Assessment of the implementation of the peri-operative nutrition ERAS guidelines in elective colorectal surgery patients in a tertiary hospital in South Africa

by
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DECLARATION

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ABSTRACT

Introduction: The ERAS (enhanced recovery after surgery) guidelines recommend a set of perioperative nutritional interventions which optimize recovery and reduce surgical stress. However, traditional perioperative nutritional practices still persist in many settings worldwide, many of which can be detrimental to patient recovery. The extent of compliance with the ERAS guidelines in South Africa has not been studied. Implementation of the guidelines locally has the potential to decrease morbidity, mortality and length of hospital stay, thereby lowering health care costs. This study aimed to evaluate the current practices and barriers to implementation of the ERAS guidelines in South Africa.

Methods: An observational descriptive cohort study with an analytical component was conducted at a tertiary academic hospital in South Africa. Thirty adult colorectal surgery patients were observed throughout their surgical journey. Patients completed an interviewer-administered questionnaire to determine pre- and post-operative fasting times and experiences of current fasting practices. Nutritional risk of patients was determined using the NRS-2002 screening tool. A total of 58 health care professionals (HCPs) (29 professional nurses, 13 registered dietitians, three GIT surgery consultants and 13 anaesthesiology consultants) completed a self-administered questionnaire in order to assess knowledge, attitudes, practices and barriers to the implementation of the ERAS guidelines.

Results: Twenty-seven percent of patients were nutritionally at risk on admission and 70% were weighed on admission to the ward. In contrast to the ERAS guidelines, patients were fasted preoperatively from solids and liquids for a mean of 19.5 hours (SD 13.2) and 14.92 hours (SD 7.8) respectively. None of the participants received a carbohydrate loading drink preoperatively. The first enteral feed after surgery was commenced at a mean of 13.64 hours (SD 8.6) postoperatively.

Knowledge regarding the ERAS guidelines was poor, with HCPs scoring a mean of 36% (SD 27.7). The attitude questionnaire showed good awareness of the importance of nutrition with 93% of HCPs agreeing with the importance of patients being well nourished before surgery. Seventy one percent of HCPs indicated that they did not intend to order a preoperative carbohydrate drink for their patients. Participants reported advising patients to fast from solids and liquids for a mean of 9.59 hours (SD 5.69) and 4.30 hours (SD 4.31), respectively. Postoperatively, 75% of HCPs reported advising their patients to fast for between four and 24 hours, while 91% reported progressing patients slowly to a full oral diet.

Lack of co-operation of the multidisciplinary team, resistance to change, the lack of a formal ERAS policy, the unpredictability of the surgical schedule and the lack of education regarding the ERAS guidelines amongst HCPs were identified as major barriers to ERAS implementation.

Conclusion: Implementation of the ERAS guidelines in a tertiary hospital in South Africa was found to be poor and traditional perioperative nutrition practices were still largely used. This study provided further motivation for the implementation of ERAS guidelines and an insight into the barriers of such implementation in public hospitals in South Africa. Stakeholders should engage with these identified barriers in order to develop targeted strategies for successful ERAS implementation.

OPSOMMING

Inleiding: Die ERAS (verbeterde herstel na ’n operasie)-riglyne beveel ’n stel perioperatiewe voedingsintervensies aan wat herstel na ’n operasie optimaliseer en die chirurgiese stres verminder. Tradisionele perioperatiewe voedingspraktyke duur egter steeds voort in verskeie instellings wêreldwyd, waarvan baie nadelig vir pasiënte se herstel kan wees. Die mate van voldoening aan die ERAS riglyne in Suid-Afrika is nog nie ondersoek nie. Plaaslike implementering van die riglyne het die potensiaal om morbiditeit, sterftes en die lengte van hospitaalverblyf te verminder en daardeur die gesondheidsorgkostes te verlaag. Hierdie studie het ten doel gehad om die huidige praktyke en aspekte wat die uitvoering van die ERAS riglyne in Suid-Afrika belemmer, te evalueer.

Metodes: ’n Beskrywende waarnemingskohort-studie met ’n analitiese component is uitgevoer by ’n tersiêre akademiese hospital in Suid-Afrika. Dertig kolorektale chirurgiese pasiënte is deur hulle chirurgiese reis waargeneem. Pasiënte het ’n navorser-geadministreerde vraelys ingevul om die pre- en postoperatiewe vastye en ervaring van huidige vaspraktyke vas te stel. Voedingsrisiko’s is vasgestel deur die NRS-2002 siftingsinstrument te gebruik. ’n Totaal van 58 gesondheidswerks (GW’s) (29 professionele verpleegsusters, 13 geregistreerde dieetkundiges, drie GIK chirurgie-konsultante en 13 narkosekonsultante) het ’n self-geadministreerde vraelys ingevul om kennis, houdings, praktyke en struikelblokke tot implementering van die ERAS-riglyne te assesseer.

Resultate: Sewe-en-twintig persent van pasiënte het voedingsrisiko’s ervaar ten tye van toelating en 70% is geweeg tydens toelating tot die saal. In kontras met die ERAS riglyne, het pasiënte ’n gemiddelde tydperk van 19.5 ure (SA 13.2) voor hul operasie van vaste kos gevas en 14.92 ure (SA 7.8) van vloeistowwe. Geen deelnemers het ’n koolhidraatladingsdrankie voor hul operasie ontvang nie. Die eerste enterale voeding na die operasie is gemiddeld 13.64 ure (SA 8.6) na die operasie toegedien.

Kennis aangaande die ERAS-riglyne was swak met deelnemers wat ’n gemiddelde van 36% (SA 27.7) behaal het. Die houdingsvraelys het goeie bewustheid van die belangrikheid van voeding uitgelig, met 93% van deelnemers wat saamgestem het dat dit belangrik is dat pasiënte goed gevoed is voor die operasie. Een-en-sewentig persent van die deelnemers het aangedui dat hulle nie van plan is om ’n preoperatiewe koolhidraatladingsdrankie vir hul pasiënte te bestel nie. Deelnemers het aangedui dat hulle pasiënte adviseer om gemiddeld 9.59 ure (SA 5.69) en 4.30 ure (SA 4.31) van vastestowwe en vloeistowwe onderskeidelik te

vas. Verder adviseer hulle pasiënte om tussen vier en 24 uur na hul operasie te vas, terwyl 91% aangedui het dat hulle hul pasiënte geleidelik aan ’n vol orale dieëet bekendstel.

’n Gebrek aan samewerking in die multidissiplinêre span, weerstand teen verandering, die gebrek aan ’n formele ERAS beleid, die onvoorspelbaarheid van die chirurgiese skedule, en die gebrek aan opleiding aangaande die ERAS riglyne onder gesondheidswerkers, is as hoof-struikelblokke tot die implementering van ERAS geïdentifiseer.

Konklusie: Hierdie navorsing het gevind dat die implementering van die ERAS-riglyne by ’n tersiêre hospital in Suid-Afrika swak was en dat tradisionele perioperatiewe voedingspraktyke steeds grootliks gebruik word. Hierdie studie het verdere motivering vir die implementasie van die ERAS riglyne gebied en het insig tot die struikelblokke vir hierdie implementering in openbare hospitale in Suid-Afrika gebied. Belangegroepe moet by hierdie verskillende struikelblokke betrokke raak om sodoende gerigte strategieë vir ERAS implementasie te ontwikkel.

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LIST OF ABBREVIATIONS

LOHS	length of hospital stay
ERAS	enhanced recovery after surgery
NPO	nil per mouth
ADH	anti-diuretic hormone
GH	growth hormone
IL-1	Interleukin-1
TNF-α	tumour necrosis factor-α
IL-6	Interleukin-6
T3	Triiodothyronine
IASMEN	International Association for Surgical Metabolism and Nutrition
ESPEN	European Society for Clinical Nutrition and Metabolism
ASPEN	American Society of Parenteral and Enteral Nutrition
GRADE	grading of recommendations, assessment, development and evaluation
NRS-2002	nutritional risk screening
MNA	mini nutritional assessment
SGA	subjective global assessment
MUST	malnutrition universal screening tool
NRI	Nutritional Risk Index
BMI	body mass index
ONS	oral nutritional supplements
IN	immunonutrition
NGT	nasogastric tube
KAP	knowledge, attitudes and practices
HCP	health care practitioner
GIT	gastrointestinal tract
TB	tuberculosis
HIV	human immunodeficiency virus
PN	parenteral nutrition

LIST OF DEFINITIONS

malnutrition risk screening	A rapid and simple process performed by admitting staff using an appropriate validated screening tool in order to identify patients at nutritional risk.[1]
hospital malnutrition	Malnutrition is a state resulting from inadequate intake or uptake of nutrients leading to changes in body composition (decrease fat free mass) leading to diminished physical and mental function and impaired clinical outcome.[1] Malnutrition in hospitalised patients is a combination of disease-related cachexia and inadequate consumption of nutrients.[2]
enteral nutrition	Comprises all forms of nutritional support delivered via the gastrointestinal tract, including enteral tube feeding given via tube or stoma and oral nutritional supplements.[3]
nil per os	A Latin term meaning “nothing by mouth”.[4] This instruction prohibits the consumption of any food or beverages.
clear liquid diet	Consists of clear liquids that are easily digested and leave no residue in the gastrointestinal tract.
full oral diet	Synonym: Normal oral diet. The normal oral diet of an individual as consumed at home or offered by the catering system of a hospital.[3]
colorectal surgery	Surgery on any portion of the small bowel, colon or rectum via laparotomy or laparoscopy.[5]
oral nutritional supplements	Supplementary oral intake of dietary food for special medical purposes in addition to the normal food. ONS are usually liquid but they are also available in other forms like powder, dessert-style or bars.[3]

CHAPTER 1:
INTRODUCTION AND MOTIVATION

Traditionally, patient's scheduled for elective surgeries are advised to fast from midnight the night before surgery, a dogma based on scant evidence that has persisted for almost half a century and which has only been challenged in the last two decades.[6] Not only does evidence suggest that this amount of preoperative fasting is unnecessary, it can also negatively impact post-surgical recovery.[7] In the last three decades, the traditional fasting times of patients post-surgery began to be recognised as problematic in light of mounting evidence regarding post-surgical early enteral feeding being shown to enhance patient recovery and the long-recognised relationship between pre-surgical patient nutritional status and post-surgical recovery, as well as morbidity and mortality.[8] A body of research thus began to emerge recognising nutrition as an important determinant of surgical outcomes and suggesting a set of principles that could ultimately modulate the stress response to surgery and have a far reaching impact on recovery.[5,9] This ground breaking recognition and the research supporting it culminated in the formation of the ERAS (enhanced recovery after surgery) Society in 2010.[10]

In 2013, the ERAS Society released its updated set of consensus review guidelines, which were published in the World Journal of Surgery.[11] The ERAS guidelines were released as a set of evidence-based best practice guidelines using a number of multimodal interventions designed to be implemented pre-, intra-, and post-operatively that have been shown to enhance patient recovery and improve surgical outcomes.[5,12,13] These guidelines included a number of nutrition-related interventions, including updated evidence-based pre- and post-operative fasting guidelines and guidelines related to preoperative optimisation of nutritional status.[5,12,13]

Despite the mounting evidence and the change in consensus guidelines, change in practice has been slow to follow and fasting times have been reported to be unchanged in many settings.[4,8,14,15] In addition, implementation of ERAS perioperative nutrition guidelines in South Africa and broader developing healthcare settings, is yet to be studied. Few studies have been done observing the practices of perioperative nutrition in surgical units and the barriers to implementing the ERAS nutritional guidelines in developed healthcare systems, and no studies have been found relating to ERAS implementation in a developing healthcare system.

Potential benefits are thought to be more pronounced in such settings due to ERAS perioperative nutrition interventions being relatively cost-effective in terms of human and financial resources and carry little to no risk to the patient. In addition, implementation of ERAS guidelines has the potential to lower costs for the public health system by decreasing morbidity and mortality in surgical patients as well as length of hospital stay (LOHS).[16] Studying the degree of compliance with perioperative ERAS nutritional guidelines as well as identifying barriers quantitatively, will allow for further motivation for the implementation of ERAS perioperative nutrition guidelines in public hospitals in South Africa as well as possible solutions to overcome these barriers.

CHAPTER 2:
LITERATURE REVIEW

2.1 HOSPITAL MALNUTRITION

Malnutrition has been defined as a state resulting from inadequate intake or uptake of nutrients leading to changes in body composition (decrease fat free mass) leading to diminished physical and mental function and impaired clinical outcome.[1] Malnutrition in hospitalised patients is seen as a combination of disease-related cachexia and inadequate consumption of nutrients.[2]

The prevalence of hospital malnutrition has been said to range anywhere between 20% and 50%, depending on the setting, patient population and diagnostic criteria used.[17] Studies on the prevalence of hospital malnutrition in a range of geographical settings show a weighted mean prevalence of 41.7%; however this prevalence is a lot lower (31.4%) in studies from Europe and the United States, indicating that developing healthcare settings may have a higher prevalence of hospital malnutrition than developed settings.[17]

A recent systematic review on the prevalence of hospital malnutrition in Latin America indicated that malnutrition ranged between 40% and 60% but may be as high as 73.2% in some settings.[18] A Vietnamese study found the prevalence of malnutrition in elective abdominal surgery patients to be 55.7%, while the Latin American review reported that the prevalence of malnutrition in surgical patients ranged between 17.6% and 66%, with the highest prevalence of malnutrition in surgical patients being amongst gastrointestinal surgical patients, with malnutrition for those undergoing gastrointestinal surgery ranging between 55% and 66%.[18,19]

Studies on the prevalence of hospital malnutrition in South Africa are limited; however, the available studies were recently summarised in a review article by Prins and Visser.[20] Although the broader prevalence of hospital malnutrition in South Africa and the African continent is largely unknown, the authors are aware of a multicentre, multi-country study currently underway, examining adult hospital malnutrition prevalence in South Africa, Ghana and Kenya. This study will help to contribute to our understanding of the prevalence of hospital malnutrition in South Africa. South Africa is a developing country with a high burden of chronic as well as infectious diseases and many socio-economic factors which are all recognized as causative factors in the aetiology of malnutrition. Thus the prevalence of malnutrition in South

African hospitals would be expected to be higher than those of developed healthcare systems and may be similar to those of other developing countries, such as Latin America.[18]

Malnutrition prevalence has been shown to increase significantly over the course of admission up to as much as 80% after two weeks of hospitalisation.[17,18] The causes of malnutrition in hospitalised patients are multi-factorial. Socio-economic factors lead to both inadequate dietary intake and disease, which both result in malnutrition.[17] Disease itself can also prevent intake of adequate nutrients, thus leading to malnutrition. This lowered intake of nutrients could be due to a decrease in appetite, inability to prepare or eat food, or physical and mechanical factors of the disease that increase losses of nutrients or prevent nutrients from being consumed, absorbed and assimilated.[2,17] On a metabolic level, the metabolic response to trauma and disease can increase requirements for certain nutrients and promote protein catabolism in a process known as cachexia.[2,17]

Malnutrition in hospitalised patients has been shown to result in an increase in both mortality and morbidity.[17] In the Latin American Review, six out of the seven studies evaluating mortality found a significant increase in mortality in malnourished patients.[18] A multi-centre study in Australasia found a significant increase in mortality in malnourished patients as opposed to well-nourished patients, while a study on hospitalised patients in Singapore found that malnutrition was a significant predictor of overall mortality.[21,22] Malnutrition in hospitalised patients significantly delays wound healing post-operatively and increases the risk of infectious and non-infectious complications.[2,17,18] An increase in morbidity and slower recovery leads to a significant increase in LOHS in malnourished patients, with an average of 40–70% or 4.3–17.1 days increase in LOHS, as well as increase in rates of readmission and lowered quality of life scores.[2,17,18,21,22] The increase in morbidity and LOS in malnourished patients has been shown to increase cost of care for these patients by between 24% and 309%, and cost of care has been shown to be increased independent of confounding factors.[17,18,22,23] In a cost–benefit analysis, the authors of the Latin American review determined that for every dollar spent on nutritional interventions, four dollars would be saved on healthcare costs.[18] A recent review by Prins and Visser summarised the increased costs associated with hospital malnutrition reported in various studies, showing that although costs vary depending on setting, costs of hospitalisation were consistently higher for malnourished patients.[20]

Despite ample evidence indicating a high prevalence of malnutrition in hospitalised patients and the negative effects of such prevalence on both patient outcomes and costs, identification and awareness of malnutrition in hospitalised patients remains low.[2,17,18] Awareness and identification of malnutrition are considered to be essential to appropriate treatment of malnutrition.[2,17,24] Proposed reasons for lack of awareness and management of hospital

malnutrition include lack of education of medical staff, lack of nutrition education in medical curricula and lack of hospital policies formalising malnutrition screening.[17,18]

2.2 TRADITIONAL FASTING GUIDELINES:

"Do not have anything to eat or drink after midnight". This is the universal instruction repeated by doctors, anaesthetists, surgeons and nurses the world over to patients going in for elective surgeries the following day.[6] The practice of preoperative fasting is as old as anaesthesia itself and was initially guided by the intent to avoid the "unpleasantness" of vomiting during surgery.[6] Later, it was discovered that aspiration of gastric contents during anaesthesia could lead to many serious and potentially fatal complications.[6] The "no food or drink from midnight" instruction first appears in the literature in 1964 and seems to have become a permanent fixture thereafter, despite lack of evidence to suggest that an arbitrary fasting time of more than six hours is effective in preventing pulmonary aspiration.[6] This fasting tradition seems to have emerged out of a need for simple, straightforward and uniform fasting instructions that also allow for flexibility in surgical schedule.[6,25]

In 1986, Maltby *et al*. began to question the non-distinction between solids and fluids in traditional fasting guidelines by conducting various randomised controlled trials, showing reduced gastric residual volumes and comparable gastric pH in those given liquids up to 2.5 hours before surgery as opposed to those fasted from both solids and liquids for the traditional amount of time. The results showed that liquids empty from the stomach within two hours of ingestion and therefore, do not pose a risk for aspiration.[6,26] This spurred a series of similar randomised controlled trials over the next decade, which essentially began to emerge as an evidence base to guide recommendations on preoperative fasting.[6] As evidence began to mount, a worldwide call to change traditional fasting practices strengthened, resulting in the Norweigan Society of Anaesthesiology releasing evidence-based fasting guidelines in 1994, followed shortly by the American Society of Anaesthesiologists in 1999, the Association of Anaesthetists of Great Britain and Ireland in 2001, the Cochrane Database of Systematic Reviews in 2004, and finally, the Canadian Anaesthetists' Society, Norwegian National Consensus Guideline and Royal College of Nursing guidelines in 2005.[6,7,27–31] The South African Society of Anaesthesiologists published their evidence-based fasting guidelines in 2010.[32] All guidelines agreed that fasting times should be reduced to two hours pre-surgery for liquids and six hours pre-surgery for solids.[25]

In addition to the traditional practice of routinely fasting patients from the night before elective surgery, there are a series of other traditional perioperative nutrition-related practices that are carried out globally, which have been shown to be futile and guided simply by "medical dogma".[14,33] Traditionally, patients undergoing elective gastrointestinal surgery will be kept

fasted or on a liquid diet after surgery until such time as the bowel has been deemed functional.[34–36] Return of gastrointestinal motility is often assessed via non-clinical endpoints such as the return of bowel sounds, the passing of flatus or a bowel movement, this often results in nutrition support being unnecessarily delayed for up to several days or weeks.[14,36,37]

In addition to delayed resumption of feeding post-surgery, surgical patients are traditionally subject to a slow advancement back to a full oral diet.[14,37] This advancement usually starts off with a clear liquid diet, after which the patient is allowed a full liquid diet and then lastly, a full oral diet, with a fourth step sometimes added to include a soft diet before the allowance of the full oral diet.[14,37]

A national survey of 23 colorectal surgical departments in Israel in 2001 found that 22% of surgical departments began oral fluids between post-operative day one and three, 22% only began oral clear fluids after the passing of flatus, 13% of departments only began oral fluids after the removal of the nasogastric tube, which was routinely inserted during surgery, 4% of departments only started oral fluids after a bowel movement and the remaining department did not respond.[36] The authors concluded that prolonged perioperative dietary restrictions are used in the majority of surgical departments, although the available evidence does not support the need for such restrictions.[36]

Another study conducted in ICU patients at the University of Louisville Hospital in 2011 found that surgical patients were routinely kept Nil Per Os (NPO) for one day post-operatively and that the second most common reason for the order for NPO in the ICU was that the patient was post-operative.[33]

These traditional practices of delaying post-operative feeding in gastrointestinal surgery patients are thought to have emerged out of the notion that restricting oral feeding is necessary to give the gastrointestinal tract (GIT) time to recover and heal in order to minimise complications.[34] The withholding of enteral nutrition in colorectal surgery patients is thought to prevent complications such as post-operative ileus, aspiration, surgical site infection, intra-abdominal infection and anastomotic complications.[34,36,37] Other reasons for delayed post-operative feeding include inadequate resuscitation and haemodynamic instability, the concern that re-operation may be necessary, and the lack of awareness about the impact of early nutrition support on recovery.[37] Reasons given for keeping ICU patients NPO and on clear liquid diets for extended periods of time included: concern for ileus, the need to await signs of bowel function, mechanical ventilation, and anticipation of extubation, haemodynamic instability and nausea with or without vomiting.[33]

