MIT provides one crude estimation of total food consumption. In future validation studies, it would be recommended to have raters provide one crude estimate consistent with how patients were asked to estimate their intake on the M-MIT.

Dietitian estimations were made by collecting participants' meal trays after they were done their meal and estimating the remaining waste based on what was originally provided. Participants weren't observed while they were eating. Thus, if participants threw out or spilled items, or saved them for later, this could have caused dietitians to assume that those items were consumed causing an over-estimation of intake. However, if this occurred, this would have decreased the observed measures of agreement, which suggests that these measures of validity may have been underestimated in this investigation. As mentioned, a "saved for later" section was added to the revised M-MIT so that future users do not count these items as consumed.

There was a lack of randomization in the meals that were selected for food intake monitoring. Meals were chosen at the site dietitians' discretion. This could have influenced validation results. For example, differing appetites at different mealtimes may have had an effect on the accuracy of intake estimation. Alternatively, some foods (e.g. milk, cereal at breakfast) can be more difficult to estimate consumption than foods provided at other meals (e.g. a sandwich at lunch). However, in this study intake was crudely dichotomized to $\leq$ 50% and > 50%, which likely eliminated some of these potential differences in estimation accuracy due to type of food provided. Randomization or a quota system could be used to promote an even number of breakfasts, lunches, and suppers monitored in a future study.

Though the M-MIT can be completed by someone else if a patient cannot complete it themselves, this proxy completion was not assessed in this study. Some dietitians noted whether a proxy completed the M-MIT, but this information was not explicitly collected. This could have introduced proxy

respondent bias[93] if proxies responded differently than when participants completed the M-MIT themselves. The few cases (< 10) that noted that proxy support was used to complete the tool did not warrant a separate analysis, especially as they were instructed not to make estimations themselves, but to complete the M-MIT based on how participants responded when read or shown the questions. Future work should validate M-MIT with different users including staff, volunteers and family, especially for patients who cannot respond reliably (e.g. delirium, dementia).

The completion rate of M-MIT of approximately 80% indicates that most participants were able to complete the form. Sensitivity analyses were completed including incomplete forms. The follow-up questionnaire attempted to uncover the reasons for non-completion and the revisions made to M-MIT attempted to address some of these reasons (e.g. confusing questions and symbols, wording). In practice, lack of completion should result in a staff member completing the form and future research should determine the validity of this approach. It is also possible that non-response bias may have occurred due to the healthy volunteer effect.[93] There was no information collected on those eligible patients who declined to participate in the study and it's possible that those who declined may have been more frail/sick than those who agreed to participate. As well no participation rate determined. Participation rate would have been difficult to calculate, as ethics clearance only allowed nursing staff to approach prospective patients about participating and not information on who declined participation. It is just as likely that this process was influenced by nursing routines and capacity to approach patients on certain shifts. , It is still recommended by the authors that M-MIT would be beneficial as a monitoring tool for patients that are able to complete it so that staff resources can be more efficiently directed to those who cannot complete the M-MIT themselves.

4.5.3 Next Steps

Building off of this initial study, it would be worthwhile to validate the revised version of M-MIT using the methodological recommendations suggested. The sample used in this study contained diverse

hospitals and patient types. Future validation studies could focus on more specific patient groups to determine with which patients the M-MIT may or may not be appropriate. For example, a sample of 80+ year old patients could be observed to determine if Se and Sp vary as compared to younger adults. Additional investigations could also uncover whether statistically significant differences in estimation accuracy exist between demographic characteristics and appetite level, as N was too small in this study when the sample was divided by these attributes. Future work could also determine the M-MIT's sensitivity and responsiveness to change over time. The M-MIT is meant to be used as an ongoing monitoring tool to be used repeatedly in practice. Thus, validation of repeated use of the M-MIT (e.g. over the course of a week) could determine the tool's ability to detect changes in FI within each patient over time.

It would be worthwhile to determine the cost vs. benefit of the improved identification of low intake patients with the M-MIT, as well from using a 50% vs. 75% cut-off for low intake. Implementation research could also determine if M-MIT completion leads to additional nutritional support or a dietitian consultation and if this improves food intake. Future work could determine the increased resource (financial, time) strain that this process would require and whether the M-MIT is feasible as part of the quality nutrition care activities in hospital. However, if hospitals are interested in improving their nutrition care and monitoring FI, this study has shown that the tested version of M-MIT has sufficient validity for those patients who were able to complete it.

It is acknowledged that making changes to care processes in hospital can be an incredibly complex task. More-2-Eat (M2E) is a study that is currently underway across five Canadian hospitals that aims to implement INPAC into their nutrition care practices. Within M2E, the finalized version of the M-MIT will be used for a detailed data collection on a subset of patients. The study will aim to identify barriers and facilitators to the successful implementation of all components of INPAC, including FI monitoring with M-MIT. M2E will determine whether M-MIT can be implemented into routine care

practices and help to detail out how to deal with a number of potential issues that could arise when trying to implement M-MIT. These could include: establishing who will distribute and collect the forms; determining ideal 'low' intake cut points and how to flag this information for the appropriate clinician; determining how much training and education of staff is needed; assessing the feasibility of having proxies complete the M-MIT for those patients who cannot complete it themselves; and detailing processes of how to deal with incorrectly completed or incomplete forms.

4.6 Conclusions

The aim of creating and validating the M-MIT was to provide a statistical rationale for a simple tool that hospitals can use to improve their monitoring of food intake. This study has shown sufficient validity of the tested version of M-MIT in elderly, cognitively able medical and surgical patient populations across four diverse Canadian hospitals. The tested version has been revised and improved as a result of this study, which should further improve M-MIT's validity. Future studies on more specific hospital types or patient populations could provide more insight on M-MIT's accuracy within these different contexts. Future validation with repeated M-MIT use could also determine the tool's ability to detect FI changes over time. However for the first time, a study has shown a patient self-completed FI monitoring tool that is valid across a single mealtime, which if used in hospitals has the potential to improve nutrition care if results are followed up and new interventions put into place based on the recording of low FI. With further identification of poor FI in hospital patients, it is anticipated that proactive strategies can be put in place to support intake and improve recovery of patients. Future testing of M-MIT as part of a comprehensive pathway like the INPAC to improve nutrition care is needed. This next step is currently underway with the M2E study, which will glean insight on how to successfully implement M-MIT (and more broadly, INPAC) into routine clinical practice.

4.7 Data Tables

Table 1 - *Participant Hospital Characteristics*

Hospital Site	Province	Hospital Type	Approximate # of Beds	Anglophone/Francophone
1	British Columbia	Community	285	Anglophone
2	Saskatchewan	Academic	650	Anglophone
3	Ontario	Community	600	Anglophone
4	Quebec	Academic	1200	Francophone

Table 2 - *Patient Demographics (n=120)*

Characteristic	Total Sample % (n)	Site 1 % (n)	Site 2 % (n)	Site 3 % (n)	Site 4 % (n)
Gender					
Male	43.3 (52)	33.3 (10)	43.3 (13)	50.0 (15)	46.7 (14)
Female	56.7 (68)	66.7 (20)	56.7 (17)	50.0 (15)	53.3 (16)
Age					
Mean age (years +/- SD)*	78.4 +/- 8.4	85.0 +/- 7.1	76.7 +/- 6.5	75.8 +/- 8.4	76.2 +/- 8.0
65-69 years	20.0 (24)	6.7 (2)	20.0 (6)	30.0 (9)	23.3 (7)
70-79 years	32.5 (39)	13.3 (4)	36.7 (11)	36.7 (11)	43.3 (13)
80-89 years	35.8 (43)	50.0 (15)	43.3 (13)	26.7 (8)	23.3 (7)
90-99 years	11.7 (14)	30.0 (9)	0	6.7 (2)	10.0 (3)
Highest Level of Education Achieved*					
Primary school or less	10.8 (13)	0	10.0 (3)	3.3 (1)	30.0 (9)
Some high school	26.7 (32)	16.7 (5)	43.3 (13)	30.0 (9)	16.7 (5)
Graduated high school	28.3 (34)	50.0 (15)	16.7 (5)	20.0 (6)	26.7 (8)
Some post-secondary/graduated post-secondary	34.2 (41)	33.3 (10)	30.0 (9)	46.7 (14)	26.7 (8)
Living Situation					
Lives alone	41.7 (50)	53.3 (16)	30.0 (9)	43.3 (13)	40.0 (12)
Lives with spouse	40.0 (48)	30.0 (9)	46.7 (14)	40.0 (12)	43.3 (13)
Lives with other family/friends	13.3 (16)	13.3 (4)	16.7 (5)	13.3 (4)	10.0 (3)
Lives with spouse and other family	2.5 (3)	0	6.7 (2)	3.3 (1)	0
Long term residence	2.5 (3)	3.3 (1)	0	0	6.7 (2)
Unit Type*					
Medical wards	78.3 (94)	100 (30)	100 (30)	60.0 (18)	53.3 (16)
Surgical wards	21.7 (26)	0	0	40.0 (12)	46.7 (14)
Reason for Admission					
Orthopedic	22.5 (27)	40.0 (12)	0	36.7 (11)	13.3 (4)
Respiratory	12.5 (15)	3.3 (1)	23.3 (7)	6.7 (2)	16.7 (5)
Falls/weakness/dizziness	12.5 (15)	20.0 (6)	6.7 (2)	10.0 (3)	13.3 (4)
Cancer	10.0 (12)	3.3 (1)	3.3 (1)	3.3 (1)	30.0 (9)
Cardiovascular	6.7 (8)	10.0 (3)	16.7 (5)	0	0
Gastrointestinal	6.7 (8)	0	10.0 (3)	13.3 (4)	3.3 (1)
Wound/Infection	5.8 (7)	6.7 (2)	6.7 (2)	10.0 (3)	0
General surgery	3.3 (4)	0	0	0	13.3 (4)
Stroke	1.7 (2)	0	0	6.7 (2)	0
Other	17.5 (21)	13.3 (4)	33.3 (10)	13.3 (4)	10.0 (3)
Missing	0.8 (1)	3.3 (1)	0	0	0

*** statistically significant difference p<0.05; mean age statistically significantly different among sites with post hoc tests noting difference among site 4 and 1.**

Table 3 - *Contingency Table for Solid Intake Calculation Method 1*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	16	19
	> 50%	5	54
	Total	21	73

Table 4 - *Contingency Table for Solid Intake Calculation Method 2*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	25	36
	> 50%	5	54
	Total	30	90

Table 5 - *Contingency Table for Solid Intake Calculation Method 3*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	16	19
	> 50%	14	71
	Total	30	90

Table 6 - *Contingency Table for Fluid Intake Calculation Method 1*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	13	15
	> 50%	8	62
	Total	21	77

Table 7 - *Contingency Table for Fluid Intake Calculation Method 2*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	22	27
	> 50%	9	62
	Total	31	89

Table 8 - *Contingency Table for Fluid Intake Calculation Method 3*

		Dietitian VE	
		≤ 50%	> 50%
M-MIT Estimations	≤ 50%	13	15
	> 50%	18	74
	Total	31	89

Table 9 - *Sensitivity and specificity of M-MIT fluids section and of most common individual fluid items*

Fluid Type	N of patients identified ≤ 50% according to dietitian VE	Overall % Agreement	Sensitivity (%)	Specificity (%)
Coffee/Tea[a]	17	88.0	70.6	97.0
Juice[b]	7	85.7	71.4	88.1
Milk[c]	14	77.3	64.3	83.3
Total fluids[d]	21	76.5	61.9	80.5

[a]**n=50, (**$p < 0.001$**)**, [b]**n=49, (**$p < 0.001$**)**, [c]**n=44, (**$p < 0.01$**)**, [d]**n=98, (**$p < 0.001$**)**

Table 10 - *Overall Agreement, Sensitivity & Specificity stratified by demographics/appetite for solid food intake*

Characteristic	N of patients identified ≤ 50% according to dietitian VE	Overall % Agreement	Sensitivity (%)	Specificity (%)
Gender				
Male (n=42) (p < 0.001)	7	88.1*	85.7	88.6
Female (n=52) (p < 0.05)	14	63.5	71.4	60.5
Age (p < 0.01)				
< 80 years (n=47)	9	76.6	66.7	78.9
≥ 80 years (n=47)	12	72.3	83.3	68.6
Education (p < 0.01)				
Less than high school (n=31)	7	80.6	85.7	79.2
Graduated high school (n=63)	14	71.4	71.4	71.4
Appetite				
Very Good/Good (n=47) (p < 0.01)	3	87.2	66.7	88.6
Fair/Poor (n=31) (p < 0.05)	14	71.0	85.7	58.8

*** indicates significant difference (z = 2.723, p < 0.01)**

Table 11 - *Overall Agreement, Sensitivity & Specificity stratified by demographics/appetite for total fluid intake*

Characteristic	N of patients identified ≤ 50% according to dietitian VE	Overall % Agreement	Sensitivity (%)	Specificity (%)
Gender				
Male (n=44) (p < 0.05)	6	81.6	50.0	86.8
Female (n=54) (p < 0.01)	15	72.2	66.7	74.4
Age				
< 80 years (n=52) (p < 0.001)	10	82.7	70.0	85.7
≥ 80 years (n=46) (p < 0.1)	11	69.6	54.5	74.3
Education				
Less than high school (n=34) (p < 0.05)	6	73.5	83.3	71.4
Graduated high school (n=64) (p < 0.01)	15	78.1	53.3	85.7
Appetite				
Very Good/Good (n=51) (p < 0.01)	4	84.3	75.0	85.1
Fair/Poor (n=30) (p < 0.05)	11	73.3	72.7	73.7

Table 12 - *Low food and fluid intake (50% or less) for dietitian and M-MIT estimations across hospital sites*

Hospital Site	Dietitian Estimated % Low Food Intake (n=30)	M-MIT Form % Low Food Intake	Dietitian Estimated % Low Fluid Intake (n=30)	M-MIT Form % Low Fluid Intake
1	26.7	57.7* (n=26)	40.0	36.0 (n=25)
2	16.7	32.0 (n=25)	23.3	8.7 (n=23)
3	26.7	24.0 (n=25)	20.0	30.0 (n=30)
4	30.0	33.3 (n=18)	20.0	38.1 (n=21)
Overall	**25.0 (n=120)**	**37.2 (n=94)**	**25.8 (n=120)**	**28.3 (n=99)**

***indicates statistically significant (p < 0.05)**

Table 13 - *"How was your appetite at this meal?" – % of participants with low appetite & reasons for low appetite across hospital sites*

Hospital Site	% with Low Appetite	"I was not interested in eating" (%)	"I had nausea/ vomiting" (%)	"I was tired" (%)	"I had pain" (%)	"I ate outside foods and was not hungry (%)
1	42.9	26.9	7.7	15.4	11.5	0
2	34.8	8.0	0	8.0	0	4.0
3	34.5	13.8	10.3	13.8	6.9	0
4	54.5	0	11.1	14.8	22.2	0

Table 14 - *"Did you have any challenges at this meal?" – Number of challenges experienced by participants across hospital sites*

Hospital Site	Completed "Challenges" Section (n)	# of M-MIT Challenges (%)		
		0	1	2
1	26	57.7	38.5	3.8
2	25	68.0	32.0	0
3	29	41.4	55.2	3.4
4	27	59.3	33.3	7.4

Chapter 5

The Mealtime Audit Tool (MAT) – Inter-rater reliability testing of a novel tool for the monitoring and assessment of food intake barriers in acute care hospital patients

5.1 Abstract

Background: Malnutrition in hospital patients results in increased length of stay and cost of care. Barriers to food intake (FI), whether physical or organizational, exist that exacerbate the insufficient FI that is already common in hospital patients. The Mealtime Audit Tool (MAT) is a clinical assessment tool administered by staff to identify FI barriers for individual patients.

Objectives: There were three main objectives of this research: 1) To determine whether the MAT has sufficient inter-rater reliability to be recommended for use in a clinical setting; 2) To revise and improve the MAT using feedback from users; and 3) To use the MAT to characterize barriers to FI in older adults in four diverse hospitals.

Methods: Two studies were conducted. Study 1 included 120 cognitively able patients over the age of 65 from four Canadian hospitals. Participants had one mealtime assessed for the occurrence of barriers using the MAT. Descriptive analyses were conducted to characterize the prevalence of barriers across the hospitals and any differences in barriers experienced due to patient characteristics. Revisions made to the MAT resulted in version 2 of the tool. Study 2 tested for inter-rater reliability using version 2 of the MAT in which two raters assessed 90 patients across 30 different mealtimes using the MAT. To determine reliability, an intraclass correlation coefficient (ICC) was calculated for the mean total MAT scores between the raters. Additionally, kappa coefficients were calculated for each of the 18 barrier items on MAT version 2. Similar descriptive analyses to study 1 were also performed in study 2.

Results: The mean number of barriers experienced by each patient in study 1 was 2.93 +/- 1.58 and in study 2 was 2.51 +/- 1.19. A number of barriers were common across all hospital sites while other barriers

were more prevalent at specific sites. The ICC of 0.68 (95%CI: 0.52-0.79) of version 2 indicated good agreement between raters. Ten of 16 items in which kappa could be calculated had at least fair agreement, and 14 of 18 items had > 90% agreement in responses between the two raters.

Conclusion: MAT is sufficiently reliable when used by auditors with minimal training. Further revisions were made to version 2 of the MAT to improve functionality. Currently, monitoring FI barriers in hospital units is not done in any systematic way. Routinely auditing mealtimes with the MAT would be useful in identifying and removing barriers, potentially increasing patients' opportunities to consume enough food.

