# THE RECIPROCAL RELATIONSHIP OF NUTRITION RESEARCH INTO CLINICAL PRACTICE IN METABOLIC AND BARIATRIC SURGERY

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A thesis submitted in partial fulfilment of the requirements of the University of Sunderland for the degree of PhD by Existing Published or Creative Works

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## Abstract

### AIMS

The central aim of the thesis is to provide evidence for the claim of recognition for retrospective doctoral level work focused on the missing or “unseen” integration of nutrition with metabolic and bariatric surgery (MBS) and the potential pathophysiological impact when it is not addressed. The strategic objectives of the study are threefold:

1. To provide evidence of the retrospective creation of optimal resources for use by international interdisciplinary healthcare professionals in the assessment, diagnosis, management, and prevention of nutrient deficiencies (both short and long-term) in patients who are in the pre-and post-operative stages of MBS.
2. To highlight the relative clinical invisibility, yet salience, of the term ‘metabolic’ within the context of post-bariatric surgical nutrition and the avoidance of medical complications.
3. To highlight innovative best practices in optimal and individualised bariatric nutritional care in addressing the conceptual basis of ‘M’ metabolism and to raise awareness of its consequential significance in MBS, specifically micronutrient deficiencies.

### METHODS

This thesis represents the cumulation of eight peer-reviewed publications specifically identified, justified, and developed to facilitate medical and healthcare practitioners’ ability to educate, assess, diagnose and manage very specific and

otherwise unidentified nutrient deficiencies in patients who are either planning to have metabolic and bariatric surgery (MBS) or living post-operatively with its impact. Bronfenbrenner's Ecological Systems theory is modified to provide a theoretical lens through which various complex adaptive systems have been investigated and evaluated. This is articulated within a pragmatist paradigmatic approach, enabling the highest level of systematic rigour of both the methodological approach adopted and the articulation of research findings. This approach also permits a pluralist positionality vis a vis what are optimally valid and positive clinical interventions. One additional peer-reviewed work is provided as a mechanism for contextualising and further evidencing the global impact of this work to date. The taxonomy used to classify these specific works is as follows:

- Clinical practice guidelines (Publications 1 - 2)
- Best Practices (Publications 3 - 5)
- Primary Research (Publications 6 - 8)
- Context (Appendix 1)

## RESULTS

Micronutrient deficiencies (MND) persist and have continued to increase even though there are three nutrition-related Clinical Practice Guidelines (CPG) from the United States, including the two presented here as context and foundation of nutrition care in MBS (2008) and as an update with a focus on MND (2017) and the international CPG (2022) a collaboration between the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) and the World Gastroenterology Organization (WGO) to revise the 2010 WGO Obesity Guidelines..

MBS alters both the functional anatomy and physiology of the gastrointestinal tract, altering the metabolism of nutrients, thus creating the potential for micronutrient deficiencies.

The evidence provided contextually frames the vital need for assessing, diagnosing, and managing nutrient deficiencies as metabolic complications of surgery, not simply nutritional or behaviour-related issues.

## CONCLUSION

This thesis provides a series of key resources for optimal nutritional care and advice for patients living with MBS, representing the culmination of my clinically impactful career trajectory. It also has the potential to facilitate medical and healthcare clinicians' ability to address specific micronutrient (MN) complications as part of the metabolic nature of MBS by including micronutrient deficiencies as an additional differential diagnosis when working with patients who had MBS many years ago (10 or more years).

*"Life can only be understood backwards, but it must be lived forwards."*

Søren Kierkkegaard

## Lay Summary

Over the past 20 years, my work has involved clinical work in hospitals, universities, private practice, and communities as a Registered Dietitian (RD), Nutrition Specialist, and Behavioral Health Coach. I discovered the need to have nutrition recognised as a critical component and basis for overall well-being for patients who struggle with obesity, particularly within the evolving field of metabolic and bariatric surgery (MBS). When working, I tend to see gaps in patient care, specifically a lack of attention to and recognition that nutrients, regardless of type, affect the proper functioning of the human body. Moreover, when a person has surgery, the body has an increased need for nutrients. Without essential vitamins and minerals from the diet or supplements, our bodies are unable to heal and much less perform the functions necessary in our daily lives. Nutrient deficiencies can develop, causing a potential breakdown in the skin, bones, muscles, nerves, brain, heart and other physical organs and systems. This malfunctioning of the seemingly independent parts of the body will also affect the coordination of movement and behaviour. For example, if a patient is tired to the point of needing naps during the day, this can also affect thinking and interaction with others. We often attribute fatigue to the normal wear and tear of daily living. However, the typical diet of most people cannot provide all the nutrients needed. Though most individuals are unaware of this, their chronic fatigue could be due to one or more micronutrient deficiencies. Add to this mixture a surgery, specifically one that affects dietary intake and how the body can use nutrients (digest, absorb, metabolise, and excrete), and you now have a person primed for nutrient deficiencies. So, this recognition of the critical nature of nutrients serves as the basis for the various types of research and published clinical practice guidelines,

best practices for clinicians, and primary research (studies that investigate nutrient deficiencies and relationships) presented here. Within these publications, I have incorporated the nutrition care process in MBS (1) for clinicians who conduct nutritional assessments, evaluation, and ongoing monitoring, (2) pre- and post-surgical supplementation to help prevent and correct nutrient deficiencies and (3) preparation for pre- and post- MBS including lifestyle changes and special considerations such as pregnancy and paediatrics in MBS.

Along the way, I have also been part of and witnessed the development of nutrition in MBS, as well as the overall field of nutrition and dietetics. This has been a field that struggles to find its place within a dominated and unbalanced society – much like my career experience working within a contested space. Scientific publications, by design, generally have an air of timelessness—of being somehow decontextualised and above the rough and tumble politics of day-to-day human activity. However, by pulling my corpus of work into a historical narrative, it becomes clear that the explanation for “why this study at this time?” is deeply grounded in the contested history of the development of a profession.

The development of nutrition care in MBS is also part of my journey. I was fortunate to be involved from the very beginning and to help shape the profession as it exists today. However, the path was not without obstacles, twists, and occasional dead ends. The nature of the nutrition profession in MBS can only be understood in the context of the century-long tension between (male) surgery and (female) nutrition. Similarly, within the profession of nutritional practice, more recent tensions regarding the definition of nutrition practice have shaped and been shaped by my academic work (is it merely counselling or is it medical nutrition

therapy as well?). It's not that one or the other side of the dichotomy is bad, but the dichotomy itself is misplaced. We need both – a collaboration and partnership between the two sides. This has been the thrust of my work.

The story of my corpus of research is the localised story of the development of a profession. It is a story of science, yes. But it is also a story of gendered practice and praxis—shaped by deeply held assumptions about the nature of three supposed dichotomies: male/female, medicine/nutrition, medical therapy/counselling versus counselling/ medical therapy.

## Acknowledgements

I am grateful for the guidance and support of my thesis committee in helping me reach this goal. I want to specifically thank Professor Yitka Graham, my Director of Studies, who met with me tirelessly at all hours and in different countries, as well as Professor Catherine Hayes, my Co-Supervisor, who encouraged me to explore the realm of philosophy to strengthen the methodological foundation of my research into a cohesive thesis. Both amazing women provided professional and emotional support and demonstrated the strength and motivation that inspired me to see this thesis come to fruition. I also thank Professor Kamal Mahawar for his constructive comments and support. Moreover, I look forward to the continued development of our collegial relationships and friendships.

In presenting this PhD thesis, I would like to express my gratitude to Dr. Kristoffel Dumon for his unwavering support in both my clinical and research endeavours despite the challenging political environment we encountered. I also want to acknowledge the invaluable contributions of my research team: Dr. Kristoffel R. Dumon, MD, FACS, Associate Professor of Surgery; Armaun D. Rouhi, BA; Austen J. Parrott, BS; and J. Scott Parrott, PhD. Their expertise and dedication, even outside of regular work hours, enabled me to conduct and publish the research included in this thesis, which would not have been possible otherwise.

Additionally, I want to express my appreciation to my colleague and friend Mary O'Kane, who has been consistently supportive and flexible with the deadlines of the various projects we have been working on together. Lastly, I extend my heartfelt thanks to Professor J. Scott Parrott for his methodological insight and

ability to be accommodating at all hours by deftly interchanging roles between husband and professor.

Finally, I am grateful for the support of my close and extended family, who motivate me to complete my tasks promptly so that I can join them in conversation and fun with the recurrent questions “Are you finished yet?” and “How much longer?”

C’est Fini!

## Table of Contents

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## List of Figures

## Abbreviations

| | |
|---|---|
| § | Section |
| < | Less than |
| = | Equal |
| ≥ | Greater than or equal to |
| AACE | American Association of Clinical Endocrinologists |
| ACS | American College of Surgeons |
| ADA | American Dietetic Association |
| AHEA | American Home Economics Association |
| AIN | American Institute for Nutrition |
| AND | Academy of Nutrition and Dietetics |
| ASBS | American Society for Bariatric Surgery |

| | |
|---|---|
| ASMBS | American Society for Metabolic and Bariatric Surgery |
| BMI | Body mass index |
| BP | Blood pressure |
| BPD | Biliopancreatic diversion |
| BSCOE | Bariatric Surgery Center of Excellence |
| BSG | Bariatric support group |
| CBN | Certified Bariatric Nurse |
| cm | Centimeter |
| CMS | Centers for Medicare and Medicaid Services |
| COE | Center of Excellence |
| COVID | Corona Virus |
| CPG | Clinical practice guideline(s) |
| DPG | Dietetic Practice Group |
| DS | Duodenal Switch |

| | |
|---|---|
| e.g. | For example |
| EMR | Electronic medical record(s) |
| et al. | And others |
| etc. | Etcetera |
| EWL | Excess weight loss |
| F | Test statistic measures how much of a difference in the dependent variable there is between the groups |
| FASEB | American Home Economics Association |
| GRADE | Grades of Recommendation, Assessment, Development, and Evaluation. |
| HCP | Health care practitioner(s) |
| HIEFSS | Hospital, Institution, and Educational Food Service Society |

| | |
|---|---|
| ICMJE | International Committee of Medical Journal Editors |
| ID | Iron deficiency |
| IDA | Iron deficiency anaemia |
| IFSO | International Federation for the Surgery of Obesity and Metabolic Disorders |
| IH | Integrated Health |
| IRB | Institutional Review Board |
| LTFU | Long term follow-up |
| M | Metabolism |
| MACRO | Macrosystem |
| MBS | Metabolic and bariatric surgery |
| MBSAQIP | Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program |
| MD | Doctor of Medicine |

| | |
|---|---|
| MDT | Multidisciplinary team |
| MESO | Mesosystem |
| MICRO | Microsystem |
| ML | Machine Learning |
| MN | Micronutrient |
| MND | Micronutrient deficiency(-ies) |
| MNT | Medical Nutrition Therapy |
| mvi | Multivitamin |
| n/a | Not available |
| NR | Not reported |
| NAC | North American Chapter |
| NCHS | National Center for Health Statistics |
| NCP | Nutrition Care Process |
| NCPM | Nutrition Care Process and Model |

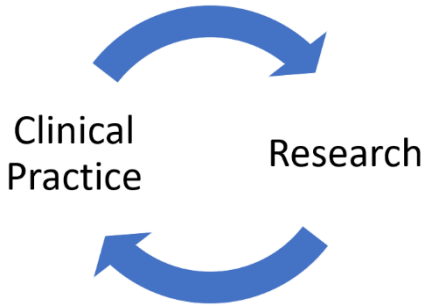
| | |
|---|---|
| NEATS | National Guideline Clearinghouse (NGC) Extent of Adherence to Trustworthy Standards |
| NFPE | Nutrition Focused Physical Examination |
| NHS | National Health System |
| NIH | National Institutes of Health |
| OAGB | Single Anastomosis Gastric Bypass |
| p | Probability |
| PhD | Doctor of Philosophy |
| PICO(T) | Patient, Intervention, Comparison, Outcome and (sometimes) Time. |
| PRISMA | Preferred reporting items for systematic reviews and meta-analyses |
| pt | Patient |

| | |
|---|---|
| PubMed | Search engine database for peer-reviewed articles |
| R2 | Statistical measure for the proportion of variance in the dependent variable that can be explained by the independent variable |
| RCT | Randomized clinical trial |
| RD | Registered Dietitian |
| RDN | Registered Dietitian Nutritionist |
| RN | Registered Nurse |
| RYGB | Roux-en-Y Gastric Bypass |
| SADI-S | Single Anastomosis Duodenal-Ileal bypass with Sleeve |
| SAGES | Society of American Gastrointestinal and Endoscopic Surgeons |

| | |
|---|---|
| SCOPUS | Indexing database with abstract and full-text links by Elsevier |
| SOARD | Surgery for Obesity and Related Disorders |
| SOP | Scope of Practice |
| SOPP | Standards of Professional Performance |
| UK | United Kingdom |
| URM | Uniform Requirements for Manuscripts |
| USA | United States of America or United States |
| WGO | World Gastroenterology Organisation |
| WWI | World war I |
| WWII | World war II |
| WYSIWYG | What you see is what you get” |

## Professional background

My professional career has been characterized as a conversation between clinical practice and research; working to bring research insights to bear on clinical practice, but also generating clinically motivated research projects.




I began practicing nutrition in metabolic and bariatric surgery (MBS) in 2000 when Centres of Excellence (COE) for MBS was non-existent and there were no standards of practice or clinical practice guidelines (CPG) to direct nutrition care (nutrition assessment, prevention, or treatment of nutrient deficiencies, diet progression, etc.) in MBS. It was essentially a wide-open field with many different beliefs and practices. Nutrition practice was generally based upon the beliefs and biases of surgeons (for example, patients should not eat foods that were white, no red Jell-O, and diet progression consisted of clear liquids for more than seven days, etc.). In 2004, a colleague from ASMBS and myself (Academy of Nutrition and Dietetics Bariatric Sub-unit Chair) discussed developing a CPG for nutrition in MBS. With little guidance but with support from the ASMBS, a Registered Dietitian (RD) with extensive research experience co-led the nutrition sub-committee, CPG co-authors, to create the first narrative review of nutrition in MBS (Aills et al., 2008). This CPG was well received within the American Society for Metabolic and Bariatric Surgery (ASMBS) and became one of the most read and cited articles for the journal Surgery for Obesity and Related Disorders (SOARD). This spoke to the demand and hunger for nutrition recommendations in MBS. It has been cited by numerous professional and public health organisations, including the American

Association of Clinical Endocrinologists (AACE), The Obesity Society (TOS), the American Society for Metabolic and Bariatric Surgery (ASMBS), the American Heart Association (AHA), European Society for Clinical Nutrition and Metabolism (ESPEN) and the British Obesity & Metabolic Surgery Society.

Next, I led the update to the ASMBS 2008 CPG guidelines with a group of 5 expert Registered Dietitians (RD) practicing in MBS, focusing on micronutrients. We determined to use a more rigorous methodology than the prior CPG. So, we updated the questions, literature search, assessed risk of bias for all the articles and graded recommendations. The 2016 Micronutrient Update was accepted with no revisions for publication within 24 hours after submission (online 2016 and in print 2017) (Parrott, et al., 2017). Like the previous CPG, the updated guidelines are one of the most highly cited articles in SOARD (in the 100th percentile for citations, captures and social media) and have surpassed the number of citations for the 2008 CPG. The ASMBS CPGs stimulated three follow-on research projects. The first was to create an internal methodological manual for how to create Integrated Health ASMBS CPG. While the larger ASMBS has no formal method for this, the Integrated Health (IH) section now has an internal non-published document. In the second project, I conducted a content analysis (using NVIVO) of the methodological rigour of existing CPGs in bariatric surgery and presented this at the IFSO annual meeting in 2017. The third project was a scoping review of macronutrients (as part of a 2-step approach to create a CPG). Our findings indicated that there was an insufficient research base to create evidence-based guidelines for macronutrients in MBS. Thus, we redirected our efforts from creating a CPG without a solid evidence base to using the findings of the scoping review to create a “call to action”. Working with an international team

of RD nutrition researchers, this project aimed to provide a *vision* and guidelines for future research in this area so that, in time, we will have a sufficient and rigorous body of research for evidence-based CPG. This scoping review was published after I completed the selection of my research corpus. While the above details my efforts to bring research to bear on clinical practice, I have also used my clinical experience to inform original research and scholarship. Throughout the years I have engaged in original research and best practice scholarship. For instance, in 2012, clinical questions prompted a retrospective analysis of 1129 patients to determine whether there is a relationship between patient outcomes and having a specialist MBS RD versus a clinician with general nutrition education. We found that patients were more likely (67% vs 57%) to meet a 5% EWL across procedures and significantly greater ($p< 0.001$) EWL at 1 and 3 months postop with specialised RD counselling. This was presented, and the abstract was published in 2012 in the Journal of the Academy of Nutrition and Dietetics (AND), but it was not included in my corpus of works since it was outside the included time-frame. Most recently, my clinical experience prompted another original research study—a case-control study of a large Northeastern USA program (n=5946 patients) that uses machine learning methods to predict vitamin C deficiency and scurvy among patients with MBS. Our results indicate that the prevalence of vitamin C deficiency and scurvy is dramatically higher than anticipated. This is a critical finding since the previous CPGs do not provide recommendations for either screening or treating patients with MBS for vitamin C deficiency—sometimes with deadly consequences. We presented these results at the IFSO 2022 annual meeting and a more technical version of the study was published in Obesity Surgery in 2023.

Based on my expertise over the past two decades, I have been invited to collaborate on six chapters and papers on best practices for different professional societies: ASMBS, AND, the World Gastroenterology Organization (WGO), and IFSO. One of these works, written by a group of international RD specialists, translates current CPG and best evidence practices into optimal nutrition care within a program setting (Parrott et al., 2020).

It is impossible for me to gauge the real-world patient-centred impact of my work accurately. My research and scholarship have gained attention from professionals, with 1746 citations and an h-index of 8 (Google Scholar). However, the main goal is to improve the day-to-day quality of nutrition care for patients with MBS. How many programs in the USA and worldwide have integrated the guidelines or best practices that I've developed? In the USA, Centers of Excellence require programs to have designated clinical pathways. Most programs incorporate guidelines by ASMBS. An estimate should include the number of COE programs in the USA (data not available) combined with the metrics for each of the papers listed in the published papers section.

**Format and content of the thesis**

This thesis presents a body of published work comprising six first-authored peer-reviewed publications. Each of the papers forming this submission is presented independently alongside a written narrative that acts to produce a cohesive body of work. I have used the British spelling for typical narrative style, but for USA organisations or documents, I have used the American English spelling. Personal reflections are woven throughout. Please keep in mind that these are my personal

experiences in an American context and are not meant to be generalized in a global manner.

An introduction provides a literature review of the different types of metabolic and bariatric surgery (MBS) and how these procedures affect nutrient uptake and absorption. Next, the role of the dietitian in general and, more specifically, in MBS is presented along with a chronology of historically relevant events in nutrition, science and medicine. The importance of multidisciplinary care is woven throughout the Center of Excellence accreditation standards in MBS. The problems encountered via a lack of an RD/RDN Specialist in MBS designation are linked to the lack of proper medical nutrition therapy consisting of both counselling and therapy (interpret labs and treat accordingly).

The methodology chapter explores my positionality and the philosophical underpinnings of my research, presenting my rationale for each publication by type of study. The results section presents the main findings of my eight publications organised by study type (clinical practice guidelines, best practice, and primary research) and then by system framework (microsystem through megasystem levels) modelled after Bronfenbrenner's Ecological Systems Theory. The discussion presents a summary of important discoveries, a comparison of the work to the existing literature, a critical exploration of the strengths and limitations of the work, implications for clinicians and policymakers and unanswered questions for future work in this field. A concise conclusion to the body of work follows this. The thesis concludes with reflections on my research journey and the completion of a PhD by Existing Published Works.

**Published Works**

**Publication 1:** American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update (Parrott et al., 2017)

**Publication 2:** IFSO-WGO Guidelines on Obesity  Section 5: Lifestyle Changes and Other Non-operative Management (IFSO-WGO, 2023)

**Publication 3:** Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery (Parrott, 2014)

**Publication 4:** The Optimal Nutritional Programme for Bariatric and Metabolic Surgery (Parrott et al., 2020)

**Publication 5:** New Concepts in The Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice? (Parrott, 2021)

**Publication 6:** Developing a Long-term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives (Graham et al., 2023)

**Publication 7:** Screening for Vitamin C Deficiency: Why and When? (Parrott et al., 2022)

**Publication 8:** What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

**Appendix 1:** Context Allied Health Sciences Section Ad Hoc Nutrition Committee, ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008)

**Contribution Statements**

I collected statements from my co-authors using a structured template provided by the University of Sunderland. This template includes four categories: idea or conception, methodology, literature review, and editing. These are represented as column headings for each publication listed below. Each author was contacted via email and asked to report my contribution to our collaborative work. I understood that the reporting might not be entirely accurate since the percentages are based on memory, making it challenging to determine exactly how much work each person contributed, even with real-time reporting. Typically, the lead author has the clearest understanding of each author's contributions, as they are responsible for guiding the overall idea, methodology, literature review, and editing of the work. After receiving each co-author's estimated percent contribution, I collated the results into a table for each of the eight works. If any clarifications were needed, I contacted the co-author by phone or email.

In this collaborative effort, each co-author evaluated the percentage of work I contributed, rather than assessing their own contributions. I included my own assessment (JP) to provide a reference point for the reader. Consequently, the figures in the columns for idea generation, methodology, literature review, and editing reflect each co-author's perceived level of effort that I contributed to the work. It’s important to note that these percentages do not add up to 100%.

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update (Parrott et al., 2017)*

| Initials of collaborator | % Idea or conception | % Methodology | % Literature review | % Editing |
|---|---|---|---|---|
| JP | 75 | 75 | 40 | 80 |
| LF | 60 | 60 | 30 | 50 |
| RR | 80 | 50 | 20 | 80 |
| LCD | 30-40 | 40-50 | 40-50 | 70-80 |
| KAI | 50 | 60 | 20 | 99 |
| LMG | 90 | 80 | 20 | 80 |

I volunteered to lead the nutrition RD group to update the 2008 nutrition CPG. So, I was lead author and created the idea (what and how to update) – following a modified AACE for grading of literature and recommendations. Each co-author wrote and edited their chosen nutrient section while I wrote the vitamin D and calcium section. After receiving all nutrient sections, I created one cohesive document and met with authors to clarify any questions or responses to the ASMBS liaison, member comments, and the journal editors with proof queries until final publication.

**Publication 2:** *IFSO-WGO Guidelines on Obesity  Section 5: Lifestyle factors and other non-operative management (IFSO-WGO, 2023)*

I wrote 80-90% of the following sections on pages 97-104 (co-authors could have contributed without my knowledge). This included literature review, write-up, and editing. The nutritional screening prior to metabolic and bariatric surgery includes (1) practicalities of the dietary assessment, (2) prevalence of micronutrient deficiencies before and after surgery with original figure of reported micronutrient deficiencies and specific pre-operative recommendations including (1) pre-op nutritional preparation (2) perioperative pregnancy recommendations with pre and post-MBS considerations and paediatric recommendations. All authors were asked to participate in a Delphi consensus for questions without enough evidence to develop recommendations.

**Publication 3:** *Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery (Parrott, 2014)*

| Initials of collaborator | % Idea or conception | % Methodology | % Literature Review | % Editing |
|---|---|---|---|---|
| JP | 90 | 70 | 90 | 50 |
| JSP | 100 | 80 | 100 | 50 |

This chapter is included in a 2-volume series developed by the ASMBS, to provide a comprehensive guidebook that all disciplines could use when caring for a patient with MBS. I developed the idea for the chapter and

conducted all the literature review, majority of the methodology and half of the editing.

**Publication 4:** *The Optimal Nutritional Programme for Bariatric and Metabolic Surgery (Parrott et al., 2020)*

| Initials of collaborator | % Idea or conception | % Methodology | % Literature Review | % Editing |
|---|---|---|---|---|
| JP | 20 | 40 | 40 | 25 |
| LCD | 25 | 25 | 25 | 15 |
| SLF | 25 | 25 | 25 | 15 |
| MOK | 25 | 25 | 39 | 20 |

MOK recruited the co-authors and identified the thematic framework. Each co-authors wrote their allocated section. JP and MOK reviewed and revised each section into a cohesive paper.

**Publication 5:** *New Concepts in the Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should we Change our Practice? (Parrott, 2021)*

I was the sole author which consisted of 95% of the idea, 100% of methodology, literature review, and editing.