A clear liquid diet is thought to lower risks of complications as it is easier to swallow and is low residue therefore it will lead to quicker gastric emptying, increased absorption in the small bowel, will be well tolerated and prevent nausea and vomiting.[36,37] For these reasons, a clear liquid diet is often routinely prescribed as a safer alternative to a full oral diet.[36,37] However, current evidence does not support the notion that bowel rest post-operatively prevents complications or that early enteral feeding increases the risk of post-operative complications.[34,36,37] In addition, a clear liquid diet is an inadequate source of nutrition and not a viable alternative to a full oral diet and therefore, can result in significant calorie deficits in the post-surgical patient, which can be detrimental to the patient outcome.[36,37] The consistency of a clear liquid diet may, in fact, be more difficult to swallow and increase the risk for aspiration, while the high osmolarity can potentially slow gastric emptying.[36]

2.3 PHYSIOLOGY

It is prudent to understand the pathophysiology and characteristics of the stress response to surgery in order to conceive the mechanisms by which nutritional interventions can modulate this response. The stress response is activated by mechanical trauma, which in surgery would begin at the site of the initial incision.[38] There are two mechanisms by which the response is activated, the first being neuronal activation from the nerves around the site of trauma which sends impulses to the brain causing a systemic endocrine response.[38] The second mechanism is a cytokine response activated by the innate immune system at the site of trauma, which has both local and systemic effects.[38]

The endocrine response to stress is characterised by an increase in the secretion of glucagon, cortisol, anti-diuretic hormone (ADH), growth hormone (GH) and catecholamines and a decrease in the insulin–glucagon ratio.[8,38] Neuronal activation leads to activation of the sympathetic nervous system, which in turn leads to release of nor-adrenaline and catecholamines.[38] This sympathetic nervous response results in tachycardia and hypertension in the stressed patient, as well as an increase in energy expenditure.[8,38,39]

These endocrine changes lead to changes in the metabolic response and substrate utilisation. Increased cortisol, catecholamines and glucagon leads to increased protein breakdown, lipolysis, glycogenolysis and gluconeogenesis, thus increasing blood glucose concentrations and inhibiting glucose uptake into cells, specifically in the periphery.[38] Insulin is the primary anabolic hormone in the body and is associated with glucose uptake into cells, the formation of glycogen and triglycerides from glucose and the inhibition of proteolysis and lipolysis.[38] Following the surgical insult, cells become less sensitive to the effects of insulin, leading to the characteristic “insulin resistance” seen in post-operative patients.[8,38] Thus insulin fails to counteract the catabolic metabolic response being perpetuated by the increase in catabolic

hormones.[8,38] This effect leads to raised blood glucose levels from the onset of surgery and this hyperglycaemia can persist post-operatively for as long as catabolic hormone levels are raised and may increase the risk for infections and impair healing.[8,38]

In addition to changes in carbohydrate metabolism, protein and fat metabolisms are also affected. Lipolysis results in the release of triglycerides, which are then further metabolised and used for gluconeogenesis.[38] Protein catabolism leads to the breakdown of skeletal muscle, which results in weight loss and muscle wasting in surgical patients.[38] Catabolised protein is used for energy or to form acute-phase proteins.[38] Excessive losses of skeletal muscle through protein catabolism impairs wound healing and immune function, compromises respiratory function and leads to loss of strength and endurance, with all of these factors increasing mortality risk.[39]

The endocrine response leads to changes in water and sodium excretion, with the increases in ADH and Aldosterone leading to water retention and production of concentrated urine as well as sodium and water resorption from the renal tubules.[8,38]

The cytokine response to surgery is routed in the innate immune response and cytokines generally function as inflammatory mediators while also stimulating the release of catabolic hormones.[38,39] At the site of tissue trauma, activated macrophages and monocytes release interleukin-1 (IL-1) and tumour necrosis factor-α (TNF-α), both cytokines mediating and maintaining the inflammatory response and which stimulates the release of another cytokine, interleukin-6 (IL-6).[38] IL-6 is the main cytokine responsible for initiating the acute phase response that is characterised by the production of acute-phase proteins in the liver, acting as inflammatory mediators and aiding in tissue repair.[38,39]

The nett effect of the metabolic response to surgery is an increase in the metabolic rate and a state of hyper catabolism, which is proportional to the extent of the surgical insult.[8,38,39] In this hypermetabolic, catabolic state, nutritional stores are quickly depleted, threatening the survival of the patient.[39] In a patient with inadequate nutritional stores prior to surgery, this risk would be exacerbated.[8,39] Although nutritional support may not attenuate the catabolic response following surgery, supplying exogenous nutrients can provide substrate for acute phase protein synthesis, thus helping to modulate the inflammatory response, preventing excessive skeletal muscle losses, optimising wound healing and maintaining immune function.[8,39]

2.4 METABOLIC EFFECTS OF FASTING:

The metabolic effects of fasting share some similarities with the stress response to trauma and surgery. In the unfasted or fed state, insulin dominates metabolism and is released in response to feeding in order to induce the uptake of glucose into cells and conversion into glycogen for storage.[8] Gluconeogenesis, lipolysis and protein breakdown in the muscles is halted, therefore carbohydrates become the primary source of fuel.[8] This fed metabolic state persists for about four hours after a meal, after which the metabolism shifts over to the fasted state.[8] In the fasted state, insulin levels drop and glucagon and cortisol levels rise, causing the metabolism to shift over from an insulin-dominated anabolic state to a catabolic state where protein and fat is oxidised for fuel, rather than carbohydrates.[8] Initially, glycogen, which is stored in the liver can be oxidised for fuel. However, these stores only last for up to 24 hours, after which metabolism shifts over into the starvation state where survival depends solely on the oxidation of fat and protein for gluconeogenesis and ketogenesis.[8] These stores can last for up to two months.[8] After about two to three weeks of starvation, metabolic adaptation occurs in order to prolong survival by sparing protein stores for as long as possible.[8] This adaptation is characterised by a drop in Triiodothyronine (T3) levels, which leads to a reduction in the metabolic rate and protein sparing through increased lipolysis and a shift to the use of ketone bodies as a primary fuel source.[8] This is in contrast to the increased metabolic rate in a stress metabolism, resulting in accelerated muscle protein depletion and depletion of fat and protein stores.[8,38]

It is important to note that starvation metabolism can occur without complete fasting, in the presence of caloric intake if energy intake does not meet the requirements for an extended period of time.[8] In this hypocaloric state, blood glucose concentrations are decreased and the insulin/glucagon ratio decreases, resulting in insulin resistance and a shift to a catabolic state for the stimulation of gluconeogenesis in as little as one to three days.[8]

Traditionally, patients are told to fast from midnight the night before surgery, thus resulting in a standard eight-hour fast from both solids and liquids. However, in actuality due to delays in the surgical schedule and the lack of opportunity for patients to eat after dinner, this fast is often much longer, with some studies citing fasting times of up to 20 hours.[4,40,41]

Therefore, a patient entering surgery after an overnight fast, or even a fast as short as four hours, would be entering surgery in a catabolic fasted state with high stress hormone levels. This is most likely not the best way to prepare for the insult of surgery and the following stress response.[8] In a patient who is malnourished or who has had inadequate caloric intake prior to surgery, the effects of the surgical stress response would be further compounded by the starvation state of the patient.

2.5 ERAS GUIDELINES

In light of the mounting evidence regarding the benefits of evidence-based perioperative care in surgical patients, the ERAS study group was formed in 2001 with the aim of integrating the concepts of multimodal surgical care and evidence-based, perioperative practices into current surgical practices.[10] The ERAS study group was comprised of leading surgical groups from the United Kingdom (UK), Sweden, Norway and the Netherlands.[10] The study group found that practice in surgical units was still based on tradition and was contrary to evidence-based best practice.[10]

In 2005, the ERAS study group published an evidence-based consensus statement including a multi-modal protocol for colonic surgery patients which they had developed.[10,42] In 2009, an updated consensus was published by the ERAS study group to include rectal surgery, in which each item of the protocol was given a consensus recommendation based on a review of the available good-quality literature.[10,43]

In 2010, the ERAS Society was officially registered with the mission of improving post-operative recovery through implementation of evidence-based practice and the first ERAS implementation programme. This programme was aimed at providing training and skills development with a focus on well-coordinated surgical teams in order to successfully implement ERAS in surgical units, took place in Orebro University Hospital in Sweden.[10,44] Between 2010 and 2016, ERAS implementation programmes were initiated in over 16 countries worldwide, including Sweden, Switzerland, Canada, USA, Spain, Columbia, Mexico, Brazil, Singapore, Philippines, New Zealand, South Africa, Netherlands, Portugal, Israel and Turkey.[10]

Following the formation of the ERAS Society in 2010, the society published a manual entitled, *Enhanced Recovery: Manual of Fast Track Recovery for Colorectal Surgery in 2012*, followed the ERAS Society guidelines in 2013.[5,10,12,13,45] These guidelines, which were published in the World Journal of Surgery, were released as three separate publications to address three specific types of surgical interventions, namely pancreaticoduodenectomy, elective colonic and elective rectal/pelvic surgeries and were endorsed by the ERAS Society, IASMEN (International Association for Surgical Metabolism and Nutrition) as well as ESPEN (European Society for Clinical Nutrition and Metabolism) and are based on meta-analyses, randomised controlled trials and large prospective cohort studies and are thus formed from high quality evidence.[5,10,12,13]

The process of developing the guidelines involved a systematic review of the available evidence from 1966 up to 2012. Included studies were assessed for quality using the

Cochrane checklist. The GRADE (grading of recommendations, assessment, development and evaluation) system was used to evaluate recommendations and quality of evidence so that each practice recommendation was given an evidence level and recommendation grade.[5,12,13] The aim of the ERAS guidelines are to decrease metabolic stress resulting from surgery and thus achieve improved outcomes in terms of reducing post-surgical morbidity and LOHS as well as improving recovery time.[5]

More recently, the ERAS Society has gone on to release guidelines for the following surgical modalities: Radical cystectomy for bladder cancer, gastrectomy, gynaecologic/oncologic surgery, as well as two further publications concerning ERAS practice in gastrointestinal surgery, including a consensus statement for anaesthesia practice and a publication detailing pathophysiological considerations in gastrointestinal surgery.[46–50] Expert groups are working on a wide range of procedures to include in the future (including breast and reconstructive surgery, head and neck cancer, thoracic surgery, hepatobiliary surgery and orthopaedic surgery). For the purposes of this review, only those guidelines pertaining to colorectal surgery patients will be covered in further detail.

The ERAS guidelines include a number of items that are nutritionally related and helps to attenuate the metabolic stress response to major surgery that can potentially impede recovery.[5] These nutritionally-related guidelines are delineated in red (Figure 2.1) and will each be discussed in further detail. The ERAS guidelines include a package of preoperative, intraoperative and postoperative recommendations to be carried out on a multidisciplinary level at each stage of the patient's surgical journey to optimise patient recovery.[5] The following figure (Figure 2.1) gives a brief overview of the various ERAS guidelines through the different stages of the surgical journey.[5,42]

A 2011 Cochrane review and meta-analysis of six randomised control trials comparing ERAS care pathways to traditional care pathways in colorectal surgery patients, found that ERAS patients developed significantly fewer complications (RR 0.52; 95% CI, 0.38- 0.71, $p < 0.0001$) and had a significantly shorter primary LOHS (MD -2.94 days; 95% CI, -3.69- -2.19).[9] A 2013 meta-analysis of 13 randomised control trials also comparing ERAS care pathways to traditional care pathways in elective colorectal surgery patients found that ERAS patients developed significantly fewer total complications (RR 0.71; 95% CI, 0.58–0.86; $p = 0.0006$), general complications (RR, 0.68; 95% CI, 0.56–0.82; $p < 0.0001$), had a significantly shorter primary LOHS (weighted MD −2.44 days; 95% CI, −3.06 to −1.83, $p < 0.00001$) and total hospital stay (weighted MD −2.39 days; 95% CI, −3.70 to −1.09, $p = 0.0003$).[51]

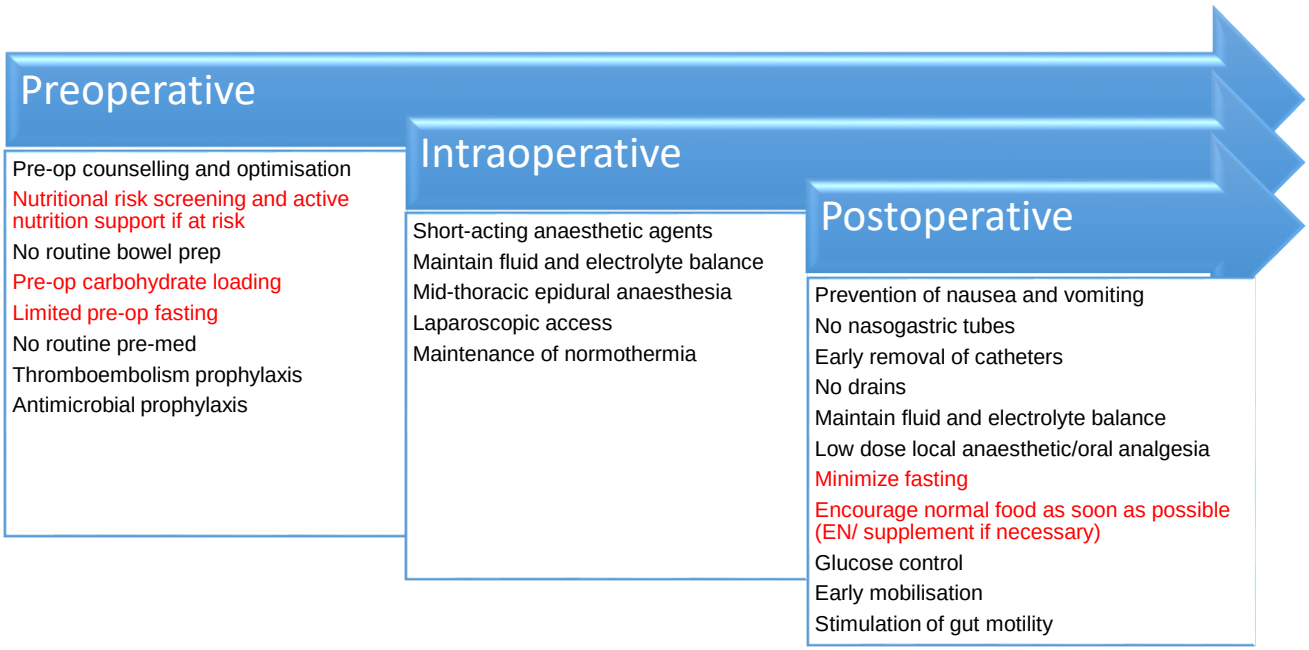


Figure 2.1: Overview of ERAS guidelines

2.6 PERIOPERATIVE NUTRITIONAL CARE

The following table represents the ERAS recommendations along with the relevant evidence level and recommendation grade for the two sets of guidelines pertaining to colorectal surgery published by the ERAS Society in 2013 (Table 2.1).[5,12,13]

Table 2.1: Perioperative nutritional care guidelines

	Colonic surgery[5]	**Rectal/pelvic surgery[13]**
ERAS item	Perioperative nutritional care	
Summary and recommendation	Screened for nutritional status and given active nutritional support if at risk for undernutrition. *ONS**: Can be used to supplement. *IN*†*:* Could be considered	*Pre-op optimisation:* Specialised nutrition support for malnourished patients. *ONS**: Should be offered
Evidence level	*Perioperative ONS* (well-fed patient):* Low *Perioperative ONS* (malnourished):* Low *IN*†*:* Low	Moderate *ONS**: Low
Recommendation grade	*Perioperative ONS*:* Strong *IN*†*:* Weak	Strong

*Oral nutritional supplements †Immunonutrition

In the perioperative phase, ERAS recommends screening of patients for nutritional risk and relevant specialised nutritional support of at risk patients, in conjunction with other ERAS nutritional guidelines pre- and post-surgery.[5,13] Nutritional screening of patients preoperatively is thought to be necessary in order to identify patients who would benefit from appropriate nutritional support and lack of identification of such patients is thought to result in a lack of appropriate nutritional support.[2,17,24,37]

Multiple validated screening tools are available for this purpose and usually include an assessment of current nutritional status, diet history and history of weight loss.[37] Although there is no generally accepted screening tool, the choice of screening tool should be appropriate to the clinical setting and should be practical in terms of time, costs, ease of use and portability, as well as provide the opportunity for re-assessment at various intervals.[37] Such validated screening tools include the Nutritional Risk Screening (NRS-2002), Mini Nutritional Assessment (MNA), Subjective Global Assessment (SGA), Malnutrition Universal Screening Tool (MUST) and the Nutritional Risk Index (NRI). [24,37,52,53]

According to the ESPEN guidelines of 2002, all patients should be screened for nutritional risk on admittance to hospital by admitting staff. The outcomes of this screening should be linked to specific actions, for example at risk patients should be given a nutrition plan and those not at risk should be re-assessed at defined intervals.[24] Nutritional screening should include an assessment of the current condition which may be assessed using the patient's body mass

index (BMI).[24] In addition to BMI, nutritional screening should include an assessment of whether the condition is stable, whether the condition may worsen and whether the disease process may accelerate nutritional deterioration.[24] These factors can be evaluated by taking a weight history, where more than 5% weight loss in three months is considered significant, by taking a dietary history indicating whether food intake has been decreased, and by utilizing a disease severity grading.[24]

ESPEN recommends the use of the NRS-2002 screening tool for detecting undernutrition in hospitalised patients, whereas MUST is recommended for use in the community and MNA for use in the elderly.[24,54] The NRS-2002 includes the nutritional components of MUST with an additional component for grading of disease severity and old age as a risk factor for undernutrition and has been validated for content as well as predictive validity (in terms of LOHS, post-operative complications and mortality), inter-observer reliability and practicability.[24,37] The American Society of Parenteral and Enteral Nutrition (A.S.P.E.N) have in the past recommended the use of SGA but most recently suggest the use of the NRS-2002 in hospitalized patients, which evaluate both nutritional status and severity of illness.[52,55,56]

The purpose of nutritional risk screening is not to identify malnutrition and reverse it prior to surgery, but rather to identify patients at nutritional risk and provide nutritional support in order to metabolically prepare the patient for surgery, thus optimising surgical outcomes and lowering risk of mortality and morbidity following surgery.[37] This can be achieved in as little as five to seven days preoperatively and Miller *et al*. recommend that elective non-emergent surgeries be delayed for this purpose.[37]

Specific recommendations for the type, volume and route of nutrition support in order to optimise nutritional status prior to surgery are beyond the scope of this review. The ERAS Society, however emphasises normal food as the basis for perioperative nutrition in an ERAS setting with the utility of oral nutritional supplements (ONS) being recognised by the ERAS society, especially in malnourished patients or patients who do not meet their requirements through normal food intake alone.[5,13] The use of such are strongly recommended in the ERAS guidelines, specifically for malnourished patients.[5,13]

It can be assumed that total nutrient intake will be low in the first few days following surgery, with studies citing spontaneous post-operative oral intake to be between 1200–1500 kcal per day, thus falling short of the requirements of some individuals.[57,58] Therefore, ONS can also be utilised in the post-operative period both before and after discharge until return to normal food intake has been achieved.[57]

Immunonutrition (IN) refers to specific immune modulating components, which are included in the patient diet to enhance immune function.[5] The most commonly studied IN components are glutamine, omega-3 fatty acids, arginine and nucleotides, which are added in various combinations to ONS, enteral and/or parenteral nutrition formulations.[5] A 2012 Cochrane review and meta-analysis showed that both perioperative and preoperative IN resulted in reduced risk of total and infectious complications as compared to no or standard nutrition support in gastrointestinal surgery patients; however, no difference was found in LOHS and there are no trials confirming the benefits of IN in an ERAS setting where surgical stress has been minimised.[5,12,59]

Despite the ERAS Society's emphasis on normal food as the basis for perioperative nutrition, there are instances where enteral tube feeding is indicated, specifically when oral intake to meet nutritional requirements is not adequate or possible.[57] The ESPEN guidelines on enteral nutrition in surgery recommend the use of enteral nutrition in patients in whom early oral nutrition will not be possible and in those who are expected to meet less than 60% of their nutrient requirement via the oral route for more than ten days.[57,60] The ASPEN guidelines recommend that all patients who cannot meet their nutritional requirements by oral intake for a period of seven to ten days, supplemental nutrition should be initiated with the enteral route being preferable over the parenteral route if the GIT is functional.[55]

Enteral nutrition is thought to be superior to parenteral nutrition in terms of costs, patient preference, and maintenance of gut barrier function due to the promotion of peristalsis, perfusion and other mechanical and physiological factors that would theoretically promote healing, enhance immune function and lead to earlier return of bowel function.[37,58,61] However, in some instances parenteral nutrition is indicated, specifically in patients who do not have a functional GIT, or in cases where the GIT can't be accessed and in patients whose nutrient requirements will not be adequately met via the oral or enteral route.[57,60]

The appropriate nutritional support regimen in terms of type, amount, route and timing for the nutritionally at-risk patient can be determined by the nutritional care team, with the dietitian playing a major role in the prescription and implementation of the nutritional care plan according to evidence-based consensus guidelines such as those released by ESPEN or ASPEN. Individual institutions can also review literature and create written policies detailing decision making within the nutrition support regimen to guide the nutritional care team. Therefore, following screening and identification of at-risk patients, active referrals and/or a functional referral system to the nutritional care team are seen as an essential step to providing nutritional support and optimises patient nutritional status in order to enhance surgical recovery.