5.2 Introduction

It is well established that malnutrition is a prevalent and significant issue in hospital patients, and is especially common in older patients (65+ years).[2,41,90] In Canada, 45% of patients are admitted to hospital already malnourished[6], while other studies in various settings have reported the prevalence of hospital malnutrition to be anywhere from 10-70%.[7-20] Malnutrition affects patient outcomes and results in increased lengths of stay and cost of care.[17,21,22,24,27] Insufficient food intake (FI), also an independent predictor of length of stay[6], is commonplace while in hospital[3,25], putting patients at further risk of declines in nutritional status. Reduced appetite plays a key role in low FI, and can be the result of a number of factors including: the patient's medical condition, medications or treatments[49], or simply the inherent stress[41] involved with being hospitalized.

Within the past decade research has emerged[33,34,63-71] identifying further barriers to FI, or food access issues, that can be physical or organizational in nature. These barriers are issues that patients experience that further prevent them from consuming enough food. Physical barriers include issues such as: difficulty cutting food or opening packages, being in an uncomfortable position to eat, or the inability to reach the meal tray.[33,71] Organizational barriers can encompass a broad range of issues, and may include: food being served at inconvenient times, patients receiving the wrong foods, or hot foods not being served hot. Barriers can occur if patients aren't offered flexible menu choices or not provided

enough information on their options.[33,71] Dissatisfaction with food quality (i.e. taste, smell, appearance)[33] can be considered a barrier as well. Finally, organizational issues can also include environmental barriers, which result in distractive eating environments due to excessive noise, smells, or being interrupted during meals.[33,71] It has been further established that patients with multiple comorbidities may be at an increased risk of experiencing physical barriers.[70] Thus, frail elderly patients may be more susceptible to experiencing barriers to intake as the prevalence of comorbidities tends to increase with age.[42,43]

The Mealtime Audit Tool (MAT) is an interview based questionnaire designed to be completed by a hospital staff member to identify barriers to FI that individual patients may encounter during a mealtime. The MAT was created to support the recently-developed Integrated Nutrition Pathway for Acute Care (INPAC), an evidence and expert consensus-based nutrition care algorithm that is meant to be a best practice guideline for nutrition care in acute care hospital patients.[35] The aim of following the practices outlined in INPAC is to better detect, monitor, and treat malnutrition in the acute care population. A component of INPAC is 'standard nutrition care', or defining the essential mealtime activities that should happen for all patients in order to promote FI.[35] Included in these 'standard nutrition care' recommendations, is ensuring the minimization of FI barriers during mealtimes. In order to influence the success of the recommendations, it was recognized that there was a need for an easy to complete tool that staff could use to identify potential FI barriers that might exist within hospital units. The goal of such a tool would be to provide hospital staff with evidence of where their care practices could be improved in order to remove existing barriers and further promote FI.

The primary aim of this research was to determine whether the MAT had sufficient inter-rater reliability for use in practice. Prior to the reliability testing, another aim was to revise and improve the tool by testing MAT's use with staff (dietitians and dietetic interns), determining its feasibility and ease of use in a clinical setting, and gathering feedback in order to make revisions. Finally, descriptive analyses were also conducted to characterize FI barriers in older adults in the samples studied.

5.3 Methods

5.3.1 Subjects and Hospitals

Data analyzed from the MAT was generated from two separate studies. Study 1 was a multi-component study focused on frail older adults admitted to hospital. The objective of study 1 was to test three clinical resources that were developed to support the use of INPAC. The MAT was one of the three resources tested for feasibility. In the study, 120 medical and surgical ward patients were enrolled from four Canadian hospitals (30 patients/hospital). Eligible patients for study 1 were: over the age of 65; admitted from their own home in the community; likely to be discharged home; admitted to a medical or surgical unit; able to speak and read English or French; not cognitively impaired; no occurrence of delirium during their admission; likely to be admitted for 2-5 days; consuming an oral diet; and consenting to participate in the testing of all three clinical resources, including a single completion of the MAT. Older adults (> 65 years) were specifically targeted due to the demography of patients who are admitted to acute care in Canada[94], as well as the belief that if the tool were feasible with older adults, it would be feasible with younger patients as well. The primary aims of the MAT data collection in study 1 were to: 1) test how the tool worked with different auditors who were provided minimal training, and 2) to improve and revise the tool prior to reliability testing. An additional objective was to characterize barriers to intake for older adults in these four hospitals. The participating hospitals were diverse in terms of region, type, size, and primary language (**Table 15**). It was anticipated that completion of the MAT with 30 patients in each hospital would provide a sufficient range of experience with the draft tool to allow for a quality revision.

After completion of study 1, revisions were made to the MAT and in study 2 the revised version was tested for inter-rater reliability. Study 2 was conducted at one hospital (Site #3 – **Table 15**) with a different sample of participants at a later date. Ninety patients from medical and surgical units were enrolled at 30 different mealtimes (~3 patients/meal) and completed the audit. Eligibility criteria included: patients in medical or surgical units; not cognitively impaired or suffering from delirium; able

to read and speak English; consuming an oral diet; and consenting to participate in completion of MAT with two different auditors for the same meal. Since patient age was not an important factor in testing for inter-rater reliability of the tool, any adult over 18 who met the eligibility requirements was included in the study.

Demographic characteristics collected for both studies included: gender, year of birth, reason for admission, and highest level of education. Living situation information was also collected in study 1.

5.3.2 Mealtime Audit Tool (MAT)

The MAT is essentially a checklist of FI barriers experienced at a mealtime that was developed for completion by hospital staff members based on patient report. It is intended to be completed through interview with patients immediately after a meal and takes approximately five minutes to complete. The tool can be used with patients who have been identified as having poor FI to determine barriers they are experiencing, or can be used as a way for hospital units to self-audit the existence of barriers over time when used routinely. Initial development included a scan of the literature to identify common FI barriers for acute care patients.[33,34,68,71] Barriers specifically identified in the Nutrition Care in Canadian Hospitals study[71] were included as they applied more to a Canadian context. The draft MAT was developed with leading nutrition clinicians and researchers and face validated[57] by five clinician experts, who provided further insight on barriers to include as well as presentation, terminology and instructions on the tool to promote consistency in use.

On version 1 of the two-page tool (used in study 1) (**Appendix F**), the first page listed three general unit-level barriers: 1) “Were patients toileted before the mealtime?”; 2) “Does the unit appear ready for mealtime?”; and 3) “Is the unit focused on mealtime?”. Also on this first page was a section for the auditor to record any other environmental observations that could have impacted the mealtime. The second page contained a checklist of 18 patient-specific barriers an individual patient may have experienced during the meal. Each question on the second page of the MAT had a Yes or No response

option, with ‘No’ indicating that a barrier had been encountered (e.g. “Received the food they ordered?” – an answer of ‘No’ indicates the patient did not receive the food they ordered and therefore represents a potential barrier for that meal). The number of ‘No’ responses was summed at the bottom of the page resulting in a total MAT “score”.

To complete the MAT, the auditor was trained to observe the unit before and during the meal to note any general environmental barriers across the unit. The auditor recorded these general unit level observations on page one. The auditor then selected patients after the meal to complete the second page to determine how many of the 18 barriers were encountered.

The initial feasibility testing of version 1 of the MAT occurred with 120 patients across four sites. This testing identified that minor changes to the tool were required in order to promote consistency. Feedback from the clinicians who used the tool in study 1 indicated that the three general unit-level barriers listed on the first page of the MAT should be modified, since the information was not being adequately captured in the final MAT “score” and the observations around toileting could only be effectively assessed through directly asking patients. However all clinicians felt that observation of the unit was a relevant and important part of identifying environmental barriers that would prevent optimal intake. Therefore the revised version included a more open-ended section on the first page requesting the auditor to comment on the unit readiness for the meal and any delays/challenges that could influence the patient perceptions of their meal. For the purposes of this study, the qualitative data acquired from the first page regarding environmental observations was not analyzed. This information however was used to write instructions on the types of activities at the unit level that may influence the eating environment for patients. These instructions were included on a MAT guidance document that was created after completion of study 2.

Changes were also made to the second page of the MAT based on clinician feedback. It was suggested that a “not applicable” option (in addition to ‘yes’ and ‘no’) be added where appropriate as it

was noted that some auditors using version 1 left questions blank when they thought the most appropriate response was 'not applicable'. Clinicians further suggested the removal of some items that they determined were not actually barriers to intake (e.g. "Food intake/hydration monitored at this meal", "Patient was provided snacks in between meals"). There were also suggestions for additions to the list such as, "Did the meal come at an appropriate time for you?" Following both deletion and insertion of items, the revised version still resulted in 18 barrier items listed. The wording of the 18 barriers was also modified so that the auditor could read them verbatim when completing the interview with the patient to promote consistency. Finally, space for comments was added to the second page to allow the auditor to note more detail if needed. The suggested changes resulted in version 2 of the tool, which was used in the data collection for the inter-rater reliability testing (Study 2) (**Appendix G**).

5.3.3 Data Collection

Ethics clearance for the data collection was obtained through a University of Waterloo Research Ethics Committee (**Appendix H**), as well as through the ethics boards of each individual hospital involved.

5.3.3.1 Study 1

Four dietitians were seconded from their regular duties to complete the descriptive data collection for study 1, recruiting eligible patients from across multiple medical and surgical units. They were trained via teleconference over a three month period, and communicated with the project team on a regular basis via email and teleconference to address any questions with respect to data collection, eligibility etc. Data collection occurred over a 2-4 month period for each site. Staff who were part of the circle of care (i.e. nursing staff, dietitians) identified eligible patients and made the initial approach to prospective participants to garner their interest in being part of the study and allow consent for the site coordinator dietitian to approach the patient with more information about the study and acquire informed written consent. During the designated meal, the dietitian attempted to observe the entire unit and completed the

first page of the MAT, noting any unit-level barriers. Data recorded on the first page was not analyzed for the present study due to the more subjective nature of the questions, but these comments were considered when creating the guidance document for MAT users. After the participant had finished his/her meal, the dietitian entered his/her room and completed the second page of the MAT verbally with the patient.

5.3.3.2 Study 2

Data collection for study 2 was conducted by two dietetic interns who completed separate mealtime audits for each patient at a single meal. The dietetic interns were trained on how to complete informed written consent, and how to complete page 1 and 2 of version 2 of the MAT. This training was in-person at the study site provided by the site study coordinator who had completed the MAT audits in study 1. Consent was completed just prior to the meal that was to be used for the audit. Participants were informed that after they completed their meal, the first intern would enter their room and ask them the MAT questions. Five to ten minutes later, the second intern entered the same participant's room and also completed the MAT questions. These auditors were blinded to each other's audit results and the order of the intern (e.g. 1 or 2) completing MAT with a particular participant varied. On average three participants were assessed per meal (range: 1-7 participants assessed per meal across the 30 mealtimes).

5.3.4 Analysis

In studies 1 and 2, descriptive analyses were performed to determine the overall mean (s.d.) total MAT score (i.e. number of barriers experienced per patient), per hospital site, and the most common barriers experienced across the hospital sites. One-way ANOVA analyses determined whether there was any significant difference in the average number of barriers experienced by patients among the hospital sites. Descriptive analyses were also completed to characterize the two samples of participants. T-test and Z test were used to compare the two samples on descriptive variables. Chi square analyses were performed to determine any associations between dichotomized demographic characteristics and the

number of barriers experienced (</≥ 3 barriers). Three or more barriers was chosen as the cut point for dichotomization as participants in the study experienced an average of approximately three barriers at their meals.

In study 2, with the sample size of 90 participants, it was determined that the smallest possible correlation that the sample was powered to detect ($\alpha = 0.05$) would be 0.350 (p.79)[86]. Thus, since agreement between raters was expected to be greater than 35%, this sample size was deemed sufficient unless calculated values fell below 35%.

The primary method of determining inter-rater reliability in study 2 was by using the total MAT score (total # of barriers encountered) for each participant and comparing these total scores between auditors. An intraclass coefficient (ICC) was calculated using a two-way random model of absolute agreement[95] to determine how well the scores between the two raters were correlated. An ICC value greater than 0.75 can be considered "excellent", 0.60-0.74 "good", 0.40-0.59 "fair", and values less than 0.4 are considered "poor".[88] Additionally, measures of inter-rater reliability were determined for each of the 18 barrier questions by calculating kappa statistics for each barrier to determine if there were questions that needed further modification. Similarly, kappa values > 0.75 can be considered "excellent", values between 0.40-0.75 are considered "fair to good", and < 0.40 would be considered "poor".[89] Kappa statistics were calculated with responses of "Yes" and "N/A" being considered the same category. The responses were dichotomized this way in order to more specifically gauge each question's reliability in identifying whether or not a barrier occurred (i.e. "Yes" and "N/A" responses both represented a barrier not being experienced; thus they were grouped together). Further, descriptive analyses were performed to determine the proportion of matching ratings between the auditors for each barrier (% of ratings in agreement for the 18 questions). For each item with a kappa coefficient < 0.7 (for the dichotomized response categories), an ICC was re-run without this item to determine if the question had an effect on the overall ICC. An F-test was run along with these ICCs using the original ICC as the test value to determine

if there was a significant difference between each new ICC and the original. A qualitative comparison was also made between the original ICC and these reduced MAT ICCs to determine if an item needed to be removed from the MAT in order to improve reliability. Based on the results of the reliability analyses and feedback obtained from follow-up meetings with the auditors, further revisions to the MAT were made to improve upon any issues that arose with its use in study 2, which resulted in the creation of a final published version.

5.4 Results

5.4.1 Patient Characteristics

The demographic characteristics of the 120 participants from study 1 and the 90 participants from study 2 are displayed in **Table 16**. Both samples had the same gender distribution (male: 43%; female: 57%). The study 1 sample was older (78.4 +/- 8.4 years) on average than the study 2 sample (67.6 +/- 14.3 years) ($t = 102.642$, $p < 0.001$). The majority of study 1 participants (77.5%) were from medical units, while the majority of study 2 participants (53.3%) were from surgical units ($z = 4.754$, $p < 0.0001$). No other characteristics were significantly different between study 1 and 2 samples. Most participants in both studies had at least a high school education (study 1: 62.5%, study 2: 71.2%) and most patients in study 1 either lived alone (41.7%) or with their spouse (40.0%). This information was not collected in study 2. The most common reasons for admission in both samples were for orthopedic conditions (study 1: 22.5%, study 2: 40%).

5.4.2 Descriptive Analysis of Mealtime Barriers

The mean number of FI barriers experienced per patient in study 1 was 2.93 +/- 1.58, ranging from zero to eight barriers experienced during one meal. The mean number of barriers experienced in study 2 (taking the average number of barriers between both raters) was 2.51 +/- 1.19. A comparison of barriers experienced across the four hospitals from study 1, along with those from the inter-rater reliability testing

(study 2), are displayed in **Table 17**. According to Tukey post-hoc tests, the only statistically significant difference (F = 4.039, p = 0.009) among the study 1 hospitals was between Site 4 (mean = 3.70 +/- 1.21 barriers experienced) and Site 2 (mean = 2.37 +/- 1.92 barriers experienced), with significantly more barriers reported at Site 4. Chi square analyses were also performed to determine whether there were any associations between certain patient demographic characteristics (gender, unit type, age, education) collected and whether patients experienced either less than three, or more than or equal to three barriers. Where required, patient characteristics were dichotomized (age: </≥ 80 years old; education: less than high school vs. at least graduated high school). The study 2 sample had a greater proportion of females than males who experienced three or more barriers (51.0% vs. 28.2%; $X^2 = 4.735$, p = 0.03). Those with less than a high school education in study 2 were also more likely to have experienced three or more barriers than those with at least a high school education (58.3% vs. 34.8%; $X^2 = 4.010$, p = 0.045). However, differences by patient characteristics were not found in the study 1 sample. Therefore, more study samples would need to demonstrate similar results before any conclusions could be drawn about associations between gender or education and the number or type of barriers experienced, especially as there is no intuitive reason as to why such associations would occur. These results are displayed in **Table 18**. There were no differences in mean number of barriers experienced amongst any of the demographic characteristics.

The proportions of patients from study 1 that experienced each FI barrier listed on the MAT are displayed in **Table 19**, along with the proportion of patients that experienced each barrier at each hospital site. The most common barriers experienced in study 1 included: food intake/hydration not monitored at the meal (71.3%); patient not visited by staff mid-meal for a check (54.3%); not offered snacks in between meals (52.9%); food did not look or smell appetizing (24.4%); and food not served hot (16.9%). Qualitatively, some barriers (e.g. items 4, 10, 13) occurred at similar rates across hospital sites, while other barriers (e.g. items 15, 16) appear to be more common at specific hospitals. Despite being the most

common barrier identified in study 1, "food intake/hydration not monitored at the meal" was removed for version 2 of the MAT because it was considered more of a nutrition care activity and would not be considered a FI barrier if it was not completed. The most common barriers experienced in study 2 (average proportion between the two raters; displayed in **Table 20**) were: patient not offered help with meal (70.4%); not visited by staff mid-meal for a check (57.9%); meal did not come at an appropriate time for the patient (26.7%); meal did not look and smell appetizing (20.0%); and not being offered help to use the washroom before the mealtime (14.7%).