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives (Graham et al., 2023)*

Research into current patient and practitioner beliefs regarding needs and gaps in MBS care for long term patient follow up – impact health care systems “hands-off” in the UK NHS system, but also in the USA health care system.

I contributed to the article review and discussion. Yitka Graham was lead author and created the idea, methodology, literature review and editing.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When? (Parrott et al., 2022)*

A case-control study of a large Northeastern USA program (n=5946 patients) that uses machine learning methods to predict vitamin C deficiency among patients with MBS. Our results indicate that the prevalence of vitamin C deficiency is dramatically higher than anticipated. We presented these results at the IFSO 2022 annual meeting.

| Initials of collaborator | % Idea or conception | % Methodology | % Literature Review | % Editing |
|---|---|---|---|---|
| JP | 90 | 50 | 90 | 70 |
| AP | 75 | 33 | 70 | 70 |
| AR | 80 | 80 | 80 | 80 |

| | | | | |
|---|---|---|---|---|
| JSP | 90 | 55 | 100 | 80 |
| KD | NR | NR | NR | NR |

KD was the Principal Investigator (PI) and two Co-PIs: myself and JSP. I created the study (concept, data collection), developed the IRB forms detailing the study purpose, literature review, data to be collected, methods with JSP (methodologist) and AP (machine learning specialist). I submitted the forms to the IRB initially with KD submitting all modifications. .All co-authors wrote the summary, conclusion and provided editing. I created the power point presentation and presented it at IFSO 2022 and to the research group at the IRB hospital of origin.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)*

This publication follows the previous oral presentation (Publication 7). We emphasized the more novel research approach to our vitamin C deficiency presentation among patients with MBS. This has generated interest from other researchers using machine learning but seemed to miss the mark with reaching clinicians. I plan to create a more practice-based approach to help clinicians with the identification, management, and prevention of vitamin C deficiencies.

| Initials of collaborator | % Idea or conception | % Methodology | % Literature Review | % Editing |
|---|---|---|---|---|
| JP | 80 | 20 | 90 | 80 |
| AP | 75 | 33 | 70 | 70 |
| AR | 80 | 80 | 80 | 80 |
| JSP | 80 | 55 | 100 | 80 |
| KD | NR | NR | NR | NR |

Roles stayed the same as noted in publication 7. I also created and managed the article submission and edits to the journal for publication.

**Context Publication**

**Appendix 1:** *ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008)*

| Initials of collaborator | % Idea or conception | % Methodology | % Literature Review | % Editing |
|---|---|---|---|---|
| JP | 80 | 10 | 20 | 20 |
| LA | NR | 10 | 20 | 10 |
| JB | NR | 10 | 20 | 20 |

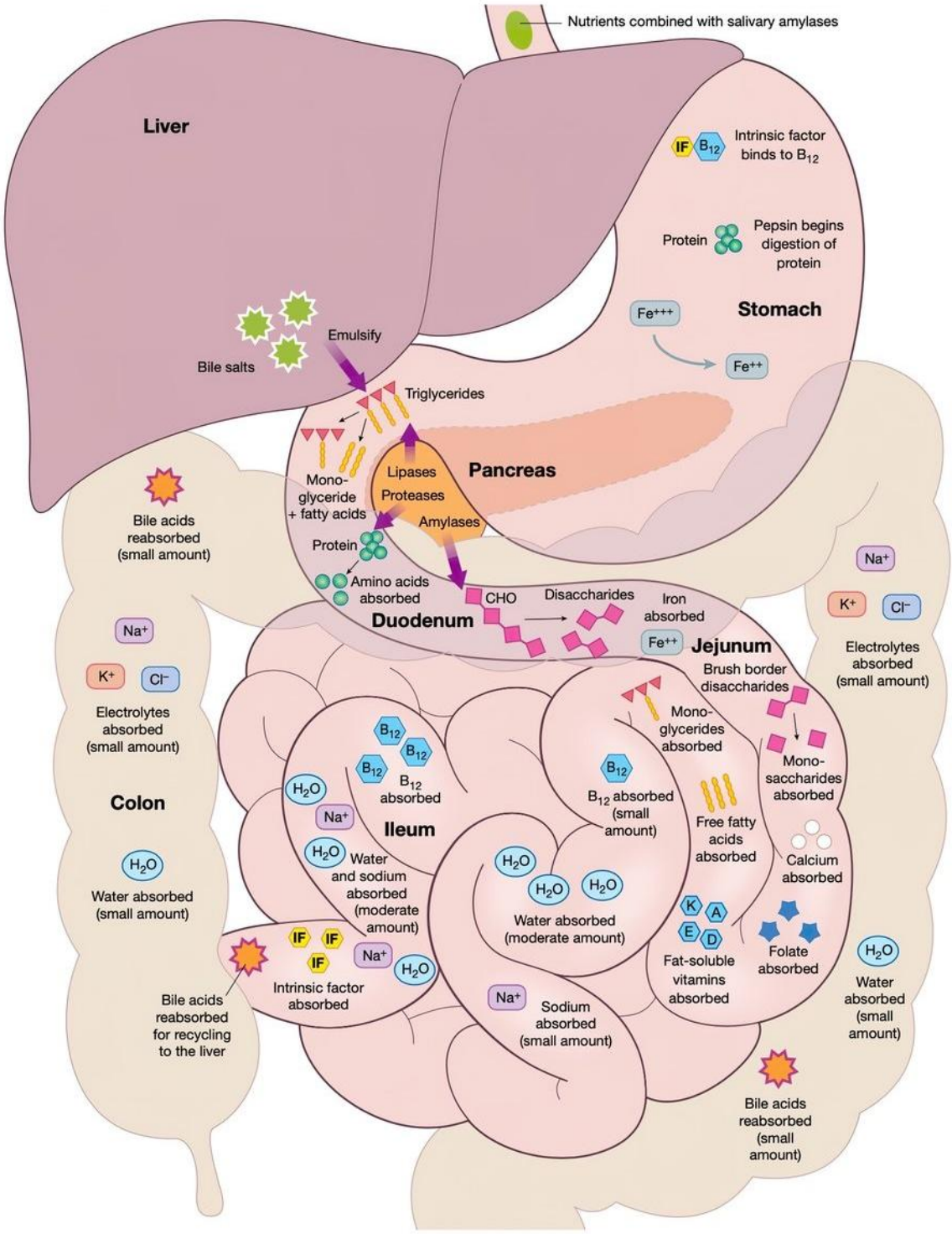
| | | | | |
|---|---|---|---|---|
| CB | 80 | 25 | 20 | 20 |
| MF | 80 | 20 | 20 | 20 |

I created a document for nutrition in MBS CPG following the Academy of Nutrition and Dietetics format. However, the format created by LA and JB was more closely aligned and accepted by the ASMBS. JB was the creator of the document and guided the methodology. Each co-author wrote a section and was responsible for following the pre-determined methodology, the literature review and providing editing. I wrote the vitamin B12 and folate section.

## Chapter 1: Introduction

The nervous, endocrine, and circulatory systems are highly coordinated and regulate the processes that comprise nutrition: digestion, absorption, metabolism, and excretion of nutrients. A normally functioning small intestine is needed to keep a person well-nourished and healthy (Figure 1). Thus, any anatomical alterations can potentially disrupt an individual's normal functioning, nutrition status and overall health (Gropper et al., 2022). Metabolic and bariatric surgery (MBS) alters the gastrointestinal tract —the stomach and for most surgeries the small intestine. Just as there is a physiological need for harmonization among the different components of the “gut” there is an irrefutable need for a symbiotic relationship among the professional and clinical aspects of nutrition care for patients with MBS.

**Figure 1 Digestion and absorption of nutrients**



In the following sections, I provide the context (clinical, professional, and personal) for my research history and agenda. I first give a brief overview of the different MBS procedures and how these differentially affect nutrition status. I assume that a typical reader will be unfamiliar with many of these specialised procedures even if they have heard of bariatric surgery more generally. In the second section, I provide a more detailed examination of the role of nutrition care in bariatric surgery—a contested history that offers a perspective on nutrition practice in MBS both as it is and as it could be.

This perspective is informed by a 25-year history of practising as a Registered Dietitian within MBS as a leader in the profession—holding formal leadership positions in national and international professional associations. My participation in the definition of nutrition care in MBS from the start has defined my clinical and professional positionality which, in turn, has shaped my research positionality. In short, the “why” and the “how” of my research corpus are interpretable only within the context of my development as an MBS nutrition professional and the concomitant development of the dietetics profession within MBS.

I have included personal reflections, highlighted in separate text boxes, to provide valuable insights into my experiences. These reflections are drawn from my own history. While they may not apply to everyone’s situation, I hope they encourage thoughtful consideration and understanding of different perspectives in our varied healthcare systems, cultural practices, and available resources.

## Chapter 2: Literature Review

### Metabolic and Bariatric Surgery (MBS)

The ASMBS/IFSO Guidelines now recommend MBS for individuals with a BMI of 35 or more “regardless of presence, absence, or severity of obesity-related conditions” and that it be considered for people with a BMI 30-34.9 and metabolic disease and in "appropriately selected children and adolescents" (D. Eisenberg et al., 2023).

Types of MBS – endorsed by ASMBS and IFSO

Figure 2 presents the surgeries endorsed by ASMBS. MBS are all metabolic surgeries except one non-metabolic surgery— adjustable gastric band, which does not directly affect the metabolism of nutrients and therefore exerts its effect through restriction. Whereas all other surgeries involve changes to the gut-brain communication via gastric manipulation *(Weight Management Dietetic Practice, 2021)*. For example, one of the changes — decreased secretion of hydrochloric acid, impairs the body’s ability to digest and absorb specific nutrients such as protein, fats, vitamins B12 and iron (Stein et al., 2014).

**Gastric Banding:** nonmetabolic surgery in which an adjustable gastric band (AGB) is placed laparoscopically around the top of the stomach to reduce the physiological capacity. Thus, dietary intake is decreased. The band is adjustable via a port that is placed under the skin and connected via tubing to the band. Saline is injected through the port in small amounts over time —called “adjustments” to provide satiety. This procedure is

typically called the laparoscopic adjustable gastric band (LAGB) *(Weight Management Dietetic Practice, 2021)*.

**Roux-en-Y Gastric Bypass or Gastric Bypass**: metabolic surgery in which the stomach is transected into two parts, creating a small pouch, typically 10-30cc, and a remnant —the larger bypassed, remaining portion of the stomach. The first portion of the small intestine — the duodenum is also bypassed to create a biliopancreatic limb, allowing pancreatic and bile secretions to enter the small intestine and eventually mix with the alimentary or roux limb food bolus into the “common channel”. This procedure creates an alternate route for ingested foods and liquids to be digested and absorbed, which looks like a Y, thus the Roux-en Y name. This procedure has been considered the benchmark since 1967 (Mason, 2005).

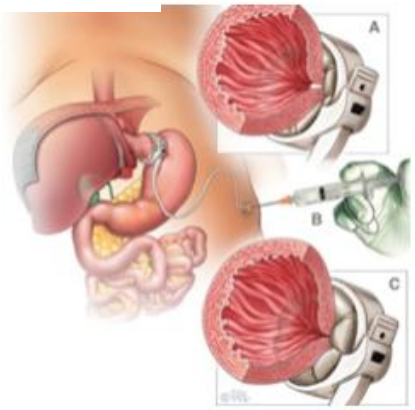
**Sleeve Gastrectomy**: metabolic surgery in which a bougie, a tool used to guide the creation of a new stomach sleeve or narrow tube by following the natural contour of the stomach. Both the pyloric sphincter and intestines remain intact, leaving the foods ingested unaltered. Approximately 75-80% of the stomach— the most expandable portion of the stomach is removed *(Weight Management Dietetic Practice, 2021)*.

**Duodenal Switch (DS) or Biliopancreatic diversion (BPD) with DS**: A patient may first have the Sleeve Gastrectomy and at the same time or later have the second stage – the DS. If two stages are planned, then the Sleeve is made larger to decrease possible malnutrition. The second stage involves leaving the pylorus sphincter intact and a small portion of the

duodenum; yet bypassing about 75% of the small intestine, including the jejunum (middle portion of the small intestine). This malabsorptive component rearranges the small intestine to divert the flow of food from the flow of bile and pancreatic secretions. Then, the biliopancreatic loop joins the digestive loop via the second anastomosis, forming a common channel of 75 to 100 cm (measured from the ileocaecal valve), considerably longer and better for nutrient absorption than the BPD. Two anastomoses are created, allowing for the passage of ingested food from the sleeve to the switched small intestine. Overall, this procedure decreases the amount of calories and nutrients absorbed, creating weight loss (presented below) *(American Society for & Bariatric, 2023; International Federation for the Surgery of & Metabolic)*.

**Figure 2 MBS endorsed by ASMBS and IFSO**

Adjustable Gastric Band




Roux-en-Y Gastric Bypass

Sleeve Gastrectomy

Duodenal Switch

© Dr Levent Efe, courtesy of IFSO

Types of MBS – endorsed by IFSO

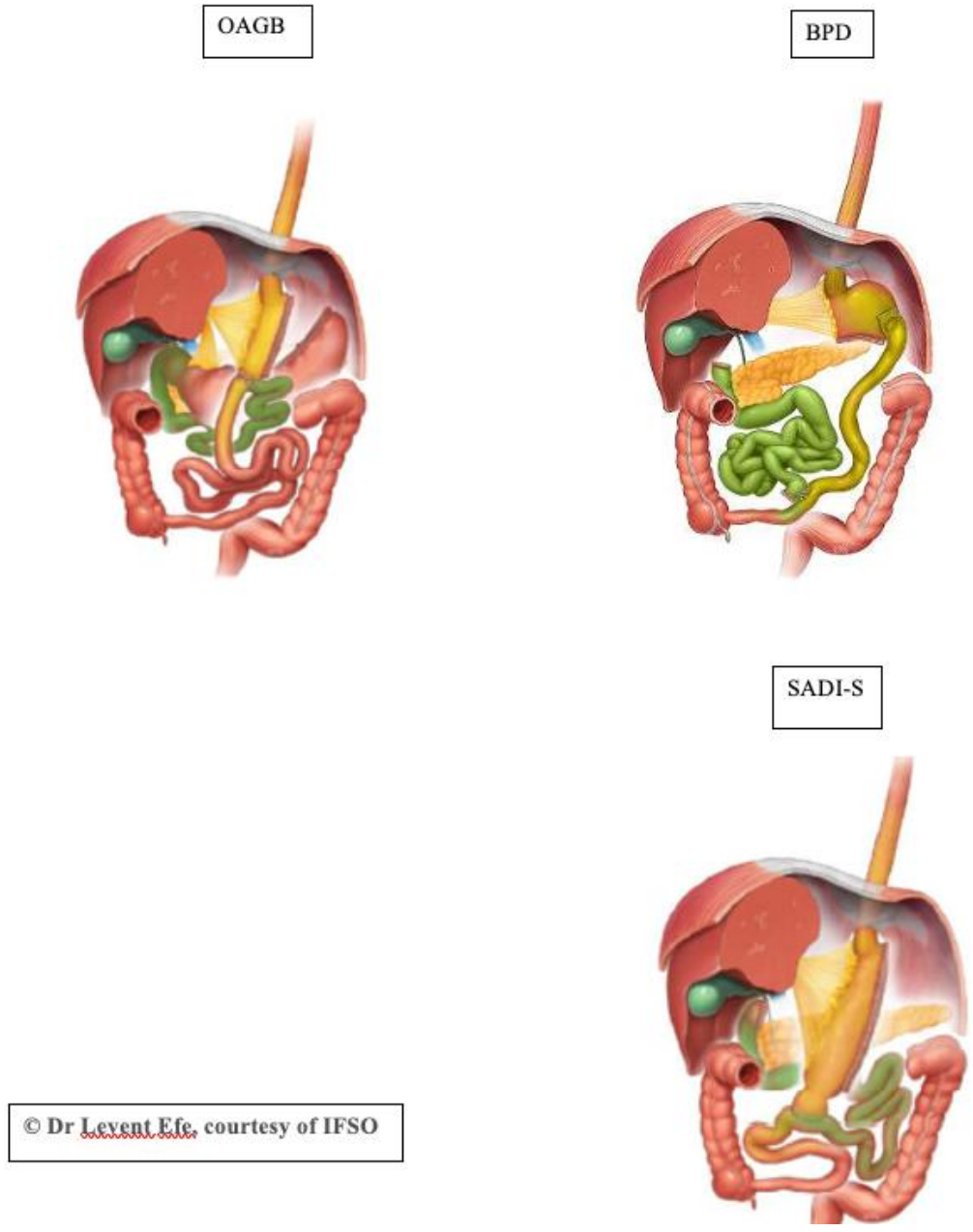
See Figure 3 for types of MBS endorsed by IFSO. All the prior procedures plus the additional three presented here, commonly performed internationally, are approved by IFSO. There are five regional chapters within IFSO, including the North American chapter (NAC), which is comprised of Canada and ASMBS from the United States."Why do the two primary MBS organizations endorse procedures differently?" The American College of Surgeons (ACS) and the local hospital systems has more stringent guidelines for approved procedures. The following procedures promote some malabsorption; thus, patients need to be more closely monitored to avoid nutrient deficiencies.

**Single Anastomosis Gastric Bypass (OAGB)-** a long and narrow restrictive lesser-curvature gastric pouch is created. Then a 150-200 cm jejunal bypass with a gastro-jejunal anastomosis is created; causing significant fat malabsorption and weight loss *(International Federation for the Surgery of & Metabolic)*.

**Biliopancreatic Diversion (BPD)-** creates a smaller stomach similar to the RYGB. It changes normal digestion by bypassing a large portion of the small intestine (duodenum and jejunum) and finally connecting to the ileum via a gastro-ileal anastomosis, about 250 cm from the ileocecal valve. The common channel is measured 50 cm from the ileo-caecal valve, thus providing very limited mixing of pancreatic and bile secretions, resulting in hypoproteinaemia and fat-soluble vitamin deficiencies *(International Federation for the Surgery of & Metabolic)*.

**Single Anastomosis Duodenal-Ileal bypass with Sleeve (SADI-S)-** a procedure intended to simplify the BPD-DS by creating only one anastomosis between the duodenal stump and jejunum versus the two created in the RYGB, BPD, and BPD-DS. In the first step a sleeve gastrectomy is created with almost 80% of the stomach removed. Next the jejunum, middle portion of the small intestine, is bypassed so that a connection or anastomosis between the duodenum and ileum is made to facilitate passage of ingested food. Similar or greater weight loss has been achieved in this procedure compared to the RYGB *(International Federation for the Surgery of & Metabolic)*.

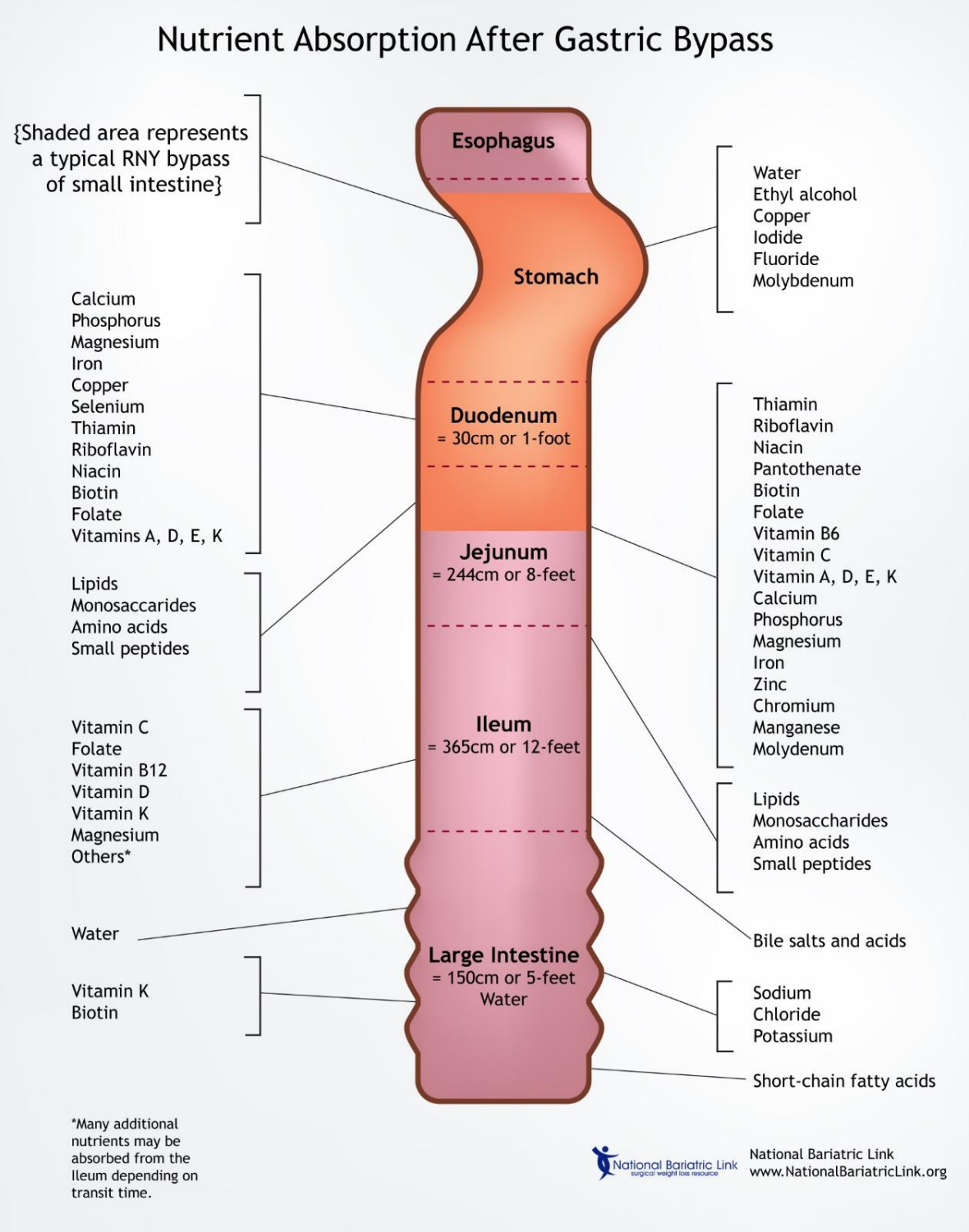
**Figure 3 MBS endorsed by IFSO**



Nutrient uptake and absorption affected by procedures

In addition to desirable outcomes, there are also undesirable sequelae of bariatric surgery – due to surgically induced physiological changes. Nutrient absorption (Figure 4) is affected by altered biliary and pancreatic functions, intestinal transit time and gastric secretion as well as bypassing primary sites of absorption (duodenum) (Stein et al., 2014).

**Figure 4 Sites of nutrient absorption**



Despite the beneficiary effect of bariatric procedures, MBS puts patients at high risk of poor nutritional status; thus, ensuring there is robust nutritional support readily available for patients who underwent MBS is of vital essence (Table 1) (Bahardoust et al., 2022; Parrott et al., 2020).

The need to monitor nutrient status is well-established and supported by ongoing research (Stein et al., 2014; Xia et al., 2023). Unfortunately, data regarding diet or supplements alongside surgical interventions continues to be inconsistently collected. This tends to minimise the role of nutrient status by creating an illusion of patient well-being since nutrients are not reported as complications. Thus, an “out of sight, out of mind” attitude may be taken towards this important aspect of patient care.

**Table 1 Nutrients potentially affected by MBS**

| Yes ✓, No X<br>High Risk +, Low Risk - | SG | RYGB | OAGB | DS | SADI-S |
|---|---|---|---|---|---|
| **Thiamine (B1)** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Vitamin B12** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Folate** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Iron** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Vitamin D and Calcium** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Vitamins A, E, K** | - | +Vit A | ✓ | + | + |
| **Zinc** | ✓ | ✓ | ✓ | + | + |
| **Copper** | - | ✓ | ✓ | + | + |
| **Selenium** | ✓ | ✓ | ✓ | + | + |
| **Lipids** | X | X | ✓ | + | + |
| **Protein** | X | X | ✓ | + | + |

The following factors are associated with nutrient deficiencies in patients after MBS:

- Amount and location of removed/bypassed stomach
- Shortening or bypassing portions of the small intestine
- Length of the common limb channel (portion of the small intestine where food and digestive enzymes mix after passing through the stomach)
    - A shorter common channel means more malabsorption:
        - DS > SADIs > OAGB > RYGB
- Bile production and availability to mix with nutrients

**The role of the Registered Dietitian in MBS**

To understand the significance of my research positionality, it is first crucial to understand my clinical positionality—the former proceeds from the latter. As with all healthcare professions, dietetics in the United States (USA) developed over time and involved explicitly mapping out the expertise and scope of practice of the dietitian in healthcare—often with reference to the professional boundaries of other healthcare professions.