2.7 PREOPERATIVE FASTING

The following table represents the ERAS recommendations along with the relevant evidence level and recommendation grade for the two sets of guidelines pertaining to colorectal surgery published by the ERAS society in 2013 (Table 2.2).[5,12,13]

Table 2.2: Preoperative fasting guidelines

	Colonic surgery[5]	**Rectal/pelvic surgery[13]**
ERAS item	Preoperative fasting	
Summary and recommendation	Clear fluids allowed up to two hours and solids up to six hours prior to induction of anaesthesia	
Evidence level	Moderate *For diabetic patients*: Low	Moderate
Recommendation grade	Strong *For diabetic patients:* Weak	Strong

In the preoperative phase the ERAS guidelines recommend that clear fluids be consumed up to two hours and solids up to six hours prior to the induction of anaesthesia.[5,13] In both colonic and rectal/pelvic surgery, this recommendation is graded as “strong” and the evidence level as “moderate” according to the GRADE system.[5,13] The same guidelines apply for pancreaticoduodenectomy; however the evidence grade for fasting from solids is “low” and there has been no systematic reviews to guide this recommendation.[12]

The recommendations above were largely guided by the findings of a Cochrane review, which was published in 2003.[7] The review systematically looked at 22 randomised controlled trials of patients undergoing elective surgeries and demonstrated that the traditional fasting practice of no food or water 12 hours prior to surgery did not increase gastric pH, decrease gastric contents or have a positive effect on the rate of complications as compared to the novel fasting practices recommended by ERAS.[7] In addition, the intake of clear fluids up to two hours preoperatively was associated with significantly lower gastric volumes, decreased perceptions of thirst, dry mouth and hunger and decreased anxiety and nervousness as compared with traditional fasting practices.[7] These results indicate that allowing patients to drink clear fluids up to two hours before surgery may improve patients’ subjective preoperative experience by reducing discomfort prior to surgery. Patients with slowed gastric emptying are considered to be at increased risk for aspiration. Although data has shown that gastric emptying is normal in uncomplicated Type 2 Diabetics, diabetic patients with neuropathy may still have slowed gastric emptying, thus these patients may need to be given special consideration in terms of recommended fasting times.[5,13]

2.8 PREOPERATIVE CARBOHYDRATE LOADING

The following table represents the ERAS recommendations along with the relevant evidence level and recommendation grade for the two sets of guidelines pertaining to colorectal surgery published by the ERAS society in 2013 (Table 2.3).[5,12,13]

Table 2.3: Preoperative carbohydrate loading guidelines

	Colonic surgery[5]	**Rectal/pelvic surgery[13]**
ERAS item	Preoperative carbohydrate loading	
Summary and recommendation	Oral carbohydrate treatment up to two hours preoperatively (clear fluid 12% maltodextrin) in non-diabetics	
Evidence level	Low *Diabetic patients:* Very Low	*Improved outcomes:* Low *Reduced insulin resistance:* Moderate
Recommendation grade	Strong *Diabetic patients:* Weak	Strong

In addition to reducing preoperative fasting times, ERAS recommends preoperative carbohydrate loading via a carbohydrate drink two hours prior to surgery.[5] This recommendation is graded as “strong” however the evidence regarding the recommendation is “low”.[5]

A preoperative carbohydrate drink two hours prior to surgery has been shown to be safe and to reduce patients’ experience of anxiety, hunger and thirst preoperatively as well as allowing for better blood glucose control following surgery.[5,7,62]

Despite immediate effects on patient comfort and well-being, the initial reasoning behind the implementation of the preoperative carbohydrate drink was to enable metabolic changes within the patient to best prepare for the trauma of surgery.[62] Overnight fasting causes a shift in metabolism leading to the breakdown of fat and muscle protein stores for energy, led by decreased insulin release and increased cortisol and glucagon release, resulting in insulin resistance.[62] During trauma and surgery, the mobilisation of glycogen stores is essential for healing, while a predominance of stress hormones only exacerbate catabolism and the stress response, resulting in less favourable outcomes.[62] Allowing patients to go into surgery in an anabolic fed state is thought to result in less cytokine and stress hormone release, better mobilisation of glycogen stores and fewer losses of muscle protein and fat stores, largely due to insulin release, which shifts metabolism to carbohydrate utilisation.[62]

Therefore, the carbohydrate drink provided should contain a sufficient carbohydrate load and concentration to induce insulin release equivalent to that following a mixed meal.[62] The

effective carbohydrate concentration has been found to be 12% or 12 g of carbohydrate for every 100 ml of fluids, while the effective load has been found to be 50 g of carbohydrates.[5,62,63] This would mean that approximately 400 ml of a 12% carbohydrate solution would provide the recommended load of carbohydrates.[63] A 400 ml volume is also practical as it allows enough fluid to quench thirst while not requiring the patient to drink large amounts of fluids, which may cause discomfort and possible fluid overload.[62] In addition to carbohydrate concentration and load, it is important for the drink to be a clear fluid and for the osmolality of the drink to remain low to ensure quick gastric emptying prior to surgery, therefore, complex carbohydrates should be used, with maltodextrins being recommended as the optimal form of carbohydrates.[5,62,63] Since this recommended formulation was proposed in the literature, it has been tested on more than 2 000 patients in clinical studies and more than two million patients in clinical practice with no adverse events being reported.[62]

Although not specifically mentioned in the ERAS guidelines as a recommendation, some ERAS literature suggests the use of preoperative carbohydrate loading the evening before surgery in order to achieve optimal muscle glycogen stores and to stimulate insulin release and prevent a shift into a fasted metabolic state.[37,64,65] This is usually done by providing 800 ml of a 12% carbohydrate solution the night before surgery, delivering 100 g of carbohydrates, in addition to the 400 ml solution two hours prior to surgery.[37,64,65] This practice has been utilised in some of the randomised controlled trials assessing the efficacy and safety of preoperative carbohydrate loading leading to the ERAS Society recommendations.[37,64,65]

The use of a preoperative carbohydrate drink has been shown to decrease post-operative insulin resistance by up to 50% and patients who receive preoperative carbohydrate loading display less impaired post-operative insulin sensitivity.[62,64,66] In a prospective cohort study conducted on over 950 colorectal surgery patients in Sweden, a preoperative carbohydrate drink was shown to significantly reduce the risk of post-operative nausea and vomiting, pain, diarrhea and dizziness.[67] This reduced the risk of post-operative symptoms by 44% (OR 0.56; 95% CI, 0.40–0.77) and was a major independent predictor of post-operative outcomes.[67] In addition, a preoperative carbohydrate drink was found to reduce the risk of post-operative wound dehiscence (OR 0.16; 95% CI, 0.05-0.50).[67] Other studies have reported no difference in the incidence of post-operative complications, thus concluding that the use of preoperative carbohydrate loading is safe and provided mixed outcomes in terms of incidence of post-operative nausea and vomiting.[66]

By improving insulin sensitivity and reducing glycosylation of muscle, preoperative carbohydrate loading has been shown to have a positive effect on postoperative protein status and return of motility and muscle function.[37] Studies have shown that the administration of a

preoperative carbohydrate formulation significantly reduces loss of muscle mass and preserves lean body mass in elective abdominal surgery patients.[62,65,68,69] In addition, carbohydrate loading has been shown to significantly reduce loss of post-operative muscle strength in elective bowel resection patients and reduce whole body protein breakdown and post-operative losses of protein and nitrogen.[62,65,68,69]

Some studies have reported a positive effect of preoperative carbohydrate loading on post-operative recovery and LOHS. In a small 2001 meta-analysis of three randomised controlled trials, it was shown that preoperative carbohydrate loading had a significant effect on LOHS, with an average reduction of 1.2 days or 20%, while Yuill *et al*. showed a reduction in LOHS of two days; however this difference was not significant.[62,63,65] A 2013 meta-analyses of 21 randomised controlled trials showed a significant reduction in LOHS of 1.08 days only in elective major open abdominal surgery patients.[66] The authors concluded that the reduction in LOHS in major open surgery patients may be due to the limited stress response and development of insulin resistance in minor and laparoscopic surgical patients, limiting the benefits of a carbohydrate loading intervention.[66]

There are various commercially available products on the market that satisfy the requirements for a preoperative carbohydrate loading drink, both internationally and locally making the implementation of this recommendation possible in practice. In the public sector, there are commercial preoperative carbohydrate loading products available on tender contract. There is one such commercial product currently available to the study hospital on tender contract meaning it can be ordered using the budget available to the hospital dietetics department for nutritional supplements.

2.9 POSTOPERATIVE RESUMPTION OF FEEDING

The following table represents the ERAS recommendations along with the relevant evidence level and recommendation grade for the two sets of guidelines pertaining to colorectal surgery published by the ERAS society in 2013 (Table 2.4).[5,12,13]

Table 2.4: Postoperative feeding guidelines

	Colonic surgery[5]	**Rectal/pelvic surgery[13]**
ERAS item	Early oral intake	
Summary and recommendation	Normal food as soon as possible after surgery	Oral ad lib diet four hours after surgery
Evidence level	*Safety*: High *Improved recovery and reduced morbidity*: Low	Moderate
Recommendation grade	Strong	Strong

Postoperatively, ERAS recommends resumption of a normal oral diet within 24 hours post-surgery.[5] Normal oral intake can resume as early as four hours following colorectal surgery.[13] ERAS grades early postoperative enteral feeding as “high” level of evidence in colonic surgery patients due to established safety in the literature and “moderate” for rectal/pelvic surgeries, while the recommendation is graded as “strong” for both surgical modalities.[5,13]

A systematic review and meta-analysis of 13 randomised controlled trials on colorectal surgery patients found a significant difference in mortality risk between patients receiving enteral feeding within 24 hours of gastrointestinal surgery and those kept NPO (combined RR 0.41; 95% CI, 0.18–0.93).[35] In addition, enteral feeding within 24 hours showed a reduction in risk of complications post-surgery, specifically pneumonia, wound infections and anastomotic dehiscence, as well as reduced LOHS by an average of one day, as compared to those kept NPO, although the difference was not significant.[35] Early enteral feeding increased risk of vomiting (RR 1.27, 95% CI, 1.01- 1.61) as opposed to those who were kept NPO after surgery.[35] The authors concluded that there is no benefit to keeping patients NPO after gastrointestinal surgery.[35]

A more recent systematic review and meta-analysis of seven randomised controlled trials on elective colorectal surgery patients found a significant reduction in LOHS (–1.58 days; 95% CI, –2.77 to –0.39 days; p=0.009) as well as risk of total post-operative complications (RR 0.70; 95% CI, 0.50–0.98; p=0.04) in those patients who received oral feeding within 24 hours of gastrointestinal surgery as opposed to those who were not fed orally within 24 hours. [34] No significant difference was found in risk for pneumonia, wound infections, anastomotic dehiscence, vomiting, nasogastric tube (NGT) reinsertion or mortality between those receiving early oral feeding and traditional oral feeding.[34] The authors concluded that early oral feeding after colorectal surgery is safe and provides benefits in terms of reducing LOHS and total post-operative complications.[34]

Various imaging studies conducted during the 1970’s and 1980’s ascertained that small bowel function is normalised within four to eight hours after gastrointestinal surgery, even if gastric emptying is slowed, and studies of early post-operative enteral feeding often begin feeds within four to six hours post-operatively, thus the ERAS Society has recommended that feeding start as early as four hours postoperatively.[67,70–72] Early enteral feeding has been associated with abdominal bloating, impairment of mobilisation and impaired pulmonary function when not implemented along with other multimodal interventions to prevent postoperative ileus, nausea and vomiting, thus highlighting the importance of each ERAS intervention within the context of multimodal care and not as isolated interventions.[42,57,73]

2.10 IMPLEMENTATION OF ERAS

Despite the release of evidence-based fasting guidelines from as early as 1999, and the release of the ERAS guidelines in 2013, perioperative nutrition practices in many settings are still based largely on tradition and do not reflect evidence-based best practice.[4,8,14,15] The extent of compliance with the ERAS guidelines varies between settings but trends towards implementing more liberal fasting guidelines are beginning to emerge in some settings, albeit slowly.

A national survey of 23 colorectal surgical departments in Israel in 2001 found that 22% of surgical departments began oral fluids between post-operative day one and three, 22% only began oral clear fluids after the passing of flatus, 13% of departments only began oral fluids after the removal of the nasogastric tube, which was routinely inserted during surgery, and 4% of departments only started oral fluids after a bowel movement.[36] In 2004, 65% of surgical departments began oral fluids within the first 24 hours after surgery and 22% of departments began fluids on the second day post-op, with the remaining departments beginning fluids on an individual basis, thus showing a trend away from traditional post-operative fasting practices towards more evidence-based practices.[36]

This slow advancement of translating proven medical knowledge into daily practice has been acknowledged, with some saying the change takes up to 15 years.[74] However, this is considered to be too slow and the ERAS Society aims to speed up this process through the use of ERAS implementation programmes that are run for eight to ten months in order to equip hospital departments with the necessary skills and team management to implement ERAS successfully.[74]

Furthermore, it has been suggested that simply having a guideline is not enough to implement an ERAS programme.[74,75] A study evaluating the implementation of an ERAS programme in five countries in Europe between 2001 and 2004 found that protocol compliance pre- and intraoperatively was good, but that postoperative compliance with the protocol was the biggest challenge.[75] Mean compliance with the preoperative carbohydrate loading guideline was 75% and with normal food intake on postoperative day one was 66.7%.[75] A more recent 2016 study measuring the compliance with ERAS protocol elements in a Portuguese hospital where an ERAS protocol was implemented in 2010, found that 59% of colorectal surgery patients were fasted for two hours preoperatively and 57.5% of patients were fed orally on the first post-operative day.[76] Once again, showing varied implementation of ERAS guidelines in different settings and a failure of guidelines to result in complete compliance.

A 2011 a prospective cohort study at one of the original ERAS centres in Sweden, reported that after implementation of the ERAS protocol in 2002, total compliance with ERAS protocol elements was only 43.3% between 2002 and 2004.[67] In particular, 50.3% of patients received a preoperative carbohydrate drink and 84.3% of patients received solid food on post-operative day one.[67] The ERAS protocol was relaunched in 2005 to help improve compliance and total compliance with the ERAS protocol rose to 70.6% between 2005 and 2007, with the compliance with preoperative carbohydrate loading improving to 66.9% and solid food on post-operative day one showing up to 90.5% compliance.[67] The authors found that enhanced compliance with the protocol improved patient outcomes in a dose–response relationship.[67] Those with high adherence had a 25% decreased risk of complications and a 27% increase in ERAS compliance between periods led to a 27% decrease in risk of 30-day post-operative morbidity.[67]

A more recent 2015 study looking at ERAS protocol compliance in over 2000 colorectal surgery patients in six countries over five years found a mean compliance of 76.6%, with increased compliance being independently associated with reduced LOHS and reduced complications, once again demonstrating a dose–response relationship between enhanced compliance and patient outcomes.[77] Over 90% compliance resulted in a 33% risk of complications as opposed to compliance of below 50% which resulted in a 47.8% risk of complications.[77]

When considering the extent of ERAS implementation, it is important to consider the role of the ERAS team. Relevant members of the ERAS team involved in implementation of the guidelines include surgeons, anaesthetists, nurses, dietitians, intensive care specialists and physiotherapists.[26,37,57] Successful implementation of the guidelines rely on the co-operation of all members of the multidisciplinary team and the reliance of ERAS on multidisciplinary co-operation makes the programme vulnerable to failure.[57,77]

A Turkish study looking at preoperative fasting practices in Turkish hospitals found that preoperative fasting times for patients are determined based on the surgeon's orders.[15] Furthermore, the surgeon plays a role in the implementation of ERAS at every point in the patient's perioperative journey, from preoperative screening and education through to post-operative initiation of feeding and preparation for discharge.[37]

The anaesthetist also plays an important role in the implementation of the ERAS guidelines, specifically with regards to the nutrition-related guidelines. The anaesthetist would be involved in the preoperative screening process and decisions, along with the rest of the team regarding preoperative nutrition optimisation.[37]

The role of the nurse or primary care practitioner has been highlighted as essential in implementing ERAS as the nurse is involved in all stages of perioperative care pathway and generally is the member of the team who has the most contact with the patient.[37,78] The nurses' role have been highlighted in preoperative screening, patient education, administration of medications, preoperative patient preparation (including feeding and carbohydrate loading) and postoperative patient care (including feeding and monitoring intake).[37,78]

Dietitians play an important role in the advocacy of the ERAS perioperative nutrition guidelines in the hospital setting as they tend to be concerned with optimising the nutrition of hospitalised patients. No studies have been found indicating dietitians' knowledge, attitudes and practices regarding the ERAS perioperative nutrition guidelines. Dietitians are directly implicated in the implementation of these guidelines as they are usually involved in preoperative screening and nutrition optimisation, provision/ordering of carbohydrate drinks, postoperative enteral nutrition and general nutritional support.[37]

In the ERAS care pathway, the patient is also considered a member of the ERAS team and patients are expected to be active participants in their own recovery, therefore patient compliance with the ERAS recommendations are considered essential for successful implementation and patient feedback regarding their experiences with the guidelines may help to guide future practice and improve compliance.[15,37,79] A 2016 study looking at patient experiences of an ERAS programme found that patients felt pressurised to eat more than they were comfortable with after surgery and that the postoperative feeding recommendations of solid foods on day one postoperatively were difficult to comply with.[80]

2.11 ERAS IN SA/DEVELOPING CONTEXT

To the author's knowledge, no studies have been done evaluating the implementation of ERAS guidelines in the South African context and there are no published reports indicating perioperative fasting practices in South Africa. In April 2015, Encare, the ERAS-affiliated company that provides the ERAS Implementation Programmes, and audit systems to ERAS centres globally, announced on their website that they were expanding into South Africa.[81]

In December 2015, the first Asian, Australiana and African ERAS Implementation Programme was started in Singapore and leading centres from South Africa, New Zealand, Singapore and The Philippines joined the programme.[10] In April 2016, the 4th ERAS World Congress was held in Portugal and experts from around the world, including South Africa, as well as North America, Latin America, Australia and Europe, presented lectures.[82] The South African lecture was presented by Dr. Ravi Oodit on 30 April 2016 with the theme of "ERAS – Overcoming Hurdles Globally".[83] Dr. Ravi Oodit is listed as the only national contact for South Africa on the

ERAS Society's website, with the contact centre being listed as Groote Schuur Hospital, Cape Town.[10] Encare has one reference location in South Africa and the only in Africa with the Constantiaberg Mediclinic in Cape Town, being listed as an ERAS qualified centre.[84]

South Africa represents the only country in Africa moving towards implementation of the ERAS guidelines, while other developing countries have begun to adopt ERAS practices, with the first Latin American ERAS Implementation Programme taking place in Argentina in 2015.[82]

A 2014 study in a public university hospital in Brazil with no perioperative fasting protocols found that compliance with ERAS perioperative fasting guidelines was poor, with patients being fasted for a median of 15.75 hours preoperatively and 15.67 hours postoperatively.[4] In addition, 40% of patients underwent more than one preoperative fasting period due to delayed or cancelled surgeries.[4] The most common fasting instructions given to patients were to fast from midnight or from 22h00.[4] This is one of the only studies representing the current fasting practices in a developing country and may share similarities with the South African scenario.