A major discrepancy was noted between version 1 and version 2 of the MAT for item 9. On version 1, item 9 is phrased: "If required, assistance with eating/drinking was offered", while on version 2 it was phrased: "Were you offered any help with your meal?" The proportion of participants who indicated this was a barrier in study 1 was 0.8% (**Table 19)**, while in study 2 the proportion that indicated it was a barrier (averaged between both raters) was 70.4% (**Table 20**). The difference in reported proportions between the two versions is likely due to differences in interpretation of the questions caused by the differences in wording. Item 9 was revised after study 1 as the auditors identified that the question was double-barrelled, in that the auditor had to establish that 1) help was required, and 2) that help was offered. Thus, in version 2 the qualifier "If required" was removed from the item. However, the increased prevalence reported on version 2 suggests that the wording may not have been specific enough to those **who required assistance** with their meal; it is likely that a number of participants who did not *require* help still answered 'no' when asked "Were you *offered* any help with your meal?". Not being offered help when it wasn't needed would not represent a barrier, thus the appropriate response in that situation would have been 'n/a'. Additionally, absolute agreement between auditors for item 9 was < 80% (the only item to be this low) (**Table 20**) and thus revision was deemed necessary for the published version. Final revisions, including item 9 are noted below.

5.4.3 Inter-rater Reliability

Revisions to the MAT after study 1 resulted in version 2 of the tool, which was tested for inter-rater reliability in study 2. The ICC for total MAT score between the two raters was 0.68 (95% CI = 0.52-0.79), indicating good agreement. **Table 20** shows the kappa correlation coefficients for each barrier item – with responses dichotomized by combining "yes" and "N/A" responses – as well as the proportion of agreement in responses between raters. The third column displays what the ICC for total MAT score would be for each barrier with a low kappa (< .70) if that barrier was removed. Most individual items (10 of 16 in which kappa could be calculated) had good to excellent agreement. The mean number of questions with exact agreement between the two raters for each patient was 15.66 +/- 1.70 out of 18. The median and mode number of matches between raters for each patient was 16 and 17 barriers, respectively, with values ranging from 12 matches to 18 matches per patient. The negative kappa for items 3 and 17 were likely a result of the minimal variance in responses, as noted by the 93.2% and 92.2% agreement between auditors for these items, respectively. Similarly, kappa for items 7 and 14 could not be determined due to absolute agreement in responses between raters. When items with moderate to low kappas were removed from the total MAT score count, none of the re-calculated ICCs were statistically different from the original ICC of .68, according to an F-test.

5.4.4 Revisions Made to MAT

Based on the reliability analysis, item 18 ("Were you undisturbed at the meal?") was considered for removal from version 2 due to having the lowest kappa. However, as it contained a unique and common[34,71] barrier, it was retained in the final version. After completion of version 2 testing, the researchers met to review in detail with the auditors how to further improve the MAT. Despite the good reliability and improvements from version 1, it was determined version 2 could be further improved.

On page one, questions were added to provide a better description of the meal timing (e.g. when the food cart arrived, when trays distributed to patients). On page two, a section was added at the top of

the page asking for patients' perspectives on the importance that they place on food and fluid intake as well as the importance that they felt staff placed on their food and fluid intake, rated on scales out of ten. Also on page two, potentially double-barrelled barrier items from version 2 were divided into two-part questions. In relation to the issue with item 9 described above, it was noted that items 10 and 11 were only relevant if item 9 indicated that the patient needed help, so these questions were amalgamated to read: a) "Are you able to eat your meal without help?", and b) "If staff helped you, did you get help when you wanted it? *N/A if no help provided by staff*". Specifying that this was help "to eat your meal" should remove the potential vagueness of this item and the confusion with how to respond if help was not required that may have occurred with version 2. Item 8 ("Were you able to reach your meal tray?") was revised to include a component on opening packages and was changed to read: a) "Were you able to reach your tray?", and b) "Were you able to open your food packages OR did you get help to open packages?"). Item 18 was changed from "Were you undisturbed at the meal?" into two separate items in an effort to better distinguish between types of disturbances experienced by a patient. The published version now includes: "Were you able to eat your meal without interruptions (e.g. doctor, nurse, physical therapist visiting)?" and "Was your meal free from noise, cleaning or other disturbances?". The final (published) version of the MAT is 17 questions; the tool (**Appendix I**) along with a guidance document (**Appendix J**) for clinicians and hospital staff can be found at: www.nutritioncareincanada.ca/resources.

5.5 Discussion

5.5.1 MAT as a Feasible Tool for Change in Nutrition Care

This report has shown that the Mealtime Audit Tool, an assessment of FI barriers experienced, has sufficient reliability. The estimated ICC of 0.68 is a good measure of inter-rater reliability while the 95% CI of 0.52-0.79 falls in the range of fair to excellent.[88] Revisions to the MAT using feedback from auditors in the two studies have made the tool more user friendly and ensured that relevant barriers were

included in the final version. This is the first study that determined the inter-rater reliability of a tool designed to measure FI barriers in hospital patients. Naithani et al.[34] developed a similar patient experience questionnaire measure of food access issues that demonstrated content and criterion validity, as well as internal consistency between responses from patients in different wards. Inter-rater reliability was not measured for this questionnaire, however. Naithani's questionnaire is different from the MAT in that it was designed for research and has been used to characterize barriers experienced throughout the hospital stay[71], as opposed to a single mealtime. It has many more items than MAT and includes items that are not specifically barriers to eating a meal, such as hunger (e.g. "My visitors bring in food for me because I am hungry"). While feeling hungry may represent a food access issue, visitors bringing in preferred foods for patients can actually be a strategy to ensure that patients are getting enough to eat.[35] Naithani's questionnaire was also based on the overall patient meal experience throughout their stay as opposed to one specific mealtime, which could increase the risk of recall bias[93] in patient responses.

The MAT was designed for clinical practice and is a tool that can be used to support a change in nutrition care. It can be used as a monitoring tool for nutritionally at-risk patients to identify barriers and challenges they may have with mealtimes. The aim of identifying barriers would be to then ensure that these barriers are removed to maximize patients' potential for sufficient FI. This could include removing physical barriers, like staff helping patients with positioning or with opening packages. Or if organizational barriers (e.g. incorrect food items being delivered, food not served hot, patients disturbed, etc.) are commonly identified in a number of patients, this can signal to staff and hospital management that something may need to be changed within their food service practices. Used in conjunction with the care processes described in INPAC[35], routine identification of barriers with the MAT can be a way to audit these changes in practice and ensure that nutrition care is being improved by identifying and removing barriers to intake within hospital units.[71]

5.5.2 Prevalence of Mealtime Barriers in Hospital Patients

There has been limited research focused on identifying the prevalence of mealtime barriers to food intake until recently.[33,34,63-71] The barriers listed on the MAT were selected based on common barriers identified in previous research. Descriptive analyses of barriers experienced in this report add to the knowledge base of the prevalence and existence of these barriers. This report is more specific to elderly patients than other studies have been, as the entire study 1 sample was over 65 years of age and three-quarters of the study 2 sample was older than 60 (**Table 16**). Some barriers were common across all study 1 sites as well as in study 2. A common issue observed across all sites was that meals did not look or smell appetizing. Mealtime disturbances also occurred across all sites. Disturbances from excessive noise or smells, visits from staff or physicians, or being taken away for medical testing during a meal can result in an unpleasant eating environment and potentially prevent the patient from eating if, for example their food gets cold due to an interruption or they miss their meal completely.[33]

More than half of the participants in both samples were not checked on by staff mid-meal. Not checking on patients mid-meal is not a direct barrier to intake, as it would not directly cause decreased FI. However, checking on patients is a nutrition care activity that could ensure that patients have what they need to be able to eat sufficiently at each meal, whether that involves physical assistance or a request for other foods. Having staff members check on patients ensures that they are focused on the mealtime and the assistance offered could improve FI[37,78], which helps promote the importance of a "food-aware" culture among hospital staff.[37]

The descriptive analyses highlighted that the prevalence of FI barriers can vary by hospital and that the MAT can identify these differences. In study 1, there were barriers that were reported in differing proportions between the four sites (**Table 19**). For example, half of the Site 4 participants reported that their food wasn't served hot while no one reported this at Site 3, and one in ten participants reported it in study 2 (also at Site 3). Thus, the MAT can identify that the existence of barriers can vary between units

within the same hospital as well. Hospital units differed in terms of size, staffing, resources, specializations, patient demographics, etc., and likely differed in the quality of nutrition care provided. Quality of nutrition care and of the food itself has a direct influence on FI.[47] Information on the existing mealtime practices within the participating hospitals was not collected. These hospitals were approached to participate, and likely agreed to participate, because they are centres that already have a heightened interest in nutrition care. It is possible that these hospitals already had better mealtime practices in place than other hospitals, thus it is possible that the prevalence of barriers observed across these sites was lower than in the general hospital patient population.

Even if hospital management commits to implementing quality nutrition care policies, such as INPAC[35], there is no guarantee that a standard of care will be met throughout all units within a hospital. This is why a tool like the MAT would be useful for unit staff to routinely audit their mealtime practices, using the patient feedback to identify where their nutrition care is specifically lacking and make improvements.

5.5.3 Strengths and Limitations

As previously mentioned, this is the first study that described a clinical measure of FI barriers at a single mealtime that showed reliability between raters. Samples were of sufficient size and diversity; statistically significant differences in patient characteristics for the study 2 sample demonstrate the sufficiency of the sample. However, further samples would need to demonstrate these significant differences in barriers experienced between demographic characteristics before conclusions can be drawn. The relatively tight 95% CI for ICC provides confidence in the estimate of reliability calculated. As well, a research team that involved clinicians and users of the tool were involved in developing, revising and finalizing the tool, promoting a tool that has clinical utility. However, it is acknowledged that there were some potential limitations to this work.

The order in which the dietetic interns audited each participant in study 2 was not recorded, although they were instructed to vary their order. It would have been prudent to record rater order to rule out any effect that responding first or second may have had on total MAT score. The time at which each interview was completed was also not recorded. The MAT required auditors to record: the time the auditor arrived on the unit, time the meal truck arrived, and the times tray distribution started and ended. The time of the interview was not an essential piece of information for the MAT itself, but for inter-rater reliability, the time between assessments should have been clearly defined in the study protocol.[84] If time between interviews was too long this could have caused recall issues from participants forgetting the details of their mealtime experience. However, this would have resulted in reduced measures of reliability. Due to the high level of concordance between auditors for most items (14/18 items have > 90% agreement between auditors; **Table 20**), this limitation likely did not negatively influence results. Going through the questions a second time may have also caused some participants to over-analyze their mealtime experience and identify barriers they might not have the first time. This is another effect that could have been controlled for by recording the order of audits. It is assumed that measures of reliability would have been improved if these limitations were controlled for.

The hospital site (Site 3) in which the inter-rater reliability testing was conducted is also likely a higher centre of nutrition care than most hospitals. The dietitian site investigator (HM) has a heightened interest in nutrition care and nutrition research. This hospital site takes on a number of dietetic interns and has a number of diet techs on staff within their hospital units, and therefore may have a higher capacity for nutrition care than most. This may have caused an increased reliability of the MAT if the auditors in this study were more careful in their completion of the MAT than would occur in other hospital sites. However, there was no difference in barriers experienced in Site 3 compared to the other three hospital sites in Study 1, so it is assumed that the level of nutrition care provided in Site 3 was not sufficiently different from what was provided across the other sites to influence these results.

5.5.4 Next Steps

Building upon this initial reliability testing, it would be worthwhile to conduct further inter-rater reliability testing on the final revised version of the MAT using the methodological improvements suggested above across a wider range of hospital sites. However, after two rounds of revisions to the tool, the wording on the published version of the MAT is similar to the tested version 2, aside from the splitting of double-barrelled questions described above in "Revisions Made to MAT". As the overall inter-rater reliability measures in this study were deemed sufficient, it is still recommended that hospitals adopt the MAT into their care practices if they choose.

However, it is recognized that adopting new tools or procedures into existing care practices can be quite challenging. The next step after developing and testing clinical tools is to implement them into practice. The More-2-Eat (M2E) study is currently underway across five Canadian hospitals and aims to implement INPAC into their nutrition care practices. Within M2E, the finalized version of the MAT will be used in a detailed data collection on a subset of patients. The study will aim to identify barriers and facilitators to the successful implementation of all components of INPAC, including the monitoring of FI barriers with the MAT. M2E will help evaluate how the MAT can be implemented into routine care practices providing insight on specifics of process, such as what staff are best suited to conduct MAT audits, the amount of training necessary, how to identify patients that need an assessment of barriers, and determining the follow-up processes that should occur when FI barriers are identified.

5.6 Conclusions

This study demonstrates that the MAT is reliable when used by auditors with minimal training. Use of the MAT in two study samples has led to revisions being made to improve the tool. The MAT is a novel measure of FI barriers, which are not regularly or systematically monitored in most hospital units today. Descriptive analyses demonstrated the prevalence of mealtime barriers that are likely to affect FI and how prevalence can vary across hospitals. The differences in types of barriers observed across hospitals

supports the idea that the occurrence of barriers can be contextual in nature potentially due to the variability in patient populations and quality of nutrition care provided from hospital to hospital. Therefore an audit tool such as the MAT may be useful for hospitals to be able to identify which barriers do exist in their units, providing them with tangible evidence on where they can improve care. As FI is essential to recovery and impacts length of stay[6], it is relevant to assess and remove barriers at the individual, unit and hospital level in order to give patients the best opportunity to consume the foods they're provided. The MAT has sufficient inter-rater reliability for clinical use and has the potential to play a role in monitoring, changing and improving nutrition care. However the next step, currently underway with the M2E study, is to determine whether the MAT can be implemented effectively into clinical practice.

5.7 Data Tables

Table 15 - *Participant Hospital Characteristics*

Hospital Site	Province	Hospital Type	Approximate # of Beds	Anglophone/Francophone
1	British Columbia	Community	285	Anglophone
2	Saskatchewan	Academic	650	Anglophone
3*	**Ontario**	**Community**	**600**	**Anglophone**
4	Quebec	Academic	1200	Francophone

***inter-rater reliability (Study 2) site**

Table 16 - *Patient Demographics for Study 1 and 2*

Characteristic	% (n) Descriptive Analysis (Study 1) (n=120)	% (n) Inter-rater Reliability (Study 2) (n=90)
Gender		
Male	43.3% (52)	43.3% (39)
Female	56.7% (68)	56.7% (51)
Age		
Mean +/- sd*	78.4 +/- 8.4	67.6 +/- 14.3
< 60 years	0	26.7% (24)
60-69 years	20.0% (24)	27.7% (25)
70-79 years	32.5% (39)	24.5% (22)
80-89 years	35.8% (43)	17.8% (16)
90-99 years	11.7% (14)	3.3% (3)
Highest Level of Education Achieved		
Primary school or less	10.8% (13)	11.1% (10)
Some high school	26.7% (32)	15.6% (14)
Graduated high school	28.3% (34)	25.6% (23)
Some post-secondary/graduated post-secondary	34.2% (41)	45.6% (41)
Other (trade school or foreign education)	0	2.2% (2)
Living Situation		
Lives alone	41.7% (50)	N/A
Lives with spouse	40.0% (48)	
Lives with other family/friends	13.3% (16)	
Lives with spouse and other family	2.5% (3)	
Long term residence	2.5% (3)	
Unit Type*		
Medical wards	78.3% (94)	46.7% (42)
Surgical wards	21.7% (26)	53.3% (48)
Reason for Admission		
Orthopedic	22.5 (27)	40.0 (36)
Respiratory	12.5 (15)	4.4 (4)
Falls/weakness/dizziness	12.5 (15)	4.4 (4)
Cancer	10.0 (12)	2.2 (2)
Cardiovascular	6.7 (8)	5.6 (5)
Gastrointestinal	6.7 (8)	10.0 (9)
Wound/Infection	5.8 (7)	4.4 (4)
General surgery	3.3 (4)	8.9 (8)
Stroke	1.7 (2)	8.9 (8)
Other	17.5 (21)	11.1 (10)
Missing	0.8 (1)	0

***denotes significant difference between study 1 and study 2 samples at p<0.05**

Table 17 - *Descriptive analysis for barriers experienced by patients across hospital sites and studies*

Sample	Hospital Site/Rater	Mean	Standard Deviation	Minimum	Maximum
Descriptive Analysis (Study 1)	1	2.87	0.97	1	6
	2	2.37	1.92	0	8
	3	2.79	1.78	0	7
	4	3.70	1.21	2	6
Inter-rater Reliability (Study 2)	Rater 1	2.87	1.50	0	6
	Rater 2	2.16	1.22	0	7

Table 18 - *Comparison of number of barriers experienced by selected patient characteristics*

Characteristic	% (n)			
	Study 1		Study 2	
	< 3 barriers	≥ 3 barriers	< 3 barriers	≥ 3 barriers
Gender				
Female	39.7 (27)	60.3 (41)	49.0 (25)	51.0 (26)
Male	37.3 (19)	62.7 (32)	71.8 (28)*	28.2 (11)*
Age				
< 80 years	34.9 (22)	65.1 (41)	59.2 (42)	40.8 (29)
≥ 80 years	42.9 (24)	57.1 (32)	57.9 (11)	42.1 (8)
Highest level of education				
Less than high school	36.4 (16)	63.6 (28)	41.7 (10)	58.3 (14)
Graduated high school or higher education	40.0 (30)	60.0 (45)	65.2 (43)**	34.8 (23)**
Unit Type				
Medical	40.2 (37)	59.8 (55)	57.1 (24)	42.9 (18)
Surgical	34.6 (9)	65.4 (17)	60.4 (29)	39.6 (19)