Medical Nutrition Therapy and the Nutrition Care Process

A key step in defining the current identity of dietitians within the USA healthcare institution occurred in 1994 with the introduction of the term “Medical Nutrition Therapy” (MNT) (Pastors et al., 2002). The choice to use the terms “medical” and “therapy” was a clear effort to position the profession as an integral part of the clinical care team—both terms

signalling alignment with the historically well-established medical profession. MNT involves two phases: (1) assessment of the nutritional status of the patient or client, and (2) treatment, which includes nutrition therapy, counselling, and the use of specialised nutritional supplements (Pastors et al., 2002).

Chronology of the role of the dietitian

This may seem unremarkable now, but this was a radical step away from the previous association of the profession of dietetics as somehow associated with *cooking*. Like many things, it was war that gave the initial impetus for the development of the dietetics profession. Indeed, the origin of the dietetics profession has been traced back to the work of Florence Nightingale during the Crimean War (1854) (Hwalla & Koleilat, 2004). Upon her arrival in Crimea and finding the barracks hospital in utter confusion, some of her first tasks were to begin cooking, establish an extra kitchen for the patients, and organise cooking services for the soldiers. While the recognition that optimal nutrition was vital for human health and performance was critical, the clear association was with functional *cooking* rather than *therapeutic intervention.*

It makes sense that women were not supposed to be highly educated or given opportunities to become highly educated up until the 1800s. They were essentially tied to the home and “expected to be ladies” (Cassell, 1990). This association between nutrition care as “cooking” was further strengthened when, in 1881, Sara Tyson Rorer—the first USA dietitian—founded the Philadelphia Cooking School. Here she started a “diet kitchen

‘where *physicians* could send a *prescription* and get food prepared for special diseases’” [emphasis mine] (Hwalla 2004). So, while the importance of nutrition was recognised, it was still clearly the (male) physician (and their knowledge and skills) that was in charge of the nutrition *therapy*. Even in the early part of the 20th century, specialised diets were often named after the (again, male) *physicians* who prescribed them. (Notably, we still see remnants of this proclivity in the “Atkins diet”—how many diets can the reader think of named after a [female] dietitian?).

Hearth Versus Blade: Embodiment of larger cultural categories

It is against this historical backdrop that encoded the dietitian/female/cooking versus physician/male/therapy dichotomy that the significance of the term “Medical Nutrition Therapy” should be understood.

**Reflection:**

It is notable that this occurred during my first professional position after obtaining my Bachelor of Science in Scientific Nutrition, which included four biochemistry courses, while working as a Foodservice Supervisor in a hospital kitchen. I was horrified to encounter a male physician requesting that my boss and Director of the Nutrition department (who had her master’s degree in nutrition and had practised many years as a Renal Dietitian) personally stop her work to make him a piece of toast from the hospital kitchen. Clearly, from my experience in the late 1980s, females and dietitians were still not ‘out of the kitchen’.

The unspoken dichotomy of structured cultural categories evident in my personal experience in Texas aligns with the larger cultural categories described in Riane Eisler's "Chalice and the Blade". She depicts a dominator model—a patriarchy—where one half of society dominates the other, in contrast to a partnership model in which neither group is considered superior or inferior. Eisler explores the turning point from a prior balanced equipoise toward these long-standing preconceived biases and prejudices, which give rise to a "naturally occurring" imbalance in the experiences I describe which have been embedded within medicine, nutrition, and dietetics in the United States (USA). In line with these larger cultural categories that shape the way we understand the world, there is an inherent bias within medicine to think of nutrition as a field "close to the hearth" or "in the kitchen" instead of a field in which meaningful change can be made within a patient's life (Eisler, 1987).

The blade versus chalice imagery is apt because it also signals an entire range of cultural associations—none of which particularly benefit the Nutrition profession. Following Eisler, we might imagine these cultural categories aligning in the following manner (Table 2):

**Table 2 Cultural structural dichotomies as they relate to nutrition in MBS**

| Blade | Chalice |
|---|---|
| Male | Female |
| White | Non-White |
| Medicine | Nutrition |
| Active | Passive |
| Analytic | Holistic |
| Science-Centred | Person-Centred |
| Public | Home/Hearth |

These structural dichotomies are not mere ideas or remnants of patriarchal Western culture. In the tension between the medical and nutrition professions, we see instances of these categories (and their implication for power relations) actively reproduced and normalized. To see this in action, we need only ask: what counts as active therapy and who gets to define that? For that answer, we need to re-examine the intertwined histories of two professions in the USA: the medical profession and the nutrition profession (Figure 5).

The American Medical Association (AMA), founded in 1847 (the last years of the USA Civil War), has the regulatory ability to define both what "counts" as medical therapy as well as (at least as important) what does

not count. The latter part of the 19th century saw a growth in medical schools—some of which were associated with teaching universities, but most were smaller, more diverse (i.e., a growth in medical schools catering to recently emancipated Black Americans to provide physicians for the formerly slave community), and more heterogeneous in terms of therapies (e.g., including non-allopathic forms of treatment). In response to this, in 1908, the AMA founded the Council on Medical Education to establish the science-based biomedical model as the core of medical education. With the support of the Carnegie Foundation, the Flexner Report was commissioned and released in 1910 (Duffy, 2011). This had the effect of delegitimizing medical education that was not associated with teaching universities and resulted in the closing of 75% of USA medical schools, ultimately providing access to only upper-class (white, male) students (Wright-Mendoza, 2019).

Notably, the key therapies now defined as legitimate were those associated with prescriptive authority. Therapies that did not have rigorous scientific support (note that the first vitamin, thiamine, was not discovered until 1926) were delegitimized as true (i.e., science-based) interventions. The result was to relegate nutrition (and females in general), once again, back into “the kitchen”. But could the events that happened over a century ago have such an impact on the current practice of nutrition care in MBS? Unfortunately, as Eisler points out, cultural structures persist and a true partnership between surgery and nutrition had not yet evolved in MBS care.

**Reflection:**

An example of an "unbalanced partnership" can be seen in my work in 2000 as a clinical nutrition specialist and MBS study coordinator in the Midwestern USA. I was involved in many aspects of the program and research, specifically enrolling our clinical program in the lap band research trials. During this time, I collaborated with a highly skilled male laparoscopic surgeon, who was recruited to the university hospital for his expertise.

During our clinic sessions, I asked him where the rest of the program was, particularly the multidisciplinary aspects. His response was, "I am the program". This statement reflects the medical model promoted by the Flexner Report nearly 90 years ago and highlights the cultural expectations surrounding male leadership in healthcare, which were still prevalent 25 years ago.

To provide some context, I was responsible for the nutrition component of the program, but psychological evaluations and other specialties were not yet included. As a result, when patients needed to (1) lose weight to meet equipment weight maximums, they were instructed to leave, lose weight (20-50 lbs), and return only after achieving that weight loss and (2) find their own psychologist to do evaluations.

## Legitimizing nutrition as therapy: the science of nutrition and the growth of the American Dietetic Association

At about the same time, the medical profession in USA was retrenching to redefine medical education and practice as the domain of the white, male

upper class; the convergence of science and the practice of nutrition was happening in parallel.

## The advent of nutrition as a science

If nutrition lacked a firm scientific basis in 1910, that was soon to change. Within just four years of each other, the American Home Economics Association (AHEA,1908) and the Federation of American Societies for Experimental Biology (FASEB, 1912) were founded. While the AHEA, was still focused largely on “home”, it was significant in three respects: (1) it was founded by a woman and made up primarily of women, (2) it sought to integrate science into home management, and (3) it had an “outward”, public health facing orientation (providing education to the working classes). Soon thereafter, FASEB was formed in 1912 as a forum and collective voice for biological and biomedical research and policy. Both these organizations shared a combined scientific and public policy orientation and, significantly, were open to both men and women. However, these two organizations were still largely parallel rather than integrated. But that was about to change, and it was again war that provided the impetus.

This integration of nutrition, science and public health was pushed further with the USA's entry into WWI. Dietitians were actively recruited to serve in WWI and the first military dietitian began her foreign military tour of duty in 1917. It was war that again prompted the move out of the home kitchen, but this time, there was a solid science requirement to do so. Dietitians

were required to have two years of college majoring in home economics and have at least four months of practical experience (Cassell, 1990).

After WW1 and following the discovery of the first vitamin (thiamine [B1]) in 1926 and vitamin C in 1932 (Mozaffarian et al., 2018), The American Institute for Nutrition (AIN) was founded in 1928 as the first scientific society *dedicated* to nutrition science. Its members included both male and female biochemists and physiologists. In 1940, AIN became an associate member of FASEB (FASEB, 2024).

What is important about these social changes, again, to use Eisler's framework, is that they began to blur the hearth/public, food/science, and male/female dichotomies that were entrenched within the medical profession just over a decade earlier. Women brought science into the kitchen, but science took nutrition and women back into the public space.

**Reflection:**

My journey into the field of nutrition and dietetics began in a context that balanced both scientific inquiry and practical application. FASEB was the first national scientific conference I attended, where I was selected to present my Master's thesis (in the UK it is a dissertation) research on the Dietary Intake and Growth Patterns of Children with Autism. Though female attendance at research universities during the first part of the 20th century may have been a rarity, by the time I entered the field, I had access to many brilliant female scientists as mentors — including the chair of my committee. In my early experience, science—and by extension, nutrition—

was no longer an “old boys club”, and this, no doubt, shaped my perspective on what the nature of nutrition practice should be. However, at the time, I was unaware of the diligent work that female practitioners (dietitians) had made in the previous 80 years to define the profession into which I was entering (Cassell, 1990).

The long road to nutrition as therapy

Given the changes that were happening with science, nutrition, public health and, of course, war, it should come as no surprise that the American Dietetic Association (ADA) was founded in 1918 (as a product of the AHEA and, at this point, all female). Although men were accepted as non-active members, the first male Dietitian was “mistakenly” granted active membership in 1921 (Cassell, 1990). Yet, the formation of the ADA and its role in society was not met without resistance from medical professionals. In 1922, at the 5$^{th}$ annual meeting of the ADA, a guest speaker, Dr. Howard, MD, presented “Shoemakers, Stick to Your Last” effectively delivered as “Dietitians, Stay in Your Kitchen”—seeking to reinforce the normalized cultural dichotomies. His presentation was wildly unpopular. However, it did highlight the fact that there was still much work to do for the profession of dietetics to become firmly institutionalised as a key part of the healthcare team. Stereotypical prejudices aside, the larger society increasingly realised the importance of nutrition and the role of dietitians in healthcare. A pivotal moment in this regard was when, in 1930, M.T. MacEachern, surgeon and president of the American Hospital Association and an honorary member of ADA, wrote a specific requirement for an RD into the hospital accreditation manual (Cassell,

1990). Within just a year, 22 out of 86 AMA-approved medical schools offered nutrition courses, and 12 required one course in 3rd year.

It is important to note that while 1930 was a significant moment for the recognition of nutrition as a key part of comprehensive healthcare, this was more a matter of bringing nutrition into the medical realm than allowing women into the boy's club. Indeed, according to the historical data compiled by Moehling et al 2019, the proportion of women physicians was at its lowest point, 4%, since the 1910 Flexner report (Moehling et al., 2019). Prior to the end of WWII, all-male medical schools encountered increasing pressure to admit female students. In fact, Harvard Medical School contemplated this until the school's male students presented a petition, stating that "whenever a woman proved herself capable of intellectual achievement, the area in question cease to constitute an honour to the men who had previously prized it". It wasn't until 1945 that Harvard finally admitted women to the medical school (Moehling et al., 2019). Due to the medical reform or "shutdown and shut out", women enrolled in medical school and practising as physicians declined and did not return to their 1900 level until after 1960 (Moehling et al., 2019). The impetus for the increased medical school enrolment by women occurred when a class-action lawsuit was filed in 1970 against all medical school admissions for discrimination against women (Moehling et al., 2019). Title IX of the Education Amendments Act of 1972 prohibited discrimination on the basis of gender (Moehling et al., 2019). Subsequently, enrolment by women increased from 9% in 1970 to 21% in 1976 (300% higher than 1940) and in 2019 to just over 50% (Moehling et al., 2019).

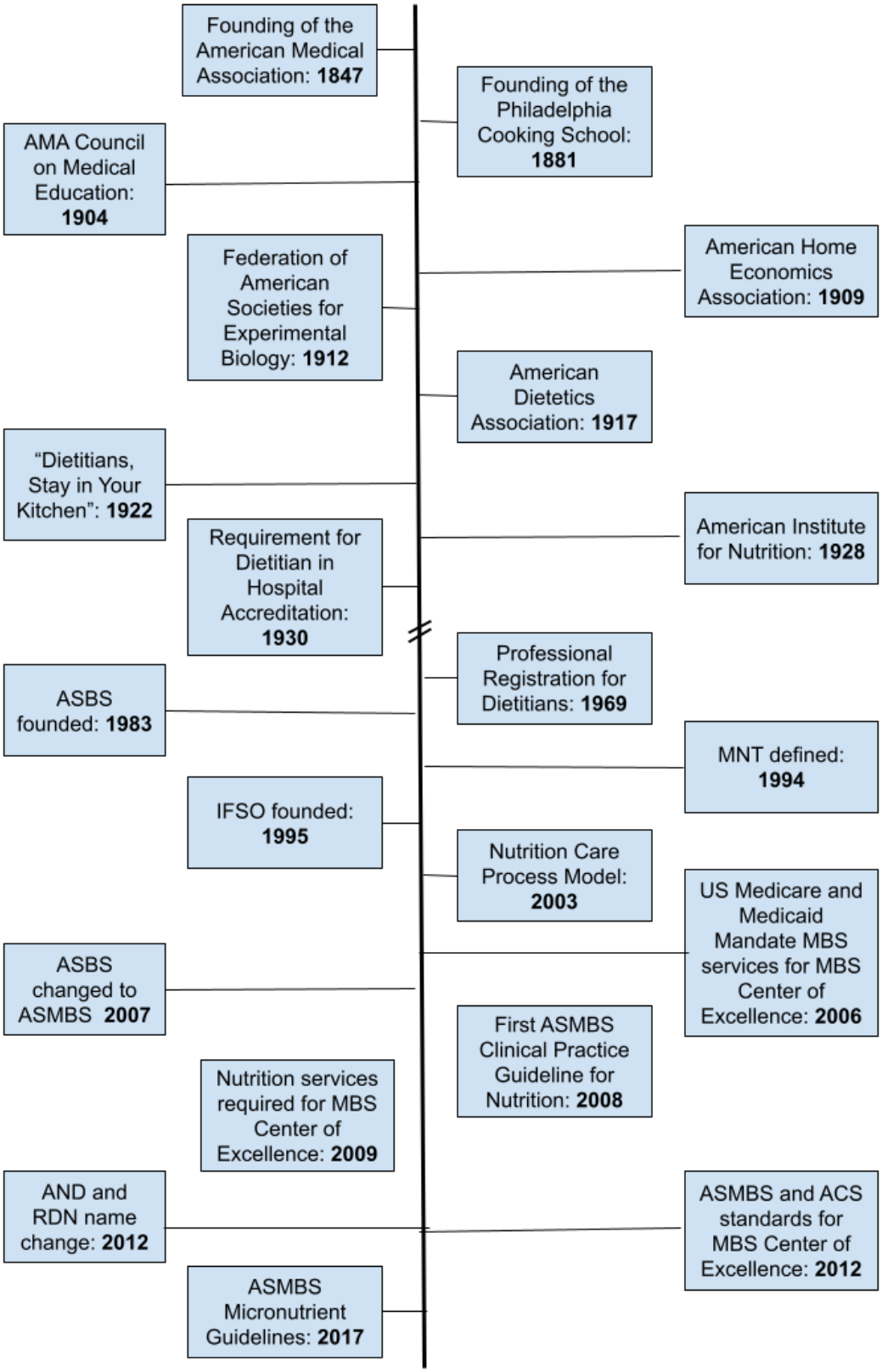
It wasn't until the 1960s that the profession of dietetics in the USA began to take its now recognisable form. This time, the push came not from war but from the government. In 1960, the National Office of Vital Statics and the National Health Survey merged to form the National Center for Health Statistics (NCHS). In 1965, the NCHS requested a definition of "dietitian and nutritionist" as there was some confusion for the upcoming publication of the 1965 Health Resources Statistics report. It turns out that formulating this definition (establishing a clear professional identity) was contentious. In 1960, the Hospital, Institution, and Educational Food Service Society (HIEFSS) formed a close working relationship with the ADA and many members of the ADA were involved in food service (rather than what later became known as Medical Nutrition Therapy). So, it was not until 1972 that a final report from the Study Commission on Dietetics presented a definition for dietitian as "a translator of the *science* of nutrition into the skill of furnishing optimal nourishment of people". Though this definition left many dietitians in food service administration feeling excluded by the terminology, the professional identity was now established, and science was clearly at the front and centre (Cassell, 1990).

The definition of Medical Nutrition Therapy was still over 20 years away, and it was during this intervening period that the American Society for Bariatric Surgery (ASBS) was formed (1983). So, within the context of MBS, the next phase of the development of the MBS Dietitian is intertwined with the development of MBS as a surgical sub-profession.

## Further development of two professions: Dietetics and MBS

Throughout my professional career, the advancements in Nutrition and Dietetics, along with the establishment of MBS as a recognized surgical specialty in the USA, are closely connected (Figure 5).

**Figure 5 Timeline of nutrition in MBS**



The effort to define nutrition care as therapy progressed in 2003 when the ADA adopted a Nutrition Care Process and Model (NCPM) that included the medical term “diagnosis”, identified the unique contribution of dietetics practitioners to health care outcomes, and established a global standard for the provision of nutrition care by dietetics practitioners. The goal of the NCPM is to improve the quality, consistency, and predictability of patient outcomes with a four-step process (Hammond et al., 2014; Swan et al., 2017). This process was divided into “problem-identification” (the first two steps (Nutrition assessment and Diagnosis) and “problem-solving” (the second two steps: Nutrition Intervention and Monitoring and Evaluation) (Swan et al., 2017). The model is unidirectional, but in practice, it is dynamic and multidirectional to allow for critical thinking and incorporation of new information within the ongoing monitoring and evaluation of a patient (Swan et al., 2017).

1. Nutrition Assessment
2. Nutrition Diagnosis
3. Nutrition Intervention
4. Nutrition Monitoring and Evaluation

Similar to the evolving NCP, the title for Registered Dietitians (RD) has also changed from “therapeutic dietitians” to “clinical dietitians” and in 2012 to “registered dietitian nutritionists” (RDN) (Hammond et al., 2014). The professional society name, ADA also changed in the same year to The Academy of Nutrition and Dietetics (AND), signifying the combining of

Dietetics and Nutritionists. An RD can be a Nutritionist (RDN), but a Nutritionist in the USA cannot be an RD without meeting AND criteria.

Currently, an RDN's scope of practice (SOP) is determined by education, training, credentialing, experience, and demonstrating and documenting competence to practice (subject to state regulations). The individual scope of practice in nutrition and dietetics has flexible boundaries to capture the breadth of the individual's professional practice. Professional advancement beyond the core education and supervised practice to qualify for the RDN credential provides RDNs practice opportunities, such as expanded roles within an organization (such as a hospital) and within each state, licensure based on training and certifications.

Medical Nutrition Therapy and multidisciplinary patient care in MBS

The guidance for working with patients who had MBS was minimal up until 2008 when the first ASMBS clinical practice guidelines (2008) were published. In my experience up to this point, nutritional care was often directed by surgeons and based on anecdotal beliefs regarding their impact on patient care (e.g., "patients shouldn't eat any white-colored foods" or "patients should not eat red Jello post-operatively due to the possibility of associating the color with bleeding") versus research to substantiate recommendations. It could be compared to the "Wild West" with the lack of specific guidance for the nutrition care of patients with MBS. However, over the previous two decades, it had become increasingly clear across the field of MBS that because MBS affects more than just a patient's weight—it has dramatic implications for all body

systems and the person as a whole—MBS care requires a supportive network of integrated health professionals who work together to help a patient with MBS adapt to the altered anatomy, metabolism, and lifestyle. MBS requires pre- and post-operative support from a variety of disciplines: medicine, nutrition, psychology, and exercise physiology as well as gastro-intestinal services, haematology and other medical specialties. For some practitioners, however, this was evident early on (Figure 6) (Patel & Saumoy, 2021).

**Figure 6 Multidisciplinary team involved in MBS**


The Integrated Health team approach combines a spectrum of disciplines to support the short- and long-term health goals of patients with MBS. The multidisciplinary approach has been recognised by the National Institutes of Health (*NIH*), the American College of Surgeons (*ACS*), and the American Society for Bariatric Surgery/Society of American Gastrointestinal and Endoscopic Surgeons (*ASBS/SAGES*).

A multidisciplinary team (MDT) can help assess and manage the patient's modifiable risk factors with the goal of decreasing potential perioperative complications. A Registered Dietitian (RD/RDN) with experience in MBS can assist the MDT by providing the patient's comprehensive weight history, identifying maladaptive eating behaviours or patterns and correcting MND preoperatively. Moreover, the RD can help patients understand how to better manage postoperative food intolerances and malabsorption issues, as well as to prevent, manage and treat MND and facilitate weight loss while preventing weight regain (Dan Eisenberg et al., 2023).

During this "wild west" period, however, I was fortunate enough to work with clinical teams who had a broader vision of the role of nutrition in MBS. As a clinical professional, I was afforded a level of autonomy that was, perhaps, unusual at the time. As I did then and still do now, I weave nutrition into patient visits as part of their overall lifestyle and medical history.

**Reflection:**

For example, I assessed the patient's energy level. If they were tired, why—forgetting vitamins, protein, not sleeping well, or something else? Had the patient seen a medical provider recently? If not, I requested that appointment. Had the patient completed their regularly scheduled lab work? Did they have deficiencies? Were they taking their lifelong recommended supplements? Were they experiencing financial constraints that might

affect their ability to purchase the necessary supplements?

How did any of these seemingly incongruous issues have anything to do with nutrition? Early on, I realised that since MBS changes a person's body, it changes their lifestyle, their support network, and their ability to cope with daily stresses. I also knew that nutrition plays a huge role in any of these factors, particularly if the nutrition status is compromised.

Fortunately, the recognition that MBS affects all aspects of a person's life was gaining traction in the broader field. Thus, in 2006, the USA Centers for Medicare and Medicaid mandated that MBS would be covered by Medicare only when performed at a Center of Excellence or at an American College of Surgeons (ACS) Level 1 bariatric surgery centre. Then, in 2012, ASMBS and ACS combined their certifications to create one set of excellence criteria (Sugerman, 2013). Thus, the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) was formed.

Center of Excellence standards for MBS: road to standardising nutrition care

Prior to 2003, nutrition had a multitude of recommendations and very little standardisation across procedures, as did bariatric surgeons and MBS programs prior to 2006. Standards were created for both surgeons and programs to improve the depth and breadth of services available in communities (Elrod & Fortenberry, 2017).

The inclusion of nutrition care as part of the Center of Excellence (COE) criteria was not immediate. Even though a collaboration was established in November 2003 between ASMBS and the Surgical Review Corporation (SRC), nutrition did not become a designated component of the MBS COE programs in the United States until 2009 (Pratt et al., 2006). Significantly, this occurred after the publication of the first nutrition care guideline in MBS in 2008. But first came the recognition that nutrition complications were common in MBS. As the ASMBS Bariatric Surgery COE indicated in 2006:

> *"The applicant maintains documentation of a program dedicated to a goal of long-term patient follow-up of 75% at 5 years, with a monitoring and tracking system for outcomes. The applicant also maintains an agreement to provide a yearly outcome summary to the SRC in a manner consistent with HIPAA regulations. This requirement is based on the observation that a significant number of patients develop nutritional deficiencies, return of previous emotional disorders, as well as other late complications related to their procedure. There is no requirement that the surgeon provide the follow-up personally, only that he or she is aware of the long-term status of the patient as provided by a certified and licensed healthcare provider. Accordingly, the follow-up data can be gathered during group sessions, reunions, or through visits to other physicians' offices. The applicant agrees to enter all patients who undergo surgery in the group or individual practice; no patients will be excluded" (Pratt et al., 2006).*

In 2007, ASMBS had a busy year. The Certified Bariatric Nurse (CBN) program was established in June 2007, and ASBS changed its name to ASMBS. "Metabolism" was introduced into the then-professional bariatric surgery society name, the American Society for Bariatric Surgery (ASBS), to demonstrate the all-encompassing effect of bariatric surgery upon "metabolic diseases", particularly type 2 diabetes and obesity. However, it

seems the recognition that the broader understanding of “metabolism”—meaning *all* the processes in the human body necessary to convert food into energy—was overlooked. On August 15, 2007, the ASBS became the American Society for Metabolic and Bariatric Surgery (ASMBS). I recall thinking somewhat sceptically during the voting process that the organisation might have trouble living up to its new name.