2.12 BARRIERS TO IMPLEMENTATION

Translating established medical knowledge into practice is a complex process and many theoretical models for understanding this process have been proposed in the literature.[14,85] Assessing context-specific barriers to change is considered an essential step in facilitating this process as an understanding of local barriers allows for the development of targeted strategies to overcome these barriers in order for guidelines to be successfully implemented.[14,85]

Studies looking at the implementation of ERAS and novel fasting guidelines have identified various barriers or constraints to implementation in different settings. In a 2013 paper, Heyland *et al*. proposed a framework for understanding the potential barriers to feeding elective surgical patients.[14] The framework categorises barriers into five key areas: system characteristics, provider intent, patient characteristics, knowledge tool characteristics (in this case the ERAS guidelines) and the implementation process.[14]

System characteristics include the political and economic context, hospital and surgical department structure, hospital and surgical team culture, hospital care processes and resources.[14] The perception that the surgical schedule may be less flexible with the implementation of modern fasting guidelines seems to be a common barrier mentioned in the literature.[6,15,26,86] In Karadag's 2014 study, 12.3% of nurses and doctors claimed that they had problems applying novel fasting protocols due to uncertainty of surgical time of patients.[15] In a similar study carried out in Japan in 2005, 50% of anaesthetists indicated that they were not applying novel fasting guidelines as the traditional guidelines allow flexibility for changes in

the surgical schedule.[41] In a qualitative study carried out in Canada, some surgeons and anaesthetists were resistant to shortening preoperative fasting times due to the possibility of having to cancel a surgery in the event of a patient being pushed forward on the surgical schedule.[86]

In addition to the surgical schedule presenting a barrier to the implementation of ERAS in hospitals, other system characteristics that have been cited as barriers include lack of colleague support, lack of co-speciality support and co-operation, poor interdisciplinary communication, lack of nursing staff, lack of time, nursing staff culture, lack of financial resources and poor pre-admission resources.[80,86,87] In a survey of colorectal surgeons in New Zealand and Australia, 55% of participants indicated that they did not follow a formalised ERAS programme and the most common perceived barrier cited was that of lack of colleague and co-speciality support making up 57% of answers, while 39% indicated that lack of institutional support was a barrier.[87] Surgeons who elaborated on their answers indicated that the lack of cooperation was from anaesthetic and pain services and that there were different anaesthetists every week as well as a lack of social service interest.[87] In a 2014 qualitative study carried out in Canada evaluating the perceived barriers and enablers of anaesthetists, nurses and surgeons to ERAS implementation, providers agreed that having a standardised guideline or hospital policy would facilitate ERAS implementation. Nurses in particular felt that lack of manpower and time would be a barrier to implementation, while surgeons agreed that lack of nursing staff time would be a barrier.[86]

Barriers concerning the negative organisational culture have also been cited. In Pearsall *et al.'s* study, surgeons felt that they, their department, residents and their colleagues were a barrier to the implementation of ERAS guidelines due to resistance to change and personal preferences.[86] In the same study, nurses and anaesthetists also felt that surgeons would present a barrier to ERAS implementation due to resistance to change and surgeon and anaesthetist resistance were mentioned as a specific barrier to the implementation of the preoperative fasting guidelines by participants.[86]

Provider intent refers to the individual healthcare provider's intended behaviour, which is influenced by the interaction between provider characteristics, provider knowledge and provider attitudes.[14] Awareness and familiarity with the guidelines influence knowledge.[14] In a 2005 Japanese survey, 14% of anaesthetists claimed that they did not implement the novel fasting guidelines because they were unaware of them, while a 2007 study in America found that 16% of anaesthesia care providers and 13% of nurses were unaware of the novel fasting guidelines.[40,41] In a 2014 qualitative study in Canada, anaesthetists, surgeons and nurses felt that education of the entire multidisciplinary team was important for successful implementation

of ERAS and that early postoperative feeding would require guidelines and education and surgeons felt that residents may be a barrier to implementation of the ERAS guidelines due to lack of awareness of the guidelines.[86]

Attitudes are influenced by agreement with the guidelines, motivation, self-efficacy and outcome expectancy.[14] In a 2014 qualitative study carried out in Canada evaluating the perceived barriers and enablers of anaesthetists, nurses and surgeons to ERAS implementation, it was found that most participants were in agreement with the implementation of an ERAS programme, while an Australasian study found that 12% of surgeons don't implement ERAS because they don't believe in it.[86,87]

Karadag *et al.* found that doctors and nurses displayed low compliance with novel fasting guidelines and most often applied the guidelines in patients that they deemed to be compliant. The measure of patient compliance was determined subjectively by the health personnel and had no standard measure.[15] This perception regarding lack of patient compliance or understanding as a barrier to the implementation of ERAS and novel fasting guidelines has been a common finding in studies on the topic.[15,40,79,86,87]

Various poor outcome expectancies also present a provider intent-driven barrier to implementation. In a qualitative study in Canada, some surgeons said they would be resistant to changing their practices as they did not believe change would make a difference for their patients.[86] This sentiment was repeated in Shime *et al.'s* study where 21% of anaesthetists said that they did not implement novel fasting guidelines as there was no benefit to the anaesthetist and 56% said there was no benefit to the hospital in changing current practice, while 5% said there was no benefit to the patient.[41] In Kahokehr *et al.'s* study, surgeons said they did not feel a need to implement ERAS guidelines as they were satisfied with their current care results.[87]

The third key category seen as a barrier in Heyland *et al.'s* framework is that of patient characteristics which refers to the clinical condition of the patient and includes the preoperative nutritional status of the patient and the type of surgery or co-morbidities present.[14] This was reflected as a barrier in Pearsall *et al.'s* study where respondents said that early feeding guidelines are dependent on the patient population.[86]

The fourth key category of barriers categorized by Heyland *et al.'s* framework is that of characteristics of the guidelines or knowledge tool and refers to the unique characteristics of the ERAS guidelines, which may present as a barrier, including a lack of evidence or the nature of the message.[14] The perceived lack of evidence has been shown to be a barrier in

studies regarding the implementation of the ERAS guidelines. Kahokehr *et al.* reported that 9% of surgeons did not implement ERAS guidelines because they believed there was not enough evidence to support them and Shime *et al.* reported that 12% of anaesthetists did not comply with novel fasting guidelines due to doubt about the clinical applicability of American recommendations to Japanese practice.[41,87] In addition, Pearsall *et al.* reported that respondents did not feel there was enough evidence for the use of preoperative carbohydrate loading and postoperative oral nutritional supplements in their setting.[86]

The nature of the message has also been shown to present a barrier, specifically with regards to novel preoperative fasting guidelines presenting a more complex message than traditional guidelines.[26] This may be connected to the perception of healthcare providers that patients will not understand or will not comply with novel fasting instructions, as mentioned previously. In addition, in Shime *et al.'s* study, 40% of anaesthetists said that they did not comply with novel fasting guidelines in order to avoid intra-hospital confusion associated with changes in the fasting period.[41]

Lastly, barriers related to the implementation process include time limitations for planning and education.[14] Kahokehr *et al.* reported that 21% of surgeons cited the implementation process as a perceived barrier to ERAS implementation, specifically with regards to time limitations for planning and education.[87]

2.13 ECONOMIC EFFECTS OF ERAS

Although lack of finances are often cited as a barrier to the implementation of ERAS guidelines, reports indicate that ERAS interventions result in cost benefits to the system.[16,79,88]

A study conducted in Alberta, Canada found that the cost of ERAS intervention during the study period was 258 741 Canadian dollars, while the estimated cost saving for colorectal cancer patients was 620 498 – 1 173 042 Canadian dollars, thus resulting in a net saving of 1 096 – 2 771 Canadian dollars per patient.[16] Cost savings in non-cancer patients were even greater at 3 388 – 7 103 Canadian dollars per patient.[16]

A 2013 study conducted in a hospital in Switzerland found that although operative costs were significantly higher in patients who received ERAS care, there was an overall cost saving of 4 434 Euros per patient and a mean overall saving of 1 651 Euros per patient once all costs had been accounted for.[89] A 2014 systematic review of ten studies found that enhanced recovery programmes are cost-effective, with eight out of the ten studies reporting lower costs for enhanced recovery programmes as opposed to conventional treatment protocols.[88]

The potential benefits of ERAS programmes for the surgical patient, healthcare worker and hospital have been well documented and nutritional support of hospitalised patients has clearly been shown to improve outcomes, specifically in those who are malnourished. Considering the extent of the evidence, moving over from traditional surgical nutrition practices to the evidence-based practices recommended by ERAS is a vital step to not only improve patient outcomes but decrease healthcare costs, specifically in a resource poor settings such as South Africa. The successful implementation of ERAS requires a dedicated ERAS team as well as a thorough understanding of the setting-specific barriers in order for interventions and education to be successful in overcoming such barriers.

CHAPTER 3:
METHODOLOGY

3.1 RESEARCH OBJECTIVES

3.1.1 Research problem

The current practices with regards to surgical nutrition and the extent of compliance with ERAS perioperative nutrition guidelines in colorectal surgery patients in South Africa, has not been quantified. Setting-specific barriers to implementing ERAS perioperative nutrition guidelines have not as yet been identified in the South African context.

3.1.2 Research aim

To evaluate the extent of implementation of the ERAS perioperative nutrition guidelines in elective colorectal surgery patients in a tertiary academic hospital in South Africa and to assess barriers to implementation as well as to describe patient experiences regarding ERAS perioperative nutritional practices.

3.1.3 Specific objectives

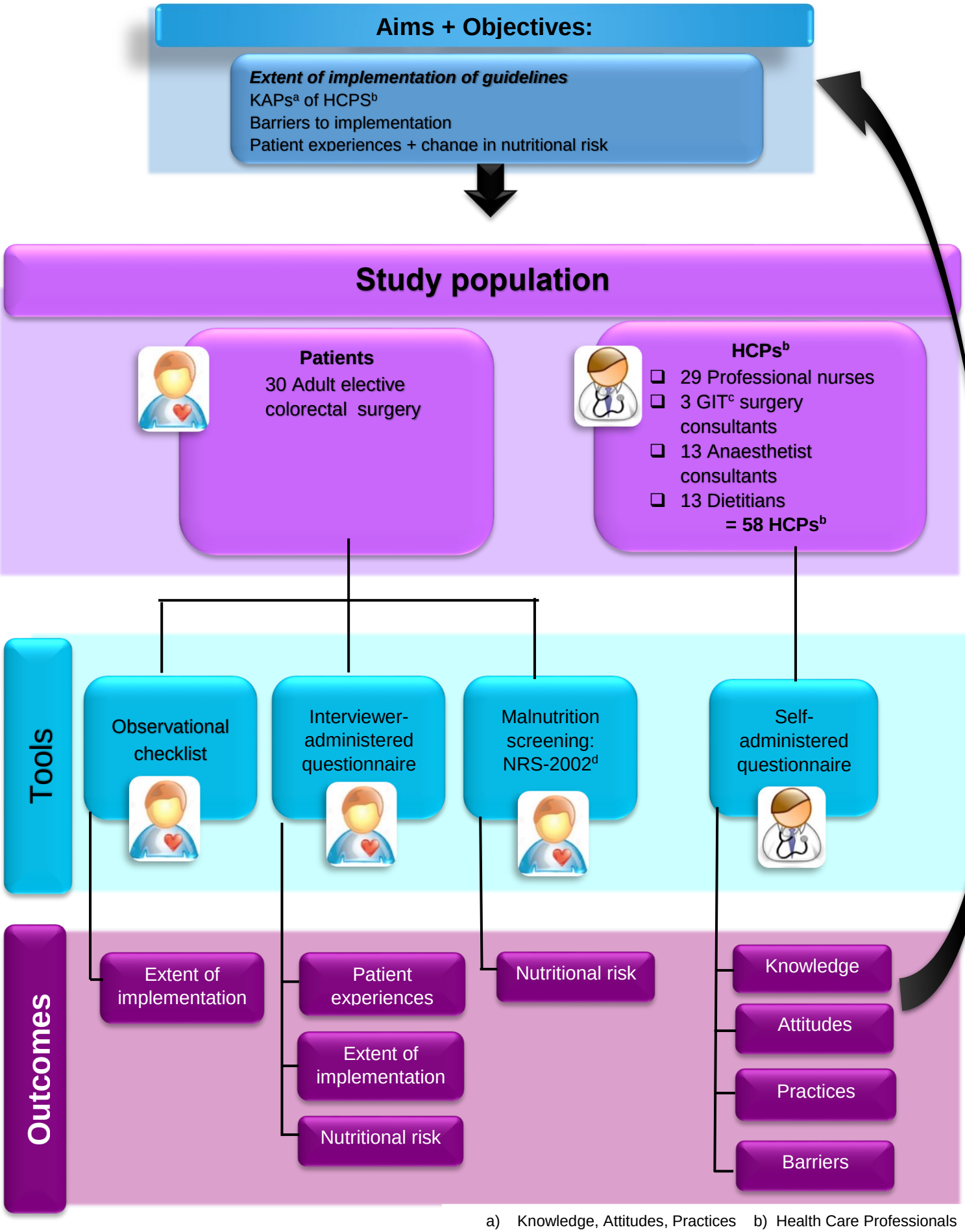
1. To determine the extent of implementation of the ERAS perioperative nutrition guidelines (malnutrition screening and preoperative optimisation, preoperative carbohydrate loading, preoperative fasting and postoperative resumption of feeding).
2. To assess the knowledge, attitudes and practices (KAPs) of the healthcare professionals (surgeons, anaesthetists, dietitians and nurses) with regards to the ERAS perioperative nutrition guidelines.
3. To identify barriers to the implementation of the ERAS perioperative nutrition guidelines as perceived by the nurses, dietitians, anaesthetists and surgeons of elective colorectal surgery patients.
4. To determine change in nutritional risk of elective colorectal surgery patients from admission to the postoperative period and the magnitude of this change in relation to the extent of observed compliance with ERAS perioperative nutrition guidelines.

3.1.4 Hypothesis

The following null hypotheses was tested:

> There is no difference between the ERAS perioperative nutrition guidelines and relevant perioperative nutritional practices as observed by the researcher and as reported by HCPs.

The following figure (Figure 3.1) represents a conceptual framework of the aims and objectives of the study and the methodology employed to address these aims and objectives. The methodology is covered in further detail throughout the chapter.



a) Knowledge, Attitudes, Practices b) Health Care Professionals
c) Gastrointestinal Tract d) Nutritional Risk Screening 2002

Figure 3.1: Conceptual Framework

3.2 STUDY PLAN

3.2.1 Study type

An observational descriptive cohort study with an analytical component was conducted at a tertiary academic hospital in South Africa.

3.2.2 Study population

The study population included two groups of participants:

A. All adult elective colonic/rectal surgery patients admitted to Tygerberg Hospital over the data collection period (hereafter referred to as patient participants).
B. All healthcare professionals; namely professional nurses, dietitians, surgeons and anaesthetists involved in the perioperative care of the above mentioned surgical patients over the data collection period (hereafter referred to as HCP participants).

3.2.2.1 Patient participants

a) Inclusion criteria

- All adult patients (18 years or older)[a] who were admitted to Tygerberg Hospital for elective colorectal surgery during the data collection period were eligible for inclusion.
- Elective surgery was defined as any non-emergency surgery that is scheduled in advance.[b,5]
- Colorectal surgery was defined as surgery on any portion of the small bowel, colon or rectum via laparotomy or laparoscopy.[b,5]

b) Exclusion criteria

- Subjects considered minors who were below the age of 18 years
- Subjects who did not give informed consent
- Subjects who did not speak either English, Afrikaans or Xhosa
- Subjects receiving emergency colorectal surgery (non-elective surgery)
- Subjects admitted for non-colorectal surgeries

[a] Patients legally considered minors were not included in the study population due to the ERAS guidelines' focus on adult patients, thus only patients who have been proven to benefit from the ERAS interventions were included.
[b] The definitions used for elective colorectal surgery were taken from the ERAS literature for the purpose of including the specific patient population who have been proven to benefit from these interventions.

3.2.2.2 HCP participants

a) Inclusion criteria

The following four categories of HCPs were eligible for inclusion:

- All professional nurses employed at Tygerberg hospital working in the abdominal surgical wards and intensive care unit (ICU) [i.e. wards D2, D5 and A1W][c]
- All anaesthetist consultants employed at Tygerberg hospital involved in the perioperative care of elective colorectal surgical patients.
- All surgeons who were consultants in the GIT surgical unit at Tygerberg Hospital
- All permanent dietitians employed at Tygerberg hospital.

b) Exclusion criteria

- Subjects who did not give informed consent
- Subjects who did not speak English, Afrikaans or Xhosa.
- Subjects who were on annual or maternity leave during the data collection period.
- Professional nurses not currently working in the abdominal surgical wards and ICU (i.e. wards D2, D5 and A1W).
- Staff and student nurses.
- Locum and contract dietitians
- Surgeons not involved in colorectal surgeries
- Non-permanent agency staff members who are not contracted to Tygerberg Hospital.

3.2.2.3 Sample size

a) Patient participants

Due to the population being quantifiable and small, the entire population of patients at Tygerberg Hospital were sampled. Calculations conducted by the statistician established that in order to test the null hypothesis for the mean of a single sample to be equal to a specified value, with a sample size of 30 patients, we would be able to detect an effect size of 0,55 with 90% power with a t-test of significance level of 0,05.

Based on statistics from January to July 2013, the average number of colorectal surgeries performed at Tygerberg hospital was 4,7 per month.[90] Therefore, in order to reach a sample

[c] These specific wards were included as the majority of colorectal surgery patients are managed in these wards and thus the nursing staff in these wards were able to give a good representation of the knowledge, attitudes and practices as well as barriers regarding ERAS in this specific patient population.

size of 30 patients, data collection was estimated to take place over 6,4 months or about 26 weeks.

b) HCP participants

Due to the study population being small and quantifiable, the entire population of relevant HCPs at Tygerberg Hospital were sampled. According to the establishment report as of 15 August 2014, this will allow a sample size of 16 anaesthetist consultants, 56 nurses, two GIT surgical consultants and 15 dietitians.[91]

3.2.2.4 Sample selection

a) Patient participants

Eligible patient participants were selected via purposive sampling. All possible study participants were identified at the start of data collection using the surgical schedule book for the GIT surgery unit, which details elective surgery bookings. All patients booked for GIT surgery in the surgical schedule book during the data collection phase were selected. Identified patients were then allocated in their respective wards (usually ward D2) on admittance to the hospital and screened for eligibility. In addition, ward and theatre schedules were checked daily to screen for further eligible patient participants.

b) HCP participants

Healthcare participants were selected via purposive sampling. All GIT surgeons, dietitians, anaesthetists and professional nurses who met the inclusion criteria were selected.

3.2.3 Methods of data collection

The following table (Table 3.1) presents the methods used for data collection per participant category along with the timing of these methods and the study tools used. A detailed explanation of the methods used is presented in the text.

Table 3.1: Methods of data collection

Participants	Method	Frequency/timing	Tools/questionnaire
Patients	Observation by researcher	On admission	Addendum A: *Screening form*
	Observation and measurements of patient by researcher	On admission	Addendum B: *NRS-2002*
	Used in conjunction with Addendum B and Addendum D	On admission and postoperatively	Addendum C: *Standard operating procedure for anthropometrical measurements*
	Observation by researcher of patient, ward staff and patient file	Part 1: On admission/preoperatively Part 2: Day of surgery Part 3: Postoperatively	Addendum D: *Observational checklist*
	Researcher-administered questionnaire to patients	Part 1: Day of surgery Part 2: Postoperatively	Addendum E: *Researcher-administered questionnaire*
	Used in conjunction with Addendum E	Day of surgery and postoperatively	Addendum F: *Patient experience card*
Dietitians	Self-administered written questionnaire	Weekly dietetics team meeting	Addendum I: *Self-administered questionnaire*
Nurses	Self-administered written questionnaire	Various occasions in wards	Addendum H: *Self- administered questionnaire*
Anaesthetists	Self-administered written questionnaire	Over two days in anaesthesiology department	Addendum G: *Self-administered questionnaire*
Surgeons	Self-administered written questionnaire	Via email at time of own choosing	Addendum G: *Self-administered questionnaire*

3.2.3.1 Patient participants

Data collection followed the patients' journey through the hospital with regards to ERAS, from the preoperative phase through to the postoperative phase. The researcher acted as the fieldworker. The data collection process spanned a period of 26 weeks from March to August 2015. Data was collected via the various participant categories, five days a week as well as weekends when necessary.

The researcher identified all possible patient study participants by looking at the surgical schedule for the data collection period. All eligible patients were screened in the wards on the day of admission. In addition, wards and theatre schedules were checked daily to screen for further eligible preoperative patient participants. The GIT surgical patients were usually admitted to ward D2 however they were on occasion admitted to one of the other medical wards based on bed occupancy in ward D2. The researcher located the selected patients in the respective ward prior to their scheduled surgery and then completed a screening form (ADDENDUM A) to ensure that all inclusion criteria were met. The subjects that met all inclusion criteria were then asked for voluntary informed consent. The researcher then

conducted a malnutrition screening on the patient using the validated NRS-2002 screening tool (Addendum B).[24] The NRS-2002 required the researcher to take measurements of the patients' weight and height and to question the patient regarding recent weight loss, reduced dietary intake and illness severity. The weight and height of the participant were measured using an electronic scale and a stadiometer, which were both calibrated before each use. The researcher used the same measuring instruments for all participants and took measurements using a standardised method.[92,93] The standard operating procedures for these measurements are outlined in Addendum C. The researcher then completed Part one of the observational checklist (Addendum D), which gathers information about the patient's diagnosis, comorbidities, whether the patient was screened for malnutrition on admittance, and whether the patient was referred to a dietitian if required. The patient was followed up by the researcher until the day of surgery. The researcher then completed a researcher-administered questionnaire (Addendum E) on the day of surgery at the patient's bedside to ascertain the amount of time since last solid and liquid meal as well as the patient's experience regarding the amount of time fasted. In cases where patients could not be located prior to surgery, for example, if patients were taken into the theatre early in the morning before the researcher arrived in the field, or if patients were unexpectedly shifted forward on the theatre schedule, Addendum E was then completed as soon as possible after the patient had returned from surgery. To avoid inaccurate recalls of fasting times, patients were asked to write down the last time of oral intake of both solids and liquids before beginning preoperative fasting in cases where surgery times were unspecified. Preoperative fasting times were calculated from the reported time of last liquid or solid meal to the time of onset of anaesthesia (as recorded in the surgical notes). Patient experience was measured using a patient experience card (Addendum F). Following the completion of Addendum E, the researcher then completed Part two of the observational checklist (Addendum D) by obtaining information from the patient file and nurses in the ward regarding timing of last meal, nutritional support received, doctors' order for preoperative fasting and any delays in surgery, which may have resulted in extended fasting times. In cases where this information was not recorded in the patient file and where nurses were unable or unwilling to provide the information, the patient was asked to supply the researcher with the information.

Postoperatively, the patient participant was located in either the abdominal surgical wards or ICU wards (A1, D2 or D5). Part three of the observational checklist (Addendum D) was completed postoperatively in the patient's respective ward to ascertain the timing of the patient's first oral meal (both liquid and solid) and whether they received any nutritional support, as well as any reasons for delayed introduction of enteral nutrition. Part three of the observational checklist also required the researcher to weigh the patient postoperatively in

order to measure perioperative weight changes and their relation to perioperative nutritional practices. This weight measurement was completed after surgery as soon as the patient was able and willing to stand on the scale and prior to discharge.

The second part of the interviewer-administered questionnaire (Addendum E) was completed postoperatively in order to gather information regarding the patient's first solid or liquid meal postoperatively, any nutritional support received and the patient's experience regarding the amount of time fasted postoperatively. Postoperative fasting times were calculated from the time of withdrawal of anaesthesia (as recorded in the surgical notes) to the reported time of first liquid or solid meal. This part of the questionnaire was completed as soon as the patient was able and willing and as soon as postoperative fasting was broken.

The interviewer-administered questionnaire was available in both English and Afrikaans. Incurring the financial costs of a daily translator for six months for the small number of patients at Tygerberg hospital who were only able to speak isiXhosa, was deemed unnecessary. In the case of an isiXhosa speaking patient who did not understand or speak English or Afrikaans, a member of the ward staff or a fellow consenting patient were asked to assist in translating. This was done for three patient participants included in the study who did not understand or speak English or Afrikaans.