***p = 0.03; **p = 0.045**

Table 19 - *Proportion of each food intake barrier experienced in study 1 (MAT Version 1)*

Barrier	Overall Sample % Experienced (n)	Site 1 % (n)	Site 2 % (n)	Site 3 % (n)	Site 4 % (n)
1. Patient did not receive the food they ordered (n=118)	6.8 (8)	0	13.3 (4)	6.9 (2)	6.7 (2)
2. Patient did not receive sufficient information to make an informed choice (n=115)	7.0 (8)	3.4 (1)	3.6 (1)	14.3 (4)	6.7 (2)
3. Food was not served hot (n=118)	16.9 (20)	6.7 (2)	10.0 (3)	0	51.7 (15)
4. Meal tray did not look and smell appetizing (n=119)	24.4 (29)	26.7 (8)	33.3 (10)	27.6 (8)	10.0 (3)
5. Patient not positioned comfortably/did not have all needed personal effects to eat/drink (n=119)	4.2 (5)	0	3.3 (1)	13.8 (4)	0
6. Help was not provided for positioning/getting ready (if needed) (n=119)	2.5 (3)	0	3.3 (1)	6.9 (2)	0
7. Tray was not accessible at bedside (n=119)	5.0 (6)	0	3.3 (1)	13.8 (4)	3.3 (1)
8. Tray was not set up for patient (i.e. packages opened) or offered (n=119)	11.8 (14)	0	13.3 (4)	20.7 (6)	13.3 (4)
9. Assistance with eating/drinking was not offered (if required) (n=119)	0.8 (1)	0	3.3 (1)	0	0
10. Patient was disturbed during mealtime (n=118)	14.2 (17)	10.0 (3)	10.0 (3)	21.4 (6)	16.7 (5)
11. Requests for replacement/additional foods were not met (n=115)	2.6 (3)	3.4 (1)	3.4 (1)	3.4 (1)	0
12. Patient did not have sufficient time to eat (n=119)	0	0	0	0	0
13. Patient not visited by staff mid-meal for a check (n=117)	54.3 (63)	36.7 (11)	62.1 (18)	62.1 (18)	55.2 (16)
14. Staff did not offer alternatives if meal tray was untouched (n=112)	12.5 (14)	3.4 (1)	8.3 (2)	10.3 (3)	26.7 (8)
15. Food intake/hydration was not monitored at this meal (n=108)	71.3 (77)	100 (30)	40.0 (10)	56.5 (13)	80.0 (24)
16. Patient was not offered snacks in between meals today (n=119)	52.9 (63)	96.7 (29)	30.0 (9)	24.1 (7)	60.0 (18)
17. Patient was not offered pain or symptom control (if needed) (n=118)	8.5 (10)	0	3.4 (1)	6.9 (2)	23.3 (7)
18. Patient was not offered constipation management (if needed) (n=118)	7.6 (9)	0	0	10.3 (3)	20.0 (6)

Table 20 - *Proportion experiencing mealtime barriers and reliability testing for study 2 (MAT Version 2) (n=90)*

Barrier[a]	Average % Experiencing Barrier	Kappa Coefficient (% Overall Agreement between Auditors)	ICC with item removed
1. Did the meal come at an appropriate time for you?	26.7	.830[b] (93.3%)	
2. Did you get the food that you ordered?	8.9	.863[b] (97.8%)	
3. Did you request any other food/drink items during this meal, and if so did you get them? (n=88)	3.4	-.019 (93.2%)	.653
4. Did your meal look and smell appetizing?	20.0	.723[b] (91.1%)	
5. Were hot foods served hot? (n=89)	9.5	.805[b] (96.6%)	
6. Did you need help being positioned comfortable prior to eating; and if so was help provided? (n=89)	3.9	.554[b] (96.6%)	.629
7. Did you have everything you needed in order to eat/drink such as your glasses, dentures, etc.?	0	n/a[c] (100%)	.630
8. Were you able to reach your meal tray?	12.8	.552[b] (90.0%)	.615
9. Were you offered any help with your meal? (n=89)	70.4	.460[b] (77.5%)	.687
10. If you needed help with your meal was it provided?	3.4	.321[b] (95.6%)	.640
11. If you needed help, did you receive this quickly?	3.9	.272[b] (94.4%)	.657
12. Did you have enough time to eat your meal?	1.7	.662[b] (98.9%)	.635
13. Were you visited by staff mid meal to check on you? (n=88)	57.9	.674[b] (84.1%)	.622
14. (If tray is untouched): Did staff offer you any other food to eat?	0	n/a[c] (100%)	.630
15. Are you suffering from constipation and if so have you been offered anything to manage it? (n=89)	4.5	.478[b] (95.5%)	.605

16. Were you offered help to use the washroom before mealtime? (n=87)	14.7	.322[b] (81.6%)	.631
17. Are you experiencing any symptoms like pain or nausea and if so have you been offered anything to manage it?	3.9	-.019 (92.2%)	.647
18. Were you undisturbed at the meal?	7.8	.257[b] (88.9%)	.636

[a]n=90 unless otherwise stated; [b]statistically significant at p < 0.001; [c]kappa could not be calculated as there was no variability in responses (Both raters responded "yes" or "N/A" for all patients)

Chapter 6
Discussion

The research conducted for the purposes of this thesis has demonstrated that two novel clinical tools – the My Meal Intake Tool (M-MIT) for the monitoring of food intake (FI), and the Mealtime Audit Tool (MAT) for the assessment of FI barriers in acute care patients – have met statistically acceptable criteria for their use in clinical practice. Forty-five percent of patients are admitted to hospital in Canada already malnourished[6] while nutrition status tends to decline further while hospitalized. A major determinant in nutritional status of patients is FI, and many patients do not consume enough to meet their daily needs, leading to further declines in nutritional status. Current nutrition care practices do not do enough to rectify the issue of malnutrition, nor is the high prevalence and significance of the problem recognized in the hospital. The Integrated Nutrition Pathway for Acute Care (INPAC) (**Appendix A**) was recently developed as a standard of care, based on evidence and expert consensus, that aims to provide patients with best practice nutrition care if implemented.[35] During INPAC's development, needs were identified for new clinical tools: 1) a patient self-completed FI monitoring tool, and 2) an assessment tool for FI barriers. Similar existing tools (e.g. nutritionDAY™ food intake questionnaire, Naithani et al.'s barrier questionnaire[34]) were deemed to be insufficient in meeting what was required within INPAC so new tools had to be developed, resulting in the creation of the M-MIT and MAT. The studies within this thesis completed key steps in the development of health measurement tools[82] by revising both tools for appropriateness and functionality, establishing criterion validity for the M-MIT, and determining inter-rater reliability of the MAT.

6.1 M-MIT and MAT – Implications for Practice

6.1.1 My Meal Intake Tool within the Integrated Nutrition Pathway for Acute Care (INPAC)

Within INPAC it is recommended[35] that patients have their nutrition risk screened at admission using the Canadian Nutrition Screening Tool (CNST)[96], and if deemed at risk, have their nutritional status assessed using the Subjective Global Assessment (SGA)[97]. After these initial steps, it is recommended that FI is monitored to be used as the primary driver in determining changes in nutrition care.[35] Patients who are screened and/or assessed with 'no risk' on admission would receive "Level A: Standard Nutrition Care" and are recommended to have their FI monitored twice per week. Patients who are mild/moderately malnourished on admission would receive "Level B: Advanced Nutrition Care" and are recommended to have their intake monitored once per day.[35] Patients who are severely malnourished on admission would receive "Level C: Specialized Nutrition Care", which involves a comprehensive nutrition assessment conducted by a dietitian resulting in an individualized plan for treatment and monitoring.[35] The development and initial validation testing of M-MIT allows for this routine monitoring to be possible for those patients that are able to complete the tool themselves or have someone else that can complete it for them. Low intake (i.e. < 50% of food provided) as reported on the M-MIT is the recommended indicator for increasing a patient's level of nutrition care as per INPAC. Patients receiving Level A care would be upgraded to Level B care if they reported low intake on one of their twice-weekly M-MIT observations. Patients receiving Level B care who report low intake for three consecutive days of monitoring would be upgraded to Level C, at which point they would receive the comprehensive assessment and individualized care plan.[35] INPAC recommends that patients reporting low fluid intake may require interventions to prevent dehydration.[98]

There are several issues to consider and further research to be conducted regarding how to fully integrate M-MIT into use with INPAC. Specifically, process evaluation research should be conducted, which is "used to monitor and document program implementation and can aid in understanding the

relationship between specific program elements and program outcomes" (p.134)[99] and helps understand why a newly implemented practice was successful or not[99]. Process evaluation with M-MIT integrated into clinical practice would help determine: ideal FI cut points to use for determining next steps in nutrition care; the feasibility of M-MIT with patients that can complete the tool themselves vs. patients who need someone else to complete it for them; how well the M-MIT works within the care processes outlined in INPAC; as well as how to deal with incorrectly completed or incomplete forms.

6.1.1.1 Determining ideal cut point for "low intake"

Though 50% intake is the suggested cut-off value for "low intake" in INPAC, healthcare staff judgement should also be used, recognizing that these tools are a guide. Fifty percent is recommended as the minimum cut-off because consumption of less than half of the food provided has been identified as being associated with a longer LOS.[6] However subjective judgments can be used to determine next steps based on the appetite and challenges questions and the patient comment box on the second page of M-MIT, in combination with the patient`s FI estimation. For example, if a well-nourished (Level A) patient noted that they ate less than usual for one meal because they had family visiting and didn't finish their meal, this would not necessarily warrant an increase in care. Additionally depending on the context, cut-off values other than 50% *could* be used to drive changes in nutrition care. In patient populations where FI is seen as especially important or in hospitals with more resources available for nutrition care, a higher cut-off value (i.e. 75%) could be used, which would increase the sensitivity of the tool[92], identifying a greater proportion patients who may be at risk due to low intake. Thus, using the higher cut point would identify a greater proportion of at risk patients but also increase the number of false positives identified (decreased specificity)[92]. This would likely require an increased use of resources as a greater proportion of patients would be receiving higher level (Level B or C) care.

However, 50% is recommended as the minimum cut point due to its association with LOS. Thus, an even lower cut-off value of < 25% would not be a recommended practice due to the inverse

relationship between sensitivity and specificity[92]. The lower the cut point used, the lower sensitivity will be, which would result in a lower proportion of patients consuming <25% actually being correctly identified as such (i.e. more false negatives). Using a lower cut-off would cause a number of patients consuming <50% of their meal who could benefit from nutritional intervention to be missed, and could result in patients staying hospitalized longer. If hospitals do not have the resource capacity to provide the necessary care using the 50% cut-off, an alternative option would be to keep the patient at the same care level longer before an increase in care (e.g. only moving Level A patient to Level B if *both* weekly meal observations are <50%, instead of just one, etc.). However it is suggested that the practices recommended in INPAC are adhered to if possible as they are based on best practices noted in the existing literature as well as consensus reached amongst an expert panel of researchers and clinicians from dietetics, medicine and nursing, including management and frontline personnel.[35] Ultimately it would be up to individual hospital management and staff to take all contextual information into account and decide on what cut point to use and the next steps to take after identifying low intake.

6.1.1.2 Determining how well M-MIT works within INPAC

Process evaluation is required to ascertain how M-MIT works within INPAC's care practices and determine how it can be successfully implemented within those nutrition care practices. For example, INPAC recommends that patients receiving Level A care should have their FI monitored preferably at three and seven days admission, and twice per week thereafter.[35] Process evaluation could determine what proportion of Level A patients actually stay to three and seven days. If most of these low risk patients have a shorter LOS on average, the recommendations given by INPAC may need to be revised. INPAC also recommends that patients receiving Level B care have their FI monitored at least once per day.[35] Process evaluation would identify the burden of daily completion of M-MIT for these patients and whether this recommendation would be feasible. Other process issues could be detailed out with process evaluation as well, such as determining who is best suited to distributing and collecting M-MIT forms,

determining how M-MIT results will be flagged for follow up, and determining the training and education needed for M-MIT to be implemented effectively.

6.1.1.3 How to deal with proxy-completed M-MIT forms

Further testing is required to determine what proportion of patients can complete M-MIT themselves compared to those who need help from a proxy to complete it, and to determine the feasibility of having other people help with completion. Several patient groups may require assistance with M-MIT completion, including those with altered mental status, literacy or language issues (M-MIT is currently only available in English and French), or those who are too physically ill, weak, or in pain to fill out the form. It would be worthwhile to validate proxy-completed M-MIT forms similarly to the validation study conducted for this thesis (against trained dietitian FI estimations). Proxy completion would also allow testing for inter-rater reliability between proxies. Validation and reliability testing would provide an idea of the usefulness of proxy completion of the M-MIT. A variety of people could act as proxies for M-MIT completion, including patients' family members, hospital volunteers, personal service workers, nursing staff, food service workers, etc. Similar to the decision of what cut-off value to use, the decision on who would act as a proxy would likely be context-specific depending on hospital resource capacity. Process evaluation in clinical settings would help determine who would be best suited to fulfill this role.

6.1.1.4 How to deal with incomplete M-MIT forms

Finally, process evaluation with the M-MIT would be useful in determining how to deal with incomplete or incorrectly completed forms. Approximately 20% of M-MIT forms in the criterion validation study were either incomplete or incorrectly completed with a number of common errors observed. In practice, processes would need to be outlined as to how to deal with such forms. Staff could remind patients to complete forms or alternatively, proxies could help with completion or totally complete the tool based on their estimation of the tray. If a patient only completes the first page of M-MIT (i.e. no reasons for low

intake on page two provided), it is recommended that the next steps for low intake are to be followed as outlined in INPAC. Another common error observed was that some patients checked multiple boxes for the proportion of food consumed. Again, process evaluation would help determine what course of action would make the most sense in that situation. A subsequent meal would likely have to be monitored to make up for the incorrectly monitored meal, and likely with the help of someone else (e.g. staff, family, etc.) to make sure it is filled out properly.

6.1.2 Mealtime Audit Tool within the Integrated Nutrition Pathway for Acute Care (INPAC)

Barriers to FI are acknowledged at all three levels of nutrition care (Level A/B/C) within INPAC. In Level A, staff are encouraged to ensure that basic physical barriers are removed (i.e. tray within reach, open packages, assist with eating, etc. if needed). In Level B, assessment of further barriers such as pain is recommended in order to address and remove these issues. In Level C care, more in-depth assessment of potential barriers (i.e. swallowing assessment, medication side effects, depression, etc.) is recommended.[35] The MAT is likely most useful for Level A and B patients as a trained health professional with specific expertise in nutrition is not expected to be involved with these patients.

6.1.2.1 How the MAT can be used in practice

The MAT can be used for multiple purposes: 1) to establish a baseline on mealtime barriers that patients may experience; 2) to identify differences between units, or within a unit, when nutrition changes occur during the implementation of the INPAC care processes in order to track progress; 3) to identify priorities for change and where improvements in care need to be made; or 4) to educate staff on the needs, barriers and perspectives of their patients.[100] Frequency of MAT use would thus be dependent upon the purpose of the audit.

If baseline barrier information is established, the MAT could be used as a routine audit tool on random samples of units or patients within a unit. Over time, randomly selecting patients with diverse

characteristics would provide hospital staff with information on the type of patients that are more likely to experience more barriers or certain specific barriers. Or, specific patient groups (e.g. frail older adults, stroke patients, cancer patients, etc.) could be targeted to identify their most common FI barriers. Consistency in the meal or time of day audited would correct for differences in nutrition care provided during different shifts. For example, it would not be practical to compare the results of day shift audits to those from night shifts.

For hospitals that choose to implement INPAC into their care practices, routine auditing of mealtimes with the MAT could act as a way to identify specific patient barriers and track improvements in nutrition care once INPAC is implemented. It has been established that routine auditing is an effective method in improving clinical practices[81]. Thus, regular use of the MAT may have the potential to be an effective tool in tracking improvements to nutrition care through reductions in the number of barriers observed. If some barriers are commonly observed, this would highlight to hospital staff and management where improvements in care could be made.

Finally, the results of MAT audits could be used to educate staff on the needs and barriers experienced by patients. Awareness of staff on the existence and impact of barriers to intake may be low. If patients don't let staff know about certain issues they are having during mealtimes, then these issues will never be identified and resolved. The MAT is a potential means for this type of communication to occur. For example, MAT results within a hospital could be disseminated during staff training sessions to emphasize where care is lacking using tangible data. Increasing awareness is a key first step in initiating improvements in nutrition care.[37]

6.1.2.2 Process evaluation with the MAT

As with the M-MIT, now that inter-rater reliability of the MAT has been established, process evaluation research would be a key next step in determining the usefulness of the tool. Process evaluation would help establish whether the MAT is feasible in clinical practice and whether the tool is useful to improving

nutrition care in practice (i.e. whether routine use is possible and leads to changes in care). This research would also establish how to best integrate the MAT into practice, in terms of identifying who will conduct the audits, what to do with audit results, and how those results will be used to prompt improvements in care.

Regarding staff roles, any hospital staff member could be minimally trained to be a MAT auditor. A guidance document (**Appendix J**) for clinicians for the MAT's use has been created (www.nutritioncareincanada.ca/resources) and a brief training session going over the points covered in this document is all that would be needed to sufficiently equip someone to use the MAT. Nursing staff or volunteers could be trained to complete the MAT, but dietary staff (e.g. food service supervisors or diet technicians) may be especially appropriate as they could more readily address the food service or nutrition care issues that the MAT would uncover.[100] As with the M-MIT, context would have significant influence on deciding the best person for such a role, as well as on deciding who should compile the MAT results and how those results will be used to improve care.