Then, in 2009 and significantly after the publication of the first ASMBS nutrition care guideline in MBS (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008) the Bariatric Surgery Center of Excellence (BSCOE) standards were revised to specify professions, far surpassing mere recognition of the problem and record-keeping requirements.

> *“Multidisciplinary care is integral to the treatment of a bariatric patient and is required for BSCOE designation. The multidisciplinary team assembled at a BSCOE generally includes nutritionists, psychologists, pulmonologists, cardiologists and other medical specialists trained in bariatric care” [emphasis mine] (Pratt et al., 2006).*

The 2022 update of the MBSAQIP standards now includes specifications for obesity medicine services. These specially designated MBSAQIP-Accredited Centers with Obesity Medicine Qualifications must have in place all the following care pathways developed by the Obesity Medicine Director:

1. Comprehensive medical examination
2. Evaluation of medical complications related to obesity
3. Assessment of personal and family history of obesity
4. Laboratory testing
5. Nutrition counselling

6. Fitness and exercise counselling
7. Behaviour and lifestyle counselling
8. Anti-obesity medication
9. Evaluation and treatment for abnormal weight gain

While the specification of nutrition as part of the required component of a COE is now essential, what is *not* specified within the standards are clear definitions of the scope of practice. For instance, who can and should carry out nutritional counselling? Only a registered RD, or does that also fall within the scope of a psychologist or behaviour change specialist? Who can and should be responsible for the interpretation of laboratory testing values? Only a medical professional, or is this within the dietitian's scope as well (consistent with the Academy of Nutrition and Dietetics (AND) clearly defined Nutrition Care Process and the past two MBS nutrition guidelines) (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008; Hammond et al., 2014; Parrott et al., 2017; Splett & Myers, 2001; Swan et al., 2017)?

Why has the Identification and interpretation of nutrition-related biochemical results within an outpatient MBS setting declined, or even more importantly, why is this well-document foundational component of the Nutrition Assessment step within the Nutrition Care Process (NCP) considered the purview of other MBS team members, when this clearly falls within the scope of practice and training of an RD? In short, the above list could be read as identifying the role of the RD exclusively with nutrition

counselling while excluding the clinical aspects, evaluation and assessment of laboratory testing from the scope of the RD.

This ambiguity in the scope of practice is confounded or exacerbated by the difference in terminology describing how nutrition interventions are described in the nutrition care process versus the COE in Obesity Medicine standards/criteria: “medical nutrition *therapy”* in NCP versus “nutrition *counselling”* in MBSAQIP.

- The first, “therapy”, connotes the provision of a treatment intended to relieve or heal a disorder (which need not include any type of behaviour change, e.g., provision of enteral or parenteral nutrition, provision of iron infusion, blood-glucose monitoring, limiting the intake of some electrolytes for patients in renal dialysis).
- The second, “counselling”, explicitly denotes interventions designed to bring about cognitive or behavioural change.

In MBS, do dietitians assess, diagnose, treat, and monitor nutrition conditions, or do they simply counsel patients on healthy eating habits? This is ambiguous, both in the document and in practice. Of note, the original MNT definition distinguishes between nutrition therapy and counselling. To make matters worse, this confusion has been magnified by the more recent efforts of the AND Weight Management Dietetic Practice Group.

Academy of Nutrition and Dietetics (AND) weight management: a move away from therapy to counselling

The following section is a personal account. While many of the changes to the nutrition and MBS surgery professions described above happened during my lifetime, the following account records my involvement in a shift that I consider detrimental to nutrition care in MBS. This is a first-person account—history as I experienced it. Doubtless, others involved in the same set of events would tell slightly different stories. However, to truly understand my clinical positionality and how my research positionality flows from it, some autobiographical perspective is warranted.

Within the Academy of Nutrition and Dietetics there are subspecialty groups called dietetic practice groups (DPGs). The weight management DPG (WMDPG) was created in the early 2000s. At the time, three sub-units were developed within the WMDPG to address obesity and weight management more comprehensively:

1. Bariatrics
2. Paediatrics
3. Health Coaching

I became the first Chair of the Bariatrics sub-units. In this role, I began a collaboration with the RD lead for ASMBS so we could discuss building bridges for gaps in RD professional services. While I could not get support from AND WM DPG to develop clinical practice guidelines in bariatric surgery, we were able to get support from ASMBS. So, in 2004, under the

auspices of the newly formed ASMBS nutrition sub-committee (including an RD with extensive research experience), we developed the 2008 bariatric clinical practice guideline (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008). We had two male surgeon advisors and three additional expert co-authors under Harvey Sugarman, the founding editor of the ASMBS journal Surgery for Obesity and Related Diseases. The lead RD was responsible for reporting the CPG committee's progress to ASMBS Executive Council meetings. This process took four years. Only one of the surgeons remained as an active advisor to our committee. During this time, our group and a few other expert RDs who had been working in the USA, with bariatric surgery patients joined together to develop educational seminars, webinars, and sessions for the annual meetings with the goal of providing education specific to MNT in MBS to RDs and other healthcare providers.

It is important to note that these original nutrition practice guidelines in MBS took care to distinguish the therapeutic actions commonly associated with medical practice identified within the Nutrition Care Process (lab value monitoring and nutritional supplementation) from counselling. As the first sentence of the guideline states:

> *"It is common knowledge that a comprehensive bariatric program includes nutritional supplementation guidance, routine monitoring of the patient's physical/mental well-being, laboratory values, and frequent counselling to reinforce nutrition education, behaviour modification, and principles of responsible self-care" (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008).*

Both MN *therapy as* well as *counselling* are vital for dietetic practice within MBS, but the concepts are distinct and ought to be clearly operationally defined and delineated.

However, other changes were happening within the larger field of weight management that threatened to undo or at least confuse the distinction between therapy and counselling within MBS. At about the same time, the nutrition guidelines were being formulated, counselling or “readiness to change” via motivational interviewing began gaining attention within the broader obesity arena because many patients were struggling to lose weight and, at the time, the general perspective was that losing weight was primarily about the patient’s “will power”. This type of therapy, along with cognitive behavioural therapy and, more recently, dialectical behavioural therapy, has been helpful when dealing with health goals and behaviour change for achieving modest non-surgical weight loss (Spahn et al., 2010). However, motivational interviewing in particular, is arguably less critical with MBS preparation (pre-operatively) than it is in non-surgical weight management treatment because many patients will and should have already gone through behavioural weight management programs (many as a requirement for insurance coverage for MBS and surgery should be a final option after other non-surgical options have failed) and have been unsuccessful with the “will power” route (Dan Eisenberg et al., 2023). By this time, the patient often knows what they need – surgery, i.e., they are ready to change. So, by the time a patient is ready for MBS, they need MNT because of the physiological changes and resulting nutritional sequelae they will encounter (Parrott & Parrott, 2014).

For example, the AND Pocket Guide to Bariatric Surgery, 1st edition 2009—in which I was one of eight reviewers—included lab reviews and nutrition-focused physical findings (in the nutrition assessment) while there was no section on nutrition counselling, as included in the more recent 2014 and 2021 editions. Conversely, even though reviewing labs is listed as integral to the RD assessment of nutrition status in the 2021 edition, there is no lab review incorporated into the sample Nutrition Assessment documentation, while seven pages are devoted to nutrition counselling techniques. Once again, “out of sight – out of mind”.

Another example of misplaced focus within the nutrition and MBS arena involves emphasising the effects of surgery, not MNT. Six RDs with extensive experience in MBS volunteered for the AND Evidence-Based Practice Committee to conduct a systematic review of nutrition-related practices in MBS between 2003 and 2015. Even though micronutrient deficiencies pre – and post-MBS are well-documented, and the prevalence of nutrient deficiencies continues to rise (Parrott et al., 2017), none of the four research questions addressed nutrient deficiencies or prevention in any capacity. This was a crucial missed opportunity by RD experts in MBS. Two of the four research questions focused on the effect of MNT on behaviour change and weight loss, and the other two looked at the impact of *surgery* — not MNT— upon resting metabolic rate and energy intake (Andromalos et al., 2019).

Lack of MBS RD Specialist Certification

In 2007, ASMBS nurses successfully established a credentialing certificate program: Certified Bariatric Nurse. A Certified Bariatric Nurse (CBN) is a specialty certification for registered nurses (RN) in the USA and internationally (qualification determined on an individual basis) (ASMBS, 2023). The CBN status helps identify nurses with expertise and experience working with patients with MBS (ASMBS, 2023). This triumph for nurses in ASMBS motivated RDs to lobby for a specialist certification to recognise and standardise the specialised knowledge and skills required for nutrition care in MBS. This is important because even though I have taught the Micronutrient section of the CBN courses at several ASMBS conferences and presented numerous educational sessions for advanced-level practitioners and clinicians, as well as internationally presented research and sessions regarding nutrition in MBS at IFSO conferences and endorsed courses, there is not an equivalent certification route for advanced-level RDs. So, this means that any level of nutrition expertise in MBS has to be earned in an alternate pathway rather than through a certification course (Parrott et al., 2020; Schiavo, Pilone, Rossetti, & Iannelli, 2019).

Several years after implementing the CBN certification, I served on the Executive Council with ASMBS and met with the ASMBS Integrated Health President to discuss the possibility of a similar program for RDs. There was agreement that enough RDs worked in the MBS field to make the certification cost-effective. The Academy of Nutrition and Dietetics

(AND) also expressed an interest in collaborating with ASMBS to create the RD MBS certification. AND already had certificate courses in obesity: Paediatrics, Adult, and Advanced Obesity & Weight Management. However, these courses contained no MBS information (I know because I attended all three multi-day certification courses). Thus, it seemed at the time that a distinct certification path for nutrition care in MBS, recognizing the importance of both nutrition therapy and nutrition counseling, was finally becoming a reality.

However, our hope for the new certification was short-lived. Fiscal issues and a lack of understanding of the long-term physiological and metabolic realities ultimately left the MBS nutrition community with no certification. A reality of certification programs is that they cost time and money to create and implement. As I noted above regarding my conversations within ASMBS, one of the first concerns was whether there was enough demand for a specialist MBS nutrition certification to make the time and effort worth the cost. However, certification programs may also be considered revenue generators for some outside MBS (or even within the field, whose interests differ from those of the practising clinician).

Unfortunately, the interest in the new certification focused more on revenue for AND than on recognising and standardising nutrition practice in MBS. It was proposed that more money stood to be made if a more general certification, open to any integrated health practitioner, were developed. On the face of it, broadening the certification, in and of itself, may not seem to be a critical problem (though, for many of us in the field

at the time, it had the distinct feel of dietitians, once again, being relegated to a sort of second-class status as health professionals). However, because of the concomitant shift toward behavioural change counselling within the broader obesity management field (described above), expanding the certification beyond MBS nutrition care resulted in a redirection in the planned focus of the certification content away from the laboratory aspects of medical nutrition therapy to behavioural change counselling.

One of the main stakeholders from AND lobbied strongly (and, unfortunately, successfully) for this wider approach to a specialty certification and, in so doing, imported her own (counseling-centric) perspective into the process. Thus, the original idea was abandoned in favour of a more inclusive specialty board certification in Obesity and Weight Management available to RDs and any integrated health member who met specific qualifications. The new exam and preparation materials had very little information about bariatric therapy. Surprisingly, only 12% of the current certification exam (February 2024) is made up of questions about Medical Nutrition Therapy (MNT), which includes topics such as caloric and protein needs, vitamin B12 deficiency symptoms, and counselling. Out of the 125 questions on the exam, none of the 15 bariatric-related questions specifically cover nutrition-related labs. This seems ironic considering that one of the reasons for establishing the MBS Center of Excellence certification was to acknowledge the long-term health issues related to micronutrient deficiencies. Although, at the time, there was much discussion, dispute, and feelings of betrayal, our initial effort

ultimately became a certification with a preparatory course that generated money for AND with minimal bariatric information relevant to MNT.

> **Reflection**:
>
> One of the RD champions for the new AND Obesity Specialty certification and session presenter at a national MBS conference announced to an audience of surgeons and integrated health clinicians that…
>
> "After 1-2 years, all patients with MBS should be treated the same as any weight management patient."
>
> I don't think the evidence reporting long-term MND in patients with MBS supports this viewpoint that was unfortunately presented to several hundred clinicians.

The above account is meant to clarify my clinical positionality and set the stage so that the reader can understand my research positionality—why I have done and continue to do the type of research I do. Lest the reader has any remaining questions, my clinical and, thus, research positionality focuses squarely on the medical and empirical aspects of patient nutrition care in MBS.

<u>The clinical nutrition labs space is empty – no one is "in charge"</u>

The implication of the above historical and professional change in the USA is serious. An entire generation of RDs (with some notable exceptions) are being trained in such a way that a crucial part of their scope of practice is being hidden from them. The above account should make clear that, in a sense, I currently work in an empty space—no one profession is primarily

responsible for monitoring nutrition therapy, specifically micronutrient deficiencies, for a multitude of reasons: lack of training (many dietitians working in MBS, as well as most mid-level clinicians and surgeons), time (clinicians are already overwhelmed), comfort (relatively few clinicians have a deep understanding of how micronutrients are implicated in different metabolic pathways), and interest may be focused on counselling to the detriment of assessing nutrient status.

In some cases, lab results are unavailable to Dietitians. Still, as with all healthcare practitioners, the problem *du jour* takes precedence and claims much of the clinician's time and effort interacting with a patient. So, the review of lab results either falls to someone else on the team or lab results are not addressed. If labs do get reviewed, they may be incorrectly interpreted by a provider looking simply at the "abnormal" levels for patients without MBS. In fact, iron deficiency is often completely missed (Parrott, 2021).

**Reflection:**

I choose to work in this area – because I understand the importance of micronutrients as the biological underpinnings of all behaviour, diet, activity, and cognition. Without a fully functioning micronutrient status, a person's energy level is compromised –from ATP production at a cellular level to a person's ability to make choices at a cognitive and behavioural level.

What is possible: Nutrition Scope of Practice (SOP) and Standards of Performance Practice (SOPP)

This empty space need not exist—indeed, it should not exist. The dietetics scope of practice (SOP) and standards of professional performance (SOPP) both provide ample flexibility and opportunity for dietitians to stake out their legitimate claim to be the primary profession responsible for the whole of medical nutrition therapy (and not just counselling) in MBS. Additional training is available to RDs, but they must seek the training in order to expand their scope.

RDs are encouraged to pursue additional training and experience to maintain currency and expand their individual SOP within the boundaries of the legal SOP, as defined by each state law (if applicable) and federal regulations. The Academy of Nutrition and Dietetics (AND) has a Scope of Practice Decision Algorithm that helps to ensure RDs have the knowledge, skills, education, and training to practice within a specific area ("Academy of Nutrition and Dietetics: Revised 2017 Scope of Practice for the Registered Dietitian Nutritionist," 2018; Andersen et al., 2018; Registration, 2022).

The four SOPs in nutrition care and six SOPPs describe a minimum competency level of nutrition and dietetics practice and professional performance. SOPs and SOPPs are self-evaluation tools. The standard operating procedures (SOPs) in nutrition care apply to practitioners responsible for the well-being of patients, clients, or populations. ("Academy of Nutrition and Dietetics: Revised 2017 Standards of Practice

in Nutrition Care and Standards of Professional Performance for Registered Dietitian Nutritionists," 2018).

**Reflection:**

Even though the professional scope of practice permits dietitians to provide nutritional therapy beyond counseling, how can this be implemented in a field where dietitians are mainly viewed as pseudo-counselors? While I don't have a solution for the entire profession, I have found that cultivating two essential therapeutic skills define me as a dietitian rather than just a nutrition counsellor: (1) the ability to interpret lab values, order labs, and prescribe remediation, and (2) the ability to carry out nutrition-focused physical examinations.

While some surgeons understand and advocate for optimal nutrition status, some still insist that MND could not be the cause of physiological complications.

**Reflection**:

I met with a patient who had recently visited the Emergency Department (ED). During her visit, she reported symptoms including paresthesia, an inability to tolerate vitamins, nausea, and vomiting. Additionally, she experienced blurry vision and rapidly declined from walking independently to occasionally using a walker, eventually becoming completely dependent on a wheelchair by the time we met two weeks later. The patient had been active on support group websites for patients with MBS, where she discussed her symptoms and was encouraged to ask her surgeon about a

potential vitamin deficiency, specifically thiamine. She had raised this concern with her surgeon both in the ED and at her follow-up appointment, only to be told that it was too soon after her surgery to develop a vitamin deficiency. During our office visit, I addressed the patient's concerns while encouraging her to discuss nutrition-related issues with me or other RD specialists rather than the surgeon. I've found that the best way to diffuse a patient's frustration/ anger is to be simple and direct: "You have an excellent surgeon and dietitian. I don't think you want me performing your surgery, just as you wouldn't want the surgeon to handle your nutrition." This reinforces the importance of each professional's role and positively redirects the conversation.

I had no access to prescription thiamine, so I strongly encouraged her to start taking a specific over-the-counter thiamine supplement (three times a day) in addition to her other vitamins. I also advised her to change her routine for taking her bariatric multivitamin from the morning to nighttime. She tolerated both changes well, and within 1.5 months, she was fully mobile, with no paresthesia or vision problems. However, despite patients becoming more educated about MND, especially thiamin, some surgeons still overlook these issues and attribute the symptoms to a strange disorder of unknown etiology.

Biochemical data, including labs

The ambiguity regarding whether dietitians have the specialised knowledge to interpret or order labs is not simply a result of surgeon or clinician bias. The nutrition profession is currently unclear on the

positionality of the dietitian regarding biochemical data and labs. If the nutrition profession is not clear, then how could other professions have a clear understanding of the dietitian's scope of practice?

**Reflection:**

I have needed to establish a therapeutic space to practice MNT in MBS. Most RDs in MBS do not work in this area, and when entering a new practice, I found that I must tread gently at first by developing rapport and a foundation of trust with other members of my MBS team (surgeons, mid-level practitioners and RDs). I have had to prove that I am competent and able to assess and interpret biochemical data, medical tests, and some procedures even though this is part of an RD's scope of practice and basic nutrition assessment "Assesses laboratory profiles (e.g., acid-base balance, renal function, endocrine function, inflammatory response, vitamin/mineral profile, lipid profile), and medical tests and procedures (e.g., gastrointestinal study, metabolic rate)" listed in §1.3 of the RD Nutrition Assessment (Andersen et al., 2018; Charuhas Macris et al., 2018; Tewksbury et al., 2022). It has been a continued uphill battle to practice MNT in this space. Other healthcare members (including RDs) are not accustomed to working with RDs who assess labs and frequently do not know how to use the assistance.

Part of this issue could be that the AND SOP does not clearly connect the Nutrition Assessment Sections (§) 1.3 and 1.4 lab and NFPE assessment to the next step in the NCP Nutrition Intervention/ Plan of Care. Additionally, only one out of 44 indicators in the nutrition assessment

mentions labs: §3.12A1 “Implements, initiates, or modifies orders for therapeutic diet, *nutrition-related pharmacotherapy management*, or nutrition-related services”. Should we blindly assume that RDs will follow through with labs and NFPE in metabolic and bariatric surgery (MBS) as §3.12D suggests? The statement in §3.12D states that RDs "Implement critical thinking and synthesis to guide decision making in concurrent conditions (e.g., pre/post metabolic and bariatric surgery, post-bariatric surgery vitamin deficiencies)." But is this assumption valid?

**Reflection:**

If the idea of an MBS RD interpreting labs is foreign, the idea of an RD *ordering* labs is often beyond comprehension. However, I have now worked in three institutions where I was finally afforded the opportunity to order or pend labs. But, as I noted above, this ability is not immediately recognised (as it might be if there were a specialist certification that acknowledged this ability). Instead, it takes time (often years) to gain the recognition and respect of surgeons and mid/advanced-level clinicians to practice in this manner.

Beyond merely interpreting labs and identifying patients at risk, a key skill is to know the appropriate lines of therapy—or, in the words of the SOP and Nutrition Intervention/ Plan of Care §3.6C “tailor nutrition prescription to meet nutrient and energy needs” and §3.12B “addresses topics with patient/ client as outlined in nutrition prescription when developing the plan of care” (Tewksbury et al., 2022). In the USA, an RD typically does not have independent authority to either order labs or prescriptions. Thus, step

by step, once my expertise is recognised, I am finally allowed the ability to pend orders. This recognition process requires a huge amount of effort and patience.

It is worth indicating how different this is from other professions within the MBS field. For instance, from the first moment a physician is licensed to be an independent practitioner, they have all the resources they need to care for patients. In contrast, dietitians are forced to *individually* fight to have their skill sets recognised and their scope of practice respected. This can be exhausting and so it is no surprise that many dietitians are content to simply stay within the counselling space relegated to them by the vague MBS standards.

Nutrition-focused physical examination (NFPE)

A second component of MNT that is relevant for MBS and moves beyond the counselling space is the Nutrition-focused physical examination (NFPE) as part of the RD SOP and listed in Standard 1.4 of the RD Nutrition Assessment. NFPE may include visual and physical examination: Obtains and assesses findings from NFPE (e.g., indicators of vitamin/mineral deficiency/toxicity, oedema, muscle wasting, subcutaneous fat loss, altered body composition, oral health, feeding ability [suck/swallow/breathe], appetite, and affect) (Tewksbury et al., 2022).

During the COVID-19 pandemic there was a switch to virtual practice. As my clinical practice as an RD remains virtual and/or hybrid, I have adopted

a modified version of the NFPE which allows for a more observational type of assessment. This type of nutrition-focused physical assessment (NFPA) has been recommended as an alternate tool to monitor nutrient deficiencies and appropriate supplementation in patients (Esper, 2015).

**Reflection:**

NFPE has been one of my practices that helps substantiate pending lab orders yet seems alien to my RD team members. Recently, I suggested a collaborative opportunity to standardize our team's nutrition assessment knowledge by sharing the cost of a virtual NFPE training. Given that NFPE is a fundamental requirement for practicing Registered Dietitians (RDs) in the USA and it has been an incredibly powerful tool helping me communicate to the healthcare team patient symptoms and severity of a patient's micronutrient deficiencies; I was optimistic about this initiative. However, to my disappointment, none of the four RDs took advantage of this chance to earn 23 continuing education hours at a significantly reduced price.

Unfortunately, NFPE does not seem to be a skill widely recognized in MBS and outpatient weight management clinics. This is in stark contrast to other nutrition subdisciplines where NFPE is more commonly used, such as nutrition support [parenteral and enteral nutrition] and critical care, including dialysis and organ transplant).

This disparity highlights a need for increased awareness and training in NFPE within the MBS community to

ensure comprehensive nutrition assessments are part of our practice.

The missing ‘M’: missing the micronutrient in ‘metabolic’

Micronutrient deficiencies, often referred to as "hidden hunger", are prevalent in the general healthy population as well as in medical-surgical patients, posing a significant threat to public health worldwide. Over 2 billion people are affected by these deficiencies, not only patients with MBS (Berger et al., 2019; Wang et al., 2023). Hidden hunger, a form of undernutrition associated with MND, has implications for cognitive function, the immune system, and other organ systems. Since the reference ranges for biochemical tests in patients with MBS have not been precisely established, the adequacy of preventing and treating MND via the recognition of symptoms and appropriate dosing requires much expertise and clinical judgment (Berger et al., 2019). Typically, MND occurs by limited access to foods, reduction of intake and malabsorption. Patients with MBS have an additional factor— altered anatomy which can affect intake, digestion, absorption, metabolism, and excretion – all of the physiological processes that make up nutrition status. By missing the fact that nutrients, specifically micronutrients are vital for metabolism, thus human functioning, clinicians of all types without this understanding risk being blind to how integral these nutrients are for the ‘metabolic’ nature of MBS.