3.2.3.2 HCP participants

Data collection from the dietitians took place at a scheduled weekly team meeting, while data collection from the nurses took place on various occasions in the wards. The surgeons were contacted via email and data collection for the anaesthetists took place over two consecutive days in the anaesthetics department.

All nurses, anaesthetists, dietitians and surgeons who met the inclusion criteria, were approached by the researcher to complete a self-administered questionnaire in order to ascertain the KAPs of these healthcare workers as well as any perceived barriers regarding implementation of ERAS preoperative fasting recommendations. The HCPs were asked to provide voluntary informed consent before being enrolled in the study. There were three questionnaires, one for the surgeons and anaesthetists (Addendum G), one for the nurses (Addendum H) and a final one for the dietitians (Addendum I). The questionnaires were completed by the nurses in the presence of the researcher in order to ensure a controlled environment and to allow for clarification and questions. However, this was not possible for all of the dietitians, anaesthetists and surgeons, due to time constraints. All questionnaires were checked for completeness at the end of each data collection session and filed away for data capturing.

The nurses were asked to complete the self-administered questionnaire on the allocated days for data collection during their lunch hour or tea breaks or during a quiet time in their shift. The dietitians were located at their weekly team meeting and were recruited to complete the self-administered questionnaire at the end of the scheduled meeting. The anaesthetists were located in their department on the allocated days for data collection and were asked to complete the self-administered questionnaire during their breaks or during a quiet time in their day. The surgeons were unable to schedule a designated time for data collection during their work day due to the unpredictability of surgical schedules and were therefore contacted via email in order to complete the self-administered questionnaires at a time of their choosing. The completed questionnaires were collected by the researcher on an agreed upon date.

The research instruments were developed by the researcher and were based on the current literature and existing ERAS documents in order to achieve the objectives of the study. Available research instruments found in the literature were not used due to the non-response from authors and not being fully applicable to the aims of this study. All research instruments were developed in English and translated into Afrikaans. The translation of the research instruments into isiXhosa was deemed unnecessary as professionals at Tygerberg Hospital should be fully versed in English and/or Afrikaans as training at all tertiary institutions in South Africa include tuition in English and use of English text.

A pilot study was conducted in February 2015 in the Orthopaedic Surgery unit (Ward F4) at Tygerberg Hospital, in order to ascertain validity and reliability of the study tools. A sample of three patients and three nurses (to represent the healthcare workers) were selected for the pilot study. Face validity of study tools was checked by conducting the pilot study on a group of participants demographically similar to the sample population. Professional nurses and patients were sampled from the Orthopaedic surgery ward for the purposes of the pilot study. Relevant changes were made to the questionnaires in order to correct for ambiguities following the pilot study. Content validity was attained by sending the questionnaires for checking and feedback to two experts in the field of clinical nutrition and observational research prior to the pilot study.

3.2.3.3 Data collection tools

The following tools were used for data collection:

- NRS 2002 malnutrition screening tool (Addendum B)
- Electronic scale and calibration instruments
- Stadiometer and calibration instruments
- Observational checklist (Addendum D)
- Interviewer-administered patient questionnaire (Addendum E)

- Patient experience card (Addendum F)
- Self-administered HCP questionnaire (Surgeons and anaesthetists) (Addendum G)
- Self-administered HCP questionnaire (Nurses) (Addendum H)
- Self-administered HCP questionnaire (Dietitians) (Addendum I)

3.3 ANALYSIS OF DATA

Data was captured by the researcher using Microsoft Excel 2013. Data analysis was performed by the statistician in consultation with the researcher using Statistica version 12 (2014). A significance level of 5% was used throughout for all analyses.

Descriptive statistics for continuous numerical variables were summarised using means, standard deviations and 95% confidence intervals if the data was normally distributed. Where the data was not normally distributed, they were summarised using medians and interquartile ranges. Continuous numerical data was presented graphically using histograms.

Descriptive statistics for ordinal variables were summarised using medians and interquartile ranges if data was not normally distributed. Ordinal data was presented graphically using histograms.

Descriptive statistics for nominal variables were presented using frequency distributions. Nominal data were presented graphically with the use of bar charts. A 95% confidence for binary proportions was presented.

Comparative analyses for two continuous variables were done using Pearson's correlation (if both variables were normally distributed) or Spearman rank's correlation (if both variables were not normally distributed).

Comparative analyses for two nominal variables were done using Pearson's chi-square test (for independent proportions) or McNemar's chi-square test (for dependent proportions). Where the expected cell frequencies were less than 5, exact tests were used.

Comparative analyses for one continuous and one binary variable were done using Student's T-test (if the continuous variable was normally distributed) or Mann-Whitney U-test (if the continuous variable was not normally distributed).

Comparative analyses for one continuous and one nominal variable were done using ANOVA (if the continuous variable was normally distributed) or Kruskal-Wallis ANOVA (if the continuous variable was not normally distributed).

Hypothesis testing was done using a single sample t-test with a 95% confidence interval and a significance of $p < 0.05$.

Knowledge was assessed using a knowledge score sheet (ADDENDUM L). A score of 80% or above was considered “good”, between 50% and 80% “average” and below 50% “poor”.

3.4 ETHICS AND LEGAL ASPECTS

The protocol was approved by the Health Research Ethics Committee (HREC) in the Faculty of Medical and Health Sciences at Stellenbosch University (S14/10/250) (Addendum L). Thereafter it was submitted to Tygerberg Hospital and the necessary permission was obtained from the Medical Superintendent: Research (Addendum M).

Ethics approval was necessary as this study accessed confidential information including patient medical records and diagnoses. The study abided by international ethical standards, including the Helsinki declaration. Research approval for the study was sought from Tygerberg hospital management and in particular the surgical unit following ethical approval.

A written consent form (Addendum H and I) was completed by each individual who gave voluntary informed consent to participate in the study in his/her language of choice (English, Afrikaans or Xhosa). All study participants received a signed copy of the informed consent form, which they were allowed to keep. The consent form included information assuring study participants of anonymity and confidentiality. All individuals included in the study were able to give written informed consent, therefore no non-written consent procedures were necessary.

The study procedure, aims, risks and benefits were verbally explained to the subjects and were included in the informed consent form. In addition, study participants were advised verbally before agreeing to participate in the study regarding their anonymity and confidentiality as well as the ability to withdraw from the study at any point in time. Refusal to participate or withdrawal from the study was the right of the research subject and did not result in negative consequences to the participant in any way. All subjects were informed of this right before giving informed consent.

Anonymity of participants was ensured by identifying all study participants via a number and not via their names. All questionnaires were anonymous and participants’ names were not recorded on the questionnaires. The number assigned to each participant was used throughout the data collection and analysis process. The identities of study participants were not reported in the results of the study and were unknown to both the researcher and statistician during data analysis in order to prevent bias and to protect study participants.

Confidential information pertaining to any aspect of study participants such as diagnoses, opinions, etc. was protected via anonymity. All raw data, including questionnaires, were viewed only by the researcher and statistician and were stored safely at all times. Informed consent forms were filed and will be kept for legal reasons in a secure location.

Patient participants with an NRS score of three or above, indicating that the patient was nutritionally at risk, were referred to the ward dietitian for appropriate nutritional care as soon as possible after exit from the study but prior to discharge.

CHAPTER 4:
RESULTS

4.1 PATIENTS

The wards, theatre schedule and surgical schedule were screened for eligible patient participants on a daily basis. A total of 34 patients who met the screening criteria and agreed to participate were enrolled in the study, with 30 patient participants completing the study and the remaining four patients not completing the study for various reasons (see Figure 4.1).

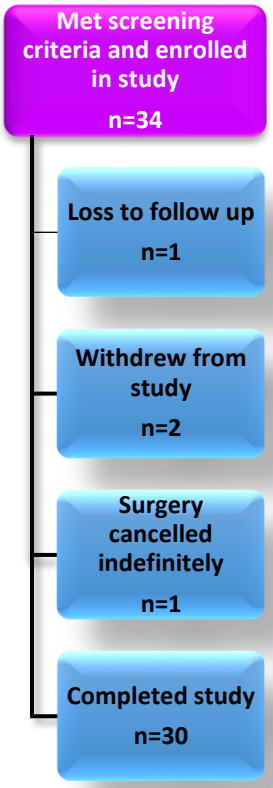


Figure 4.1: Patient sampling framework

4.1.1 Descriptive statistics

The study population consisted of 30 patients, 17 of whom were male (57%) and 13 of whom were female (43%). Participant ages ranged between 28 and 84 years old, with a mean age of 52,57 years (SD 14,28) and a median age of 53 years.

Fifty percent (n=15) of patient participants were in need of gastrointestinal surgery due to a malignancy, while 13% (n=4) were in need of gastrointestinal surgery due to a traumatic injury.

The remaining 37% (n=11) were having surgery due to a variety of other diagnoses, including disseminated Tuberculosis (TB) (n=1), abscesses (n=2), and ischaemic bowel (n=2).

The following figure depicts the surgeries for which patient participants were scheduled at the time of admission (Figure 4.2)

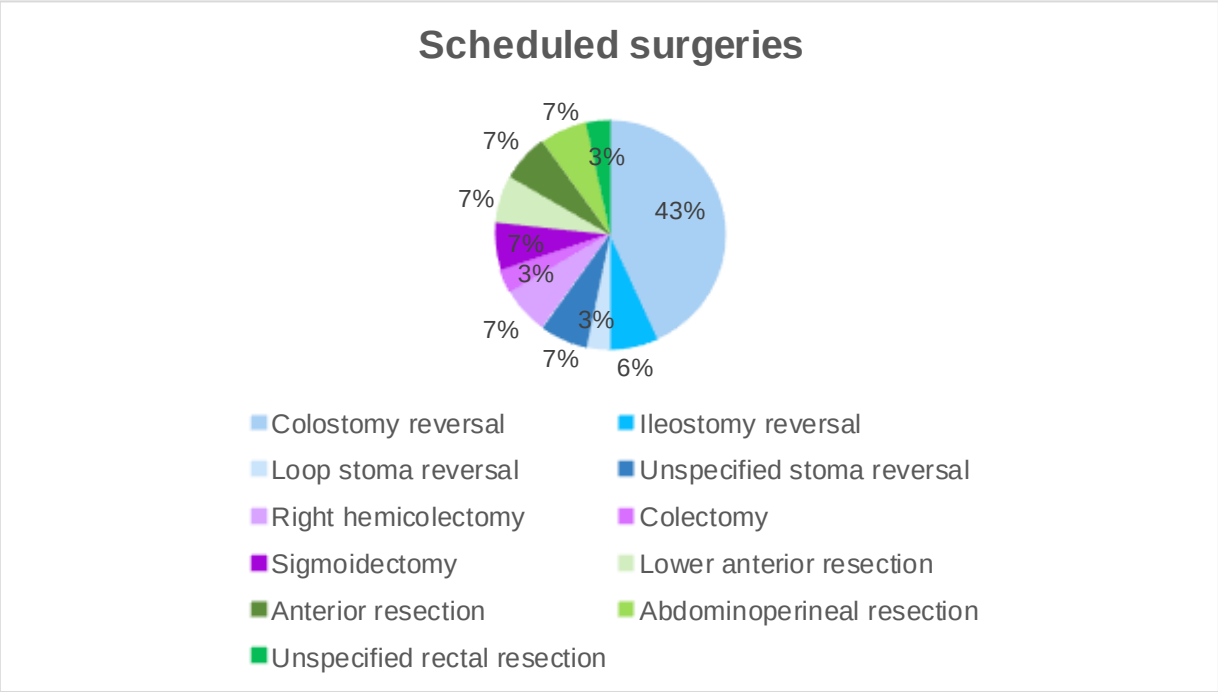


Figure 4.2: Scheduled surgeries of patient participants

Stoma reversals (including colostomy reversals (n = 13), ileostomy reversals (n = 2), loop stoma reversals (n = 1) and unspecified stoma reversals (n = 2)) accounted for the majority (60%, n = 18) of scheduled surgeries, while the remaining surgeries were divided between colonic (17%, n = 5) and rectal resections (23%, n = 7). Colonic resections included right hemicolectomies (n = 2), colectomies (n = 1) and sigmoidectomies (n = 2), while the rectal resections included lower anterior resections (n = 2), anterior resections (n = 2), abdominoperineal resections (n = 2) and an unspecified rectal resection (n = 1) (Figure 4.2).

Comorbidities in the study population included hypertension (23%, n = 7), diabetes (20%, n = 6), hypercholesterolemia (10%, n = 3), human immunodeficiency virus (HIV) (7%, n = 2), TB (3%, n = 1), cardiovascular disease (3%, n = 1), rheumatoid arthritis (3%, n = 1) and epilepsy (3%, n = 1).

One participant (3%) experienced complications during surgery, namely cardiac arrest and 10% (n = 3) of participants experienced complications after surgery. Complications after

surgery included ileus and sepsis in one participant; nausea, vomiting and pyrexia in another and a third experienced vomiting and a mesenteric bleed, which required a repeat surgery.

4.1.1.1 Nutritional status of participants

a) Preoperative nutritional status

Weight and height of patient participants were measured and a NRS-2002 malnutrition screening was conducted prior to surgery. Table 4.1 below depicts the weight, height, BMI and NRS-2002 scores for both male and female participants prior to surgery.

Table 4.1: Preoperative nutritional status of participants

	Mean	Median	Minimum	Maximum	Lower quartile	Upper quartile	Standard deviation
Weight (kg)							
Male (n = 17)	72.7	67.6	51.9	109.5	58.3	83.7	16.9
Female (n = 13)	74.3	67.7	48.9	147.4	59.9	77.7	24.9
Total (n = 30)	73.4	67.7	48.9	147.4	59.5	83.7	20.4
Height (cm)							
Male (n = 17)	172.3	170.6	163.4	181.8	170.0	175.6	5.1
Female (n = 13)	160.2	157.6	151.0	172.2	155.0	168.0	6.8
Total (n = 30)	167.1	168.0	151.0	181.8	161.2	172.2	8.4
BMI (kg/m^2)							
Male (n = 17)	24.5	22.4	17.7	33.8	21.5	27.2	5.4
Female (n = 13)	29.0	27.4	16.5	52.2	24.0	31.1	9.0
Total (n = 30)	26.4	25.3	16.5	52.2	21.5	30.1	7.4
NRS score							
Male (n = 17)	1.6	1	0	5	0	3	1.8
Female (n = 13)	0.9	0	0	3	0	2	1.2
Total (n = 30)	1.3	0.5	0	5	0	3	1.6

Weight of participants on admission ranged between 48.85 kg and 147.4 kg, with a mean weight of 73.38 kg (SD 20.38) and a median of 67.65 kg for both males and females combined (Table 4.1). Preoperative weight did not differ significantly between males and females (Mann-Whitney U, $p = 1.00$).

Height of participants ranged between 151 cm and 181.8 cm with a mean height of 167.08 cm (SD 8.4) and a median height of 168 cm (Table 4.1). As could be expected, male participants were significantly taller than female participants, with a mean height of 172.3 cm (SD 5.1) as opposed to a mean height of 160.2 cm (SD 6.8) in females (Mann-Whitney U, $p < 0.01$)

Participant BMI on admission ranged between 16.47 kg/m^2 and 52.23 kg/m^2. The mean BMI for both genders combined was 26.4 kg/m^2 (SD 7.4), which is in the overweight range (Table 4.1). However, when stratified for gender, males had a mean BMI in the normal range (24.5 kg/m^2, SD 5.4) and females had a mean BMI in the overweight range (29.0 kg/m^2, SD 9.0). Despite this difference, preoperative BMI did not differ significantly between genders (Mann-Whitney U, p = 0.18). Thirty seven percent (n =11) of participants had a normal BMI, with 10% being classed as underweight (n=3), 27% (n = 8) being classed as overweight and 27% (n = 11) as obese. Preoperatively, BMI classifications did not differ significantly between genders (Pearson's chi-square, p=0.32)

NRS scores of participants upon admission varied between 0 and 5, with 50% (n = 15) of participants having an NRS score of 0 and 73% of participants (n = 22) having an NRS score below 3, indicating that they are not nutritionally at risk (Table 4.1). Twenty-seven percent (n = 8) of participants had an NRS score of three or greater, indicating that they are nutritionally at risk and require nutritional intervention. There was no significant difference between NRS scores of male and female participants (Mann-Whitney U, p = 0.40).

b) Postoperative nutritional status

Weight and height measurements of participants were repeated postoperatively in order to assess changes in nutritional status between the pre- and postoperative periods (Table 4.2). The following table depicts the postoperative weight, height and BMI of both male and female participants, as well as weight loss (both absolute and relative) between the pre- and postoperative periods.

Table 4.2: Postoperative nutritional status of participants

	Mean	Median	Minimum	Maximum	Lower quartile	Upper quartile	Standard deviation
Weight (kg)							
Male (n = 17)	70.0	65.3	52.4	104.0	58.7	76.9	14.9
Female (n = 13)	73.6	65.9	49.5	142.4	60.6	77.5	23.5
Total (n = 30)	71.5	65.8	49.5	142.4	58.7	77.5	18.8
Height (cm)							
Male (n = 17)	172.3	170.6	163.4	181.8	170.0	175.6	5.1
Female (n = 13)	160.2	157.6	151.0	172.2	155.0	168.0	6.8
Total (n = 30)	167.1	168.0	151.0	181.8	161.2	172.2	8.4
BMI (kg/m^2)							
Male (n = 17)	23.6	22.4	17.0	32.6	19.9	26.2	4.9
Female (n = 13)	28.7	27.4	16.7	50.5	23.4	31.5	8.5
Total (n = 30)	25.8	25.1	16.7	50.5	20.5	29.7	7.1
Weight changes (kg) [%]							
Male (n = 17)	2.7 [3.2]	1.8 [3.1]	-3.5* [-6.7]*	13.2 [13.4]	-0.5* [-0.8]*	5.1 [7.4]	4.3 [5.4]
Female (n = 13)	0.7 [0.6]	0.2 [0.3]	-1.9* [-2.6]*	5.0 [3.4]	-0.65 * [-1.3]*	1.8 [2.7]	1.9 [2.1]
Total (n = 30)	1.9 [2.1]	1.3 [1.4]	-3.5* [-6.7]*	13.2 [13.4]	-0.65* [-1.0]*	2.6 [3.5]	3.6 [4.4]
NRS score							
Male (n = 17)	2.7	2	1	5	1	4	1.5
Female (n = 13)	1.6	1	1	4	1	2	1.0
Total (n = 30)	2.2	2	1	5	1	4	1.4

*Negative weight changes denote that the participant gained weight

NRS scores decreased significantly between the pre-operative and post-operative period (Wilcoxon Matched Pairs Test; $p < 0.01$).

Weight of participants after surgery ranged between 49.5 kg and 142.4 kg, with a mean weight of 71.53 kg (SD 18.8) and a median of 65.8 kg (Table 4.2). Postoperative weight did not differ significantly between males and females (Mann-Whitney U, $p = 0.74$). Weight decreased significantly between the pre- and post-surgery periods (Wilcoxon Matched Pairs Test, $p = 0.009$).

Weight changes ranged between -3.5 kg and 13.2 kg, with a mean loss of 1.85 kg (SD 3.55) and a median of 1.3 kg (Table 4.2). Although male participants lost more weight than female participants, this difference was not significant (Mann-Whitney U, p = 0.19).

Percentage weight change ranged between -6.74% to13.44%, with a mean loss of 2.07% (SD 4.4) (Table 4.2). Twenty percent (n = 6) of participants experienced a clinically significant weight loss of more than 5% over the perioperative period. Percentage weight change did not differ significantly between genders (Mann-Whitney U, p = 0.12).

Participant BMI post-surgery ranged between 16.69 kg/m^2 and 50.45 kg/m^2 with a mean BMI of 25.8 kg/m^2 (SD 7.06) and a median of 25.1 kg/m^2 (Table 4.2). Females had a significantly higher postoperative BMI than males (Bootstrap, p = 0.024).

The following figure depicts the changes in BMI per BMI category before and after surgery, for both males and females as well as for the study population as a whole (Figure 4.3).

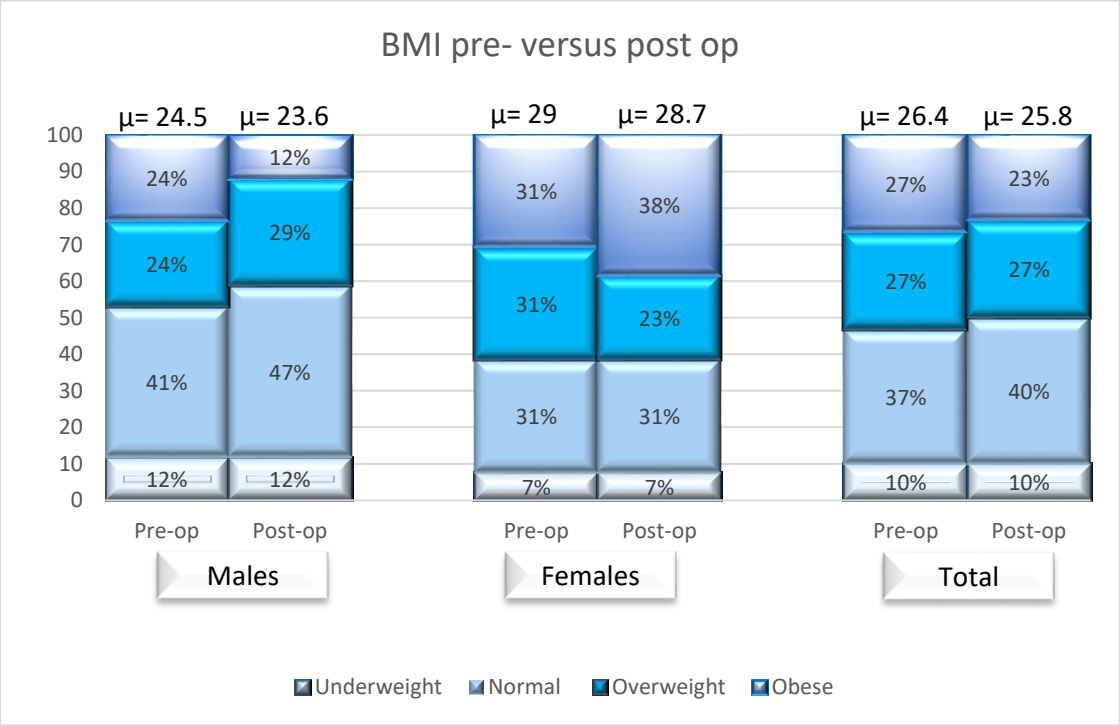


Figure 4.3: BMI categories pre- and post-surgery

There was a significant change in BMI categories from admission to the postoperative period (chi-square (df = 9), = 40.14, p < 0.001). Two of the obese participants moved into the overweight category, one of the overweight participants moved into the obese BMI category and another one moved into the normal BMI category (Figure 4.3).