6.2 Implementing Changes in Nutrition Care Practices

6.2.1 Value of M-MIT and MAT Outside of INPAC

The M-MIT and MAT are valuable components within INPAC, however they are still valuable tools that could improve the quality of nutrition care even if not used within INPAC. Similar tools have been used for clinical research (i.e. nutritionDAY™ and Naithani's questionnaire), however the studies within this thesis are the first to show statistical evidence of the suitability of such tools in clinical practice.

The M-MIT allows for a more standardized method of monitoring FI that has been validated against trained dietitian estimations. Implementing M-MIT into nutrition care practices, for those patients that are able to complete it, would allow more patients to be monitored and likely result in more accurate estimations than current monitoring methods that are either inaccurate or not done at all[31,32]. Hospital staff

could use the data collected by the M-MIT to help determine which patients need a dietetic referral. This tool, alongside screening (e.g. CNST) and assessment tools (e.g. SGA), assists in providing another standardized method leading to dietetic referral. Standardizing the referral process would result in more efficient identification of patients at nutrition risk than the generally ad hoc processes that currently exist[73].

Monitoring of FI barriers on hospital units is currently not common practice. The MAT provides hospitals with a simple questionnaire assessment requiring minimal skill to complete that would allow selected patients to have their mealtime challenges identified and action taken to address those challenges. The MAT would be a useful tool for hospitals that are serious about improving their food provision practices. Documentation of barrier data would provide hospital management and staff with tangible evidence of the barriers that exist, who could then take steps to ensure that the barriers are reduced as much as possible.

6.2.2 Improving Nutrition Care Requires a Multidisciplinary Approach

Development of new tools and providing evidence for their use are important for improving nutrition care, yet they are only small components in a much larger process. Though statistical evidence of the M-MIT and MAT have been established in a clinical experimental setting, their true impact can only be measured by implementing them into existing clinical care practices and determining their effectiveness[101] in contributing to improved patient outcomes. Changing care processes in hospital, even making small changes, can be incredibly complex. Normalization process theory (NPT)[101] describes factors that promote or inhibit new interventions from being implemented and sustained in everyday practice. According to NPT, four main factors play a role in normalizing practice. *Coherence* means that participants understand the purpose and value the benefits of the new intervention. *Cognitive participation* occurs if participants think an intervention is a good idea and are willing to invest their time and energy into changing the practice. *Collective action* refers to the amount of work that needs to be

done in order to change practice (e.g. how it affects workloads, amount of staff training necessary, etc.). Finally, *reflexive monitoring* refers to how participants perceive the change in practice once it has been in place for an extended period of time (e.g. is it being perceived as advantageous and can the change in practice be improved upon now that it is in place?).[101]

Therefore before changes can be made, an increase in awareness of the importance of FI, the significance of barriers to intake, and the significance of malnutrition itself (i.e. coherence[101]), needs to occur.[37] Some work has been done in this area, particularly through the Nutrition Care in Canadian Hospitals (NCCH) study. In one component of the NCCH, nurses who were surveyed generally under-estimated the prevalence of malnutrition.[102] In another component of the same study, physicians surveyed felt that current nutrition care practices did not match up with what they thought should be optimal practice and that nutrition-related resources were lacking in hospital units.[103]

Increasing awareness at all levels (management, staff, and patients and their families) would promote a culture change in the importance placed on nutrition by all.[37,104] It needs to recognize that current practices in detecting, monitoring, and treating malnutrition are not up to par, and everyone should be involved from the organizational level through to hospital staff, as well as patients and their families.[37] The causes of malnutrition are multifactorial and thus require a multidisciplinary solution.[37] Dietitians are a specialized resource, and although they are a key component in changing nutrition culture, they are only one component in making this change[102]. Staff roles around nutrition care need to be clearly defined with sufficient training provided, and patients need to be educated on the role that their nutrition can play in their successful recovery.[37] There is currently a disconnect in communication between the different disciplines[37] that needs to be diminished for palpable changes to be made. For example, for the M-MIT to be successfully implemented it would likely fall on front-line staff (i.e. nursing, food services) to collect completed forms and systems would need to be put in place to have that FI information passed on to dietetics staff. Likewise for the MAT, barrier information collected by staff who completed the audits

would need to be communicated back to front-line staff in order for the barriers to be addressed. For novel tools like the M-MIT and MAT or for care processes like INPAC to make a difference, hospitals at the organizational level need to be made aware[37] that there is a problem and be willing to implement change, with everyone involved in making that change.

6.3 Next Steps

The M-MIT and MAT were created as tools to support the recommended nutrition care practices outlined in INPAC.[35] By validating the M-MIT and establishing inter-rater reliability of the MAT, this research has provided a rationale to support their use. It would be worthwhile to re-test the revised versions of the tools for reliability and validity, as well as within specific hospital patient populations to ascertain whether certain populations (i.e. 80+ years old, specific medical condition populations, etc.) have more trouble with the tools' completion. However, based on the results of this thesis the M-MIT and MAT can be recommended for clinical use due to the lack of similar existing tools that could help standardize processes that are currently either ad hoc or non-existent. The Canadian Malnutrition Task Force has endorsed their use independently and within INPAC and are available for clinicians to download at "www.nutritioncareincanada.ca/resources".

Changing care practices and implementing new practices are significant and complex steps that involve translating knowledge from research into action. Clinical research often results in novel recommendations or tools to improve practice, yet organizations often fall short of effectively implementing this knowledge.[105,106] Currently, the More-2-Eat (M2E) study is underway across five Canadian hospitals that aims to implement INPAC in these institutions, detailing the challenges and needs that hospitals will have with changing their care processes. The study is a developmental evaluation, and the five sites are encouraged to use a series of iterative Plan-Do-Study-Act (PDSA) cycles[107] to implement the care processes. An INPAC implementation toolkit will be created, which will encompass all materials (e.g. educational materials, training programs, posters, slide decks, etc.), tips, strategies, and

case examples that will help facilitate the implementation of INPAC for any other hospitals that choose to do so. The M-MIT and MAT will be included in the implementation study, specifically for detailed data collections on subsets of patients, and will be included in the toolkit. Sites are encouraged to incorporate M-MIT and MAT across all unit patients as they continue to roll out INPAC steps and activities. Several components of the process evaluation steps that were recommended for the M-MIT and MAT will take place within the M2E study. M2E will uncover if and how the tools can best be used in practice, and identify barriers and facilitators to integrating these tools into routine care practices. This thesis has shown the tools to be sufficiently valid (M-MIT) and reliable (MAT) for clinical use, and the M2E study will determine what is needed to successfully integrate them into clinical practice.

6.4 Concluding Remarks

The research presented in this thesis has completed key steps in the development of new clinical tools – My Meal Intake Tool and the Mealtime Audit Tool. These tools provide hospitals with the potential to improve their nutrition care with their use. The next step after developing and testing tools is to determine how to implement them into practice, a step which is currently underway with the M2E study. While these tools can only play a minor role in improving such a complex issue as hospital malnutrition, their inclusion in standardized care frameworks such as INPAC, have the potential to make a major impact. Awareness and attitudes towards hospital malnutrition are hurdles that need to be overcome, but once a more "food aware" culture[37] becomes commonplace, the M-MIT and MAT may have the ability to play a role in improving nutrition care.

Bibliography

[1]Watterson C, Fraser A, Banks M, Isenring E, Miller M, Silvester C, Hoevenaars R, Bauer J, Vivanti A & Ferguson M (2009). Evidence based practice guidelines for the nutritional management of malnutrition in adult patients across the continuum of care. *Journal of the Dietitians Association of Australia*, 66(S3), S1-S34.

[2]Morley JE (1998). Protein-energy malnutrition in older subjects. *Proceedings of the Nutrition Society*, 57, 587-592.

[3]Mudge AM, Ross LJ, Young AM, Isenring EA & Banks, MD (2011). Helping understand nutritional gaps in the elderly (HUNGER): A prospective study of patient factors associated with inadequate nutritional intake in older medical inpatients. *Clinical Nutrition*, 30, 320-325.

[4]Cederholm T, Boaseus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, Muscaritoli M, Nyulasi I, Ockenga J, Schneider SM, de van der Schueren MAE & Singer P (2015). Diagnostic criteria for malnutrition – An ESPEN Consensus Statement. *Clinical Nutrition*, 34, 335-340.

[5]White JV, Guenter P, Jensen G, Malone A, Schofield M, the Academy Malnutrition Work Group, the A.S.P.E.N. Malnutrition Task Force & the A.S.P.E.N. Board of Directors (2012). Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: Characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). *Journal of Parenteral and Enteral Nutrition*, 36(3), 275-283.

[6]Allard J, Keller H, Jeejeebhoy K, Laporte M, Duerksen D, Gramlich L, Payette H, Bernier P, Vesnaver E, Davidson B, Teterina A & Lou W (2015). Malnutrition at hospital admission – Contributors and effect on length of stay: A prospective cohort study from the Canadian Malnutrition Task Force. *Journal of Parenteral and Enteral Nutrition*, doi: 10.1177/0148607114567902.

[7]Guigoz Y (2006). The Mini Nutritional Assessment (MNA) review of the literature – What does it tell us? *Journal of Nutrition Health and Aging*, 10(6), 466-485.

[8]Pirlich M, Schutz T, Norman K, Gastell S, Lubke HJ, Bischoff SC, Bolder U, Frieling T, Guldenzoph H, Hahn K, Jauch KW, Schindler K, Stein J, Volkert D, Weimann A, Werner H, Wolf C, Zurcher G, Bauer P & Lochs H (2006). The German hospital malnutrition study. *Clinical Nutrition*, 25(4), 563-572.

[9]Banks M, Ash S, Bauer J & Gaskill D (2007). Prevalence of malnutrition in adults in Queensland public hospitals and residential aged care facilities. *Nutrition & Dietetics*, 64(3), 172-178.

[10]Kondrup J & Sorensen JM (2009). The magnitude of the problem of malnutrition in Europe. *Nestle Nutrition Workshop Series Clinical & Performance Program*, 12, 1-14.

[11]Waitzberg DL, Caiaffa WT & Correia MI (2001). Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. *Nutrition*, 17(7-8), 573-580.

[12]Aghdassi E, McArthur M, Liu B, McGeer A, Simor A & Allard JP (2007). Dietary intake of elderly living in Toronto long-term care facilities: comparison to the dietary reference intake. R*ejuvenation Research*, 10(3), 301-309.

[13]Singh H, Watt K, Veitch R, Cantor M & Duerksen DR (2006). Malnutrition is prevalent in hospitalized medical patients: are housestaff identifying the malnourished patient? *Nutrition*, 22(4), 350-354.

[14]Villalon L, Laporte M & Carrier N (2011). Nutrition screening for seniors in health care facilities: a survey of health professionals. *Canadian Journal of Dietetic Practice and Research*, 72(4), 162-169.

[15]Rojer AGM, Kruizenga HM, Trappenburg MC, Reijnierse EM, Sipila S, Narici MV, Hogrel JY, Butler-Browne G, McPhee JS, Paasuke M, Meskers CGM, Maier AB & de van der Schueren MAE (2015). The prevalence of malnutrition according to the new ESPEN definition in four diverse populations. *Clinical Nutrition*, http://dx.doi.org/10.1016/j.clnu.2015.06.005

[16]Tannen A & Lohrmann C (2013). Malnutrition in Austrian hospital patients. Prevalence, risk factors, nursing interventions, and quality indicators: a descriptive multicentre study. *Journal of Advanced Nursing*, 69(8), 1840-1849.

[17]Isabel M, Correia MI & Waitzberg DL (2003). The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clinical Nutrition*, 22(3), 235-239.

[18]Corish CA & Kennedy NP (2000). Protein-energy undernutrition in hospital in-patients. *British Journal of Nutrition*, 83, 575-591.

[19]Agarwal E, Miller M, Yaxley A & Isenring E (2013). Malnutrition in the elderly: A narrative review. *Maturitas*, 76, 296-302.

[20]Ray S, Laur C & Golubic R (2014). Malnutrition in healthcare institutions: A review of the prevalence of under-nutrition in hospitals and care homes since 1994 in England. *Clinical Nutrition*, 33, 829-835.

[21]Agarwal E, Ferguson M, Banks M, Batterham M, Bauer J, Capra S & Isenring E (2013). Malnutrition and poor food intake are associated with prolonged hospital stay, frequent readmission, and greater

in-hospital mortality: Results from the Nutrition Care Day Survey 2010. *Clinical Nutrition*, 32, 737-745.

[22]Lim SL, Ong KCB, Chan YK, Loke WC, Ferguson M & Daniels L (2012). Malnutrition and its impact on cost of hospitalization, length of stay, readmission and 3-year mortality. *Clinical Nutrition*, 31, 345-350.

[23]Ahmed T & Haboubi N (2010). Assessment and management of nutrition in older people and its importance to health. *Clinical Interventions in Aging*, 5, 207-216.

[24]Hiesmayr M, Schindler K, Pernicka E, Schuh C, Schoeniger-Hekele A, Bauer P, Laviano A, Lovell AD, Mouhieddine M, Schuetz T, Schneider SM, Singer P, Pichard C, Howard P, Jonkers C, Grecu I, Ljungqvist O & The NutritionDay Audit Team (2009). Decreased food intake is a risk factor for mortality in hospitalized patients: The NutritionDay survey 2006. *Clinical Nutrition*, 28, 484-491.

[25]Dupertuis YM, Kossovsky MP, Kyle UG, Raguso CA, Genton L & Pichard C (2003). Food intake in 1707 hospitalised patients: a prospective comprehensive hospital survey. *Clinical Nutrition*, 22(2), 115-123.

[26]Schindler K, Pernicka E, Laviano A, Howard P, Schutz T, Bauer P, Grecu I, Jonkers C, Kondrup J, Ljungqvist O, Mouhieddine M, Pichard C, Singer P, Schneider S, Schuh C, Hiesmayr M & The NutritionDay Audit Team. How nutritional risk is assessed and managed in European hospitals: A survey of 21,007 patients findings from the 2007-2008 cross-sectional nutritionDay survey. *Clinical Nutrition*, 29, 552-559.

[27]Lainscak M, Farkas J, Frantal S, Singer P, Bauer P, Hiesmayr M & Schindler K (2014). Self-rated health, nutritional intake and mortality in adult hospitalized patients. *European Journal of Clinical Investigation*, 44(9), 813-824.

[28]Kondrup J, Allison SP, Elia M, Vellas B & Plauth M (2003). ESPEN Guidelines for Nutrition Screening 2002. *Clinical Nutrition*, 22(4), 415-421.

[29]Rasmussen HH, Kondrup J, Staun M, Ladefoged K, Lindorff K, Jorgenson LM, Jakobsen J, Kristensen H & Wengler A (2006). A method for implementation of nutritional therapy in hospital. *Clinical Nutrition*, 25, 515-523.

[30]Keller H, Allard JP, Laporte M, Davidson B, Payette H, Bernier P, Jeejeebhoy K, Duerksen DR & Gramlich L (2015). Predictors of dietitian consult on medical and surgical wards. *Clinical Nutrition*, 34, 1141-1145.

[31]Palmer M, Miller K & Noble S (2015). The accuracy of food intake charts completed by nursing staff as part of usual care when no additional training in completing intake tools is provided. *Clinical Nutrition*, 34(4), 761-766.

[32]Malone A & Hamilton C (2013). The Academy of Nutrition and Dietetics/The American Society for Parenteral and Enteral Nutrition consensus malnutrition characteristics: application in practice. *Nutrition in Clinical Practice*, 28(6), 639-650.

[33]Naithani S, Whelan K, Thomas J, Gulliford MC & Morgan M (2008). Hospital inpatients' experiences of access to food: a qualitative interview and observational study. *Health Expectations*, 11, 294-303.

[34]Naithani S, Thomas JE, Whelan K, Morgan M & Gulliford MC (2009). Experiences of food access in hospital. A new questionnaire measure. *Clinical Nutrition*, 28, 625-630.

[35]Keller HH, McCullough J, Davidson B, Vesnaver E, Laporte M, Gramlich L, Allard J, Bernier P, Duerksen D & Jeejeebhoy K (2015). The Integrated Nutrition Pathway for Acute Care (INPAC): Building consensus with a modified Delphi. *BMC Nutrition Journal*, doi: 10.1186/s12937-015-0051-y.

[36]Cheung G, Pizzola L & Keller H (2013). Dietary, food service, and mealtime interventions to promote food intake in acute care adult patients. *Journal of Nutrition in Gerontology and Geriatrics*, 32(3), 175-212.

[37]Laur C, McCullough J, Davidson B & Keller H (2015). Becoming food aware in hospital: A narrative review to advance the culture of nutrition care in hospitals. *Healthcare*, 3, 397-407.

[38]What is malnutrition? (no date). Canadian Malnutrition Task Force website. Accessed from http://nutritioncareincanada.ca/malnutrition/what-is-malnutrition/

[39]McKinlay AW (2008). Malnutrition: the spectre at the feast. *Journal of the Royal College of Physicians of Edinburgh*, 38, 317-21.

[40]Curtis L, Keller H, Allard J, Bernier P, Jeejeebhoy K, Laporte M, Gramlich L, Duerksen D & Payette H (Unpublished, 2015). The costs of malnutrition in acute care: A report of the Canadian Malnutrition Task Force. University of Waterloo.