# Chapter 3: Methodology and Positionality

## Axiology

The purpose of this chapter is to present both my own personal position and the position of the work forming this thesis with reference to the specific building blocks that form my overall research paradigm: Axiology, Ontology, Epistemology, Methodology, Methods and Sources (Brown & Dueñas, 2020).

I was told I was a “WYSIWYG” when I was very young. In other words, “what you see is what you get”. Even then I was a forerunner of action since the computer term, “WYSIWYG” wasn’t developed until the early 1970s. Whether human or computer – the application is pragmatic – seeing things as they are AND working for things as they should be. This orientation later defined my fundamental axiological position: looking for a better way of accomplishing goals. This emphasis on “what works” has prevented me from assuming that there is only one way of thinking, believing, or acting. Instead, like any good craftsperson, the key is to use whatever tools are available to reach the goal.

Prince, one of my favourite artists, sang “She’s never satisfied” in his song “When Doves Cry” (a top ten song of mine). I interpret this in a positive manner to mean she is always looking for a better way to do something; that is - not settling for the status quo. Additionally, my parents, the early influencers in my life and who were born during the “Silent Generation” provided living examples of working hard to make the most out of life. My

mother demonstrated that creativity is the key to living life. In fact, she demonstrated that if “there is a will – there is a way”. While my father who was a tenacious workhorse and had a pragmatic approach to life, showed me that if he did not have the tools he needed, he would create them. For example, he wanted to sail, but did not have a boat. So, he built his own sailboat and took me and my siblings sailing. Or a more mundane example, whenever appliances needed to be fixed, my father would use duct tape and whatever else he had on hand to make it work (maybe not the best way, but nonetheless a pragmatic way).

**Ontology**

Using whatever tools are “ready to hand” or “handy” may sound simple. However, the world is a wickedly complex environment in which to bring about change (Sturmberg & Martin, 2022). I tend to approach life by looking for patterns within complex systems and ask questions such as “what is missing?” or “what will work best for this situation, person, program, etc.?” or “what can we do better?” (Long et al., 2018) I’ve learned how to be tenacious and look for ways to renegotiate “what is” to “what it could be – better”. The implications are clear: reality is messy, complex so that overly “pure” ontological paradigms like Realism or Interpretivism are more limiting than liberating. For some problems (e.g., approaches to patient-centred care), the personally and socially constructed world of the patient is paramount. For other problems (e.g., which molecular pathways are implicated in micronutrient deficiencies), the most useful operational hypothesis is to assume the hard objectivity of

diseases that have no respect for how humans think about them. This pragmatic type of ontology is evident with my publications and the use of multiple approaches to answer the following questions:

- Clinical Practice Guidelines – How can RDs (Registered Dietitians) provide optimal nutrition care to patients in bariatric surgery without evidence-grounded standards or guidelines?
- Best Practices – How do we provide the best nutrition care for our patients without some trailblazers directing practice via published reviews, consensus statements, or other?
- Primary Research – What and why are MND overlooked as part of the metabolic component in the nutrition assessment for patients with MBS?

These questions can all be answered by balancing hard science with interpretive science (e.g. how a patient constructs their main problem or goal) taking facts (positivist paradigm) to answer a question by focusing on what is important to the patient (constructivist paradigm) (Brown & Dueñas, 2020). Essentially, the key is to take a middle-of-the-road stance (or better yet, “change lanes” as needed) with the goal of finding what works.

**Epistemology**

Philosopher William James stated it flatly: Truth is what works (James, 1907). In line with this thinking, I want to find the best method that will provide the best change /answer to the problem at hand. So, I use a

pragmatic approach to my research and clinical practice—relying, based on the need, sometimes on what is observable and sometimes on what is interpreted. The question asked or the information needed (such as a developing clinical practice guideline versus identifying micronutrient deficiencies in patients) shapes “what counts as true”, which in turn determines the appropriate methodology and methods I use. Hence, I enjoy working with various research methodologies associated with both the positivist and constructivist epistemology. I don’t see the need to limit how change is created by aligning with only one epistemology; for example, drawing on a positivist epistemology and its associated objective empirical testing of a hypothesis versus the interpretive subjective approach to reality by a constructivist epistemology when trying to understand a patient’s lifeworld (Habermas, 1987). I see no virtue in operating as if there is only one way to do things. I pride myself on seeing at least two sides to every problem and being flexible with my thinking. The pragmatic approach to problem-solving is critical when working with patients in clinical care (Long et al., 2018). Furthermore, there does not need to be an incompatibility or separation of quantitative and qualitative methodology for research when we have the opportunity to use the best of both worlds (Wahyuni, 2012).

Published works and the associated epistemology

Since the research question and the goal at hand drives the pragmatist approach to epistemology, each of the published works has been

categorized into its respective research paradigm by looking at the associated epistemology:

CPGs and Best Practices use secondary research, the review of published works (literature review) to determine recommendations, based on a specific question(s) (usually PICOT or PICO) (Parrott et al., 2020). *Pragmatism* (application of “hard” clinical science to “soft” patient care) was implicated in the PICO used to compare different interventions related to a prognosis, diagnosis or therapeutic intervention (Jahan et al., 2016).

CPGs, particularly in the United States, have a power relationship component in which the RD is set apart (conspicuously *less than*, truth be told) from the surgeon and other midlevel practitioners: Integrated Health versus Surgeons. For the past two ASMBS Integrated Health (IH) CPGs, the RDs have developed the IH CPG from their own set of resources and strictly on volunteer time (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008; Parrott et al., 2017). In stark contrast, the surgeon CPG co-authors have been fully supported with resources from the ASMBS such as a librarian, access to journals and articles and even paid writers. Unfortunately, this leaves the “nutrition” CPG and the “Surgeon” CPG to essentially compete. In fact, authors of the most recent ASMBS CPG (Mechanick et al., 2020) publication, did not contact the lead author for permission or even as a courtesy to use the tables produced in the ASMBS Nutrition CPG (Parrott et al., 2017). Clearly, it is considered perfectly appropriate for the work done by members of a largely female profession (88.3%) to be appropriated by a historically male dominated

profession (Registration., 2023). Sadly, there is not the unified multi-disciplinary approach of RDs and surgeons co-creating a CPG for nutrition in MBS in the USA such as BOMSS CPG in the UK (O'Kane et al., 2020). This could be considered a *Critical Theory – knowledge is not neutral or objective but is shaped by the social and political context in which it is produced.*

The dominant group constructs the world in a way that may become "the way the world works". However, other research presents alternative viewpoints.

Long-term follow-up care uses qualitative research to understand the patient's perspective on the meaning of MBS. Constructivism emphasizes that individuals construct their own knowledge through direct experience and learning from new experiences. However, the patient's perspective may differ from the surgeon's perspective on “how the world works”.

The editorial on changing iron deficiency diagnostic practices (Parrott, 2021) illustrates the co-creation of the shared version of “how the world works”. the authors of the study conducted primary research to determine if their new approach to diagnosing a nutrient deficiency (iron) was more accurate when assessing patients with MBS. They then posited the new criteria as a question to practitioners: should we change our practice (Benotti et al., 2020)? Given that empirical facts do not interpret themselves (humans must create meaning—ideally, collectively—from the raw data itself) what is true proceeds from dialogue within a community of practice. My invited commentary (Parrott, 2021) then addressed the

question in a constructivist manner – by creating a conversation between the publication, authors and clinicians.

Constructivism and positivism both share a common feature - the identification of patterns. In our primary research, "What We Are Missing Using Machine Learning Models to Predict Vitamin C Deficiency in Patients with MBS", we delved into the patterns between vitamin C deficiency and other characteristics. These previously unseen deficiencies were predicted by machine learning models. Our research was initiated by recognizing patterns in patients with MBS who were experiencing unexplained symptoms. Once these patterns were discovered, we needed to interpret their significance: what do they mean for patient health and practice? Positivism and constructivism are not opposing concepts; rather, they should be used together to maximize the quality of patient care.

**Theoretical perspectives**

I look for the explanation/answer that best fits the facts AND the patient's input into the question or concern. I then work back and forth between the scientific hard facts and the more subjective experience of the patient to meet the goal or answer the question(s). Thus, I use a pragmatist approach within pluralistic ontologies and epistemologies to address problems. For example, working with patients or creating clinical practice guidelines occurs within complex adaptive systems – the healthcare system (Fuyane, 2021). In fact, these "wicked problems" do not have clear and formulaic answers due to the interconnectedness and interdependency of hierarchically nested systems (Sturmberg & Martin,

2022). Ultimately, which theory I use depends upon the goal and the problem to be solved.

## Methodologies

Mixed methods and a combination of other research methods have been used to provide the best and most meaningful information to answer questions in the nutrition care of bariatric surgery patients across several levels of nested systems, including: the individual, population health, and the health service system (Long et al., 2018). Additionally, because the focus of my research has spanned general practices and networks, hospitals and their associated networks, and national programs, adopting methods to address the realities of complex adaptive systems has been necessary. Thus, a pragmatic approach to methodology (as well as form of communication) has been used in my research (consistent with the epistemological foundation mentioned above) (Long et al., 2018).

Table 3 provides a summary of the methodological aspects of my collected publications along with a brief description of the ethical considerations and the level of the conceptual framework the publication targeted.

### Tailoring the method to fit the problem: evolution of needs

As is clear in Table 3, the methodologies reflected in my body of research has changed over time. There is a simple reason for this: the methods changed in response to the general needs in the field at the time and in response to needs identified from previous research.

My earlier works reflect the need to summarize and systematize the extant knowledge regarding nutrition care in MBS to create clinical practice guidelines (Table 3, publications 1 and 2). However, this work identified two additional areas for further research: (1) principles by which guidelines could be implemented and adapted within different MBS practices (best practice research; Table 3, publications 3-5) as well as (2) topics that had limited research available (and so required additional primary research to fill the knowledge gap; Table 3, publications 6-8).

**Table 3 Matrix of methodological, ethical and conceptual aspects of collected publications**

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| Clinical Practice Guidelines (CPG) | | | | | |
| 1 | ASMBS Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update: | Each author used a modified AACE template to search, screen, review, and extract data | Systematic review of primary research, using modified AACE process to | Not all RDs had formal education in research, so risk of bias and grading of articles were adapted. ASMBS had an internal system of approving a CPG once a CPG was | **Megasystem** Policies - CPG should have facilitated a change in standards for MBSAQIP or COE to avoid *missing criteria in the COE standards.*<br><br>**Macrosystem** - ASMBS Industry standards for vitamin /mineral formulation – “patient (pt) needs to take x amount of vitamins.” |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | Micronutrients 2017 | from PubMed, Embase, for their section. Total 269 references: 75 non-primary research; 194 primary research articles. | GRADE articles and CPG recs – similar to ASMBS surgeon CPG. | created, but ASMBS provided no system for creating a CPG (systematic review with grading of recommendation) thus, I had to decide which tool RD for co-authors to use. | **Mesosystem** -BSG – "pt needs to take the recommended vitamins."<br><br>**Microsystem** - Pt adherence taking mvi as a measure of inter and intrapersonal:<br><br>**-Interpersonal** - Pt talking to HCP, family, etc. "I think these vitamins taste horrible."<br><br>**-Intrapersonal** Pt belief– "I need to take vitamins." |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| Clinical Practice Guidelines | | | | | |
| 2 | Lifestyle Changes and Other Non-Operative management IFSO-WGO Guidelines on Obesity 2023 | Review of relevant pre-op and post-op nutrition screening 6 CPG, consensus or review and 21 | Narrative review of most current research for lifestyle changes and non-surgical management of obesity | IFSO and WGO updated 2010 WGO Obesity CPG. Authors were vetted based on their work. To avoid conflict of interest, a transparent process to develop and implement Delphi | **Megasystem** – n/a<br><br>**Macrosystem** – 2010 Obesity CPG updated by collaboration: WGO/IFSO.<br><br>**Mesosystem** – Gastroenterology practices and specialists should review CPG to modify their existing practice/ program.<br><br>**Microsystem- Interpersonal -** n/a |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | | other references | plus Delphi consensus. | survey clearly stated and available. | **Microsystem- Intrapersonal-** n/a |
| Best Practices | | | | | |
| 3 | Nutrition Care Across the Weight Loss Surgery Process, 2014 | Relevant information reviewed from pt perspective: 3 CPGs, best practices for 42 total articles. | Narrative review | Important pt perspective to nutrition care peri-MBS within a narrative analysis. | **Megasystem** – n/a<br>**Macrosystem** – n/a<br>**Mesosystem** – Program and support group collaborative approach to setting goals and expectations<br>**Microsystem Interpersonal** – n/a<br>**Microsystem Intrapersonal** – n/a |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| Best Practices | | | | | |
| 4 | The Optimal Nutritional Programme for Bariatric and Metabolic Surgery, 2020 | Each author searched, screened, reviewed, and extracted relevant data for their section, a total of 89 references. | Narrative review from 4 expert co-authors who summarized key findings from CPG and peer-reviewed publications. | There were some terminology and slight practice differences among co-authors from 3 different countries discovered when reviewing the paper. These were amicably resolved. | **Megasystem** – n/a<br><br>**Macrosystem** - international collaboration of nutrition experts – used within IFSO and research<br><br>**Mesosystem** - HCP, RD, BSG, MBS program all communicate with each other and reinforce ideas, practices with the pt<br><br>**Microsystem Interpersonal** – n/a<br><br>**Microsystem Intrapersonal** – n/a |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| Best Practices | | | | | |
| 5 | Invited commentary: "New Concepts in the Diagnosis and Management Approach to Iron Deficiency in Candidates | Review of proposed Iron deficiency diagnostic practices compared with CPGs and best practices: 6 references. | Narrative review of proposed changes with current program and best practices. | I evaluated my current practice and made changes; I applied them to current research with vitamin C. Unfortunately, the commentary was published 1 month | **Megasystem** – n/a<br><br>**Macrosystem -** ASMBS and health systems *could* use this information to make recommendations for change, but *MND are overlooked.*<br><br>**Mesosystem**—MBS programs may use the information to change clinical pathways and MND evaluation: RD reinforces iron prevention and repletion by evaluating ID |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | for MBS: Should We Change Our Practice?" 2021 | | | after the published article. | or IDA; family, friends, and HCP reinforce the importance of taking iron.<br>**Microsystem- Interpersonal – n/a**<br>**Microsystem Intrapersonal – n/a** |
| Primary Research | | | | | |
| 6 | Developing a Long-Term Follow-Up Service for Bariatric | Individual video and audio recorded interviews with | Qualitative analysis: Thematic framework using Braun, | Multidisciplinary model of care in General Practice for LTFU needs to be established like those | **Megasystem** Policies – MBSAQIP / NHS should be a consistent handoff for post-op care of *pt to avoid poor coordination of pt care among HCP.* |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | Surgical Patients in the Community: Patient and Professional Perspectives 2022 | 2 cohorts: healthcare professionals and patients: 36 references. | Clarke and Robson methods from a social constructivist perspective identified 4 themes. | in MBS clinics. Thematic analysis needs to be carefully conducted to introduce as little bias as possible. | **Macrosystem** - ASMBS and NHS *could* use this information to revise Industry standards for LTFU. *Without a revision in standards, missing criteria for COE standards will continue.*<br><br>**Mesosystem** -MBS program and support group provide opportunities for long-term connections and sharing of study findings.<br><br>**Microsystem Interpersonal -** Pt initiates questions of HCP during interviews or data collection. |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | | | | | **Microsystem Intrapersonal -** Pt "I need to go to MBS program annually (or as directed)." Pt can adhere to visits due to clear directions. Pt internalizes importance. |
| Primary Research | | | | | |
| 7 | Presentation of the application of research "Screening for Vitamin C | Retrospective cohort study pt electronic medical records reviewed | Quantitative: Classical statistics (logistic regression) and Machine | For the presentation with an IH clinical and research audience, it was difficult to determine how much ML versus applied/ | **Megasystem** – n/a<br><br>**Macrosystem**– n/a<br><br>**Mesosystem** -BSG – "pt needs to take mvi and/or vitamin C." |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | Deficiency: Why and When" oral abstract presented at IFSO 2022 | Primary research: 7 references. | Learning (ML) (Bayesnet and Random Forest) | clinical practice to present . | **Microsystem Interpersonal-** friends, co-workers and HCP reinforce pt adherence with vitamins<br>**Microsystem Intrapersonal -** Pt – "I need to take vitamins." Pt is adherent to recommended MN – mvi / vitamin C |
| Primary Research | | | | | |
| 8 | Publication of the research "What We are Missing: | Retrospective cohort study pt electronic medical | Quantitative: Classical statistics (logistical | There was much missing data and data/ labs that were not collected at the | **Megasystem** Policies – MBSAQIP should *be changed and this nutrient should be incorporated into future CPG. There has* |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| | Using Machine Learning Models to Predict Vitamin C Deficiency in Patients with MBS", 2023 | records reviewed<br><br>Primary research: 47 references. | regression) and Machine Learning (Bayesnet and Random Forest) | same time.<br>Limitations with traditional statistics when dealing with missing data; however, ML overcomes inability to use missing data. | *not been a need in practice to include vitamin C until recently.*<br><br>**Macrosystem**<br><br>ASMBS Industry standards for mvi formulation – "pts need to take x amount of vitamins." *MN update needed*<br><br>**Mesosystem** -BSG and MBS program discuss the need for vitaminss<br><br>**Microsystem Interpersonal** – n/a<br><br>**Microsystem Intrapersonal** – n/a |

| Publications | | Data Collection | Data Analysis | Ethical Considerations | Synthesis – where do the works fit within the conceptual framework? |
|---|---|---|---|---|---|
| **Type** | **Work** | | | | |
| **Context - CPG** | ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient, 2008 | Review of resources and available primary research for Nutrition Care in MBS 163 articles, 13 consensus, position or society papers | Sections authors answered same narrative review questions. All authors reviewed the entire CPG. | No grading of research nor risk of bias with articles; so, there was inherent subjective bias with research chosen to review and how reviewed. | **Megasystem** Policies, MBSAQIP standards – RD incorporated into MDT.<br><br>**Macrosystem** - ASMBS and Industry standards for mvi formulation<br><br>**Mesosystem** -BSG and MBS program "you need to take specific mvi, protein etc."<br><br>**Microsystem Interpersonal -** Pt asks RD "Why do I need to take a mvi?"<br><br>**Microsystem Intrapersonal -** Pt – "I need to take my mvi." |

***Italicized text*** in Table 3 corresponds with work that is needed or missing (Figure 9).

## Data collection and data analysis

Similarly, data collection methods shifted to fit the needs of the project at hand see Table 3:

> **Clinical Practice Guidelines**: systematic searches combined with data extraction of key information (Table 3, publication 1) and narrative review with a Delphi consensus (Table 3, publication 2).
>
> **Best Practices**: Narrative review with assimilation of best practices using CPGs, consensus, position statements, and retrospective studies (Table 3, Publications 3, 4, 5)
>
> **Primary research**: Prospective qualitative data collection methods to identify community care needs for patients after MBS (Table 3, publication 6) Retrospective cohort studies of electronic medical record (EMR) data (Table 3, publications 7 and 8).

## Ethical considerations

It's important to use primary research, but when it is not available, other levels of research evidence may be used if it is systematically searched and documented. Within each type of publication, transparency of the process and maintaining collegial relationships is paramount. Best practice and primary research papers may be short term projects, but the creation of clinical practice guidelines (CPG) is known to be year-long projects. Since both CPGs were multi-year projects (the 2008 CPG began in 2004, and the 2017 CPG

began in 2013), there were more opportunities for ethical considerations over the multi-year time frame, as presented for each CPG below.

With all types of publications, authorship has the potential to be contentious. Thankfully, the International Committee of Medical Journal Editors (ICMJE) created the Uniform Requirements for Manuscripts submitted to Biomedical Journals (URM) in 1978 primarily to standardise manuscript preparation. Over time and with updates that go beyond the preparation phase with a much broader scope, recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals were developed. The purpose was to help authors, editors and peer reviewers create clear, reproducible, unbiased medical articles submitted for publication in ICMJE member journals (International Committee of Medical Journal Editors (ICMJE), 2024b). However, many non-medical/ ICMJE journals also use these recommendations, specifically when defining the role of authors and contributors (International Committee of Medical Journal Editors (ICMJE), 2024a).

Clinical practice guidelines

**Appendix 1:** *ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient* (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008)

The ASMBS nutrition committee met regularly to ensure a consistent process and to keep apprised of each author's status. Not all committee members had access to articles; so, articles were provided to these co-authors. Each

nutrition sub-committee co-author used the same PICO question for their respective nutrient then searched and wrote her assigned nutrient section. Questions were discussed and reconciled with the group; all the articles used to answer questions were agreed upon by the nutrition sub-committee.

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

I followed the Institute of Medicine's recommendations for quality CPG as closely as possible. ASMBS committee members were required to have research and nutrition experience in MBS so that each committee co-author could search and write her own section. Summaries of the research and recommendations were discussed among the group and any discrepancies were reconciled with at least two co-authors. But we did not have a separate search and writing team.

The ASMBS nutrition committee met regularly to ensure a consistent process and to keep apprised of each author's status. Not all committee members had access to articles; in this scenario – articles were provided to these co-authors.

We used an Excel spreadsheet to track searches and results instead of a systematic program – no one was trained in a program – nor was one such as Rayyan or SRDR available. There was no process in place to develop a nutrition or any IH CPG - only how to approve within ASMBS after it was

created; so, I investigated the ASMBS surgeon CPG process and other society CPG processes.

The authorship of our work was established when the committee was formed. However, a conflict arose when a surgeon expressed concerns about our progress and pressured the IH committee chair to unilaterally add a new member to expedite the development of the clinical practice guidelines (CPG). We were informed that this new member would assist with formatting the document, but she mistakenly believed she would be either the primary or second author, despite our previous discussions on authorship. As a result, I had to address this misunderstanding with her, which led to several uncomfortable meetings.

In late 2015 we finished with the IH narrative review, but I was highly encouraged to “grade” the CPG for credibility. Unfortunately, there was no guidance: when I asked for direction, I was told “Just do it” and then sympathetically from a key IH Executive Board member “I don’t know how to direct you, we don’t have that process”; I did find out by hearsay that the surgeons had access to a ASMBS librarian; so I requested this service for our IH CPG – which we did receive and one surgeon offered a “ghost-writer” to help with the write-up- which we did not agree to use.

**Reflection:**

This was such a long arduous process that I compared our need to re-do the CPG into a graded CPG with the turning of the Titanic (away from the iceberg, but not the collision). Along with the volunteer nature of work and the amount of

time it took, I was contemplating taking a backseat – giving over the document to another author to finish it. I was counseled not to do this but to soldier through. This was during a tough personal time – when my 84-year-old father spent 60 days in the hospital after a small bowel obstruction due to scar tissue from an appendectomy 77 years earlier.

**Publication 2:** *Lifestyle Changes and Other Non-Operative management. IFSO-WGO Guidelines on Obesity* (IFSO-WGO, 2023)

IFSO collaborated with WGO in 2020 to update the 2010 WGO Obesity CPG. Ninety-four experts (international, interdisciplinary experts in obesity management) completed a two-round, online, modified Delphi survey. The details of this process are available in the online IFSO-WGO Guidelines on Obesity.

A synopsis of the guidelines was published in the Journal of Clinical Gastroenterology: Summarizing Consensus Guidelines on Obesity Management: A Joint, Multidisciplinary Venture of the International Federation for the Surgery of Obesity & Metabolic Disorders (IFSO) and World Gastroenterology Organisation (WGO). Journal of Clinical Gastroenterology (Sharaiha et al., 2023).

However, unless I have incorrectly associated author professional associations, not one of these authors are outside the field of medicine: none of the Integrated Health experts from the 94 international experts who collaborated on the guideline were given individual credit— possibly the authors are from the medical board of advisors, but there is no representation

from the “other” multidisciplinary advisors: Sharaiha, Reem Z. MD, MSc; Shikora, Scott MD; White, Kevin P. MD, PhD; Macedo, Guilherme MD, PhD, MACG; Toouli, Jim MD, MBBS, PhD; Kow, Lillian MD.

This is another example of medical domination over the “helpers” – Integrated Health.