Figure 4.4 below depicts change in BMI between pre-and post-surgery periods for both male and female participants.

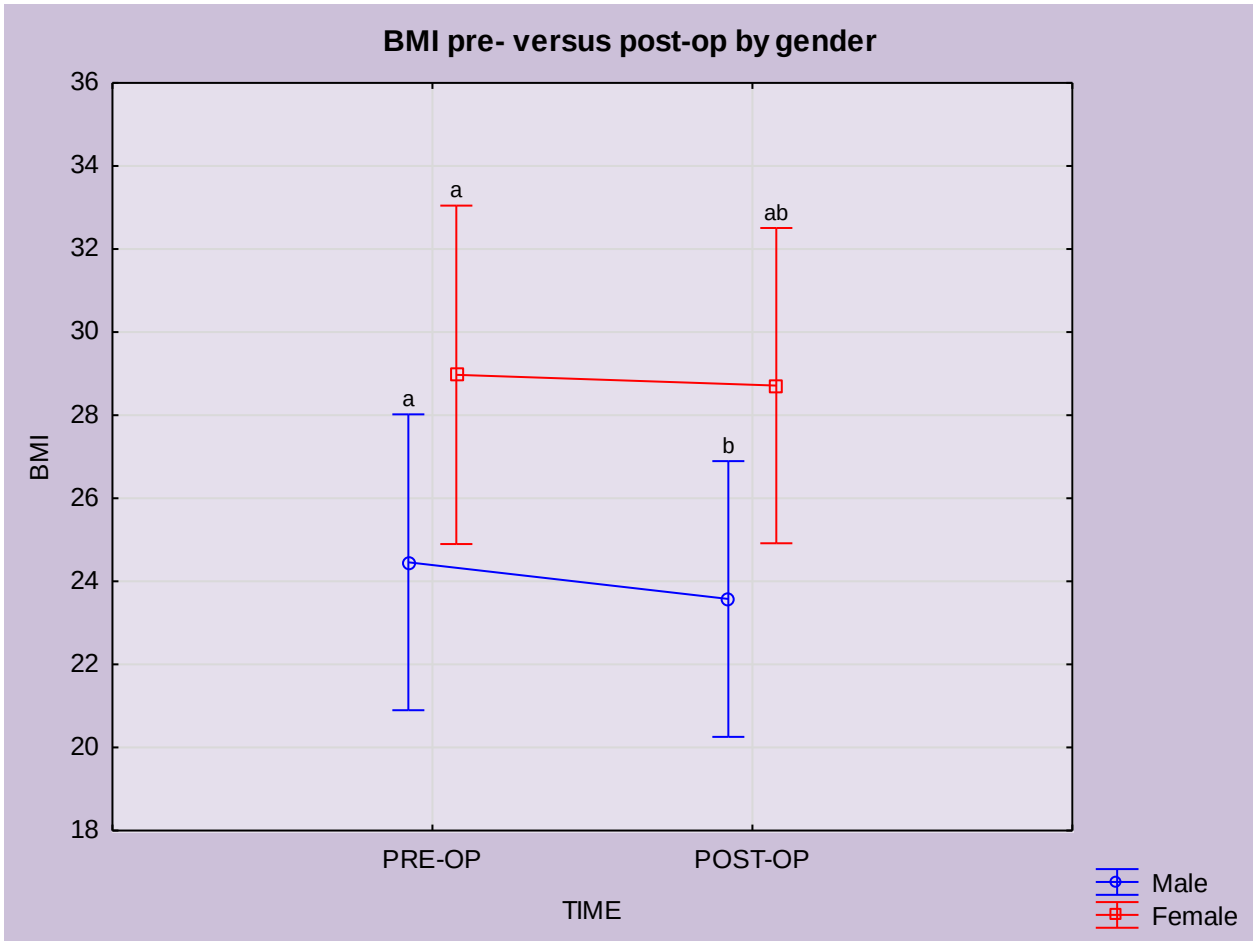


Figure 4.4: BMI pre- and postoperatively by gender

Mean total BMI decreased significantly between the pre- and post-surgery periods (Wilcoxon Matched Pairs Test, p = 0.01); however when stratified for gender, there was only a significant decrease in BMI for males (repeated measures, ANOVA, p = 0.004) (Figure 4.4).

4.1.2 Observed Implementation of ERAS perioperative nutrition guidelines

Implementation of ERAS perioperative nutrition guidelines for each patient participant (n = 30) were assessed via an observational checklist (with information being obtained from patient files and doctors' notes or verbally from the nurses and patient participants when information was not available in the file) and an interviewer-administered questionnaire to the patients. A total of seven practices were assessed, representing each of the four nutrition-related ERAS guidelines (Table 4.3). Each practice was scored according to whether the relevant ERAS guideline was complied with or not. Non-compliance with the guideline was given a score of

zero and compliance with the guideline was given a score of one. Scores for each guideline were then tallied and percentages calculated (Table 4.3).

Table 4.3: Observed implementation of ERAS perioperative nutrition guidelines

	Relevant ERAS guideline	Compliant with guideline	Non-compliant with guideline
Optimisation of preoperative nutritional status	Practice score 1: Weighing of patients on admission (n = 30)	70%	30%
	Practice score 0: Screening for malnutrition on admission (n = 30)	0%	100%
	Practice score 2: Appropriate referral to dietitian for pre-op nutrition support (n = 30)	0%	100%
Preoperative carbohydrate drink	Practice score 5: Preop carbohydrate drink received (n = 30)	0%	100%
Perioperative fasting times	Practice score 3: Recommended preoperative fasting from solids (n = 30)	0%	100%
	Practice score 4: Recommended preoperative fasting from liquids (n = 30)	0%	100%
Postoperative resumption of feeding	Practice score 6: Recommended postoperative fasting time (n = 30)	73%	27%

4.1.2.1 Malnutrition screening

The majority (70%, n = 21) of patient participants were weighed on admission to the ward; however, weights were recorded in the patient file only 63% (n =1 9) of the time. Patient participants were always weighed by a nurse on admission. Besides weight measurement, no other risk factors for poor nutritional status were assessed on admission and no malnutrition screening tool was used. None of the patient participants were referred to a dietitian on admission for relevant preoperative nutrition support and none of the participants were referred to or seen by a dietitian in the time-span between admission and surgery for relevant preoperative nutrition support.

4.1.2.2 Reduced preoperative fasting times

The majority (97%, n = 29) of participants received specific verbal and/or written orders for fasting times from their doctor or surgeon prior to surgery. Half (n = 15) of the participants received orders to remain NPO from 22h00 the night before surgery, while 44% (n = 13) were advised to remain NPO from midnight or 24h00, 3% (n = 1) were not given any fasting instructions and 3% (n = 1) were told to remain NPO from the day before surgery but no specific time was given. No distinction was made between solids and liquids in any of the fasting instructions given to patients.

The following figure (Figure 4.5), depicts the amount of time fasted from both solids and liquids preoperatively as compared to the ERAS guidelines of six hours and two hours respectively. The box delineates the upper and lower quartiles with the horizontal line indicating the median. The mean is displayed with a cross. The whiskers of the plot display the relative minimum and maximum non-outlying values and the points display outlying values.

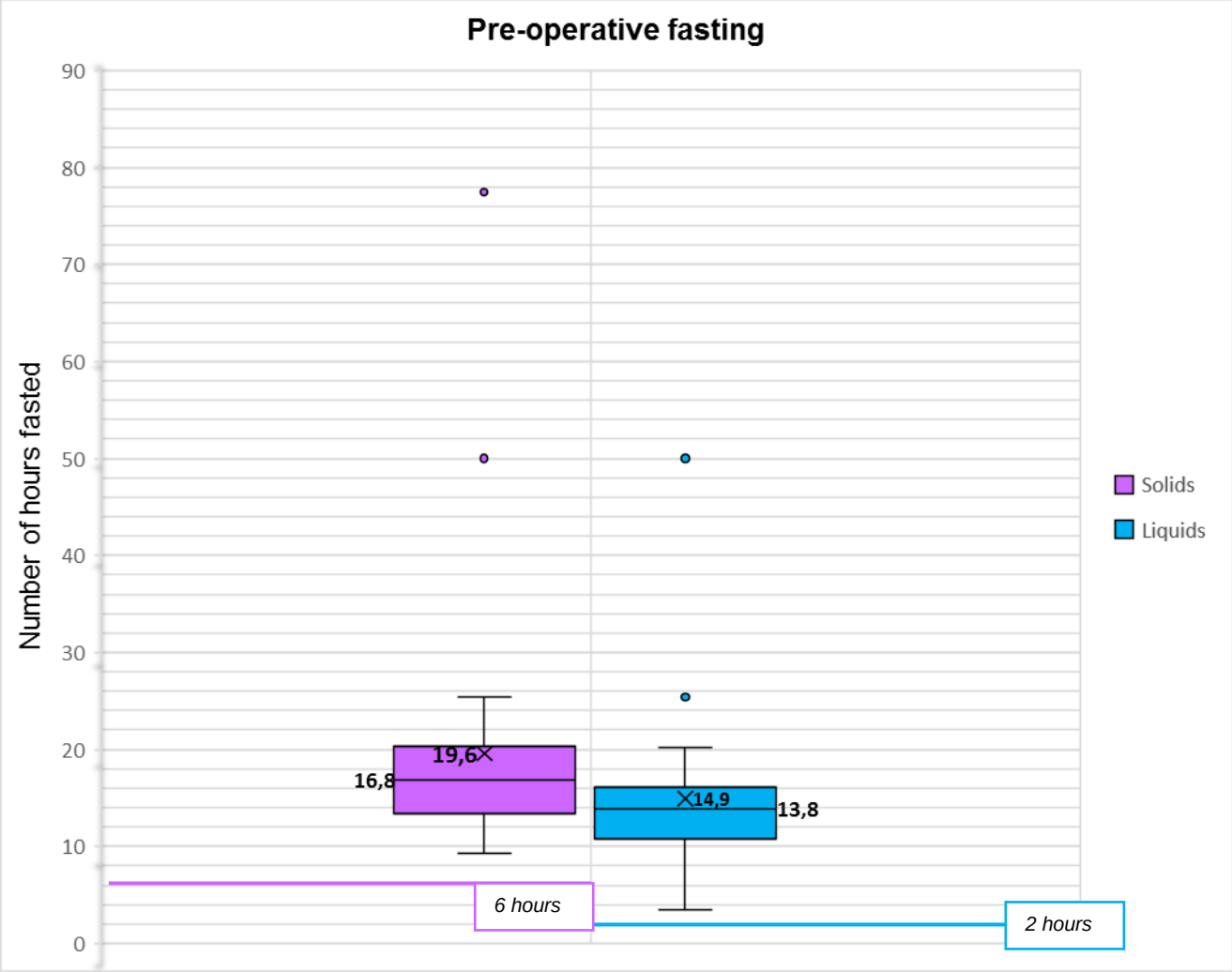


Figure 4.5: Boxplot of number of hours of preoperative fasting from solids and liquids

The mean amount of time participants were kept fasted from solids prior to surgery was 19.5 hours (SD 13.2), with a median time of 16.8 hours. Time fasted from solids ranged from 9.55 hours to 77.5 hours (Figure 4.5). All (n = 30) participants reported that their last solid meal prior to surgery was a hospital full ward diet meal. Supper was served at 17h00 in the hospital, which was the most common time for participants to begin their fast from solids, with 43% (n = 13) of participants having their last solid meal at this time.

The mean amount of time participants were kept fasted from liquids and solids (NPO) prior to surgery was 14.92 hours (SD 7.8), with a median time of 13.8 hours. Time fasted from liquids ranged from 3.5 to 50 hours, with the mean fasting time differing significantly from the ERAS recommendation of two hours (T-test, $P < 0.001$) (Figure 4.5). Participants reported that their last intake of liquids prior to surgery comprised of water (50%, n = 15), tea/coffee (40%, n = 12), juice (7%, n=2) or other (3%, n = 1). Tea was served after supper between 20h00 and 21h00, which accounted for the last liquid intake of 36% (n = 11) of participants. Thirteen

percent (n = 4) of participants had their last preoperative fluids at 17h00 with supper and 20% (n = 6) of participants had something to drink at 22h00.

Surgery schedules and patient files for most (90%, n = 27) participants displayed the scheduled surgery date without any specific time given, while the remaining participants (10%, n = 3) had no surgery date or time scheduled in their file or in the surgery schedules. The theatre lists, confirming the patients booked for surgery that day, were published on the day of surgery but also didn't specify the times of surgery. Furthermore, theatre lists were subject to change due to emergency cases being pushed forward. Thirty percent (n = 9) of participants' surgeries did not take place on the scheduled day, with 20% (n = 6) of participants having their surgery delayed once, 7% (n = 2) having their surgery delayed twice and 3% (n = 1) having their surgery delayed four times. Those participants who experienced delayed surgeries, were kept completely fasted (NPO) for a mean of 20.86 hours (SD 20.49) per delay in addition to the mean time of 14.92 hours (7.8) spent NPO prior to the surgery that did take place. There was no significant difference in pre-surgery fasting times from both liquids and solids prior to the surgery that did take place for those patients whose surgeries had previously been delayed.

4.1.2.3 Preoperative carbohydrate loading

None of the participants received a carbohydrate loading drink preoperatively.

4.1.2.4 Postoperative resumption of feeding

The majority, 97% (n = 29) of participants were not referred to a dietitian after surgery for appropriate early postoperative nutritional support, however 27% (n = 8) of participants were seen by a dietitian post-surgery as all ICU patients receive dietetics services, with or without active referrals.

The first postoperative enteral feed for 97% (n = 29) of participants was via the oral route while the remaining 3% (n = 1) was via the nasogastric route. The first enteral feed after surgery was commenced anywhere between 0.167 hours and 28.83 hours post-surgery, with a mean of 13.64 hours (SD 8.6) and a median of 15.83 hours.

Ten percent of participants (n = 3) did not receive enteral feeds within 24 hours after surgery. Of these, two experienced delayed enteral feeding due to medical reasons, namely having to be taken back into surgery for a re-look laparotomy and being haemodynamically unstable in ICU.

The first oral feed after surgery was commenced anywhere between 0.167 and 46.25 hours post-surgery, with a mean of 14.33 hours (SD 10.25) and a median of 15.83 hours.

For 90% (n = 27) of participants, the first oral feed after surgery was a liquid. Eighty three percent (n = 25) of participants reported that their first oral feed after surgery was water, 3% (n = 1) reported it was juice, 3% (n = 1) reported it was the full ward diet, 3% (n = 1) reported it was pureed food and the remaining 7% (n = 2) reported "other".

The doctors' orders for commencing feeding after surgery all (n = 29) stated that patients should be started on oral feeds, while one participant's doctor did not give any orders for postoperative commencement of feeds. Of those who gave orders for postoperative feeding, 69% (n = 20) of participants' doctors did not specify the time at which feeding should commence, 14% (n =4) stated that feeding should commence on the day of surgery, 10% (n = 3) stated that feeding can commence the day after surgery, 4% (n = 1) stated that feeding should commence the morning after surgery, and 4% (n = 1) stated that feeding should commence once recovered. Furthermore, 69% (n = 20) of participants' doctors prescribed liquids for commencing postoperative oral feeds.

4.1.3 Sub-group analyses

4.1.3.1 Observed practices versus ERAS guidelines

a) Preoperative fasting times

The mean amount of time participants were kept fasted from solids prior to surgery was 19.5 hours (SD 13.2), which differed significantly from the ERAS recommendation of six hours (t-test, P <0.001). Therefore, for this guideline, the hypothesis that observed practice is the same as the guideline, can be rejected.

The mean amount of time participants were kept fasted from liquids and solids (NPO) prior to surgery was 14.92 hours (SD 7.8), which differed significantly from the ERAS recommendation of two hours (t-test, P <0.001). Therefore, for this guideline, the hypothesis that observed practice is the same as the guideline can be rejected.

b) Postoperative resumption of feeding

Postoperative resumption of both enteral and oral feeds for liquids and/ or solids did not differ significantly from the ERAS guideline of resuming feeds as early as four hours postoperatively and no later than 24 hours postoperatively. Enteral feeding (via the oral or nasogastric route) was resumed between 9.32 and 17.97 hours postoperatively and oral feeding between 9.17 and 19.49 hours postoperatively, which is within the 99% confidence interval of the guideline recommended ranges.

c) Other

Although hypothesis testing was not possible for the remaining practices, none of the other practices were being implemented exactly according to the ERAS guidelines, and therefore, observed practices did differ from the guidelines.

4.1.3.2 Effect of extent of compliance with ERAS guidelines on weight loss and nutritional risk

The extent of compliance with practice score 1 (weighing of patients on admission) did not significantly affect weight loss (Mann-Whitney U, p = 0.86) or percentage weight loss (Mann-Whitney U, p = 0.96). The extent of compliance with practice score six (postoperative resumption of feeding) did not significantly affect weight loss (Mann-Whitney U, p = 0.37) or percentage weight loss (Mann-Whitney U, p = 0.50). Since compliance with the remaining four practices was zero, the effect of the extent of compliance on change in nutritional status could not be tested for these practices.

There was a very weak, non-significant, negative relationship between the amount of time fasted from solids and absolute weight loss (Spearman r = -0.16, p = 0.38), as well as relative weight loss (Spearman r = -0.14, p = 0.48). There was a very weak, non-significant, negative relationship between the amount of time fasted from liquids and absolute weight loss (Spearman r = -0.19, p = 0.31), as well as relative weight loss (Spearman r = -0.16, p = 0.41). Amount of time fasted had no significant effect on change in nutritional risk.

4.1.4 Patient experiences:

The majority of patients (77%, n = 23) said that they believe their nutrition before surgery will affect their recovery, while 90% (n = 27) said that they believe their nutrition after surgery will affect their recovery.

Forty percent (n = 12) of participants felt unhappy about the amount of time they had to fast from solids prior to surgery, while 40% (n = 12) felt happy and 20% (n = 6) felt very happy. Fasting time from solids did not significantly affect patient experiences concerning fasting from solids.

Thirty percent (n = 9) of participants felt unhappy about the amount of time they had to fast from liquids prior to surgery, while a further 17% (n = 5) felt very unhappy and 47% (n = 14) and 7% (n = 2) felt happy and very happy respectively. Fasting time from liquids did not significantly affect patient experiences concerning fasting from liquids.

Fifty percent (n = 15) of participants felt unhappy about the amount of time they had to fast after surgery, while a further 3% (n = 1) felt very unhappy and 30% (n = 9) and 17% (n = 5) felt happy and very happy respectively.

4.2 HEALTHCARE PROFESSIONALS

4.2.1 Descriptive statistics

Fifty-eight HCPs participated in the study, of which 29 were professional nurses, 13 were registered dietitians, three were GIT surgery consultants and 13 were anaesthesiology consultants.

Participant ages ranged from 24 to 63 years old with a mean age of 39,87 years (SD 8.6). Eighty-three percent of HCP participants were female and 17% were male. Experience in their current professions ranged 0.42 years to 43 years, with a mean of 11.7 years (SD 10.03) and a median of 7.8 years. Participants' experience with colorectal surgery patients ranged from 0.08 years to 43 years, with a mean of 7.8 years (SD 8.5) and a median of six years.

Of the 58 HCPs, only five (9%) claimed to have received training regarding the ERAS guidelines, two of which were nurses and three of which were anaesthetists, while none of the dietitians or surgeons had received such training. Thirty-eight percent (n = 21) of HCPs claimed to have attended talks or read literature regarding the ERAS guidelines; of these nine (43%) were anaesthetists, five (24%) were dietitians, four were nurses (19%) and three were surgeons (14%). Therefore, all surgeons and 70% of anaesthetists had attended talks or read literature regarding the ERAS guidelines, while only 38% of dietitians and 14% of nurses had been exposed to the guidelines through talks or literature.

4.2.2 Knowledge

Knowledge was tested using a self-administered questionnaire containing nine multiple-choice questions, each question pertaining to a specific ERAS guideline (Table 4.4). All disciplines of HCP participants were asked the same nine knowledge questions.