[41]Hickson, M. (2006). Malnutrition and ageing. *Postgraduate Medical Journal*, 82, 2-8.

[42]Fortin M, Lapointe L, Hudon C & Vanasse A (2005). Multimorbidity is common to family practice: is it commonly researched? *Canadian Family Physician*, 51, 244–245.

[43]Fortin M, Bravo G, Hudon C, Vanasse A & Lapointe L (2005). Prevalence of multimorbidity among adults seen in family practice. *Annals of Family Medicine*, 3, 223–228.

[44]Evans WJ, Morley JE, Argiles J, Bales C, Baracos V, Guttridge D, Jatoi A, Kalantar-Zadeh K, Lochs H, Mantovani G, Marks D, Mitch WE, Muscaritoli M, Najand A, Ponikowski P, Rossi Fanelli F, Schambelan M, Schols A, Schuster M, Thomas D, Wolfe R & Anker SD (2008). Cachexia: A new definition. *Clinical Nutrition*, 27, 793-799.

[45]Thomas DR (2007). Loss of skeletal muscle mass in aging: Examining the relationship of starvation, sarcopenia and cachexia. *Clinical Nutrition*, 26, 389-399.

[46]Cruz-Jentoft AJ, Landi F, Schneider SM, Zuniga C, Arai H, Boirie Y, Chen LK, Fielding RA, Martin FC, Michel JP, Sieber C, Stout JR, Studenski SA, Vellas B, Woo J, Zamboni M & Cederholm T (2014). Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). *Age and Ageing*, 43, 748-759

[47]Allard JP, Keller H, Teterina A, Jeejeebhoy KN, Laporte M, Duerksen DR, Gramlich L, Payette H, Beriner P, Davidson B & Lou W (2015). Factors associated with nutritional decline in hospitalised medical and surgical patients admitted for 7 d or more: a prospective cohort study. *British Journal of Nutrition*, 114, 1612-1622.

[48]Jeejeebhoy KN, Keller H, Gramlich L, Allard JP, Laporte M, Duerksen DR, Payette H, Bernier P, Vesnaver E, Davidson B, Teterina A & Lou W (2015). Nutritional assessment: comparison of clinical assessment and objective variables for the prediction of length of hospital stay and readmission. *American Journal of Clinical Nutrition*, 101, 956-965.

[49]Thibault R, Chikhi M, Clerc A, Darmon P, Chopard P, Genton L, Kossovsky MP & Pichard C (2011). Assessment of food intake in hospitalized patients: A 10-year comparative study of a prospective hospital survey. *Clinical Nutrition*, 30, 289-296.

[50]Ismael S, Savalle M, Trivin C, Gillaizeau F, D'Auzac C & Faisy C (2014). The consequences of sudden fluid shifts on body composition in critically ill patients. *Critical Care*, 18, R49.

[51]Hanks AS, Wansink B & Just DR (2014). Reliability and accuracy of real-time visualization techniques for measuring school cafeteria tray waste: Validating the Quarter-Waste Method. *Journal of the Academy of Nutrition and Dietetics*, 114(3), 470-474.

[52]Parent M, Niezgoda H, Keller HH, Chambers LW & Daly S (2012). Comparison of visual estimation methods for regular and modified textures: real-time vs digital imaging. *Journal of the Academy of Nutrition and Dietetics*, 112(10), 1636-1641.

[53]Williamson DA, Allen HR, Martin PD, Alfonso AJ, Gerald B & Hunt A (2003). Comparison of digital photography to weighed and visual estimation of portion sizes. *Journal of the American Dietetic Association*, 103, 1139-1145.

[54]Dhingra P, Sazawal S, Menon VP, Dhingra U & Black RE (2007). Validation of visual estimation of portion size consumed as a method for estimating food intake by young Indian children. *Journal of Health, Population, and Nutrition*, 25(1), 112-115.

[55]Berrut G, Favreau, AM, Dizo E, Tharreau B, Poupin C, Gueringuili M, Fressinaud P & Ritz P (2002). Estimation of calorie and protein intake in age patients: validation of a method based on meal portions consumed. *Journal of Gerontology: Medical Sciences*, 57A(1), M52-M56.

[56]Zeman FJ (1991). *Clinical Nutrition and Dietetics – Second Edition.* Macmillan Publishing Company, New York, p. 74-76.

[57]Streiner DL & Norman GR (1995). *Health Measurement Scales – A Practical Guide to their Development and Use*. Oxford Medical Publications, Oxford University Press Inc., New York, p. 58-59, 147-150.

[58]Rufenacht U, Ruhlin M, Wegmann M, Imoberdorf R & Ballmer PE (2010). Nutritional counseling improves quality of life and nutrient intake in hospitalized undernourished patients. *Nutrition*, 26, 53-60.

[59]Starke J, Schneider H, Alteheld B, Stehle P & Meier R (2011). Short-term individual nutritional care as part of routine clinical setting improves outcome and quality of life in malnourished medical patients. *Clinical Nutrition*, 30, 194-201.

[60]Feldblum I, German L, Castel H, Harman-Boehm I & Shahar DR (2011). Individualized nutritional intervention during and after hospitalization: The Nutrition Intervention Study clinical trial. *Journal of the American Geriatrics Society*, 59, 10-17.

[61]Smith PE & Smith AE (1997). High-quality nutritional interventions reduce costs. *Healthcare Financial Management*, 51(8), 66-69.

[62]Johansen N, Kondrup J, Plum LM, Bak L, Norregaard P, Bunch E, Baernthsen H, Andersen JR, Larsen IH & Martinsen A (2004). Effect of nutritional support on clinical outcome in patients at nutritional risk. *Clinical Nutrition*, 23, 539-550.

[63]Dickinson A, Welch C, Ager L & Costar A (2005). Hospital mealtimes: action research for change? *Proceedings of the Nutrition Society*, 64, 269–275.

[64]Bell J, Bauer J, Capra S & Puile CR (2013). Barriers to nutritional intake in patients with acute hip fracture: time to treat malnutrition as a disease and food as a medicine? *Canadian Journal of Physiology and Pharmacology*, 91, 489–495.

[65]Johns N, Hartwell H & Morgan M (2010). Improving the provision of meals in hospital. The patients' viewpoint. *Appetite*, 54, 181–185.

[66]Jessri M, Mirmiran P, Jessri M, Johns M, Rashidkhani B, Amiri P, Barfmal N & Azizi F (2011). A qualitative difference. Patients' views of hospital food service in Iran. *Appetite*, 57, 530–533.

[67]Hartwell HJ, Shepherd PA & Edwards JSA (2013). Effects of a hospital ward eating environment on patients' mealtime experience: a pilot study. *Nutrition and Dietetics*, 70, 332–338.

[68]Dickinson A, Welch C & Ager L (2008). No longer hungry in hospital: improving the hospital mealtime experience for older people through action research. *Journal of Clinical Nursing*, 17, 1492–1502.

[69]Davidson A & Scholefield H (2005). Protecting mealtimes. Journal of *Nursing Management*, 12, 32–36.

[70]Naithani S, Whelan K, Thomas JE & Gulliford MC (2010). Multiple morbidity is associated with increased problems of food access in hospital: a cross-sectional survey utilising the Cumulative Illness Rating Scale. *Journal of Human Nutrition and Dietetics*, 23, 575-582.

[71]Keller H, Allard J, Vesnaver E, Laporte M, Gramlich, L, Bernier P, Davidson B, Duerksen D, Jeejeebhoy K & Payette H (2015). Barriers to food intake in acute care hospitals: a report of the Canadian Malnutrition Task Force. *Journal of Human Nutrition and Dietetics*, doi:10.1111/jhn.12314.

[72]Diaz AV & Garcia AC (2013). Evaluation of factors affecting plate waste of inpatients in different healthcare settings. *Nutricion Hospitalaria*, 28(2), 419-427.

[73]Keller HH, Vesnaver E, Davidson B, Allard J, Laporte M, Bernier P, Payette H, Jeejeebhoy K, Duerksen D & Gramlich L (2014). Providing quality nutrition care in acute care hospitals: perspectives of nutrition care personnel. *Journal of Human Nutrition and Dietetics*, 27, 192-202.

[74]Hickson M, Connolly A & Whelan K (2011). Impact of protected mealtime on ward mealtime environment, patient experience, and nutrient intake in hospitalized patients. *Journal of Human Nutrition and Dietetics*, 24, 370-374.

[75]Stuckey CM, Bakewell LE & Ford GM (2010). The effect of a protected mealtime policy on the energy intake and frequency of non-urgent interruptions during mealtimes at the Royal Bournemouth Hospital. *Proceedings of the Nutrition Society*, 69(OCE7), E526.

[76]Weekes CE (2008). The effect of protected mealtimes on meal interruptions, feeding assistance, energy and protein intake and plate waste. *Proceedings of the Nutrition Society*, 67(OCE), E119.

[77]Hickson M, Bulpitt C, Nunes M, Peters R, Cooke J, Nicholl C & Frost G (2004). Does additional feeding support provided by health care assistants improve nutritional status and outcome in acutely ill older in-patients? – a randomised control trial. *Clinical Nutrition*, 23, 69-77.

[78]Young AM, Mudge AM, Banks MD, Ross LJ & Daniels L (2013). Encouraging, assisting, and time to EAT: Improved nutritional intake for older medical patients receiving Protected Mealtimes and/or additional nursing feeding assistance. *Clinical Nutrition*, 32, 543-549.

[79]Bell JJ, Bauer JD, Capra S & Pulle RC (2014). Multidisciplinary, multi-modal nutritional care in acute hip fracture patients – Results of a pragmatic intervention. *Clinical Nutrition*, 33(6), 1101-7.

[80]Bell J, Bauer J, Capra S & Pulle RC (2013). Multi-Disciplinary Action Research Improves Nutrition Outcomes in Hip Fracture. *ESPEN Congress: Leipzig, Germany*, 2013.

[81]Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA & Oxman AD (2006). Audit and feedback: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews 2006*, Issue 2, doi: 10.1002/14651858.CD000259.pub2.

[82]Keller HH, Hedley MR & Wong Brownlee S (2000). The development of Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN). *Canadian Journal of Dietetic Practice and Research*, 61(2), 67-72.

[83]Jones JM (2004). Development of a nutrition screening or assessment tool using a multivariate technique. *Nutrition*, 20, 298-306.

[84]Jones JM (2004). Reliability of nutrition screening and assessment tools. *Nutrition*, 20, 307-311.

[85]Jones JM (2004). Validity of nutrition screening and assessment tools. *Nutrition*, 20, 312-317.

[86]Hulley SB, Cummings SR, Browner WS, Grady DG & Newman TB (2013). *Designing Clinical Research – Fourth Edition*. Lippincott Williams & Wilkins, Philadelphia, p. 39, 79, 81.

.[87]Carmines EG & Zeller RA (1979). *Reliability and Validity Assessment*. Sage Publications, Newbury Park, California, p. 11.

[88]Cicchetti DV & Sparrow SS (1981). Developing criteria for establishing the interrater reliability of specific items in a given inventory. *American Journal of Mental Deficiency*, 86, 127-137.

[89]Donker DK, Hasman A & van Geijn HP (1993). Interpretation of low kappa values. *International Journal of Bio-Medical Computing*, 33, 55-64.

[90]Young AM, Kidston S, Banks MD, Mudge AM & Isenring EA (2013). Malnutrition screening tools: Comparison against two validated nutrition assessment methods in older medical inpatients. *Nutrition*, 29, 101-106.

[91]van Bokhorst-de van der Schueren MAE, Roosemalen MM, Weijs PJM & Langius JAE (2012). High waste contributes to low food intake in hospitalized patients. *Nutrition in Clinical Practice*, 27(2), 274-280

[92]Haijan-Tilaki K (2013). Receiver Operating Characteristic (ROC) curve analysis for medical diagnostic test evaluation. *Caspian Journal of Internal Medicine*, 4(2), 627-635.

[93]Delgado-Rodriguez M & Llorca J (2004). Bias. *Journal of Epidemiology and Community Health*, 58, 635-641

[94]Canadian Institute for Health Information. Defining High Users in Acute Care: An Examination of Different Approaches. Ottawa, ON: CIHI; 2015.

[95]Shrout PE & Fleiss JL (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin*, 86(2), 420-428.

[96]Laporte M, Keller HH, Payette H, Allard J, Duerksen DR, Bernier P, Jeejeebhoy K, Gramlich L, Davidson B, Vesnaver E & Teterina A (2015). Validity and reliability of the new Canadian Nutrition Screening Tool in the "real-world" hospital setting. *European Journal of Clinicals Nutrition*, 69(5), 558-64.

[97]Detsky AS, Baker JP, Johnston N, Whittaker S, Mendelson RA & Jeejeebhoy KN (1987). What is subjective global assessment of nutritional status? *Journal of Parenteral and Enteralal Nutrition*, 11(1), 8–13.

[98]Keller HH & The INPAC Team (2015). My Meal Intake Tool: Guidance Document. Available at <www.nutritioncareincanada.ca/resources>.

[99]Saunders RP, Evans MH & Joshi P (2005). Developing a process-evaluation plan for assessing health promotion program implementation: A how-to guide. *Health Promotion Practice*, 6(2), 134-147.

[100]Keller HH & The INPAC Team (2015). Mealtime Audit Tool: Guidance Document. Available at <www.nutritioncareincanada.ca/resources>.

[101]Murray E, Treweek S, Pope C, MacFarlane A, Ballini L, Dowrick C, Finch T, Kennedy A, Mair F, O`Donnell C, Ong BN, Rapley T, Roger A & May C (2010). Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. *BMC Medicine*, 8, 63.

[102]Duerksen DR, Keller HH, Vesnaver E, Laporte M, Jeejeebhoy K, Payette H, Gramlich L, Bernier P & Allard JP (2016). Nurses' perceptions regarding the prevalence, detection, and causes of malnutrition in Canadian hospitals: results of a Canadian Malnutrition Task Force Survey. *Journal of Parenteral and Enteral Nutrition*, 40(1), 100-106.

[103]Duerksen DR, Keller HH, Vesnaver E, Allard JP, Bernier P, Gramlich L, Payette H, Laporte M & Jeejeebhoy K (2015). Physicians' perceptions regarding the detection and management of malnutrition in Canadian hospitals. *Journal of Parenteral and Enteral Nutrition*, 39(4), 410-417.

[104]Tappenden, K.A., Quatrara, B., Parkhurst, M.L., Malone, A.M., Fanjiang, G., Ziegler, T.R. (2013). Critical role of nutrition in improving quality of care: An interdisciplinary call to action to address adult hospital malnutrition. *J Parenter Enteral Nutr.* 37:482–497.

[105]Michie S, Johnston M, Abraham C, Lawton R, Parker D, & Walker A (2005). Making psychological theory useful for implementing evidence based practice: a consensus approach. *Quality & Safety in Health Care*, 14, 26-33.

[106]Grimshaw JM, Eccles MP, Lavis JN, Hill SJ & Squires JE (2012). Knowledge translation of research findings. *Implementation Science*, 7, 50-66.

[107]Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D & Reed JE (2014). Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Quality and Safety*, 23(4), 290-298.

Appendix A
The Integrated Nutrition Pathway for Acute Care

INPAC: INTEGRATED NUTRITION PATHWAY FOR ACUTE CARE

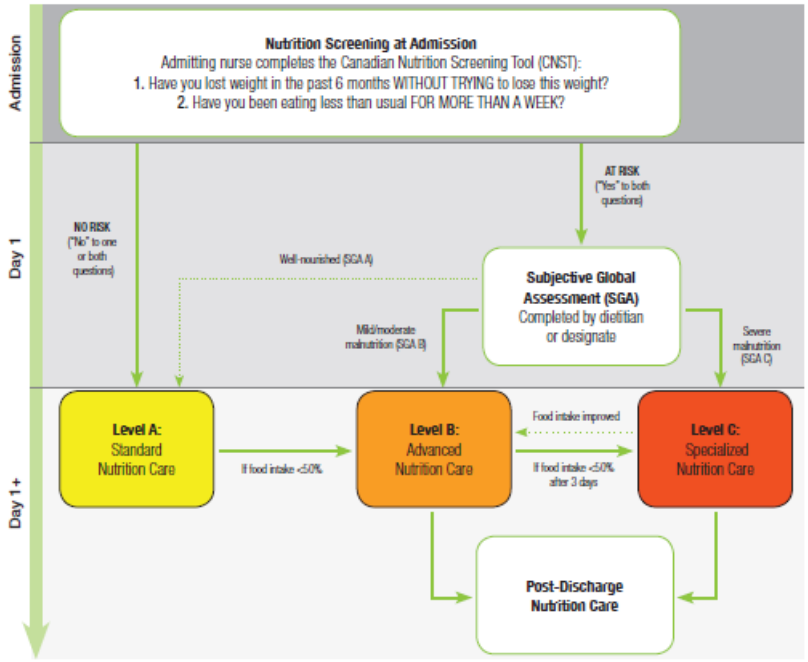
What is INPAC?

An easy-to-use algorithm to **detect, monitor** and **treat malnutrition** in **acute care patients**, this evidence-based pathway is the result of a consensus from leading Canadian researchers and clinicians.

INPAC is based on the **key principle** that **an integrated approach** – or involvement from the whole health care team – is **required** to treat malnutrition. INPAC is a **minimum standard**; institutions that provide care beyond this minimum should continue to practice at their higher quality standard.