> *“A multidisciplinary board of advisors—including members of both the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) and the World Gastroenterology Organization (WGO)—was created in the latter part of 2020 for the primary purpose of constructing and ultimately publishing consensus guidelines for the management of obesity and its associated comorbid conditions. Drafting these guidelines relied on (a) a thorough literature review conducted by a multidisciplinary team—consisting of bariatric surgeons and endoscopists, internists specializing in either endocrinology or hepatology, nutritionists/dieticians, and psychology/behavioural health care professionals—all members having extensive experience in obesity management; (b) a 3-stage, online consensus (Delphi) survey to identify areas of consensus and non-consensus in obesity management among 94 international experts spanning all the fields of expertise listed above and six continents; and (c) the drafting of guidelines, by the same multidisciplinary team. A full copy of the guidelines and all Delphi survey results have been published on both the IFSO and WGO websites. A paper summarizing the Delphi survey’s design and results has also been published elsewhere (Kow, et al., 2023). This paper summarizes the main points of the consensus guidelines”.*

Best practices

**Publication 3:** *Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery* (Parrott, 2014)

I was the lead author and requested a specific analytical co-author for this chapter since the topic was vast. I provided the content with ideas, including the patient perspective, which was novel in 2014 but needed assistance with

organization. It was important that I recognised my limitations in meeting the professional society due date(s) and worked ethically by meeting agreed-upon deadlines for this Integrated Health Professional Society—ASMBS Textbook of Bariatric Surgery, which has 22 chapters from experts in the United States MBS field.

**Publication 4:** *The Optimal Nutritional Programme for Bariatric and Metabolic Surgery* (Parrott et al., 2020)

Permission was requested for any tables and figures used from other works to meet ethical guidelines. I did not begin as the lead author for this paper, but after working with the international group, it became evident that there were some language barriers and time constraints that other co-authors were struggling to meet. After I worked diligently with the project manager and spent much time editing the other co-author sections, I was offered first authorship. This was not met with unanimous agreement.

**Publication 5:** *New Concepts in the Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice?* (Parrott, 2021)

I was asked to write a companion piece to the article, but the article had already been printed. This may be considered less than ideal because the original article is not readily available to the reader, and only certain aspects will be presented, but I experienced a personal benefit. The research I conducted for my commentary led me to analyse my own personal practice and the current practices of my MBS program. I was given the opportunity to

develop an in-service for our MBS program and a “cheat sheet” for clinicians to use when identifying iron deficiency and iron deficiency anaemia to ensure we were in better compliance with current recommended clinical practice.

Primary research

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives (Graham et al., 2023)*

Informed consent was collected prior to participation by all participants. A small monetary incentive was offered equally (to avoid any potential bias) to all participants. Funding information was provided, including the provided supplement, Celebrate Nutritional Supplements. Conflicts of interest and authorship were declared by all authors.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

**Reflection:**

This was a new award developed for a new session within the IH session at IFSO. I don’t think they planned for an older, more research-established presenter, so they also awarded a “young” Emerging Scientist Award. We both received the award—this seemed to highlight another area of potential discrimination that I am starting to experience since I am just now becoming known as a researcher at MBS. My age tends to disqualify me from many grants and other types of awards.

The hospital providing the data granted IRB approval. Gathering data involved multiple requests to the hospital's data analytics center, especially after the delayed 2022 IFSO conference, initially postponed (2020 and 2021) due to COVID-19. While this increased the number of cases included, it also resulted in repetitive analyses as new data became available.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict  Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

IRB approval was received from the hospital providing data. This was a difficult paper to complete because COVID-19 emerged during data collection. Many of the data requests from the hospital related to COVID took priority, and ours was put last in queue. We spent a year cleansing data and creating formulas to work around missing data. This was when we realised Machine Learning could handle the missing or never collected data. This is a phenomenal paper because each author truly played an important role and worked hard to achieve its fruition. We can all say, “There was no dead weight.” Authorship was determined by order of contribution as recommended by ICMJE.

# Chapter 4: Results

## Papers by study type

In this chapter the three types of papers: (1) Clinical Practice Guidelines (CPG), (2) Best Practices and (3) Primary Research presented as a collection through the lens of Bronfenbrenner's ecological systems theory (Lehman et al., 2017). First, I present the papers by study type, followed by a synthesis of my corpus of work.

Clinical practice guidelines

### Publication 1

*American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017) https://doi.org/10.1016/j.soard.2016.12.018

| Supplementary Materials – evidence supporting all recommendations<br><br>http://dx.doi.org/10.1016/j.soard.2016.12.018 |
|---|

### Novel Importance:

It is the first systematic review of nutrition in MBS and graded evidence for clinical practice recommendations. After being submitted on December 20, 2016, the publication was accepted without revision in less than 24 hours.

Best practices

**Publication 2**

*Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

| |
|---|
| World Gastroenterology Organisation (WGO) Practice Guideline Obesity<br><br>https://www.worldgastroenterology.org/guidelines/obesity |

**Novel Importance:**

IFSO collaborated with WGO in 2020 to update the 2010 WGO Obesity CPG. Ninety-four experts (international, interdisciplinary experts in obesity management) completed a two-round, on-line, modified Delphi survey. The detail of this process is available in the online IFSO-WGO Guidelines on Obesity.

A full copy of the guidelines and all Delphi survey results have been published on both the IFSO (https://www.ifso.com) and WGO (https://worldgastroenterology.org) websites. A paper summarizing the Delphi survey's design and results has also been published elsewhere (Kow et al., 2023) .

**Publication 3**

*Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery* (Parrott, 2014)

https://doi.org/10.1007/978-1-4939-1197-4

**Novel importance:**

This chapter is included in a 2-volume series developed by the ASMBS, to provide a comprehensive guidebook that all disciplines could use when caring for a patient with MBS. The objectives for our Chapter 14: Nutrition Care Across the Weight Loss Surgery Process:

This text aims to:

1. Describe the nutritional considerations for effective weight management during the four key phases of weight loss surgery: preparing, healing, achieving, and maintaining. This approach will help ensure a successful transition at each stage of the journey.

2. Outline nutritional goals and address common patient concerns and challenges that patients may face during these stages.

3. Encourage viewing the weight loss journey from a patient's perspective rather than just a surgical one.

**Publication 4**

*The Optimal Nutritional Programme for Bariatric and Metabolic Surgery*

(Parrott et al., 2020) https://doi.org/10.1007/s13679-020-00384-z

**Novel importance**:

This document was a collaborative effort of four international registered dietitians (RD) to present factors needed for the optimal nutrition care of patients with MBS. This includes the rationale for using a specialist RD versus an RD without training in MBS. This was a narrative synthesis of current international research translated into best practices for an optimal Nutrition program.

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**Publication 5**

*New Concepts in The Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice?* (Parrott, 2021) https://doi.org/10.1016/j.soard.2020.10.006

**Novel importance:**

Diagnosis and Management of Micronutrient Deficiencies, particularly iron, is an important clinical topic that remains an ongoing issue in clinical practice. Even though a primary symptom of iron deficiency is fatigue, many clinicians do not treat it before MBS unless iron deficiency anaemia is also diagnosed. This overlooked deficiency primes a patient for continued iron deficiency and anemia post-MBS. Patients with MBS should be treated for iron deficiency with or without anaemia to improve patient quality of life with the proposed diagnostic criteria. This invited commentary on Benotti, et al., 2020 “New concepts in the diagnosis and management approach to iron deficiency in candidates for metabolic surgery: should we change our practice?” was published online August 26, 2020 (Benotti et al., 2020).

*No abstract available.*

Primary research

**Publication 6**

*Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives (Graham et al., 2023)*

https://doi.org/10.1002/osp4.658

**Novel importance:**

This publication stands out due to its comprehensive interviews with both patients and professionals, shedding light on their experiences with care, identified gaps, and their insights into long-term follow-up care needs. Patients' perspectives on adherence to MVI and the significance of MDT have been thoroughly explored. This pioneering approach delves into the viewpoints of both patients and professionals on follow-up care in MBS, marking a significant advancement in the field.

**Publication 7**

*Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

**Novel Importance:**

These findings were unique and the first time this newly emerging micronutrient deficiency was presented with a clinical practice focus at an international conference, IFSO 2022 World Congress in Miami. Unfortunately, vitamin C status and implications have not been studied in patients with MBS since symptoms range widely from fatigue and easy bruising to profuse bleeding and lower extremity swelling that overlap other pathophysiological conditions. Since symptoms of vitamin C deficiency are elusive, we investigated patterns of commonly reported lab results in patients with MBS to differentiate those with and without vitamin C deficiency. This research indicates that most patients with MBS and vitamin C deficiency are undiagnosed and so at greater risk for a range of comorbidities and mortality.

Publication 8

*What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery*

(Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

https://doi.org/10.1007/s11695-023-06571-w

**Novel importance**:

Case reports, series, and outbreaks of vitamin C deficiency and scurvy have been reported worldwide. Because vitamin C is implicated in many physiological pathways vitamin C deficiency can compromise the health of patients with MBS. Not only does this research indicate that most patients with MBS and vitamin C deficiency are undiagnosed and so at greater risk for a range of comorbidities and mortality, but also that a combination of other micronutrient deficiencies could serve as indicators of risk and possible clinical alerts in electronic medical records.

Older research: context

The research presented below for consideration for PhD by published work falls within the context of my previous work.

**Context**

*ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient* (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008)

See Appendix 1

**Novel importance**:

It is the first published CPG based on a narrative review of nutrition in Metabolic and Bariatric Surgery (MBS). It was the most-read article in Surgery for Obesity and Related Disorders (SOARD) Five-year Impact Factor of 3.6 in 2022; the fourth most cited article with 369 cites in SCOPUS and 327 CrossRef. It has a Field-Weighted Citation Impact (FWCI) of 7.53. (FWCI shows how well cited this document is when compared to similar documents. A value greater than 1.00 means the document is more cited than expected according to the average. The FWCI is the ratio of the document's citations to the average number of citations received by all similar documents over a three-year window. Each discipline makes an equal contribution to the benchmark metric, which eliminates differences in researcher citation behaviour).

It has been cited by numerous professional and public health organizations, including the American Association of Clinical Endocrinologists, the Obesity

Society, the American Society for Metabolic and Bariatric Surgery, the American Heart Association, European Society for Clinical Nutrition and Metabolism and the British Obesity and Metabolic Surgery Society.

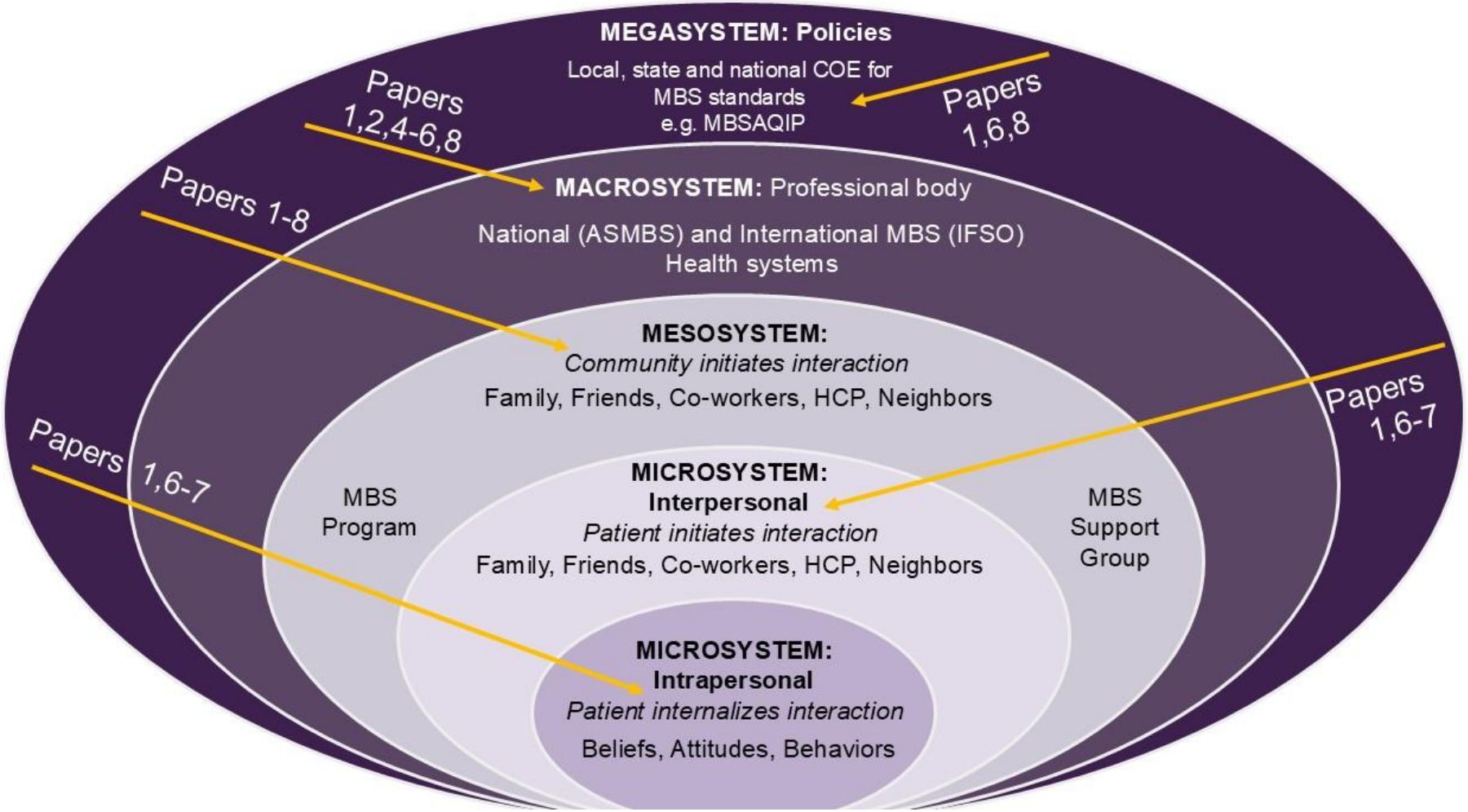
It has been used in research and education of practitioners and patients and by industry as guidance for developing vitamin and mineral supplements for patients who have had MBS. The “bariatric food pyramid” is a tool developed using some of the recommendations from Aills et al. (2008). It is easy to distribute, user-friendly and provides nutrition and behavioural recommendations for patients who have had MBS (Moizé et al., 2010).

**Framework perspective on published works**

I have adapted Bronfenbrenner's Ecological Systems Theory model to the development of "health" or nutrition status in an individual with MBS to help further illustrate the complex layers and interactions within the environment. This model incorporated the role of context and its influences on developmental research (Smith & DeFrates-Densch, 2009). This "wicked problem" of providing optimal nutrition care for patients with MBS is additionally addressed by complexity science via its interconnected and interdependent layers (Sturmberg & Martin, 2022). Within this framework, eight published works are presented, each with the goal of optimizing a patient's nutrient status at the different levels of intervention. I present the papers first by study type and then by framework system level. Each of the eight publications effects change on different levels and systems (Figure 7).

- The MEGA level includes regulatory bodies that can change policy.
- The MACRO level includes professional bodies that represent healthcare organizations.
- The MESO level includes MBS programs, support groups, and the community available to the patient in the MICRO, inter-personal level.
- The MICRO level includes both inter- and intra-personal systems and affects change on an individual basis. The key difference between MICRO and MESO is that MICRO emphasizes individual empowerment through information, allowing patients to *initiate* change by requesting information (inter-personal) and internalize knowledge (intra-personal), leading to greater self-efficacy.

**Figure 7 Conceptual framework of published works**



Megasystem

Description of Megasystem with respect to MBS

- **Definition**: The highest levels of community-level interventions generally involve large geographic communities and include broad changes, especially at the policy level, in sectors such as the environment, health care regulation, and fiscal policy. At this level, policy interventions restrict or support behaviour through laws and regulations, such as requirements to ensure patients' access rights to their personal health information (Ockene et al., 2007).
- Healthcare laws align with The Centers for Medicare and Medicaid Services (CMS)

CMS is a federal agency in the United States (https://www.cms.gov) that administers the Medicare program and works in partnership with state governments to provide Medicaid. CMS develops laws and regulations for bariatric surgery based on evidence and input from stakeholders, including healthcare providers, patient advocates, and others. For example, CMS has determined that certain bariatric surgery procedures are reasonable and necessary for Medicare beneficiaries who have a body-mass index (BMI) ≥ 35, have at least one co-morbidity related to obesity, and have been previously unsuccessful with medical treatment for obesity[1].

Insurance Providers use information from CMS as a guide. While the specific requirements for insurance coverage of bariatric surgery can vary

from one insurance company to another, there are some common requirements that many insurance companies may have. Many insurance providers require bariatric surgery procedures to be performed as an accredited Center of Excellence (COE) in order to be covered.

Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) is a joint program of the American College of Surgeons (ACS) and the American Society for Metabolic and Bariatric Surgery (ASMBS) that accredits inpatient and outpatient bariatric surgery centres in the United States and Canada that have undergone an independent, voluntary, and peer evaluation in accordance with nationally recognised bariatric surgical standards. This accreditation promotes uniform standard benchmarks and continuous quality improvement (Surgeons, 2024).

ACS has ten accreditation programs to optimize surgical care and outcomes in hospitals and healthcare organizations. In the United States, if a professional, program, or hospital system does not operate within the boundaries of the above organizations, it is more likely to be at risk for malpractice.

Programs must comply with the ten standards published by MBSAQIP to receive COE status. Pre-determined clinical pathways that provide the structure for staff education are part of these pathways. CPG has the potential to influence these standards and potential guidance by CMS. Thus, CPG tends to have the greatest impact upon megasystems.

*Published works and the megasystem*

Clinical practice guidelines (CPG)

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

This publication has influenced megasystems regarding impacting policies via the legal system and what is considered the standard of care for a patient with obesity and MBS. Standard of care is defined as “the benchmark that determines whether professional obligations to patients have been met. Failure to meet the standard of care is negligence, which can carry significant consequences for clinicians” (Vanderpool, 2021). Although the standard of care is a legal term and varies by community, it is typically determined by the prevailing published evidence at that time – including treatment guidelines or best practices. I have worked as an expert witness for 5 different medical malpractice cases and the Aills, 2008 CPG was used in the first two cases. In fact, this is how the attorney located me to see if I was interested. The subsequent cases used the 2017 CPG as part of the determination of the standard of care since they occurred after this publication in 2017. There are very few nutrition experts who can serve as an expert witness in the field of MBS. I know of two other RDs with PhDs who are considered leaders and who have worked as an expert witness on at least one case.

- An RD became an integral part of the clinical pathways in MBS after the 2008 publication, but there has not been the incorporation of

specific safety factors regarding critical micronutrients, such as vitamin B1 (thiamine) into MBSAQIP clinical pathways– yet. For instance, as part of the standard for Education. This has not been established for the nutrient vitamin B1 (thiamine), which has evidence supporting it as a potentially deadly nutrient if the deficiency is not treated quickly and without lab confirmation.

- The micronutrient recommendations for supplementation, screening for deficiencies and treatment from the 2017 CPG have been incorporated into MBS programs world-wide and are used to benchmark the standard of care for patients with MBS.
- Major bariatric vendors (Celebrate vitamins, Bariatric Pal, Bariatric Advantage, Opurity, Bariatric Fusion, ProCare Health, etc.) in the United States have followed the 2017 ASMBS CPG to develop their vitamin/ mineral products (Advantage, 2018, 2019; Fusion, 2017, 2024; Pal, 2021; Vitamins, 2024).

**Publication 2:** *Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

No direct impact on megasystem noticed yet, but anticipate policies and standards developed with guidance from this CPG.

Best practices

**Publication 3-5:** No direct impact upon megasystem.

Primary research

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives (Graham et al., 2023)*

No direct impact has been noted yet, but we anticipate some changes (eventually) from NHS in the UK.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022) Oral Abstract presented and awarded Integrated Health Emerging Scientist Award at IFSO 2022.

No direct impact upon megasystem.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

No direct impact has been noted yet, but we anticipate recommendations for vitamin C supplementation to be included in future CPGs for prevention and repletion of MND.

Context

*ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient*, 2008. MBSAQIP adopted recommendations for RD as part of the multidisciplinary team.

Macrosystem

Description of Macrosystem with respect to MBS involves both an organizational and professional integration. IN MBS we have two main professional organizations: IFSO and ASMBS:

- **Definition***:* A system integration - Professional Body
  - **IFSO: International MBS (IFSO, 2024)**

    Vision: “To optimize the control of adiposity-based chronic diseases”

    Mission: “To unify the global scientific, surgical and integrated health communities, for the purpose of dissemination of knowledge, collaboration and establishing universal standards of care for the treatment of individuals with adiposity-based chronic disease.”

  - **ASMBS: National MBS (ASMBS, 2024)**

    Vision: “Our vision is to elevate global health and quality of life by significantly reducing the impact of obesity and its associated illnesses worldwide.”

    Mission: “Our mission is to enhance the well-being of individuals affected by obesity and associated illnesses through the progression of metabolic and bariatric surgical techniques and other medical interventions.”

*Published works and the macrosystem*

Clinical practice guidelines (CPG)

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

Clinicians can use the 2017 CPG tables of recommendations to screen for nutrient deficiencies before and after surgery, supplementation to prevent deficiencies, and repletion to prevent deficiencies and signs and symptoms to help detect deficiencies with their patients before, during or after meeting with patients. Programs have incorporated and implemented CPG 2017 recommendations for vitamin supplementation into their programs with the assistance of bariatric vendors who provide bariatric-formulated supplements. There are publications assessing MBS program implementation of ASMBS CPG 2017 and patient adherence to these recommendations, particularly vitamin and mineral supplementation for prevention and or correction of micronutrient deficiencies. Reported adherence to recommended supplementation ranged from 30-45% until one-year post-op and then declined further with 20-30% of patients stopping or never taking any (Steenackrs et al., 2022; Zarshenas et al., 2020). The top three barriers to supplement use were forgetfulness, too expensive since insurance does not cover the cost and unwanted side effects (Mahawar et al., 2019; Mathews et al., 2023; Smelt et al., 2023; Smelt et al., 2020; Spetz et al., 2022; Steenackrs et al., 2022)

**Publication 2:** *Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

It is published on the WGO website and represents a collaborative effort between IFSO and WGO. Updated Obesity guidelines and anticipate incorporation into future programs and implementation of CPG. This publication has a table presenting the prevalence of MND that I created and have used in numerous educational sessions such as seminars, invited presentations and webinars. Additionally, I addressed the prevention and repletion of micronutrient deficiencies during pregnancy and with paediatrics.

Best practices

**Publication 3:** *Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery* (Parrott & Parrott, 2014)

No impact upon Macrosystems.

**Publication 4:** *The Optimal Nutritional Programme for Bariatric and Metabolic Surgery* (Parrott et al., 2020)

This is a collaborative paper among nutrition experts and researchers in which we tried to harmonize program recommendations across countries so that anyone could pick up the article and adapt the information to their respective geographical location.

**Publication 5:** *New Concepts in The Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice?* (Parrott, 2021)

This commentary provides a highlight on an article questioning the current assessment of micronutrient status – iron, which is a global issue and impacted practices within ASMBS and IFSO. The identification of iron deficiency and iron deficiency anaemia are two distinct disorders and need to be treated as such. I used this information in national and international webinars.

Primary research

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives* (Graham et al., 2023)

Research into current patient and practitioner beliefs regarding needs and gaps in MBS care for long-term patient follow-up—impacting health care systems “hand-off” in the UK NHS system and also in the USA health care system.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

Did not apply to Macrosystem – yet.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

This publication was to build awareness of the under-detection and missed diagnosis of vitamin C deficiency and scurvy in MBS. It was hoped that providers/ members within ASMBS and IFSO would be looking more closely at their programs and the possibility of a new yet “old” micronutrient deficiency.

**Context:** *ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient*, 2008

ASMBS adopted protein recommendations, and programs and researchers have used a standard of at least 60 grams of protein a day. More companies began developing bariatric-formulated vitamins, specifically calcium and multivitamins.

Mesosystem

Description of Mesosystem with respect to MBS

**Definition**: A community – interactions among microsystems (families, friendship networks, neighbours) are captured within this community level (McLaren & Hawe, 2005). Multiple family members or patients within a support group may rely on the same health resources, and information or advice from one specific health resource may spread from that setting to others through formal or informal networks (Lehman et al., 2017). For example, a particular brand of multivitamin may be deemed affordable and “good to use” in patients with MBS, even if it is not a program-recommended multivitamin. Community-level interventions target specific communities defined by geography, race, ethnicity, gender, illness, or

other health conditions. They also target groups and systems with a common interest, including health or service agencies, organizations, workplaces, schools, health care or public health practitioners, or policymakers. RDs are an integral part of a group and individual mesosystem.