Table 4.4: HCP Knowledge regarding ERAS perioperative nutrition guidelines

	Knowledge component tested (n = 58)	Correct	Incorrect
Optimisation of preoperative nutritional status	Malnutrition screening	28%	72%
	Preoperative nutrition optimisation	71%	29%
Preoperative carbohydrate drink	Timing of preoperative carbohydrate loading	33%	67%
	Preoperative carbohydrate loading formulation	31%	69%
Perioperative fasting times	Fasting duration from solids	45%	55%
	Fasting duration from clear fluids	43%	57%
Postoperative resumption of feeding	Minimum post-surgical fasting duration	26%	74%
	Maximum post-surgical fasting duration	40%	60%
	Post-surgical resumption of full oral diet	12%	88%

The knowledge question regarding preoperative nutrition optimisation was the only one answered correctly by the majority (71%, n = 41) of participants who knew that patients should be referred to a dietitian to help improve their nutritional status prior to surgery if they are malnourished (Table 4.4), while 12% (n = 7) thought they should do nothing as the patients' nutritional status does not affect the surgery and 10% (n = 6) didn't know the answer.

Twenty-six percent (n = 15) of participants answered correctly when asked the minimum amount of time patients should wait before being allowed to eat/drink after colorectal surgery (Table 4.4), while 24% (n = 14) didn't know the answer and 21% (n = 12) said that patients should wait a minimum of 24 hours before being allowed to eat/drink after colorectal surgery.

Participants seemed to have the least knowledge with regards to postoperative resumption of full oral diet with only 12% (n = 7) of participants knowing that patients can go straight to a full oral diet as tolerated after elective colorectal surgery (Table 4.4), while 33% (n = 19) of participants thought that patients should progress from water to clear fluids, to full fluids, to puree food and then to soft food before progressing to a full oral diet and 17% (n = 10) of participants didn't know the answer to this question.

Total knowledge scores ranged from 0% to 88% with the mean knowledge score across participants being 36% (SD 27.7, n = 58). The majority (67%, n = 39) of participants scored poorly (< 50%) in the knowledge questionnaire, while 28% (n = 16) achieved an average score (50–80%) and only 5% (n = 3) achieved a good score (> 80%).

4.2.2.1 Sub-group analyses

a) Differences in knowledge scores between HCP disciplines

Knowledge scores differed between participant categories, with nurses scoring the lowest with a mean score of 18% (SD 13%, n = 29) and surgeons scoring the highest with a mean score of 78% (SD 11%, n = 3). Nurses scored lower than dietitians and significantly lower than surgeons and anaesthetists (Figure 4.2). Dietitians scored a mean of 38% (SD 29%, n = 13), being higher than nurses, although not significantly higher, and significantly lower than surgeons and anaesthetists (Weighted means, $p < 0.001$) (Figure 4.6).

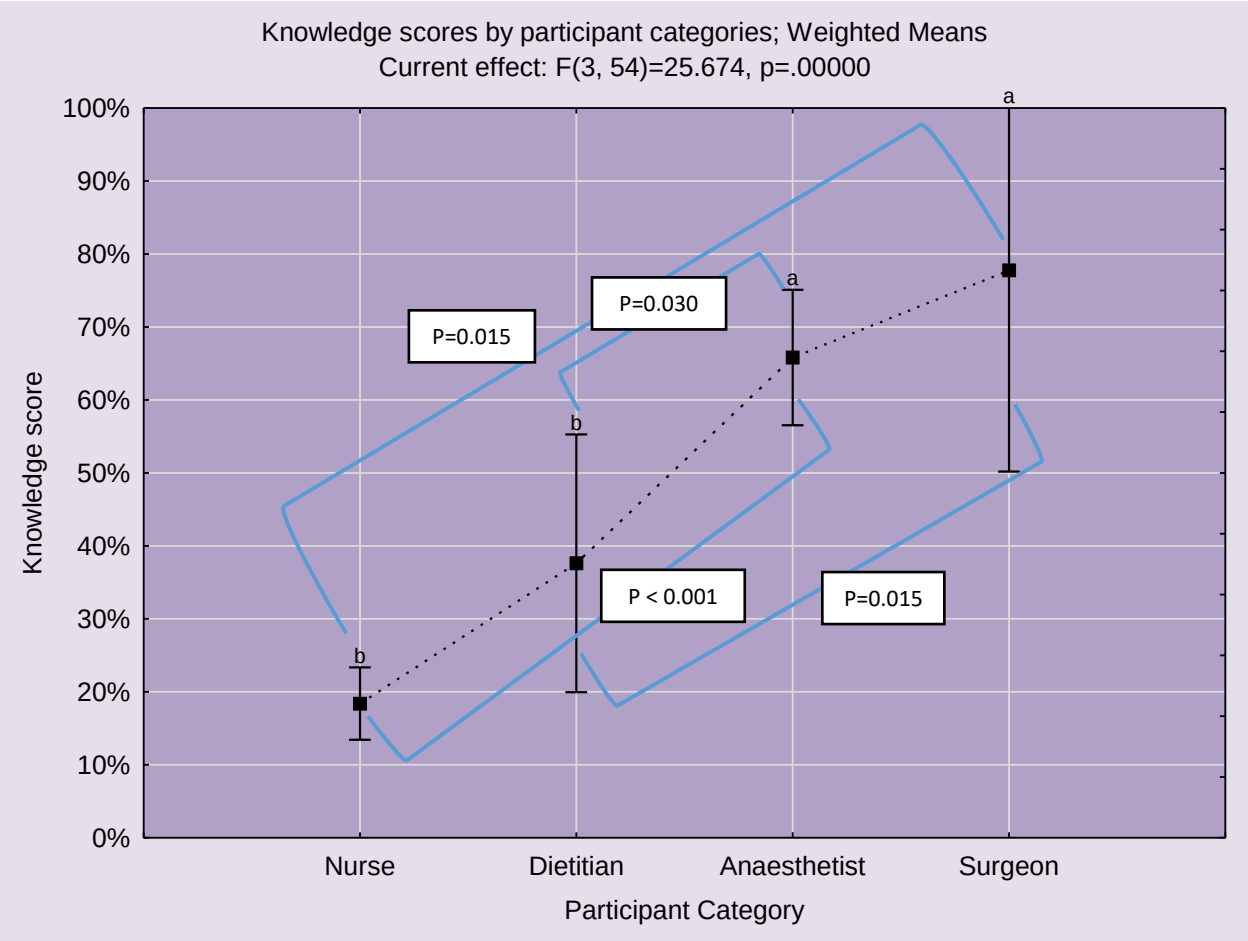


Figure 4.6: HCP Knowledge scores by discipline

b) Differences in knowledge scores based on age

There was a weak but significant negative relationship between age and knowledge scores (Spearman $r = -0.31$, $p = 0.02$), showing that knowledge scores decreased as age of participants increased.

c) Differences in knowledge scores based on experience

There was a weak but significant negative relationship between number of years of experience in a specific profession and knowledge scores (Spearman $r = -0.34$, $p = 0.01$). There was a very weak and non-significant positive relationship between number of years working with colorectal surgery patients and knowledge scores (Spearman $r = 0.10$, $p = 0.49$).

d) Differences in knowledge scores based on training received

Having received training regarding the ERAS guidelines did not have a significant effect on knowledge scores (Mann-Whitney U, $p = 0.23$).

e) Differences in knowledge scores based on literature read

Having attended a talk or read literature pertaining to the ERAS guidelines was related to significantly higher knowledge scores (Mann-Whitney U, $p < 0.01$), with a mean knowledge score of 60.3% (n = 21, SD 25) in those participants who claimed to have attended a talk or read literature regarding ERAS, as opposed to a mean score of 23.8% (n = 35, SD 18.3) in those who reported to have not attended a talk or read literature.

4.2.3 Attitudes

HCP participant attitudes towards the various nutrition-related ERAS guidelines were evaluated using a four-point Likert scale. A total of 27 attitudes were tested, each relating to different aspects of the ERAS perioperative nutrition guidelines (Table 4.5). The number of attitudes questioned differed between each discipline, with only applicable attitudes being evaluated for each discipline of HCP (Table 4.5).

Table 4.5: HCP Attitudes regarding ERAS perioperative nutrition guidelines

	Attitude component tested	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly Agree(%)
General ERAS perioperative nutrition guidelines	ERAS guidelines are not practical in our setting (n = 55)	25	60	11	4
	I am nervous to follow ERAS guidelines in case they lead to adverse outcomes (n = 25)	20	68	12	0
	Dietitians are responsible for educating other HCPs (n = 12)	0	0	67	33
	Dietitians play the biggest role in perioperative nutrition advocacy (n = 13)	0	23	62	15
	It is not the sole responsibility of dietitians to implement (n = 13)	8	8	62	23
Optimisation of preoperative nutritional status	Pre-surgical nutritional status impacts recovery (n = 29)	0	0	24	76
	Good nutritional status before surgery is important for recovery (n = 58)	3	3	29	64
	Improving nutritional status prior to surgery improves outcomes (n = 29)	0	0	34	66
Preoperative carbohydrate drink	Preoperative carbohydrate drink aids in recovery (n = 57)	5	26	54	12
	Preoperative carbohydrate drink doesn't influence recovery (n = 57)	16	58	25	2
	Preoperative carbohydrate drink helps psychologically to feel less hungry (n = 57)	4	18	6	19
Perioperative fasting times	Preoperative fasting time does not affect recovery (n = 57)	35	42	16	7
	Eating sooner than 12 hours before surgery is dangerous (n = 56)	25	30	30	14
	Perioperative fasting guidelines do not take the individual into account (n = 25)	8	72	16	4
	Not enough evidence to support benefits of reducing fasting times (n = 27)	22	56	19	4
	Fasting times are not always within my control (n = 58)	2	12	55	31
	Fasting for too long negatively impacts recovery (n = 58)	2	12	43	43
	I leave decisions about fasting times up to the patient's doctor (n = 42)	0	24	55	21
	I am too busy to worry about the patient's perioperative nutrition (n = 28)	39	46	14	0
	I do not take notice of patients' nutritional intake (n = 29)	59	41	0	0
	I follow the doctor's orders in the file regarding fasting times (n = 42)	2	14	50	33
	The doctor is always correct about fasting times (n = 42)	21	50	19	10
Postoperative resumption of feeding	Postoperative feeding guidelines are not careful enough (n = 26)	8	62	31	0
	Eating as soon as possible after surgery optimises recovery (n = 58)	5	24	57	14

	Eating too soon after surgery will result in complications (n = 58)	5	22	48	24
	Transitioning slowly to a full oral diet prevents complications (n = 58)	3	26	57	14
	Bowel sounds indicate readiness to tolerate oral nutrition (n = 58)	2	26	55	17

All HCP categories

Only nurses

Only dietitians

Nurses and dietitians

Dietitians, surgeons and anaesthetists

Key findings regarding the attitudes of HCPs towards the various ERAS guidelines will be highlighted. All other findings can be perused in Table 4.5.

4.2.3.1 General ERAS guidelines

The majority (85%) of participants disagreed that ERAS guidelines are not practical to implement in their setting and apply more to a developed healthcare system. The majority (88%) of dietitians, surgeons and anaesthetists disagreed that they are nervous to follow the ERAS guidelines in case it causes an adverse outcome in one of their patients. All dietitians agreed that it is their responsibility to educate the rest of the multidisciplinary team about correct perioperative nutrition practices (Table 4.5).

4.2.3.2 Optimisation of preoperative nutritional status

All dietitians, surgeons and anaesthetists agreed that a patient's nutritional status prior to elective colorectal surgery has an impact on their recovery and all agreed that improving patients' nutritional status in the weeks leading up to surgery is a useful intervention to improve surgical outcomes. The majority (93%) of participants agreed that it is important for patients to be well nourished before surgery so that they recover well (see Table 4.5).

4.2.3.3 Perioperative fasting times

Most (80%) of the dietitians, surgeons and anaesthetists disagreed that ERAS guidelines about patient fasting times do not take the individual patient into account and do not allow for the physician's best judgement in a specific situation, while the majority (78%) disagreed that there is not enough evidence to suggest that reducing perioperative fasting times is beneficial to patients. The majority (86%) of participants agreed that the time a patient is kept NPO is not always within their control, while most (86%) participants agreed that it is important to not fast patients for too long as this will have a negative impact on their recovery. The majority (76%) of nurses and dietitians agreed that they leave the decisions about how long to keep a patient NPO before and after surgery up to the patient's doctor, while most (88%) agreed that they follow the doctor's orders in the file to see how long to keep a patient NPO before and after surgery. Furthermore, the majority (71%) of nurse and dietitian participants disagreed that the doctor is always correct about how long to keep a patient NPO before and after surgery. The majority (85%) of nurse participants disagreed that they are too busy to worry about their patients' nutrition before and after surgery and all disagreed that they do not take notice of what or when the patients eat or drink (Table 4.5).

4.2.3.4 Postoperative resumption of feeding

The majority (70%) of participants disagreed that the guidelines regarding postoperative resumption of full oral diet are not careful enough. Most (71%) participants agreed that it is

important for a patient to eat as soon as possible after surgery in order to optimise recovery. The majority (72%) of participants agreed that allowing patients to eat too soon after surgery will result in complications and the majority (71%) agreed that transitioning patients slowly to a full oral diet prevents complications. The majority (72%) of participants agreed that bowel sounds indicate that a patient is ready to tolerate oral nutrition after surgery (Table 4.5).

4.2.3.5 Sub-group analyses

a) Differences in attitudes between HCP disciplines

The different disciplines of HCPs differed significantly with regards to the attitude "eating sooner than 12 hours before surgery is dangerous" (Kruskal-Wallis, F (3,52) = 15.32, p = < 0.01). A multiple-comparison procedure shows that nurses differed significantly from dietitians (p = 0.015), surgeons (p = < 0.01) and anaesthetists (p = 0.005) in this attitude, with nurses being more likely to agree that allowing a patient to eat sooner than 12 hours before surgery is dangerous.

The different disciplines of HCPs differed significantly with regards to the attitude "the time a patient is kept NPO is not always within my control" (Kruskal-Wallis, F (3,54) = 4.38, p = 0.01). A multiple-comparison procedure shows that nurses differed significantly from dietitians (p = 0.008) and surgeons (p = < 0.01) in this attitude, with nurses being more likely to disagree that the time a patient is kept NPO is not always within their control. Interestingly, all dietitians, surgeons and anaesthetists agreed with this statement.

The different disciplines of HCPs differed significantly with regards to the attitude that "allowing patients to eat too soon after surgery will result in complications" (Kruskal-Wallis, F (3.54) = 4.79, p = 0.02). A multiple-comparison procedure shows that surgeons differed significantly in this attitude from dietitians (p = 0.0013) and nurses (p = 0.014), with surgeons being more likely to disagree that allowing patients to eat too soon after surgery will result in complications.

The different disciplines of HCPs differed significantly with regards to the attitude that "transitioning patients slowly to a full oral diet prevents complications" (Kruskal-Wallis, F (3.54) = 2.49, p = 0.08). A multiple-comparison procedure shows that surgeons differed significantly in this attitude from anaesthetists (p = 0.004), dietitians (p < 0.001) and nurses (p < 0.001), with all surgeons disagreeing that transitioning slowly to a full oral diet prevents complications.

All other attitudes did not differ significantly between the different groups of HCWs.

b) Differences in attitudes based on literature read

Having read literature or attended a talk regarding ERAS resulted in significantly more disagreement with the statements that “allowing a patient to eat sooner than 12 hours before surgery is dangerous” (Mann-Whitney U, p =< 0.001) and “there is not enough evidence to suggest that reducing perioperative fasting times is beneficial to patients” (Mann-Whitney U, p = 0.045).

Having read literature or attending a talk regarding ERAS resulted in significantly more agreement with the statements that “the time a patient is kept NPO is not always within my control” (Mann-Whitney U, p = 0.049) and “a carbohydrate drink before surgery aids in the patient’s recovery” (Mann-Whitney U, p = 0.015).

Having read literature or attending a talk regarding ERAS did not have a significant effect on any of the other attitude components tested.

c) Differences in attitudes based on experience

Participants with more experience in their field (mean 29.2 years) strongly agreed significantly more often that the fasting time of patients before surgery has no bearing on their post-surgery recovery, as opposed to strongly disagreeing (Mann Whitney U, p = 0.001). However, when the outliers were removed from this analysis, experience did not have a significant effect on this attitude.

On removal of the outlier from the analyses, it was found that those HCP’s with less experience with colorectal surgery patients (mean 1.0 years) were significantly more likely to disagree that the time a patient is kept NPO is not always within their control (Weighted Means, p= 0.027).

d) Differences in attitudes based on age

Younger dietitians, surgeons and anaesthetists were significantly more likely to strongly agree that improving a patient’s nutritional status in the weeks leading up to a surgery is a useful intervention to improve surgical outcomes (Mann-Whitney U, p = 0.03).

On removal of the outlier from the analyses, it was found that older HCP’s were significantly more likely to strongly agree that they follow the doctor’s orders for pre-operative NPO (Kruskal-Wallis, p<0.01).

4.2.4 Practices

Study participants were requested to indicate what their current practices were in terms of the various ERAS perioperative nutrition guidelines. The practices evaluated differed between each discipline, with only practices applicable to the role of each discipline of HCP being

evaluated (Table 4.6). Practices relating to referral to dietitians for nutrition support were evaluated in all HCP disciplines, with dietitians being asked whether or not they are referred to and the other disciplines being asked whether or not they do refer. In cases where study participants were not in the position to implement a specific guideline, for example dietitians who are not currently working with elective colorectal surgery patients or anaesthetists who do not have the opportunity to have a preoperative consult with patients, participants were instructed to answer in terms of what they would do should they be afforded the opportunity to do so. Therefore, practice scores should be interpreted as the intention to implement a specific guideline and not necessarily the extent to which a guideline is actually being implemented (Table 4.6).

Table 4.6: HCP practices regarding ERAS perioperative nutrition guidelines

	Relevant ERAS guideline	Compliant with guideline	Non-compliant with guideline
Optimisation of preoperative nutritional status	Weighing of patients on admission (n = 26)	73%	27%
	Screening for malnutrition on admission (n = 26)	42%	58%
	Appropriate referral to dietitian for preoperative nutrition support (n = 50)	58%	42%
Preoperative carbohydrate drink	Ordering of preoperative carbohydrate drink (n = 53)	29%	71%
Preoperative fasting times	Recommended preoperative fasting from solids (n = 27)	52%	48%
	Recommended preoperative fasting from liquids (n = 27)	63%	37%
Postoperative resumption of feeding	Progression to full oral diet (n = 22)	9%	91%
	Recommended postoperative fasting time (n = 24)	75%	25%
	Minimum postoperative fasting time (n = 24)	20%	80%
	Maximum postoperative fasting time (n = 24)	46%	54%

All HCP categories

Only nurses

Dietitians, surgeons and anaesthetists

4.2.4.1 Optimisation of preoperative nutritional status

The practice that was most complied with, was that of preoperative weighing of patients with 73% of nurses reporting weighing elective colorectal surgery patients on admission to hospital (Table 4.6).

4.2.4.2 Preoperative carbohydrate drink

The majority (71%) of participants stated that they did not order a preoperative carbohydrate drink for their patients (Table 4.6). Dietitians reported that there were no formulated nutritional products for use as preoperative carbohydrate loading drinks available at the hospital, however available drinks cited by dietitians that could be used for this purpose included apple juice, Oros, and Hycal. These drinks, however are not specifically formulated for the purpose of carbohydrate loading and do not contain the type and amount of carbohydrates as recommended by ERAS.

4.2.4.3 Preoperative fasting times

The majority of dietitian, surgeon and anaesthetist participants were compliant with the ERAS preoperative fasting guidelines, with 52% and 63% advising patients in line with the ERAS guidelines with regards to preoperative fasting from solids and liquids respectively (Table 4.6). Participants reported advising patients to fast from solids for a mean of 9.59 hours (SD 5.69) but responses ranged between six hours and 24 hours. HCPs reported advising patients to fast from liquids for a mean of 4.30 hours (SD 4.31), while the responses ranged from one hour to 18 hours.

4.2.4.4 Postoperative resumption of feeding

The practice that was least complied with was that which related to the progression of patients to a full oral diet post-surgery, with 91% (n = 20) of dietitians, surgeons and anaesthetists reporting non-compliance with the guidelines (Table 4.6). Practices varied between participants, but the majority of 55% (n = 12) recommended that patients start on a clear fluid diet before transitioning slowly to a full oral diet.

The majority (75%) of dietitians, surgeons and anaesthetists answered in line with the guidelines that they would advise their patients to wait between four and 24 hours before eating after surgery (Table 4.6). Participants reported advising patients to fast for a mean of 8.29 hours (SD 7.08) and a median of six hours postoperatively but responses ranged between 0 and 24 hours.

The majority (80%) of dietitians, surgeons and anaesthetists responses were not compliant with the guideline pertaining to the minimum amount of time a patient should fast after surgery

(Table 4.6). Responses ranged between 0 and 12 hours with a mean minimum fasting time of 5.2 hours (SD 3.72) and median of four being recommended.

The majority (54%) of dietitians, surgeons and anaesthetists responses were not compliant with the guidelines pertaining to the maximum amount of time a patient should fast after surgery (Table 4.6). Responses ranged between two and 48 hours with a mean maximum fasting time of 18.83 hours (SD 12.29) and a median of 24 hours.

4.2.4.5 Sub-group analyses

a) Reported practices versus ERAS guidelines

i) Preoperative fasting times

Participants reported advising patients to fast from solids for a mean of 9.59 hours (SD 5.69), this differed significantly from the ERAS guideline of six hours (t-test, $p = 0.003$).

Patients were advised to fast from liquids for a mean of 4.30 hours (SD 4.31), this differed significantly from the ERAS guideline of two hours (t-test, $p = 0.010$).