It is recommended that each hospital establish an interdisciplinary team to promote the nutrition culture change required to implement INPAC.

INPAC: Designed to support nutrition health and care



See reverse for further detail…

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition

HOW DOES INPAC WORK?

INPAC involves nutrition **screening** – followed by a **subjective global assessment** in individuals deemed AT RISK – to **categorize patients** according to the **level of nutrition care** that they require; Level A: **Standard**, Level B: **Advanced**, Level C: **Specialized**.

Nutrition Screening at Admission

If patient answers "Yes" to both Canadian Nutrition Screening Tool (CNST) questions listed on reverse side **OR** if any of the following apply to the patient:

- Requires enteral/parenteral nutrition
- Unable to complete CNST (e.g., language barrier, altered mental status)
- Transferred from critical care
- Has high nutrition risk conditions (e.g., trauma, burns, pressure ulcers, SIRS, etc.)

...then follow "**AT RISK**" pathway (on reverse).
If none of the above apply, then follow "**NO RISK**" pathway.

SIRS=systemic inflammatory response syndrome.

Subjective Global Assessment (SGA)

SGA is the gold standard for diagnosing malnutrition in hospitals. Trained professionals assess food intake (and related symptoms), functional status and body composition; the assessment takes approximately 10 minutes.

Level A: Standard Nutrition Care

- Sit patient in chair or position upright in bed
- Ensure vision and dentition needs are addressed
- Address nausea, pain, constipation, diarrhea
- Confirm food is available at all times
- Monitor and report:
  - Food intake twice per week
  - Duration of NPO/clear fluid intake
  - Hydration status
  - Weekly weights
- Ensure bedside table is cleared for tray set-up, open packages, provide assistance to eat
- Monitor for signs of dysphagia
- Encourage family to bring preferred foods from home

NPO=nil per os (nothing by mouth).

Level B: Advanced Nutrition Care

Continue **Standard Nutrition Care** practices **AND**

- Assess and address other barriers to food intake
- Monitor food intake at least 1 meal/day
- Promote intake with 1 or more of:
  - Nutrient dense diet (high in energy, protein, micronutrients)
  - Liberalized diet
  - Preferred foods
  - High energy/protein shakes/drinks
  - Snacks available between meals

Level C: Specialized Nutrition Care

Continue **Standard & Advanced Nutrition Care** strategies where appropriate. Patient will undergo a comprehensive nutrition assessment completed by the dietitian, which involves:

- More detailed assessment of nutrition status using physical examination, anthropometry, dietary, clinical and biochemical markers
- Further identification of barriers to food intake (e.g., swallowing ability, medication side effects, depression, etc.)
- Identification of eating behaviours that will support food intake
- Individualized treatment and monitoring

Post-Discharge Nutrition Care

If patient is malnourished (SGA B or C) upon admission or during hospitalization, nutrition is flagged as an active issue in the discharge summary note (completed by dietitian, physician or nurse)

- Education provided to patient and family
- Transfer of care recommendations for patient's health care providers including dietitian referral if nutrition rehabilitation is ongoing

Quality nutrition care and patient safety with INPAC

This research was funded by TVN (Technology Evaluation in the Elderly Network).
Production of this resource is made possible with an unrestricted educational grant from our Visionary Partner, Abbott Nutrition.

ENS/tvn/Abb – September, 2015

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition

Appendix B

My Meal Intake Tool – Tested Version

Your Food Intake

Good nutrition is important for your recovery. This form helps us understand how you are eating.

Please complete this form after you have finished this meal. If you need assistance with this form, let us know.

Study ID:_____ Date:_____ ☐Breakfast ☐Lunch ☐Supper

My hospital diet is: _____

What & how much did you drink (all fluids including supplements)?

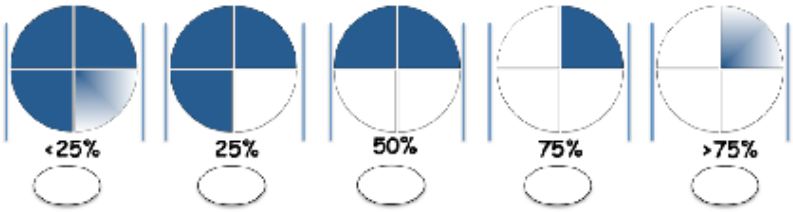
Please list all drinks on your tray. Place an "X" in the oval indicating how much you consumed.

	<25%	25%	50%	75%	>75%
Example: Milk			X		

How much of all other food on your tray did you eat?

Please insert an X

X



Please consider all items on the tray when judging amount consumed.
(main dish, side dishes, soup, bread, dessert)

How was your appetite at this meal?

☐ Very Good/Good ☐ Fair/Poor

Why was your appetite less than usual?

- ☐ I was not interested in eating
- ☐ I had nausea/vomiting
- ☐ I was tired
- ☐ I had pain
- ☐ I ate outside foods and was not hungry
- ☐ Other:

Did you have other challenges at this meal?

- ☐ I did not like the food
- ☐ I needed assistance to eat my meal
- ☐ I have problems chewing/swallowing
- ☐ I was not allowed to eat
- ☐ I did not get what I had ordered (if selective menu)
- ☐ The environment was not appetizing
- ☐ Other: _____

Any other comments to share with us?

Appendix C

M-MIT & MAT Feasibility Studies – Ethics Approval

UNIVERSITY OF WATERLOO

OFFICE OF RESEARCH ETHICS

Notification of Ethics Clearance of Application to Conduct Research with Human Participants

---

Principal/Co-Investigator: Heather Keller **Department:** Kinesiology

Student Investigator: James McCullough **Department:** Kinesiology

ORE File #: 19890

Project Title: Nutrition Care Pathway for Hospitalized Older adults: content validation and feasibility testing

---

This certificate provides confirmation the above project has been reviewed in accordance with the University of Waterloo's Guidelines for Research with Human Participants and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans. This project has received ethics clearance through a University of Waterloo Research Ethics Committee.

***Note 1**: This ethics clearance is valid for one year from the date shown on the certificate and is renewable annually. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105).*

***Note 2**: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through a University of Waterloo Research Ethics Committee and must not begin until notification has been received by the investigators.*

***Note 3**: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.*

***Note 4**: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106. Any unanticipated or unintentional changes which may impact the research protocol must be reported within seven days of the deviation to the ORE using ORE form 107.*

Maureen Nummelin, PhD
Chief Ethics Officer

OR
Julie Joza, MPH
Senior Manager, Research Ethics

OR
Sacha Geer, PhD
Manager, Research Ethics

May 26/14
Date

Appendix D

My Meal Intake Tool – Published Version

MY MEAL INTAKE

Patient Name: _____

Room #: _____

Date: _____

This form helps us understand how you are eating. Please complete this form after you have finished **this meal**. If you need help, let us know.

1. List all drinks on your tray; this includes juice, tea/coffee, milk, drink supplements, etc.
2. Place an 'X' in the circle to indicate how much you consumed of each beverage
3. For the food on your tray, place an 'X' in the circle to indicate how much you ate overall; this includes the main dish, side dishes, soup, bread, dessert
4. List any food or beverages you are saving to eat at a later time
5. **Turn the page over** and answer the remaining questions

What meal is this? ❑ Breakfast ❑ Lunch ❑ Supper

What and how much did you drink?	0% I drank none	25%	50%	75%	100% I drank all
Example: Milk	○	○	X	○	○
	○	○	○	○	○
	○	○	○	○	○
	○	○	○	○	○
	○	○	○	○	○

How much of all the food on your tray did you eat?	0% I ate none	25%	50%	75%	100% I ate all
	○	○	○	○	○

Please list any items (food or beverages) being saved for later: _____

_____

Please turn over ➔

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition

How was your appetite at this meal?

❑ Very good/Good

❑ Less than usual

Why was your appetite less than usual?

❑ I was not interested in eating

❑ I had nausea/vomiting

❑ I was tired

❑ I had pain

❑ I ate other foods and was not hungry

❑ No specific reason

❑ Other: _____

_____

_____

Did you have any challenges at this meal?

❑ I needed help to sit up to eat

❑ I needed help opening food packages

❑ I needed help to eat and/or drink

❑ I did not like the food

❑ I had problems chewing/swallowing

❑ I was not allowed to eat because I am having a test today

❑ I did not get what I had ordered (if selective menu)

❑ The environment was not appetizing

❑ Other: _____

_____

❑ I had no challenges

Other comments to share with us about your food intake: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Who completed this form? ❑ Patient ❑ Family/Friend/Volunteer ❑ Staff

Production of this resource is made possible with an unrestricted educational grant from our Visionary Partner, Abbott Nutrition Canada.

ENS/973A-November 2015

Canadian Nutrition Society / Société canadienne de nutrition

Canadian Malnutrition Task Force / le Groupe de travail canadien sur la malnutrition

Advancing Nutrition Care in Canada / Améliorer les soins nutritionnels au Canada

Appendix E

My Meal Intake Tool – Guidance Document

MY MEAL INTAKE TOOL: GUIDANCE DOCUMENT

The Canadian Malnutrition Task Force (CMTF) conducted a cohort study (2010–2013) in over 1000 adult patients, recruited from 18 acute care hospitals in eight provinces. This Nutrition Care in Canadian Hospitals (NCCH) study identified not only the prevalence of malnutrition, but also that several hospital processes affected the ability of patients to consume adequate food for their recovery. The NCCH study identified that food intake, regardless of nutritional status at admission, independently predicted the length of stay of a patient. Specifically, patients who consumed less than 50% of food provided at meals had longer lengths of stay. As a result, food intake is the key monitoring mechanism used in the Integrated Nutrition Pathway for Acute Care (INPAC) to determine when a patient requires more Advanced or Specialized Nutrition care. A food estimation tool needs to be simple enough for all medical and surgical patients to use.

In the NCCH study, food intake and challenges to food intake were collected using a patient-completed nutritionDAY™ food intake form and an in-depth food-access questionnaire. Although very basic, this estimation was sufficient to identify potential problems with intake. The My Meal Intake Tool (MMIT) was created to be a simple patient-administered meal intake record that captures the most common food access issues identified in the NCCH study. The validity and ease of completion of MMIT were tested (2014/2015) in 120 patients over the age of 65 years from four diverse hospitals. Sensitivity and specificity of food and fluid estimations were determined by comparing patient estimation to an auditor's recording of intake; MMIT was found to have adequate validity (sensitivity and specificity >70%). Minor modifications were completed after the study to promote clarity and usability of the form. English and French versions are available.

The INPAC recommends that food intake be assessed:

1. **At a single meal, twice per week for patients receiving Standard Nutrition Care (e.g., day 3 and day 7 of admission)**
2. **At a single meal, at least once per day for patients receiving Advanced Nutrition Care**

The form has been developed and tested with vulnerable patients, but does require sufficient cognition to complete. If a patient has delirium, or is presenting with cognitive or memory problems, then family, friends or staff should complete the form on the patient's behalf.

Recommendations for the use of MMIT

1. The hospital computerized tray/meal system can be programmed with Standard and Advanced care strategies with respect to monitoring food intake, whereby patients will receive the MMIT on their meal tray on selected dates (e.g., day 3 and 7 of admission for a Standard Nutrition Care patient; every lunch for an Advanced Nutrition Care patient).
2. When the meal is delivered to the patient, the staff member will notify the patient that they are being asked to record their food and fluid intake so that the staff can better monitor their nutrition needs.
3. If family is present at the meal, they can also complete this form with/for the patient.
4. If the form has not been completed when the tray is removed from the patient's bedside, the staff member can remind the patient to complete it.
5. If the patient is unable to complete the form, the staff member retrieving the tray can help the patient complete the form by asking them about their intake or by observing what is remaining on the tray and at bedside. If the staff member completes the form, they should check the appropriate box at the end of the questionnaire, indicating that staff has assisted in completion of the form.

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force
le Groupe de travail canadien sur la malnutrition

Recommendations for the use of MMIT (cont'd.)

6. Diet technicians, health care aides, other staff and/or volunteers can also be trained to complete this form with the patient; a specific process should be developed within the hospital to promote routine completion.
7. A process within the unit/hospital should be developed to analyze these forms on a daily basis to determine if a patient needs to be moved to Advanced or Specialized nutrition care as per INPAC.
8. Patients receiving Specialized Nutrition Care may require a more detailed assessment of their oral intake and/or nutritional support; MMIT should be considered a minimum for monitoring of oral intake.

Instructions for completing MMIT

1. Patient's name and room number are required so that the MMIT can become part of the patient record.
2. Patients list all beverages present at the meal in the spaces provided. The placing of an 'X' in the correct bubble indicates consumption of each beverage during the meal. If fluids are left on the tray but not consumed, they are also listed here with an 'X' placed in the 0% bubble. Some patients may drink fluids from a prior meal or have beverages brought in by family members. It is appropriate to include these additional items here if they are consumed as part of the meal, as total beverage intake at mealtime is the priority of this record.
3. Food on the tray is assessed as total overall consumption of foods provided. An 'X' is placed in the correct bubble to indicate consumption of foods from the tray.
4. If any item – not consumed during mealtime – is saved for later by the patient, it should be listed on the bottom of the first page. Beverages listed here as 'saved for later' should not appear in the beverage list above.
5. The second page identifies if the patient has a poorer than usual appetite and reasons why this may be the case. The patient can provide as many reasons as they feel are contributing to their poor appetite.
6. In addition to poor appetite, challenges are also listed on the second page. The patient can identify as many challenges as they experienced. If they had no challenges at the meal, they can tick the final box listed.
7. A comment box on page two gives the patient the opportunity to identify any other concerns they may have about the food and mealtimes.
8. The person completing the form (patient, family/friend, staff or volunteer) identifies his/herself by checking off the correct box at the bottom of the second page.

Interpretation of MMIT

1. MMIT is only the starting point for understanding food intake of patients, as it is a crude estimation. **Consumption less than 50% of overall food on the tray (e.g., main plate, side dishes, etc.) indicates that further investigation and intervention are required to promote better intake and recovery of patients**. This value is used in the INPAC as a trigger for changing nutrition care practices for the patient.
2. If beverage consumption is poor, interventions to prevent dehydration may be required.
3. Food and beverages saved for later are not considered in the estimation of food and fluid intake. The intake of this saved food/beverage is not recorded/confirmed by the patient on this record, and thus cannot be included in the estimation.

Production of this resource is made possible with an unrestricted educational grant from our Visionary Partner, Abbott Nutrition Canada.

ENS/974A–November 2015

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force™ | le Groupe de travail canadien sur la malnutrition™

Advancing Nutrition Care in Canada /Améliorer les soins nutritionnels au Canada

Appendix F

Mealtime Audit Tool – Version 1

Hospital Mealtime Audit

Instructions

1. There are two parts to the audit:
    a. General observations – section 1 – these observations are applicable to the whole unit and give a general view of the mealtime activities. Focused on the areas outside of patient rooms.
    b. Identification of specific challenges for select patients – section 2 –what happens to specific patients is determined by asking the patient or by discrete observation. If the patient does not know (e.g. intake monitoring), check with unit staff.
2. Auditors will arrive 15mins before the start time of the meal they are observing to make the general observations and observe preparation for mealtime.
3. Auditors will try not to interrupt or alter the usual mealtime in anyway.
4. After the patient has completed their meal ask them the questions on Section 2.
5. If any of the questions for individual patients are not applicable please write 'N/A' in either the 'yes' or 'no' box.
6. For the patient level issues, all false items ('No' responses) are scored as 1. Total score is a tally of all false items.

Hospital Mealtime Audit Checklist

☐ Breakfast
☐ Lunch
☐ Supper

Unit: _____ Date: _____ Time: _____

Name of auditor: _____

Participant study IDs included in audit: _____

Section 1: General observations of unit mealtime activity:

Approximate number of patients on unit	Approximate number of staff assisting with meal service (e.g. delivery of tray)	Approximate number of staff assisting patients (e.g. tray set-up, patient positioning, eating)
Were patients toileted before mealtimes? (ask nursing staff)	Yes ☐ No ☐ Comments:	
Does the unit appear ready for mealtime and the atmosphere appears pleasant, relaxed, and conducive to eating?	Yes ☐ No ☐ Comments:	
The unit is focused on mealtime; unit is free from planned activities such as teaching, unit rounds, handover, grand rounds, student visits.	Yes ☐ No ☐ Comments:	
Any further observations of the environment that impacted the mealtime?		