Communication and collaboration at the local level impact the provision of services based on the population's needs. An example of a mesosystem within MBS includes implementing an MBS Program in a community to provide patients with the required components of an MBS program's overall goals based on hospital and credentialing Typically, an RD facilitates an MBS support group for patient accountability and motivation.

The various types of education (webinars, continuing education, etc.) available to healthcare professionals can impact competence and capability within the field of MBS.

*Published Works and the Meso-System*

Clinical practice guidelines (CPG)

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

After the implementation of this CPG focusing on Micronutrients, industry changed their standards for supplements according to ASMBS CPG (Advantage, 2018, 2019; Fusion, 2017, 2024; Pal, 2021; Vitamins, 2024).

**Publication 2:**: *Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

I am not aware yet of a specific impact upon the mesosystem. The goal is for gastroenterology offices, primary care practices, medical weight management programs, and practitioners working with patients who struggle with obesity to incorporate the information into their clinical pathways and daily practices.

These two CPGs have influenced mesosystems in multiple ways. For example, vitamin recommendations have been formally integrated into MBS program clinical pathways and informally integrated via support groups.

Best practices

**Publication 3:** *Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery* (Parrott, 2014)

This is a chapter endorsed by ASMBS with the aim of presenting the preparation needed by patients for MBS during four phases: preparation, healing, achieving, and maintaining. Nutrition goals and common patient concerns and challenges were identified for each phase. Overall, the goal was to introduce a consideration of patient expectations including: How much weight can I expect to lose? Will I gain my weight back? Will I need to exercise? And What behavioural changes will I need to make? MBS programs and support groups could use this insight to help develop

seminars for patients seeking surgery, as well as topics for monthly support group meetings.

**Publication 4:** *The Optimal Nutritional Programme for Bariatric and Metabolic Surgery* (Parrott et al., 2020)

MBS programs and their support groups communicate with each other and share ideas. Other HCPs and researchers have cited this information so that HCPs and RDs within an MTD can reinforce ideas and practices with patients.

**Publication 5:** *New Concepts in The Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice?* (Parrott, 2021)

This publication is a commentary on an article questioning the current assessment of micronutrient status – iron, which is a global issue and impacted practices within ASMBS and IFSO. The identification of iron deficiency and iron deficiency anaemia are two distinct disorders and need to be treated as such. I have provided a webinar to our MBS program, and more informally to our surgeons, mid-level practitioners and RDs.

Primary research

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives* (Graham et al., 2023)

MBS programs and support groups could discuss themes reported from the study and revise current practices.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

Health care practitioners who attended the presentation have discussed the importance of vitamin C during MBS support groups and within their programs.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

We hope that this research has encouraged readers to recommend the use of reported common labs to indicate possible vitamin C deficiency and evaluate the need for vitamin C among their patients with MBS.

**Appendix 1 Context:** *ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient*, 2008

Due to the longevity of this CPG, MBS programs and support groups have incorporated recommendations for protein and diet progression, among other things.

Microsystem: interpersonal and intrapersonal

Description of Microsystem with respect to MBS

Definition: the immediate environment in which the patient interacts, which directly impacts the patient's daily life.

Definition: INTERPERSONAL- the patient initiates interaction with family, friends, co-workers, HCP and neighbours

Definition: INTRAPERSONAL – the inner experience and interaction of a patient's beliefs, attitudes, and behaviours

- Patient's Interaction Style – Intro Vs Extroverted
- Patient's Perspective on Behavioural Health Care and Help
- Patient's Experience of Health Care Bias and Stigma of Obesity
- Patient's Nutrient Status Pre- and Post-Surgery

*Published works and the microsystem*

For the three categories of publications, the overarching goal (1) intrapersonal is for patients to internalize the importance of nutrition (inclusive of micronutrients) and (2) become empowered to make optimal decisions regarding their own health.

Clinical practice guidelines (CPG)

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

Professionals refer patients to some websites to purchase supplements. Resources regarding micronutrients are posted on industry websites for both professionals and patients. Conversation between health care providers and patients is stimulated with the advertising and available resources. Additionally, both formal and informal support groups discuss

these topics which provide an opportunity for patients to ask questions or comment and ultimately internalize the importance of supplements (Advantage, 2018, 2019; Fusion, 2017, 2024; Pal, 2021; Vitamins, 2024).

**Publication 2:** *Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

There has been no direct impact yet; however, the goal is to facilitate discussion between practitioners and patients about the various topics in the CPG.

Best practices

**Publications 3-5** no papers directly address Microsystem level.

Primary research

**Publication 6:** *Developing Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives* (Graham et al., 2023)

Patient internalization of the belief that comprehensive long-term follow up care is needed and become their own patient advocate.

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

The presentation elicited practitioners' assessments of possible VCD in their patients and practices via in-person and email communication. Discussions were noted among patients, practitioners, and support groups.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

Research into the detection of vitamin C deficiency (VCD) labs and signs and symptoms to look for in patients at risk for VCD. Patient internalization of the need for better detection and screening for VCD as well as need for supplementation for vitamin C.

**Appendix 1 Context** Publication:

*ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient*, 2008

Since this CPG has been available for at least 14 years, programs have implemented recommendations for protein and diet progression among others. This has facilitated patients' ability to initiate questions from HCP and discuss with family, neighbours, etc. while internalizing recommendations, such as the belief that they need more protein to improve weight loss.

# Chapter 5: Discussion

## Summary of key findings and comparison to the existing literature

Each of the eight individual publications within the three types of papers (CPG, best practices, and primary research) have produced independent results and influence upon the field of MBS as well as the field of nutrition. These publications highlight the significance of medical nutrition therapy in the comprehensive nutrition care process, integrating the therapeutic interpretation of biochemical laboratories to achieve optimal nutrition alongside appropriately timed counseling. One of the most powerful ways to measure the impact these works have had is to use metrics such as citations, captures, mentions and social media. Citations can help indicate societal impact with regards to clinical or policy while captures is used to indicate potential future citations. Mentions may indicate people are engaging with the research. Whereas social media (Tweet, Facebook, Instagram) represents how well the research has been promoted (Libraries, 2023).

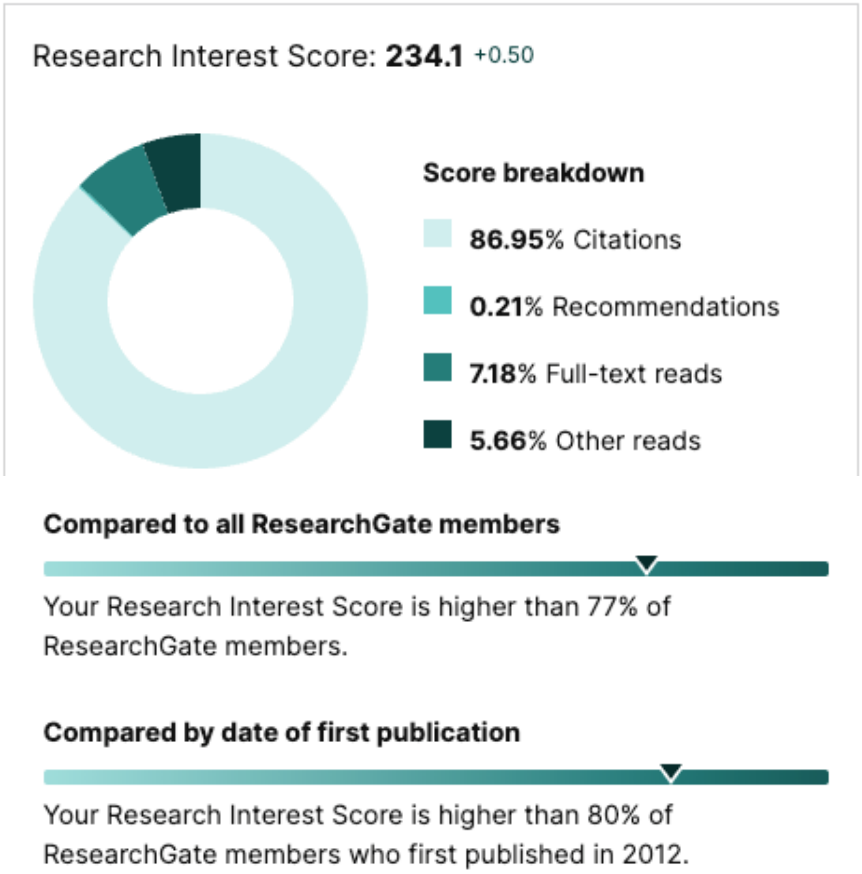
Scopus: 7 articles total 913 citations by 825 documents; *h*-index 4

https://www.scopus.com/authid/detail.uri?authorId=57204797567

accessed May 4, 2024

| Readers' Seniority | | Readers' Discipline | |
|---|---|---|---|
| PhD / Post grad / Masters / Doc 179 | 71% | Medicine and Dentistry 173 | 58% |
| Researcher 39 | 16% | Nursing and Health Professions 96 | 32% |
| Professor / Associate Prof. 23 | 9% | Agricultural and Biological Sciences 16 | 5% |
| Lecturer / Post doc 10 | 4% | Biochemistry, Genetics and Molecular Bi... 15 | 5% |

**ResearchGate** (accessed May 4, 2024)




**Published works provided guidance to the field**

Previously, there were no set standards for nutrition care in MBS, only educational materials for patients who had gastrointestinal surgery. Nor was there any specific nutrition guidance for patients struggling with obesity until the 2008 and 2017 CPG (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008; Parrott et al., 2017). Below, I highlight the contribution of the three types of published works to the field of MBS.

The lack of CPG before 2008 and subsequent CPGs indicated that a mutual collaboration between surgeons and RDs was needed. However, after 2008 CPG (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008) nutrition is now on the radar – it is now in publication and not just

suggested recommendations, but a society endorsed clinical practice guideline. Thus, nutrition and implications for MBS cannot be ignored, because it is finally in print by a prominent surgeon leader in the field of MBS: “A Brief History of the Surgery for Obesity to the Present, with an Overview of Nutritional Implications, 2013” By Mervyn Deitel (Deitel, 2013)**.**

The 2017 CPG provided detailed, graded guidelines for Micronutrients in MBS that was adopted by 2020 CPG and many industry vendors for products provided to patients; as well as used for clinical trials and in many MBS practices – globally.

Future collaboration within ASMBS Surgeons and IH is still needed. This is reflected via the current thinking and practices “if a patient does not have a problem fixable by surgery, it is not worthwhile” or “out of sight, out of mind”. A brief overview of the development of the surgical and nutrition practice guidelines in MBS illustrates both the lack of collaboration, but points toward a possible more beneficial collaboration.

In 2008 ASMBS published two CPG addressing Nutrition: IH at the time was called Allied Health and the Surgeons produced a separate CPG with nutrition as a component of perioperative care of the patient with MBS. Significantly, no dietitian was included in the development of the nutrition component of the surgeon’s CPG.

In contrast, the Integrated Health (IH) committee tasked with developing the nutrition guidelines included representatives from the surgeon’s

committee and consisted of the SOARD journal editor (a surgeon) and an additional advisor. Initially, the IH document was not even considered a "guideline". Rather, the work of the dietitians was casted as "Suggestions". Both the surgeons' guideline and IH "suggestions" pre-prints were provided to conference attendees at the 2008 ASMBS annual meeting. This publication of nutrition "suggestions" was Indexed in PubMed and Google Scholar and has 25 cites, including CPGs. In contrast, the Surgeons 2008 CPG was published in three different society journals (Mechanick et al., 2008a, 2008b; Mechanick et al., 2009) in three consecutive months and were open access.

However, at the time of publication and at the direction of the journal editor, the IH 2008 document title was changed from "Suggestions" to "Guidelines" and published in one journal, the ASMBS society journal since only one endorsed society collaborated with CPG (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008). This publication was not open access and was initially only available to ASMBS members. Remnants of this change still exist in the acknowledgments "We also thank the ASMBS… for their commitment to the publication of this white paper."

The above illustrates both the paternalistic nature of the surgical profession toward the integrated health professions (no nutrition representation on the surgical guidelines, but surgical "advisors" on the nutrition guideline) as well as sends a clear message about *whose* guidelines are more important.

However, with the 2017 and 2020 update to the nutrition and surgical guidelines there was a small, tentative (if still blatantly paternalistic) improvement. For the micronutrient guidelines, the team of dietitians no longer required surgeon oversight and were able to complete the guideline independently. Apparently, dietitians had proved that they had the capacity to synthesize the existing scientific research in a rigorous manner. When the 2020update to the surgeons' guidelines were released, they included a section on nutrition. However, this time the surgeons pulled directly *and verbatim* from the 2017 nutrition guidelines—effectively appropriating the work of the dietitians as their own. While this can be seen as a modest improvement—the work of the dietitians was apparently up to the surgeons' standards—it was done without any participation of the nutrition guideline authors. Indeed, the authors of the nutrition guidelines were not even aware of the appropriation until the publication of the surgeons' guidelines.

The current situation shows that integrated health professionals still have a long way to go before achieving a true partnership. However, it does indicate that at least some surgical MBS professionals recognise the value that integrated health professions, such as nutrition, can bring to the table.

**Publication 1:** *American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update* (Parrott et al., 2017)

**Importance:**

It is the first systematic review of nutrition in MBS and graded evidence for clinical practice recommendations. Once the publication was submitted on December 20, 2016, it was accepted without revision in less than 24 hours.

It has a Citation Index 3232 (SCOPUS, CrossRef). In addition, this CPG has had far-reaching impact in multiple fields and countries.

The CPG includes six user-friendly tables for health care professionals to use during pre-and post-op screening, supplementation, repletion of deficiencies in addition to guidance to help identify deficiencies by signs and symptoms and nutrient recommendations for patients with and without MBS.

It is the first CPG for nutrition in MBS with user-friendly tables that has been incorporated into a surgeon focused CPG. The most cited article 2017-2020 in SOARD journal.

Two tables and sections with minor updates were used in Mechanick et al., 2020 which is co-sponsored by AACE/American College of Endocrinology, The Obesity Society, ASMBS, Obesity Medicine Association, and American Society of Anesthesiologists and published in three different journals.

It was used to help develop the 2018 ASMBS paediatric metabolic and MBS CPG.

MBS Supplement Companies have used the CPG as guidance for the development of vitamin and mineral supplements for patients who have

had MBS (Advantage, 2018, 2019; Fusion, 2017, 2024; Pal, 2021; Vitamins, 2024).

It is being used as one of the international CPGs for a scoping review of international research on nutrition interventions in MBS, “Show Me the Evidence to Guide Nutrition Practice: Scoping Review of Macronutrient Dietary Treatments After Metabolic And Bariatric Surgery” in review, 2024.

**Metrics include:**

| **Citations:** | **PlumXMetrics*** |
|---|---|
| Scopus: 445 | Citations: 445 |
| PubMed Central: 191 | Captures: 551 |
| Cross Ref: 44 | Mendeley: 551 |
| Policy Citations: 4 | Mentions: 3 (Wikpedia 1) |
| ResearchGate: | 1- and 3-year percentile: 100$^{th}$ |
| Research Interest Score: 232 | citations, 100$^{th}$ captures, 100$^{th}$ |
| Citations: 420 | mentions. |
| Reads: 2704 | Policy citations: 4 |
| Google Scholar: | News mentions: 2 |
| Citations: 617 | Wikipedia reference: 1 |
| | *Tag (s): Medicine* |
| **Accessed May 4, 2024** | **Accessed May 4, 2024** |

**Policy citations:**

Ministry of Public Health Qatar. National Clinical Guideline: Bariatric & Metabolic Surgery in Adults (2021).

Bariatric surgery: an HTA report on the efficacy, safety and cost-effectiveness (Louwagie et al., 2019).

**Publication 2:** *Lifestyle Changes and Other Non-Operative Management* (IFSO-WGO, 2023)

No citations, however a summary of the Guidelines on Obesity Management was later published which should garner views from readers and citations (Sharaiha et al., 2023).

**Importance:**

Published on the WGO website representing a collaborative effort between IFSO and WGO to update obesity guidelines from 2010. We anticipate the incorporation of the information into future programs and implementation of CPG. This publication has a table presenting the prevalence of MND that I created and have used in numerous educational sessions such as seminars, invited presentations and webinars. Additionally, I addressed the prevention and repletion of micronutrient deficiencies during pregnancy and with paediatrics.

*Best practices – provided guidance for optimal nutrition care for patients when developing a program for MBS*

While guidelines provide recommendations for practice, they do not provide guidance for how to implement these recommendations into on-going clinical processes. Best practice publications are meant to fill that void.

**Publication 3:** *Nutrition Care Across the Weight Loss Surgery Process. In: The ASMBS Textbook of Bariatric Surgery* (Parrott, 2014)

**Importance:**

It is unsurprising that this publication, the official ASMBS textbook has received few citations. Textbooks are designed to be reference materials to be used in day-to-day practice—a resource to consult when a practice question arises. Writers cite articles, practitioners consult trusted sources. So, the direct influence of a textbook can be difficult to measure in terms of citations. However, according to Amazon.com, this textbook is ranked #41 in general surgery books. Citations can only be accrued for a work if the publication is accessible (open access and not embargoed) and well marketed. Neither of which has occurred for the IH second volume of the 2014 two-volume textbook. In fact, the 2025 version has been combined into one volume.

**Metrics include:**

ResearchGate: Research Interest Score: 4.6, citations: 6, reads: 340

Google Scholar: 6 citations

Springer Nature: 2 citations, 1421 accesses; 30 items cite entire book

**Publication 4:** *The Optimal Nutritional Programme for Bariatric and Metabolic Surgery* (Parrott et al., 2020)

**Importance:**

This article targets dietitians who specialize in MBS and their programs. It provides detailed information for optimizing nutritional status prior to surgery, highlights the critical importance of micronutrient status, provides concrete guidance on early post-operative nutrition and diet progression and flags common problems during the early post-operative period. It is meant as a supplement to the clinical practice guidelines by providing recommendations for how to realise the guideline recommendations in patient care with international impact.

**Metrics include:**

- SCOPUS citations 24, 61st percentile, Current Obesity Reports FWCI 0.66
- ResearchGate: Research Interest score: 9.9, citations 19, reads: 253
- PlumXMetrics: 6 citations, 40 captures
- Google Scholar: 42 citations
- Springer Nature: 30 citations, 1658 accesses
    - Location of users (data since 2019)

| Country | Turkey | USA | China (P.R.) | Australia | UK | Others |
|---|---|---|---|---|---|---|
| Accesses | 206 | 172 | 158 | 155 | 115 | 852 |
| Percent | 12.42 | 10.37 | 9.53 | 9.35 | 6.94 | 51.39 |

**Publication 5:** *New Concepts in The Diagnosis and Management Approach to Iron Deficiency in Candidates for Metabolic Surgery: Should We Change Our Practice?* (Parrott, 2021) Published online October 12, 2020 after article was already in print

**Importance:**

This is an invited commentary on Benotti, et al., 2020 “New concepts in the diagnosis and management approach to iron deficiency in candidates for metabolic surgery: should we change our practice?” (Benotti et al., 2020). The commentary makes clear that iron deficiency is a serious concern for patients with MBS. It highlights the fact that iron deficiency and anaemia are not the same (though they are often confused) and provides practitioners with guidance for identifying the symptoms of iron deficiency as well as recommendations for treatment.

**Metrics Include:**

- **Mendeley 2 captures**

Benotti PN, Wood GC, Kaberi-Otarod J, Still CD, Gerhard GS, Bistrian BR. New concepts in the diagnosis and management approach to iron

deficiency in candidates for metabolic surgery: should we change our practice? (Benotti et al., 2020)

**Review Description:**

The near universal presence of chronic low-grade systemic inflammation among patients with severe obesity disrupts iron homeostasis and underlies the association between obesity and iron deficiency. Immune activation and inflammation result in a reduction in circulating iron and diminished iron bioavailability for erythropoiesis. Inflammation also alters blood levels of commonly measured markers of iron nutrition status, which makes the diagnosis of iron deficiency difficult and has led to new recommendations regarding laboratory markers for the diagnosis. Recent evidence using these newly recommended laboratory markers, which include levels of ferritin, C-reactive protein, and transferrin saturation, suggests that the actual prevalence of iron deficiency among candidates for metabolic surgery may be double or triple the prevalence identified by low levels of ferritin alone. Thus, large numbers of surgical candidates have iron deficiency that has been largely unrecognised and inadequately treated. The assessment of iron status using the currently recommended markers in the presence of chronic inflammatory diseases and repletion of depleted stores for surgical candidates with deficiency during the preoperative period present an important opportunity for mitigating this condition in postoperative patients.

**Metrics Include:**

- PlumXMetrics 6 citations, 23 captures, 10 social media 1-year percentile: 61st citations, 75th captures, 79th
- Mendeley 23 captures

Primary research provided insight and direction for new and emerging issues

**Publication 6:** *Developing a Long-Term Follow-Up Service for Bariatric Surgical Patients in the Community: Patient and Professional Perspectives* (Graham et al., 2023)

**Importance:**

Follow-up care for patients with MBS is vital. The effects of MBS are lifelong and so specialised care for the MBS patient should be lifelong as well. However, years after surgery, who oversees the patient's care and are they qualified? This is a unique publication, based on interviews with both patients and professionals about what they have experienced with the care they have received or provided. It conveys insight, from both patients and providers into the perceived gaps in care following MBS and what is needed for optimal long-term follow up care. While the study was carried out in the UK—and so is framed within the context of the UK healthcare system—the primary point is universal.

Emerging micronutrient deficiencies (MND)

**Publication 7:** *Screening for Vitamin C Deficiency: Why and When*? (Parrott et al., 2022)

**Importance:**

Vitamin C deficiency in patients with MBS was explored and presented to clinicians at an international MBS conference. This was an international presentation which highlighted the increasing incidence of vitamin C deficiency (VCD) and scurvy that have been reported worldwide. It also emphasized the fact that because vitamin C is implicated in many physiological pathways, deficiency can seriously compromise the health of patients with MBS. Because vitamin C status and implications have not been well studied in patients with MBS, VCD may not be obvious from patient symptoms which range widely from fatigue and easy bruising to profuse bleeding and lower extremity swelling. The research provided evidence that the rate of vitamin C deficiency among patients with MBS is as high as 20%.

This retrospective study happened during COVID. The data collection started in 2019, and in 2021 we submitted an abstract with what we thought was the final data set. However, IFSO 2021 was postponed, and surprisingly the University data group provided us with a more complete data set. We were able to incorporate our planned statistical analysis and Machine Learning (ML). Our data analyst used ML to work with the missing data and made predictions of vitamin C deficiency and scurvy.

After two years of postponed conferences, we provided the requested abstract updates—which somehow did not make it to the 2022 final published abstracts. Since I presented our findings to Integrated Health clinicians, I kept the content focused on the signs and symptoms of vitamin C deficiency and scurvy. I have continued to receive requests for updates from clinicians who attended the conference regarding how to identify, treat, and manage vitamin C deficiency.

**Publication 8:** *What We Are Missing: Using Machine Learning (ML) Models to Predict Vitamin C Deficiency (VCD) in Patients with Metabolic and Bariatric Surgery* (Parrott, Parrott, Rouhi, Parrott, & Dumon, 2023)

**Importance:**

It seems that cases of micronutrient deficiencies that were thought to have been eliminated years ago are now reappearing in patients with MBS. Our recent research work, including the study on vitamin C and the ongoing study on thiamine, suggests that these previously eradicated deficiencies may pose a risk to individuals with limited food intake, poor diet, or issues with digestion, metabolism, or excretion, extending beyond the MBS community.

**Metrics Include:**

- SCOPUS citations 0, 61st percentile, Current Obesity Reports FWCI 0.66
- ResearchGate: Research Interest score: 9.9, citations 19, reads: 253

- PlumXMetrics: 6 citations, 40 captures
- Google Scholar: 0 citations
- Springer Link: 0 citations, 411 accesses
- 74th percentile of tracked articles similar age
- 57th percentile of 63 tracked articles with similar age in Obesity Surgery
- Social Media:
- Tweeters: 10
- Mendely: 10

Supporting Publications and Artefacts

**Appendix 1 Context:** *ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient* (Allied Health Sciences Section Ad Hoc Nutrition et al., 2008)

**importance**:

It is the first published CPG based on a narrative review of nutrition in Metabolic and Bariatric Surgery (MBS). It has been cited by numerous professional and public health organizations, including the American Association of Clinical Endocrinologists (AACE) the Obesity Society (TOS) the American Society for Metabolic and Bariatric Surgery (ASMBS) the American Heart Association (AHA), European Society for Clinical Nutrition and Metabolism (ESPEN) and the British Obesity & Metabolic Surgery Society (BOMSS).

It has been used in research and education of both practitioners and patients. The “bariatric food pyramid” is a tool developed using some of

the recommendations from Aills, et al. (2008). It is easy to distribute, user-friendly, and provides nutrition and behavioural recommendations for patients who have had MBS (Moizé et al., 2010). The 2008 CPG has also been used by industry as guidance for the development of vitamin and mineral supplements for patients who have had MBS.

**Metrics include:**

- SCOPUS
    - Citations: 422, Readers 372
    - 98th percentile, SOARD FWCI 7.41
- ResearchGate: Research Interest Score: citations: 282, reads; 2704
- Google Scholar:  648 citations
- PlumXMetrics
    - Citations : 100th
    - Captures : 96th
- It was the most-read article in Surgery for Obesity and Related Disorders (SOARD) Impact Factor of 3.709 in 2020 and as of October 26 2022); the fourth most cited article with 369 cites in SCOPUS and 327 CrossRef. It has a Field-Weighted Citation Impact (FWCI) of 7.53.
    - FWCI shows how well cited this document is when compared to similar documents. A value greater than 1.00 means the document is more cited than expected according to the average. The FWCI is the ratio of the document's citations to

> the average number of citations received by all similar documents over a three-year window. Each discipline makes an equal contribution to the metric, which eliminates differences in researcher citation behaviour.

**Strengths and limitations**

Each type of study has its own intrinsic strengths and limitations. I address each of these below.

There are two key weaknesses that generally plague **clinical practice guidelines**. Which weakness depends on the methodology of the guideline. For many professional associations (where members often do not have the requisite methodological or research skills), clinical practice guidelines are often based on “expert opinion”, which often has, at best, meager empirical support. They may reference exemplars from the available scientific evidence, but there is little systematic methodology applied. In contrast, evidence-based clinical practice guidelines use rigorous methodologies to systematically identify, evaluate and synthesize the available evidence (Sackett et al., 1996). This does not mean there are no limitations—indeed, the most common limitation of guidelines of this type is that there is simply not sufficient research available to determine “the best” practice approach. Within the context of MBS and my own work, many clinical practice guidelines still fall short of the threshold of what would properly be called “evidence based”. While the 2008 nutrition clinical practice guideline might best be described as principled, it would not, by current standards be considered fully evidence based. That changed with

the 2017 micronutrient guideline updates, but even here there were some deficiencies: while there was a systematic search, the risk of bias assessment was rudimentary, in large measure because of the lack of methodological training of the writing team. Still, it was a significant step in the right direction. With the macronutrient nutrition guideline (as mentioned earlier) we decided to first carry out a broad scoping review of nutrition interventions within MBS. We found, however, that because of the lack of focus, heterogeneity of interventions, and inconsistent methods of measuring outcomes, the state of the science was such that, even with the most rigorous methodology, a true evidence-based guideline was currently impossible.

While guidelines are invaluable, they are generally not at a sufficiently specific level to facilitate their full application within concrete MBS practices. Take, for instance, a single recommendation from the micronutrient guidelines [Parrott, 2017]: “Routine pre-WLS screening [of thiamine] is recommended for all patients.” But what does “routine” mean in practice? When a new patient enters the program? Before or after they are cleared for surgery? What about smaller practices that do not have access to robust panels of micronutrient labs? What about patients whose insurance does not cover these labs? Again, while we know what the science **says**, how can this actually “work” in **daily** practice? This is where the strength of **best practices** fills the gap. Best practice (at its best) is based on science but then pushes further to consider inevitable local constraints that get in the way of applying science in daily life. Best practice documents are often based on the experience of experts in the

field and focus on strategies for implementation, or, when implementation is impossible, come up with alternative solutions. But, as was just noted, this goes beyond the science and is based on the limited experience of the experts formulating these best practices. Not every contingency can be anticipated. Not every barrier can be imagined. And there are almost certainly excellent practices that are unknown to the experts.

For **primary research**, the two examples I have included as part of this thesis have very different designs and, thus, are susceptible to different sorts of weaknesses while exhibiting different strengths. The Graham et al article is a qualitative analysis. Thus, it provides a rich description of the experiences of the patients and the professionals interviewed. In so doing, it makes clear problems that may not have been considered or anticipated by researchers and policymakers. Additionally, the findings can generate hypotheses. For instance, a theme from Graham et al. is that patients feel they need longer-term support for optimal well-being. While there is no doubt that the patients in this study expressed this sentiment, we must ask: Do patients with MBS who have access to surgical care at different time frames e.g. long-term (5-10 years) versus short-term as in the UK National Health System (up to 2 years) experience healthcare outcomes differently? Is this the same for patients who receive support from community physicians (with or without knowledge of MBS) after two years? Is there a difference between patients who have good support from the multidisciplinary team versus those who do not? Additional questions can be generated, such as does weight regain occur more often in one group than another? Is there a difference in the presentation of symptoms

and susceptibility to micronutrient deficiencies in patients who receive support from experienced clinicians and have access to a multidisciplinary team?  Qualitative research can open new quantitative research agendas. However, there are two key limitations to this approach to research, one of which is indicated in the previous example. First, qualitative research is intensive and large; nationally representative samples would be impossible to manage. Thus, while we can be confident about the sentiments of patients who received MBS at Sunderland Royal Hospital, would the experience be the same as patients who had surgery at Prince Charles Hospital in Wales? We can surmise, but we cannot know without additional research. The second general weakness of qualitative research is that while it can give us insight into what participants think, feel and value (all of which are important), it cannot tell us how the world works. Again, we know that patients value additional support to enhance their long-term well-being following MBS. Still, we cannot know whether this support would bring about empirical differences in measurable health outcomes.

Parrott et al. 2023 vitamin C study is largely limited by methodology. As a retrospective study, it was dependent on the quality of data in the electronic health record. As noted within the article, the lack of consistency between what measures were ordered and when they were collected limited the analyses by preventing our ability to analyse the development of vitamin C deficiency longitudinally. We know what other patient characteristics are associated with ever developing vitamin C deficiency, but we cannot speak definitively about what sorts of patient characteristics

might lead to an acute experience of scurvy or what type of treatment may help them recover. However, the strength of this large retrospective database study is that it provided the ability to examine thousands of patients to identify common patterns. The fact that the study used a true random sampling technique strengthens our ability to generalize beyond the single large metropolitan practice.

In terms of the thesis overall, its strength and its weakness lie in the personal nature of the questions asked and the approaches used to answer them. As noted above, each of the papers included in this thesis is the product of concrete, practical problems encountered in patient care and professional practice. Thus, while there is a coherent thread that weaves throughout my work, it can hardly be viewed as a logically defined research agenda. A chance encounter with a patient, the fact that I am female, the fact that I was encouraged to pursue nutrition rather than medicine, and a particularly contentious professional meeting—all these chance circumstances have given rise to my body of work.

**Implications for clinicians and policymakers**

This corpus of work includes (1) clinical practice guidelines that prompted (2) best practices to help clinicians design excellent MBS programs and provide patients with optimal nutrition care, and finally (3) primary research when there were no answers to be found to clinical practice questions. Based on the findings from these publications and others, clinicians will continue to encounter micronutrient deficiencies in patients both pre- and post-MBS until policymakers change existing standards for Centers of

Excellence in MBS and define micronutrient deficiencies as surgical complications.

Generalisability

My reflections are based on my personal experiences throughout my career and do not necessarily reflect the broader culture or current state of affairs. Additionally, the outcomes of my published works may vary in different environments and health systems or cultural contexts. Therefore, caution should be exercised when attempting to apply the results of my published works or the personal insights I have shared.

Micronutrient (MN) deficiencies (MND)

Micronutrient (MN) deficiencies (MND) are known to cause serious and potentially irreversible damage to patients. If litigation for malpractice ensues from MND, the damage also encompasses those individuals and programs that care for a patient with MBS. However, these deficiencies continue to persist despite the publication of the 2008 CPG (which included each micronutrient's respective deficiency prevalence denoted by type of surgery), subsequent CPGs (2017 and 2020), book chapters, editorial comments, and best practices guidance for optimal programs and long-term follow up care. The facts are out there. However, until surgeons and other clinicians fully grasp the prevalence and potentially catastrophic consequences of these deficiencies, patients, programs, and clinicians continue to be at risk.

MND is not equated with complications

How do people think about vitamins? This may seem like an odd question. However, the answer may be key to understanding why micronutrient deficiencies post-MBS are so prevalent. We know that obesity is a metabolic disease. Surgery can be a highly effective method for treating the disease. However, the very nature of this treatment approach places patients with MBS at increased risk for micronutrient deficiencies. In short, micronutrient deficiencies are a potential complication of MBS. However, micronutrient deficiencies are not generally viewed as surgical complications (by clinicians or patients) but rather as benign inconveniences. Vitamins are often not viewed as medications for treating a disease but more as a healthy practice (like exercise)—something easily forgotten (Mahawar et al., 2019). This continued mindset perpetuates nutrient deficiencies in patients before and after surgery. Unfortunately, this approach can lead to life-threatening consequences for the patient, the health care providers and the hospitals or systems caring for patients. In the systems model in Figure 8, the red boxes depict problem areas that will continue to plague clinicians and policymakers until change happens at a megasystem level. Unfortunately, until micronutrient deficiencies are treated as clinical complications of MBS, these diseases will continue to harm patients, MBS practices and the individual practitioners caring for patients with MBS.

## Unanswered questions and future work

There are still unanswered questions and future work to be done in several areas: (1) issues of malpractice in MBS as they relate to micronutrient deficiencies, (2) missing criteria for COE standards, (3) overlooked nutrient deficiencies, and (4) poor coordination of patient care among health care practitioners (Figure 8). Additionally, we can assume that patients will continue to pursue MBS, and patients will be presenting for surgery with unseen micronutrient deficiencies. Thus, this body of work has a far-reaching impact, including patients with other types of abdominal surgeries, not solely MBS.

### Issues of malpractice in MBS

Due to the unrecognised nature of micronutrient deficiencies (MND), specifically vitamin B1 (presentation at IFSO 2023 and paper in review for publication), malpractice lawsuits have increased internationally (DeMaria, 2018; Morton et al., 2022; Parrott, Parrott, Rouhi, Parrott, Williams, et al., 2023; Ratnasingham et al., 2017).

Future research and commentaries are needed to both (1) emphasize the severity of the effects of micronutrient deficiencies following MBS and (2) document the cost to the field of MBS for failing to understand the prevalence and severity of these diseases (both in terms of patient quality of life and in terms of financial liability of MBS practices).

Missing criteria for COE standards

In the United States and Canada, if a professional, program or hospital system is not compliant with the ten standards created to optimize surgical care and outcomes in hospitals and healthcare organizations by the American College of Surgeons Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) they are more likely to be ineligible for COE status and to be at risk for malpractice.

One of these ten standards, number 5 (Patient Care: Expectations and Protocols), includes pre-determined clinical pathways for patient care and education (standard 5.2). This section provides guidance for staff education. There is a paragraph specifying the need for a defined pathway that provides early recognition and management of warning signs of complications, including tachycardia, fever, shortness of breath, excessive abdominal pain and vomiting (American College of Surgeons, 2022). But there is no mention of micronutrient deficiencies or information on signs and symptoms of critical micronutrient deficiencies. This is an egregious omission since micronutrient deficiencies may have life-threatening consequences. For instance, vitamin B1 (thiamine) deficiency can cause irreversible damage and death in as little as two weeks. Since this section sets the standards for staff education – it is a crucial and missing complication of MBS. Future research and programmatic efforts should be made to correct this omission.

Overlooked nutrient deficiencies

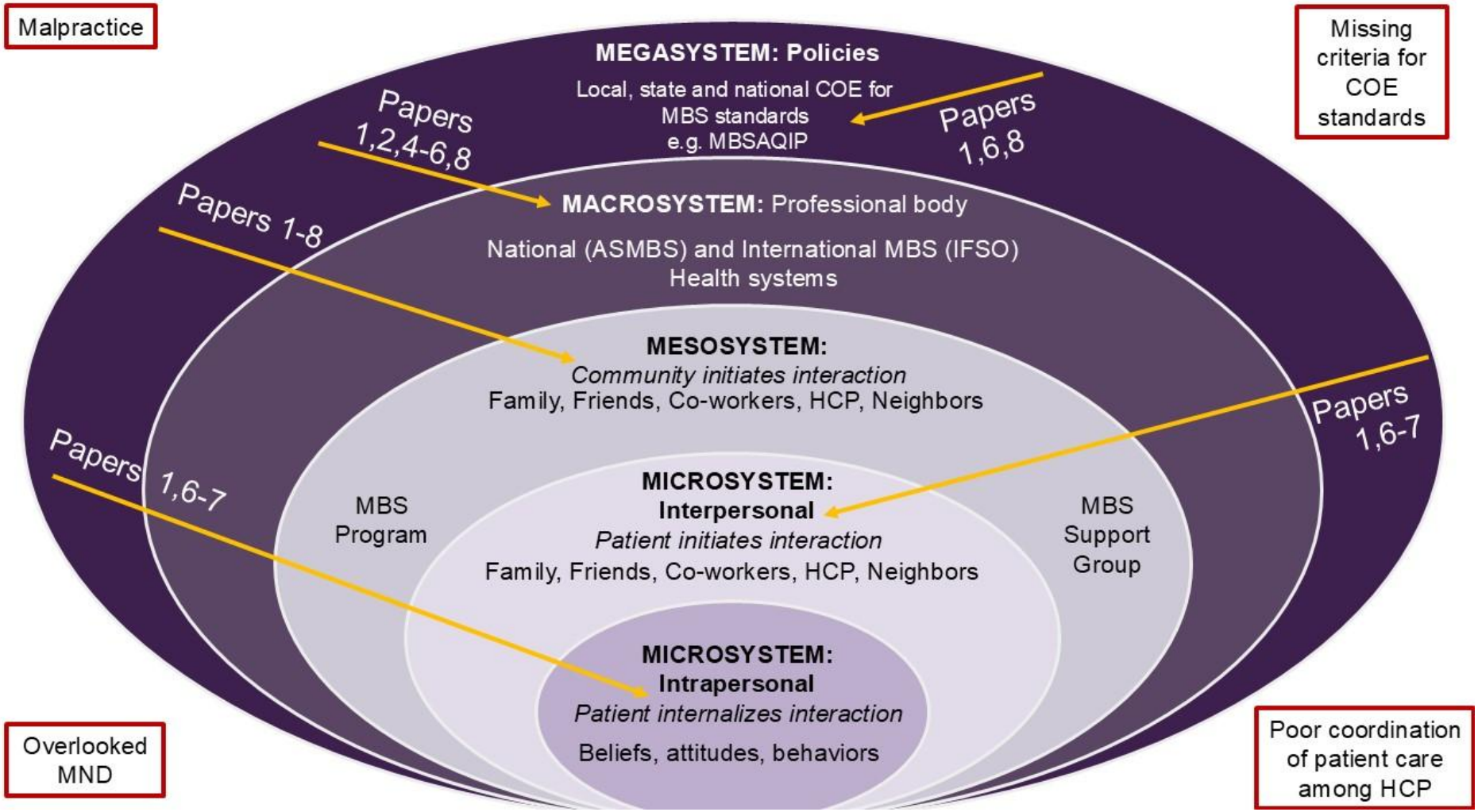
Micronutrient deficiencies that are not identified or treated *before* surgery are known to become worse after surgery. Yet in many programs and practices, the recommended preoperative screening is not conducted (Moizé et al., 2011; Parrott et al., 2017; Schiavo & Pilone, 2019; Schiavo, Pilone, Rossetti, Romano, et al., 2019; Xia et al., 2023). This leaves patients with inadequate physiological, behavioural and psychological coping strategies. Future publications should continue to emphasize the importance of adequate micronutrient status prior to surgery and highlight the fact that most patients pursuing MBS are deficient even before undergoing a surgery that will challenge their micronutrient status.

Poor coordination of patient care among healthcare practitioners

There is often poor communication among healthcare practitioners, which means that patients suffer (Tiwary et al., 2019). In a relay race, multiple runners work as a team, expertly passing a baton to each other at designated points along the track. There must be ongoing practice among the team to ensure a smooth hand-off of the baton from one runner to the next. Similarly, within MBS, the multidisciplinary team must communicate clearly with each other regarding agreed-upon roles and scope of practice. In the context of MBS, there are often instances where a runner is missing, or no one is assigned to a specific segment of a race. This scenario would create chaos during an actual race. Similarly, in healthcare, it becomes problematic when there is no designated expert to identify, diagnose, treat, monitor, and evaluate MND in patients with MBS. As noted above, many in

the field of MBS remain unclear about whether the dietitian's scope of practice includes monitoring or acting on nutrition-related lab reports. As you have read throughout this thesis, I have emphasized that dietitians trained and recognized as experts in MBS, with the ability to interpret lab results as part of their scope of practice, should be the primary clinicians responsible for identifying and treating micronutrient deficiencies. Not only does the "who" is in charge need to be addressed, but "how" the deficiencies are managed. To treat and manage micronutrient deficiencies in a timely and efficacious manner, the "who" needs to have prescriptive authority. As mentioned earlier, I have worked diligently to gain the ability to pend orders for the treatment of micronutrient deficiencies. However, there is a time delay since the treatment must be approved, ordered, and finally ready for the patient. The clinician with the expertise and scope of practice should be able to prescribe the treatment for micronutrient deficiencies with prescriptions – since that is the only accepted medical model of managing a pathophysiological disorder. I anticipate much more work will be needed to see this privilege as a reality.

**Figure 8 Conceptual framework of gaps in practice**



## Chapter 6: Conclusion

I have provided evidence for the claim for recognition of retrospective doctoral-level work focused on the missing or “unseen” integration of nutrition with metabolic and bariatric surgery and the potential pathophysiological impact when it is not addressed. This has been achieved by:

1. Providing evidence of the retrospective creation of optimal resources for use by international interdisciplinary healthcare professionals in assessing, diagnosing, managing, and preventing nutrient deficiencies (both short and long-term) in patients in the pre-and post-operative stages of metabolic and bariatric surgery (MBS).
2. Highlighting the relative clinical invisibility yet salience of the term ‘metabolic’ within the context of post-bariatric surgical nutrition and the avoidance of medical complications.
3. Highlighting innovative best practices in optimal and individualized bariatric nutritional care to help address the conceptual basis of ‘M’ (metabolism) and raise awareness of its consequential significance in MBS, specifically concerning micronutrient deficiencies.

# Chapter 7: Reflections

## My research journey and a PhD by publications

In this section, I describe my research journey throughout this thesis. My reflections about the PhD by published works reveal a process that has been challenging yet rewarding in several ways: (1) the application process, (2) the philosophy required within the write-up, (3) the history of nutrition and dietetics, medicine, and science, (4) learning about the systemic inequities among gender, race, and professions within a domination model versus partnership, (5) the difference in English language and conventional formatting and (6) need for future education and training.

## Application process

My application process began in 2020 after speaking to my committee Chair, Professor Yitka Graham about the possibility of studying implementation science and translation studies at a different UK university. Since Yitka is actively involved in the MBS field, we discussed the opportunities at the University of Sunderland. I developed a proposal and, in June 2020, sent it to Yitka, my director of studies, Professor Catherine Hayes, my co-supervisor, and Professor Kamal Mahawar, my thesis external reader and well-known surgeon at MBS. With the committee's help, I began the application process in the Fall of 2020. However, the Postgraduate Research Degree Sub-

committee recommended that I acquire more primary research in my corpus of published works. I received continuing support from my committee with a three-year Visiting Research Fellowship with the Faculty of Health Sciences and Wellbeing at the University of Sunderland to facilitate the publications needed for full acceptance into the program. I participated in the qualitative study championed by Yitka Graham regarding the long-term follow-up of patients with MBS. I conducted original research on vitamin C deficiencies and scurvy in patients with MBS. I was selected to present these findings as one of the top abstracts in Integrated Health at the 2022 International Federation of Surgical Obesity (IFSO) and won a newly created award in the Integrated Health section for Emerging Researcher. I subsequently published the paper in Obesity Surgery in 2022.

**Reflection**:

My career trajectory would not be what it is today without the support of various healthcare providers, including surgeons and dietitians. While I have reflected on key moments in my journey, I recognize that these reflections do not capture all my experiences. For instance, even after transitioning to a different hospital system, the surgeon I previously worked with at a large metabolic and bariatric surgery (MBS) clinic continued supporting my research ideas. This surgeon played a crucial role in facilitating my primary research for publications 7 and 8, which ultimately helped me achieve my PhD.

In 2022, I re-applied to the PhD by published works program with an updated application containing my expanded publications and my same committee. I was formally accepted into the program in February 2023. I have met monthly for Supervised meetings with my Director and Co-director of Studies to guide the writing of my thesis.

**Philosophy requirement for thesis**

In the last 20 years, I have received both formal and informal training in conducting high-quality clinical practice and research. One of my most significant work experiences was participating as a research specialist in a global multi-million-dollar clinical trial with Nestle Health Sciences. I played a key role in facilitating the initial development of the global clinical trial until it was ready to be transitioned to a clinical research organization. I also had the opportunity to visit Nestle's global headquarters and scientific labs in Lausanne, Switzerland, which greatly enhanced my research knowledge and skills. Even though I gained extensive research training from this experience, I never had to support my ideas by referring to the philosophical foundations of my thinking and research. My undergraduate and graduate degrees were focused on science and did not include formal philosophy courses. I found Chapter 3's focus on justifying my ontology and epistemology to be extremely challenging and frustrating. I had never deeply considered my axiology and pragmatism, nor was I aware of the ontological or epistemological foundations of my thoughts and research. These concepts continue to feel somewhat foreign to me. I was familiar with models like Bronfenbrenner but had yet to

learn where the idea came from. After deciding on a model that best represented my research positionality, I had to explore various types of epistemologies and how my assumptions and research position fit within multiple frameworks since, within the USA educational system, empiricist ontology and epistemology essentially “go without saying”—they are mainly invisible assumptions. However, clinical practice is nothing if not pragmatic. Every patient is unique and applying empirically based clinical principles requires empathy, innovation, creativity, and curiosity. All these experiences—both educational and professional—unknowingly shaped my foundational assumptions not only about how to carry out research but also about the purpose of research. Until the experience of writing the thesis, these foundational assumptions about the world, how we know it, and how we act in it (like micronutrient deficiencies) were largely unseen and unreflected upon.

**The history of nutrition and dietetics, medicine, and science**

While I was intimately aware of the recent history of nutrition within MBS, I was only vaguely aware of the longer history of the nutrition profession and its often-contentious relationship with the medical profession. I had no idea there were such powerful women who created the longstanding organizations in the USA to address nutrition, science, public health and who served in both World Wars. This thesis has allowed me to appreciate these women's passion and determination to break boundaries during their lifetime. These women provide exemplars, and I am proud to continue their work.

### Systemic inequities

Having lived and worked as a woman in the domains of science and healthcare, I have long been aware that the role of women (and “female” professions) was often contested and relegated to “second status” as in “it’s a man’s world” (another one of my favourite songs). I was not, however, attuned to the truly systemic nature of the patriarchal system and structures that continue to shape the way we think and the way we organise our social spheres. Learning about the systemic inequities among gender, race, and professions within a domination-type model versus a partnership has provided me with a different lens to view my current profession and the obstacles that had to be overcome just to be here – working on these issues – now.

### English and American language and formatting differences

Language and formatting differences may seem minor, but writing a thesis systematically is quite challenging. Is it anemia or anaemia? My spell checker keeps correcting me, and, in some words, I prefer the English over the American version, but vice versa with others. This is quite a feat for the creative brain that is trying to stay the course. My default and preferences in writing and publishing, such as font and capitalization (of all words, not just the first in a title), have posed a slight challenge to my committee as well.

### Future Education and Training

This PhD thesis by published works underscores two critical needs within the field: (1) the necessity for enhanced educational and training programs specifically designed for Registered Dietitians (RDs) aimed at improving their proficiency in diagnosing micronutrient deficiencies in patients with MBS, thereby promoting optimal patient health outcomes; and (2) the necessity for a comprehensive exploration of collaborative avenues that enable RDs in MBS to fully leverage their scope of practice as vital contributors within a multidisciplinary healthcare team.

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**Appendix 1**

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# ASMBS Allied Health Nutritional Guidelines for the Surgical Weight Loss Patient

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