Section 2: Patient level experience of mealtime

Please write N/A under the Yes/No boxes for any item that is not applicable for that patient. Please indicate the study ID (s) of the patient(s) included

	Patients											
Observation	**ID:**		**ID:**		**ID:**		**ID:**		**ID:**		**ID:**	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
1. Received the food they ordered (if applicable)?												
2. Received sufficient information to make an informed choice (if applicable)?												
3. Was the food served hot?												
4. Did the meal tray look and smell appetizing?												
5. Positioned comfortably (upright) and have all needed personal effects (dentures/glasses) to eat/drink?												
6. If needed, was help provided for positioning/getting ready?												
7. Tray was accessible (at bedside)?												
8. Tray set-up for patient (e.g. packages opened) or offered?												
9. If required, assistance with eating/drinking, was offered.												
9a. -Was assistance provided sufficient?												
9b. -How long was the wait for assistance?												
10.Undisturbed during the mealtime?												
-If No: what activities disturbed the patient?												
11. If made, were requests for replacement/additional foods met?												
12. Did the patient have sufficient time to eat?												
13. Visited by staff mid-meal for a check?												
14. If tray untouched, did staff offer alternatives?												
15. Food intake/ hydration monitored at this meal?												
16. Patient was provided snacks in-between meals today?												
17. If needed, has the patient been offered pain or symptom control?												
18. If needed, has the patient been offered constipation management?												
TOTAL (all 'No' responses)												
Comments												

Appendix G

Mealtime Audit Tool – Version 2

Hospital Mealtime Audit

Instructions

1. There are two parts to the audit:
   a. Section 1 –General observations of the unit, descriptors of the audit
   b. Section 2 - Specific challenges experienced by selected patients
2. Auditors will arrive approximately 10 mins before the anticipated start time of the meal to complete Section 1
3. Auditors will try to not interrupt or alter the usual mealtime in anyway.
4. After the selected patients have completed their meal, ask them the questions on Section 2.
5. If any of the questions for individual patients are not applicable please note 'N/A'. The item on meal selection is NA if there are no selective menus; this is not asked of these patients.
6. Provide clarifying comments, such as type of assistance needed etc.
7. Section 2: Count the total number of 'No' responses for each patient to obtain the score.

Section 1) General observations of unit mealtime activity:

Date of Audit:_____Name of auditor: _____ Which meal?:

☐ Breakfast
☐ Lunch
☐ Supper

Time Auditor Arrived on Unit (e.g. 12:00 p.m.): _____

Type/Unit: _____ Unit size: _____

Time Meal Truck Arrived _____Tray Distribution Start Time: _____ Finish Time:_____

Comment on the unit readiness for the meal, any delays/challenges that could influence the patients' perceptions of this meal.

Section 2) Questions to ask patients….	Patient ID				Patient ID:			
Part A: How was your meal?	Comments				Comments			
Part B:	**Yes**	**No**	**N/A**	**Comments:**	**Yes**	**No**	**N/A**	**Comments**
1. Did the meal come at an appropriate time for you?								
2. Did you get the food that you ordered (if applicable)?								
3. Did you request any other food/drink items during this meal, and if so did you get them?								
4. Did your meal look and smell appetizing?								
5. Were hot foods served hot?								
6. Did you need help being positioned comfortably prior to eating; and if so was help provided?								
7. Did you have everything you needed in order to eat/drink such as your glasses, dentures, etc.?								
8. Were you able to reach your meal tray?								
9. Were you offered any help with your meal?								
10. If you needed help with your meal was it provided?								
11. If you needed help, did you receive this quickly?								
12. Did you have enough time to eat your meal?								
13. Were you visited by staff mid meal to check on you?								
14. *Auditor to note if tray is untouched, if so ask:* Did staff offer you any other food to eat?								
15. Are you suffering from constipation and if so have you been offered anything to manage it?								
16. Were you offered help to use the washroom before mealtime?								
17. Are you experiencing any symptoms like pain or nausea, and if so have you been offered anything to manage it?								
18. Were you undisturbed at the meal?				What was the issue?				What was the issue?
Total of No Responses								
Part C: Is there anything we could do to make your meals better?								

Appendix H

MAT Inter-rater Reliability Testing – Ethics Approval

UNIVERSITY OF WATERLOO

OFFICE OF RESEARCH ETHICS

Notification of Ethics Clearance of Application to Conduct Research with Human Participants

---

Faculty Supervisor: Heather Keller **Department:** Kinesiology

Student Investigator: James McCullough **Department:** Kinesiology

Collaborator: Hannah Marcus **Department:** Grand River Hospital

ORE File #: 20055

Project Title: Inter-rater reliability testing of mealtime audits in acute care ward patients.

This certificate provides confirmation the above project has been reviewed in accordance with the University of Waterloo's Guidelines for Research with Human Participants and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans. This project has received ethics clearance through a University of Waterloo Research Ethics Committee.

***Note 1**: This ethics clearance is valid for one year from the date shown on the certificate and is renewable annually. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105).*

***Note 2**: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through a University of Waterloo Research Ethics Committee and must not begin until notification has been received by the investigators.*

***Note 3**: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.*

***Note 4**: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106. Any unanticipated or unintentional changes which may impact the research protocol must be reported within seven days of the deviation to the ORE using ORE form 107.*

Maureen Nummelin, PhD
Chief Ethics Officer

Date 12/15

OR
Julie Joza, MPH
Senior Manager, Research Ethics

OR
Sacha Geer, PhD

Appendix I

Mealtime Audit Tool – Published Version

MEALTIME AUDIT TOOL

Instructions

1. There are two parts to the audit:
   a. **Part 1:** General observations of the unit and descriptors of the audit
   b. **Part 2:** Specific challenges or barriers to food intake experienced by selected patients
2. Auditor will arrive approximately 10 minutes before the anticipated meal start time to complete Part 1.
3. Auditor will try not to interrupt or alter the usual mealtime in any way.
4. After selected patients have completed their meals, auditor will ask questions (as shown in Part 2). Multiple copies of the second page with Part 2 may be used for a single meal.
5. If any questions are not applicable to an individual patient, auditor will note 'N/A'. *The item on meal selection is N/A if there are no selective menus; this is not asked of these patients.*
6. Auditor will write clarifying patient comments, in the space provided, such as type of assistance needed.
7. **Part 2:** To obtain the score, auditor will count the total number of 'No' responses for each patient.

Part 1: General observations of unit mealtime activity

Date of audit: _____ Name of auditor: _____

Which meal? ❑ Breakfast ❑ Lunch ❑ Supper

Time auditor arrived on unit (e.g., 12:00 p.m.): _____

Type/Unit (e.g., medical, surgical or name): _____

Number of beds filled: _____

Time meal truck arrived on floor: _____ Time tray distribution started: _____

Time tray distribution completed: _____ Time of truck removal: _____

Comment on the unit readiness for the meal and any delays/challenges that might influence the patients' perceptions of the meal.

_____

_____

_____

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition
Advancing Nutrition Care in Canada / Améliorer les soins nutritionnels au Canada

Part 2: Questions to ask patients...

	Patient:				Patient:			
How was your meal? On a scale of 1 to 10 (1 is low and 10 is high), how important is your food and fluid intake (in hospital) to your recovery? On a scale of 1 to 10, how much importance did staff place on your food and fluid intake?	Comments				Comments			
	Self-rating			Staff rating	Self-rating			Staff rating
	Yes	No	N/A	Comments	Yes	No	N/A	Comments
1. Did the meal come at an appropriate time for you?								
2. Did you get the food that you ordered (if applicable)?								
3. a) Did you have all of the food/drink items you wanted during this meal? b) If you requested other items, did you get them? *N/A if none requested*								
4. Was your meal appetizing (presentation and aroma)?								
5. Were hot foods served hot?								
6. Did you need help being positioned comfortably prior to eating, AND if so, was help provided? *N/A if no help needed*								
7. Did you have everything you needed in order to eat/drink comfortably (such as your glasses, dentures, etc.)?								
8. a) Were you able to reach your meal tray? b) Were you able to open your food packages, OR did you get help to open packages?								
9. a) Are you able to eat your meal without help (from staff or family)? b) If staff helped you, did you get help when you wanted it? *N/A if no help provided by staff*								
10. Did you have enough time to eat your meal?								
11. Were you visited by staff mid-meal to see if you needed anything?								
12. *If tray is untouched, ask:* did staff offer you any other food to eat? *N/A if some items eaten*								
13. Are you suffering from constipation, AND if so, have you been offered anything to manage it? *N/A if no constipation*								
14. Were you offered help to use the washroom before mealtime? *N/A if no help needed*								
15. Are you experiencing any symptoms like pain or nausea, AND if so, have you been offered anything to manage them? *N/A if no symptoms*								
16. Were you able to eat your meal without interruptions (e.g., doctor, nurse, physical therapist visiting)?								
17. Was your meal free from noise, cleaning or other disturbances?								
Total of NO responses – a higher score indicates more barriers to the meal								
Is there anything we could do to make your meals better?								

Production of this resource is made possible with an unrestricted educational grant from our Visionary Partner, Abbott Nutrition Canada.
E85/3754 November 2015

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force®
le Groupe de travail canadien sur la malnutrition®

Appendix J

Mealtime Audit Tool – Guidance Document

MEALTIME AUDIT TOOL: GUIDANCE DOCUMENT

The Canadian Malnutrition Task Force (CMTF) conducted a cohort study (2010–2013) in over 1000 adult patients, recruited from 18 acute care hospitals in eight provinces. This Nutrition Care in Canadian Hospitals (NCCH) study identified not only the prevalence of malnutrition, but also that several hospital processes affected the ability of patients to consume adequate food for their recovery. **The NCCH study identified that food intake, regardless of nutritional status at admission, independently predicted the length of stay of a patient**. Specifically, patients who consumed **less than 50%** of food provided at meals had longer lengths of stay. As a result, food intake should be supported to promote patient recovery and quality of life.

The Mealtime Audit Tool (MAT) is a two-page form designed for hospital staff to document mealtime issues, challenges and/or barriers that patients may experience at the unit and individual level. The MAT was developed from the NCCH study results, as well as prior research on protected mealtimes. Testing of the MAT in 2014/2015 focused on enhancing usability and testing if auditors obtained the same result with the same patient. Usability results helped to improve the clarity of items and instructions and the MAT was found to be reliable when used by different auditors.

Recommendations for the use of MAT

1. MAT can be completed to:
   a) Establish a baseline on mealtime barriers patients may experience
   b) Identify differences between units, or within a unit, when staff education or other changes occur
   c) Identify priorities for change
   d) Educate staff on the needs, barriers and perspectives of their patients
2. Frequency of MAT completion will be dependent on the purpose of the audit. For example, a baseline audit may be done on several units within a hospital to identify those units with the highest need for improvement. When training or other change strategies are implemented, MAT may be completed to track progress of the improvements following training. MAT audits can also be used several months after training to determine sustainability of the change processes and if retraining is required.
3. MAT includes two **distinct** parts: **Part 1** is a global observation of the unit (e.g., type of unit, time of meal tray arrival) and **Part 2** is a list of key challenges or barriers individual patients may experience. Part 2 is completed with patients who are well enough (both physically and cognitively) to answer the questions. Patients who do not receive a meal tray are not eligible to complete MAT. Questions in Part 2 ask the patient about their meal experience (e.g., was the food hot enough?). For patients who cannot answer MAT questions, the mealtime can be observed and MAT used to focus the observation. However, it should be noted that MAT has not yet been tested in this manner and therefore, cannot be considered – at this point – to be comparable to MATs completed by asking patients these questions.
4. For the hospital to attain a sufficient understanding of mealtime activities on a unit, only a portion of eligible patients need to complete MAT. For example, on a unit with 34 beds, 10 patients at a single meal is an adequate sample to understand mealtimes in that unit.

1

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition

MEALTIME AUDIT TOOL: GUIDANCE DOCUMENT

Recommendations for the use of MAT (cont'd.)

5. Randomly selecting patients to complete the MAT will promote variety in clinical characteristics that may influence identification of mealtime barriers and challenges. For example, patients who have difficulty self-feeding may be more likely to experience barriers. This diversity can be achieved through random selection of eligible patients.
6. MAT can also be used to audit a specific group (e.g., frail older adults). In these specific audits, results should only be compared to other audits within the same group.
7. Any member of hospital staff can be trained to be a MAT auditor – however, dietary staff (e.g., food service supervisors or diet technicians) may be especially appropriate.

Instructions for the completion of MAT

Part 1: Arriving shortly before the trays are delivered to the floor, the auditor observes the unit environment in general and comments on the unit readiness for the meal, noting any delays/challenges that might influence the patients' experience of this meal. The auditor completes the form with information regarding meal arrival time, meal description, details on when and how the tray was delivered and how the meal service was completed. In the comment box, the auditor can note any challenges observed during the mealtime. For example:

- Is unit staff focused on the mealtime?
  - Unit staff should be involved as much as possible in mealtime. For example, they can help to set up meal trays, position patients and make sure patients have everything they need to eat successfully.
  - If staff is not focused on the meal, please note what they are doing instead, e.g., transferring patients on/off the unit; performing non-mealtime activities or tasks such as charting, conducting rounds, distributing medications, completing procedures, changing linens, etc.
- Are there excessive disturbances on the unit?
  - Excessive noise on the unit can distract patients from eating and can create a negative mealtime environment.
  - If there are any excessive noises that may disturb patients, please make note of them. For example, loud/disruptive patients or staff, call bells/alarms going off, nearby construction/maintenance, etc.
  - Disturbances can also include foul odours, which may negatively affect the mealtime environment.
  - Any other disturbances that may create an environment that is not conducive to eating should be noted. For example, if housekeeping staff is cleaning patient rooms or collecting garbage during mealtimes.
- Are patients being interrupted during mealtime?
  - Interruptions that occur during a patient's mealtime may mean that the patient does not have enough time to eat their meal or the interruption has made them miss their meal.
  - Are patients being taken off the unit for medical testing/examinations during mealtime?
  - Are patients moving rooms or being transferred to/from unit during mealtime?
  - Are there visitors in patient's room? If visitors are involved in the mealtime (e.g., helping or eating with the patient), these are not interruptions. However, if the patient does not eat with visitors present, this would be considered an interruption.
  - Do physicians/physiotherapists/nurses/other clinicians visit during mealtime?

MEALTIME AUDIT TOOL: GUIDANCE DOCUMENT

Recommendations for the use of MAT (cont'd.)

- Are there delays in meal delivery?
  - Does the meal arrive on time or is the meal truck late? Are there meal trays/items missing?
  - Are there obstacles/disturbances in the hallway that may delay meal delivery or prevent the meal truck from passing? For example, beds, furniture, housekeeping carts, etc.

These are examples of some common challenges that can affect the mealtime. MAT should also note any other observations of the environment that may have impacted the mealtime.

Part 2: This page is completed by the auditor who interviews the patient and records their responses after the patient has finished their meal. This part of MAT captures individual-level challenges that patients may face during their meal.

Identifying eligible patients and inviting them to complete MAT

1. Patients must be able to answer questions. Patients who are experiencing delirium, excessive pain or who have cognitive or memory problems are not good informants for MAT. If it becomes clear to the auditor once they begin that the patient is having considerable difficulty answering questions, it is best to stop and thank them for their time.
2. Patients who are not receiving meal trays should not be asked the MAT Part 2 questions.
3. The auditor should introduce themselves to the patient and explain the purpose of the audit and what will be required of the patient. Let the patient know that their feedback is confidential and will be used as a way of improving care in the hospital. Explain that it will only take a few minutes.

Completing MAT with patients

4. Answers for two patients can be completed on a single sheet of MAT. Make more copies of page 2 Part 2, as needed, for a single meal audit. The patient's name or room/bed number can be recorded for the audit.
5. Start the patient interview by asking a general question (e.g., How was your meal?). Brief phrases or single words can be used to capture this answer in the box provided.
6. Ask the patient to rate, on a scale of 1–10 (where 1 is low and 10 is high), how important food and fluid intake are to their recovery, as well as how much importance they thought staff placed on their food and fluid intake. Provide the numerical rating in the appropriate 'self' and 'staff' rating boxes.
7. Each of the 17 questions in Part 2 captures a different individual-level barrier. The auditor will ask the patient to answer each question with either a 'Yes' or 'No' and the appropriate column is ticked.
8. Some questions have a potential Not Applicable (N/A) response; question items may identify when N/A is a plausible option. Where the N/A column is shaded, N/A is **not** an option and the auditor should attempt to get a 'Yes' or 'No' response.

MEALTIME AUDIT TOOL: GUIDANCE DOCUMENT

Recommendations for the use of MAT (cont'd.)

9. If a patient answers 'No', this indicates that the patient encountered that issue or barrier. For example, if a patient answers 'No' to the question, 'Did you get the food that you ordered?' this indicates that the patient did not receive the food he/she ordered and thus, encountered this challenge during the meal.
10. Comments can be written beside each question.
11. Some questions have a part A) and B); the columns have been split to allow both answers to be recorded (e.g., Question 3A and 3B).
12. Remember that these are the perceptions of the patient, and your opinion – as the auditor – does not factor into the answering of these questions.

Obtaining the MAT score for each patient

13. The 'Total of NO responses' row below the 17 questions will be a sum of all of the questions in which the patient answered 'No'. This value represents the number of issues/barriers this specific patient had during his/her meal.
14. Finally, the last row asks for any patient input on how their mealtime experience could be improved; this can also be recorded in brief phrases or single words.

Interpretation of MAT

1. The higher the score, the more barriers experienced by the patient.
2. If a patient has indicated an issue with his/her meal, especially if this has significantly influenced food intake (e.g., not being able to eat because no assistance was provided), the auditor should identify the patient and communicate his/her challenge to the unit dietitian or nursing staff for follow-up and intervention.
3. If a patient asks for specific food preferences during the audit, the auditor should communicate these preferences to a food services supervisor (or another appropriate member of hospital staff).
4. The average number of barriers for the unit and meal being audited is calculated by adding the scores for all audits (at the meal) and then dividing this by the number of patients who completed Part 2.
5. Trends in MAT audits can be tracked by using line graphs, which note the average score for a given unit at specific time points (e.g., y-axis is the average number of barriers per meal and x-axis is the date of the audit).

Canadian Nutrition Society
Société canadienne de nutrition

Canadian Malnutrition Task Force | le Groupe de travail canadien sur la malnutrition

Production of this resource is made possible with an unrestricted educational grant from our Visionary Partner, Abbott Nutrition Canada.
ENS/076A–November 2015