Therefore, for HCP-reported practices regarding preoperative fasting times, the hypothesis that the practices did not differ significantly from the guidelines can be rejected.

ii) Postoperative resumption of feeding

Participants reported advising patients to fast postoperatively for a mean minimum of 5.2 hours (SD 3.72) and a maximum of 18.83 hours (SD 12.29). These practices did not differ significantly from the ERAS guidelines of four hours (t-test, $p = 0.125$) and 24 hours (t-test, $p = 0.052$) respectively.

iii) Other

Although hypothesis testing was not possible for the remaining practices, none of the other practices were being implemented 100% according to the ERAS guidelines, and therefore reported practices differed from the guidelines.

iv) Differences in practice scores based on gender

Female participants reported significantly greater compliance with the guideline pertaining to appropriate referrals to dietitians for preoperative nutrition support (chi-square (df = 1), = 12.66, $p < 0.001$) with 70% (n = 28) of female participants reporting compliance, as opposed to 10% (n = 1) of male participants.

Gender did not have a significant effect on any other of the practice scores.

v) Differences in practice scores based on training received

Those participants who had received training regarding the ERAS guidelines were significantly more compliant with the guideline pertaining to the maximum amount of time a patient should fast after surgery (chi-square(df = 1), = 5.19, p = 0.023), with 100% (n = 3) of those who had received training reporting practicing compliance.

Having received training regarding the ERAS guidelines was associated with significantly higher compliance or intention to comply with the guideline pertaining to preoperative carbohydrate loading (chi-square(df = 1), = 13.64, p < 0.001), with 100% (n = 5) of those who had received training reporting compliance with this guideline.

Training did not have a significant effect on any of the other practice scores.

b) Differences in practice scores based on literature read

Those who had read literature or attended a talk regarding ERAS were significantly more compliant with the guidelines pertaining to preoperative fasting from liquids (chi-square (df = 1) = 6.24, p = .012), with 82% (n = 14) of those who had read literature or attended a talk reporting compliance with this guideline.

Having attended a talk or read literature regarding ERAS was associated with significantly lower compliance or intention to comply with the guideline pertaining to appropriate referrals to dietitians for preoperative nutrition support (chi-square(df = 1), = 5.51, p = .019), with 62% (n = 13) of those who had read literature or attended a talk reporting lack of compliance.

Having read literature or attended a talk regarding the ERAS guidelines was associated with significantly higher compliance or intention to comply with the guideline pertaining to preoperative carbohydrate loading (chi-square (df = 1), = 5.27, p = 0.022), with 48% (n = 10) of those who had read literature reporting compliance with this guideline, as opposed to 18% (n = 6) who had not read literature.

Reading literature or attending a talk regarding ERAS did not have a significant effect on any of the other practice scores

c) Differences in practice scores based on experience

Dietitians, anaesthetists and surgeons who had been working with colorectal surgery patients for longer were significantly more likely to report compliance with the guideline pertaining to preoperative fasting from solids (Mann-Whitney U, p = 0.04), with the mean time working with colorectal surgery patients of those reporting compliance at 9.57 years as opposed to 3.1 years in those reporting non-compliance.

Dietitians, anaesthetists and surgeons with more experience in their field were significantly more likely to not follow the guideline pertaining to the maximum amount of time a patient should be kept fasted after surgery (Mann-Whitney U, P = 0.03), with the mean experience of those reporting non-compliance at 10.3 years as opposed to 4.7 years in those reporting to follow the guideline.

Dietitians, anaesthetists and surgeons with more experience in their field and with more experience working with colorectal surgery patients were significantly more likely to report following the guideline pertaining to nutritional screening of patients preoperatively (Mann-Whitney U, p = 0.03), with the mean experience of those reporting compliance at 11.15 years and the mean experience with colorectal surgery patients at 13.3 years as opposed to 5.3 years and 6.7 respectively in those reporting not following the guideline.

Experience did not have a significant effect on any of the other practice scores.

d) Differences in practice scores based on age

Age did not significantly affect the practice scores of participants.

4.2.5 Knowledge versus practices

Those participants who answered correctly regarding how long patients should be kept fasted from solids and liquids prior to surgery were significantly more likely to report complying or intending to comply with these practices for solids (chi-square test, p = 0.011) and liquids (chi-square test, p < 0.001) respectively, with 73% (n = 11) and 81% (n = 17) of those who answered correctly reporting compliance with these practices.

Those participants who answered incorrectly regarding the recommended minimum and maximum amounts of time patients should be kept fasted after surgery were significantly more likely to report non-compliance with these practices for minimum (chi-square test, p < 0.001) and maximum (chi-square test, p = 0.03) times respectively, with 100% (n = 16) and 80% (n = 8) of those who answered incorrectly reporting non-compliance with these practices

Participants who answered incorrectly regarding how to progress patients to full oral feeds after surgery were significantly more likely to report non-compliance with this practice (chi-square test, p = 0.025), with 100% (n = 15) of those who answered incorrectly reporting non-compliance with this practice.

Participants who knew that patients should be referred to a dietitian if they are malnourished prior to surgery were less likely to report this being done in practice (chi-square test,

p = 0.005), with 54% (n = 19) of those who answered correctly reporting non-compliance with this practice.

4.2.6 Observed versus reported practices

Practices, as reported by HCP participants, were evaluated using a self-administered questionnaire, with a total of seven practices being assessed, representing each of the four nutrition-related ERAS guidelines. The practices evaluated differed between each discipline, with only practices applicable to the role of each discipline of HCP being evaluated. Practices relating to referral to dietitians for nutrition support were evaluated for all HCP disciplines, with dietitians being asked whether or not they are referred to and the other disciplines being asked whether or not they do refer. As previously stated, in cases where study participants were not in the position to implement a specific guideline, participants were instructed to answer in terms of what they would do in should they be afforded the opportunity to do so. Therefore, practice scores should be interpreted as the intention to implement a specific guideline and not necessarily the extent to which a guideline is actually being implemented.

Implementation of the same seven practices was assessed for each patient via observation using an observational checklist and for each HCP via an interviewer-administered questionnaire. Therefore, the same practices were tested in two different study populations and using two different methods. Each practice was scored according to whether the relevant ERAS guideline was complied with or not. Non-compliance with the guideline was given a score of zero and compliance with the guideline was given a score of one. Scores for each guideline were then tallied and percentages calculated. The scores for both methods of evaluating practices in the two different study populations can be seen below (Table 4.7).

Table 4.7: Comparison between HCP reported practices and researcher observed practices

		Compliance with ERAS guidelines:	
	Relevant ERAS guideline	**Observed practices**	**HCP reported practices**
Optimisation of preoperative nutritional status	Weighing of patients on admission	70%	73%
	Screening for malnutrition on admission	0%	42%
	Appropriate referral to dietitian for preoperative nutrition support	0%	58%
Preoperative carbohydrate drink	Preoperative carbohydrate drink	0%	29%
Perioperative fasting times	Recommended preoperative fasting from solids	0%	52%
	Recommended preoperative fasting from liquids	0%	63%
Postoperative resumption of feeding	Recommended postoperative fasting time (n = 30)	73%	75%

All HCP categories

Only nurses

Dietitians, surgeons and anaesthetists

For the guidelines pertaining to weighing of patients on admission and postoperative fasting times of patients, rates of compliance with ERAS guidelines as reported by HCPs were comparable with those observed by the researcher (Table 4.7).

The remaining guidelines were not being implemented at all in practice, based on objective observations, whereas, compliance based on HCP self-reporting ranged between 29% and 63% (Table 4.7). However, as previously stated, HCPs were requested to indicate what they would do should they be afforded the opportunity to do so, so the discrepancy between reported and observed practices may indicate the reported intention to practice a specific guideline in the absence of opportunity to do so in practice.

4.2.7 Perceived barriers

HCP participants were asked to indicate in an open-ended question what they perceived to be the barriers to the implementation of the ERAS guidelines at their facility. Responses were analysed qualitatively and organised according to themes. Table 4.8 below shows the number of responses per participant category relating to each theme. Therefore, it was possible for there to be more than one response per participant and one response could relate to more than one theme.

Table 4.8: Perceived barriers to implementation of ERAS

Barrier	Nurses	Dietitians	Anaesthetists	Surgeons	Total
Unpredictability of surgery schedule	2	1	4	1	**8**
Lack of staff training/knowledge/education/awareness	6	3	8	1	**18**
Human resource constraints/increased workload	3	4	5	1	**13**
Financial/resource constraints	1	3	6	0	**10**
Lack of protocol/standardised hospital policy	2	1	2	0	**5**
Lack of co-operation of multidisciplinary team	8	5	3	3	**19**
Resistance to change/negative attitude towards ERAS	2	2	7	1	**12**
Fear of negative GI side effects	2	0	0	1	**3**
Lack of preoperative referrals/screening	0	3	0	0	**3**
Logistical barriers: kitchen opening hours and computer ordering system	2	0	0	0	**2**
Other	1	1	4	0	**5**
Total	**29**	**23**	**39**	**8**	**96**

The most common perceived barriers to the implementation of the ERAS perioperative nutrition guidelines were the lack of co-operation of the multi-disciplinary team and the lack of staff training/awareness regarding ERAS (Table 4.8). Participants felt that getting the entire multidisciplinary team on board, working together as a team and agreeing on decisions regarding patient care would be a challenge:

> *"The challenge will be to get all involved on board including dietitians, physio, surgeons, nurses, ICU staff, anaesthetists."* (Participant 57, GIT surgeon consultant)

Some participants felt that certain disciplines within the multi-disciplinary team would not co-operate with the implementation of the guidelines, with doctors, anaesthetists and surgeons being mentioned as barriers to implementation by various disciplines. Furthermore, some felt that they were not involved in making decisions regarding the feeding of patients. Nurses felt that they are not given responsibility to make decisions regarding the feeding of patients and that doctors and/or dietitians are usually responsible for such decisions. In addition, some felt that lack of agreement between the various members of the multidisciplinary team concerning patient feeding was a barrier:

> *"Nursing personnel are not very involved with the patient's diet. Follow doctors' orders. Patients go to the ICU postoperatively. Dietitians together with doctors make decisions about the patient's diet postoperatively."* (Participant 30, professional nurse)

Participants expressed that training of all members of the multi-disciplinary team with regards to ERAS would be important for successful implementation. Lack of familiarity, awareness, knowledge, training and understanding of the guidelines were seen as barriers to implementation.

> *"Not everyone went for training. People don't know about ERAS. E.g. if you would train more people, things will be easy giving everyone will know about ERAS and know the guidelines."* (Participant 3, professional nurse)

Beyond an awareness of the ERAS guidelines, one participant felt that creating an awareness of the importance of nutrition amongst members of the multidisciplinary team was an important step to overcoming barriers to implementation.

Human resource constraints and concerns of increased workload were mentioned as a barrier to implementation. Specifically, a shortage of dietitians in the wards surveyed was felt to present a barrier to implementation of ERAS. Dietitians mentioned that there is only one dietitian covering the surgical wards and, as one nurse stated:

> *"On weekends there (are) too few dietitians on duty. The hospital should employ more."* (Participant 28, professional nurse)

In addition to the perceived increased need for dietitians with the implementation of ERAS, it was expressed that additional human resources may be needed to co-ordinate the implementation of ERAS and that the need for extra patient monitoring may add to the workload for staff. One participant also felt that there were not enough nursing staff to administer the preoperative carbohydrate loading drink to patients and another suggested that a lack of kitchen staff at night may interfere with the delivery of meals,

> *"Kitchen staffing problems: kitchen is closed at night".* (Participant 20, professional nurse)

Participants expressed that resistance to change was a barrier to implementing ERAS and that inertia of current practice and fears of changing practices could prevent the implementation of new practices. Participants mentioned, "tradition", "changing the mindset" and conservative attitudes as barriers to implementing ERAS,

> *"Also I think most surgeons have a conservative mindset with regard to post-op feeding and mobilisation. Perhaps a dedicated ERAS course would help."* (Participant 56, GIT surgeon consultant)

Financial resource constraints were also viewed as a barrier, particularly with regards to the purchasing of specialised nutrition products for preoperative carbohydrate loading and the need for efficient transport of patients back to the hospital in the event of complications post early discharge. One participant recognised that financial output would be needed initially but in the long term financial resources would be spared with the reduced LOHS:

> *"Cost initially (should save with decreased LOS)".* (Participant 45, anaesthesiology consultant)

Others felt that the nature of the new, more complex fasting instructions may lead to confusion and misinterpretation by ward staff and/or patients and communication of such instructions may be difficult considering the language barriers that often exist between patients and staff. Concern was expressed that if a patient was allowed to receive fluids prior to surgery, ward staff may think the patient is allowed to eat and may serve him/her a meal:

> *"Confusion – if a patients is allowed a drink/there is seen to be food with the patient – patient may receive solid foods. Language barrier: it's easier just to say 'Don't eat'".* (Participant 50, anaesthesiology consultant)

Some participants also expressed concern that the socioeconomic status of the patient population would be problematic for the implementation of ERAS guidelines. Some anaesthetists mentioned that the general health of the patient population is poor and that access to balanced nutrition is limited.

CHAPTER 5: DISCUSSION

Research has shown that many traditional perioperative nutrition practices are based on scant evidence, do not prevent complications and in fact, may be detrimental to patients' recovery. In addition, many studies have shown the beneficial effects of reduced pre- and postoperative fasting times as well as other perioperative nutritional interventions. However in practice, change away from traditional practices towards these evidence-based best practices has been shown to be slow. The findings of this study confirm that traditional perioperative nutritional practices are still being practiced to varying degrees in a tertiary academic hospital in South Africa and that current implementation of ERAS perioperative nutrition guidelines is poor.

5.1 NUTRITIONAL STATUS OF PATIENT PARTICIPANTS

Rates of hospital malnutrition in the literature range between 20–50%, with gastrointestinal surgery patients having higher rates of malnutrition, ranging between 55–66%.[17–19] Therefore, the 27% prevalence of nutrition risk in this study population was relatively low, bearing similarities with those of hospitalised patients in developed countries. However, due to the small sample size this may not be reflective of the entire patient population this sample represents.

Hospital malnutrition is usually multifactorial, with disease-related factors playing a major role in the aetiology of malnutrition.[2,17] Therefore, the relatively low rate of hospital malnutrition found in this study may simply be due to the diagnoses of the patients sampled, with those sampled not being in the acute phases of disease or not having advanced stage disease. This is confirmed by the fact that most study patients (60%) were admitted for stoma reversals, which usually take place a few months after the initial disease- or trauma-related resection once the patient has recovered well. A study on 490 major abdominal surgery patients in an American hospital found that 20% of patients undergoing intestinal resection or stoma closure and 18.6% of colectomy patients were malnourished, bearing similarities with the rates of hospital malnutrition found in our study population.[94]

The mean BMI of both male and female participants was almost exactly the same as that reported in the South African Demographic and Health Survey of 2002 in the age range of 45 to 54 years (which encompasses the mean age of participants in this study).[95] This further indicates that the nutritional status of study participants is comparable to that of the general

healthy population and disease-related factors, which are known to increase risk for poor nutritional status, may not have been significant in this population.

Despite this finding, almost a third of the study population stood to benefit from nutrition optimisation prior to surgery; however no nutritional risk screening tool was available, no patients were screened for nutritional risk, and none were referred to a dietitian for preoperative nutritional support.

There was a significant difference between mean total weight and BMI from the pre- to the postoperative period and 20% of participants experienced clinically significant weight loss of more than 5% of their preoperative weight. Males tended to have a lower BMI and tended to lose more weight than females. Additionally, the decrease in BMI from the pre- to the postoperative period was only significant for males once the results were stratified for gender. The South African demographic and health survey of 2002 reported similar differences in baseline BMI between males and females.[95] This could indicate that male patients in the South African context are at greater risk of malnutrition and of deterioration in nutritional status through the perioperative period.

Although patient participants experienced a mean loss of 1.85 kg (SD 3.55) between the pre- and postoperative periods, some participants gained up to 3.5 kg, with one participant moving from the overweight BMI category into the obese BMI category. In addition, there was no significant relationship between preoperative fasting periods and weight changes, although there tended to be a very weak negative relationship indicating that longer fasting times may be related to less weight loss. This could be due to coincidence or water and sodium retention, which are a common feature of the stress response to surgery and which may be exacerbated by excessive IV fluid administration and excessive fasting in a non-ERAS setting.[38] However, it is uncertain whether the changes in weight were caused by shifts in fluid volumes, adipose stores, or lean body mass as additional body composition measurements were not performed.

5.2 IMPLEMENTATION OF ERAS GUIDELINES AND BARRIERS TO IMPLEMENTATION

Although ERAS guidelines had not been formally adopted by the hospital at the time of data collection, implementation of the guidelines were assessed in order to obtain data on current perioperative nutritional practices in the hospital. This was done via two different methods: one being through observation of patient participants and the second being through a self-administered questionnaire to HCP participants. The second method is less reliable due to possible biases in the self-reported nature of the questionnaire; however the phrasing of the questions allowed an insight into HCP intended behaviours rather than actual behaviours,

thereby giving a good indication of provider intent as a barrier or enabler to implementation of the guidelines.

Since knowledge and attitudes directly influence provider intent according to Heyland *et al.'s* proposed framework for understanding the barriers to implementing perioperative nutrition guidelines; knowledge, attitudes and provider intent for each guideline are discussed together in order to make inferences about context-specific barriers in order to guide future interventions.[14]

Weighing of patients by the nurse on admission was executed in the majority (70%) of patients and this corresponded well with nurses' reported compliance (73%), possibly indicating that in the case of weighing patients on admission, there are few system barriers impeding nurses who intend to weigh patients. Indeed, since nurses are given the sole responsibility for implementing this practice, they do not have to rely on co-operation of other members of the multidisciplinary team. In addition, scales are widely available in the study hospital, with a scale available in each ward. Patients are usually weighed by a nurse as part of the admissions process on a mechanical beam scale, which is present in the admissions room. Therefore, weighing of patients on admission to hospital is a standard procedure and is not ERAS–specific, which may be the reason for the high compliance with this guideline, despite poor exposure to ERAS principles.

The rate of compliance with this guideline is higher than that reported in other developing healthcare systems, for example the multicentre ELAN study in Latin America, which found that only 26.5% of patients were weighed on admission to hospital.[96] However, the lack of ability to translate the findings of the weight measurement into appropriate action steps leading to nutrition support of at risk patients makes the exercise of weighing patients on admission an almost futile practice.

Only 28% of HCPs from all disciplines knew that patients should be screened for nutritional risk, while 42% of dietitians, surgeons and anaesthetists claimed that they screened or intended to screen patients for malnutrition on admission. Knowledge scores for this guideline may be lower than provider intent due to nurses being included in the knowledge questionnaire and not in the practice question. Indeed, when nurses were excluded from the knowledge questionnaire, 55% of dietitians, surgeons and anaesthetists knew that patients should be screened for nutritional risk. Experience with colorectal surgery patients and discipline-specific experience were associated with enhanced reported compliance with this guideline.

The majority (71%) of all HCPs knew that patients should be referred to a dietitian prior to surgery if found to be nutritionally at risk but only 58% claimed to do so in practice. Females were significantly more likely to indicate compliance or intent to comply with this practice, with only one male HCP reporting compliance. This may simply be due to coincidence or the fact that most nurses and dietitians are female and these disciplines would be more concerned with patients' nutritional status. Nevertheless, although knowledge regarding this guideline was good, this did not result in good compliance, indicating possible system barriers preventing implementation. Interestingly, having read literature or attending a lecture regarding ERAS and having greater knowledge with regards to the need to refer to a dietitian resulted in significantly lower compliance or intended compliance, indicating that knowledge did not translate into compliance or provider intent for this practice.

Nutritional screening of patients preoperatively is thought to be necessary in order to identify patients who would benefit from appropriate nutritional support and lack of identification of such patients is thought to result in a lack of appropriate nutritional support.[2,17,24,37] Therefore, the lack of referrals to a dietitian is most likely a direct consequence of the lack of nutritional risk screening in order to identify patients who require referrals.

Dietitian referrals require good communication between dietitians and other members of the multidisciplinary team and are essentially a function of the surgical team culture. Making a referral to a dietitian is an active process, requiring a phone call, a page or a written referral, all of which take time and effort on behalf of team members who already have a high work load. Therefore, a lack of communication or cohesiveness among dietitians and the rest of the multidisciplinary team as well as a lack of a referral culture may present further system barriers to the implementation of this guideline. Indeed, team-based clinics which allow for enhanced collaboration and relationship development amongst the multidisciplinary team have been shown to have higher rates of dietitian referrals than other clinical settings.[97] In addition, dietitians mentioned a lack of referrals and nutritional risk screening as a barrier to the implementation of the guidelines in the qualitative assessment.

Attitudes regarding preoperative nutrition optimisation were generally positive with the majority of HCPs from all disciplines agreeing that good nutritional status prior to surgery is important for recovery. In addition, all dietitians, surgeons and anaesthetists agreed that improving nutritional status prior to surgery improves outcomes and that pre-surgical nutritional status impacts recovery, therefore showing good awareness of the impact of nutritional status on recovery. Younger dietitians, surgeons and anaesthetists were significantly more likely to strongly agree that improving nutritional status before surgery improves outcomes, indicating that younger HCPs may have greater awareness of the importance of nutrition in recovery.

This is most likely due to increased exposure to this topic, indicating that perhaps younger HCPs who qualified more recently have had more education regarding the latest guidelines and increased exposure to the recent literature through their studies.

Patients also displayed good awareness of the impact of their nutritional status on recovery, with 77% agreeing that their nutrition prior to surgery and 90% agreeing their nutrition after surgery will affect their recovery. The researcher noted that in general, patients found it easier to associate their postoperative nutrition with recovery as they perceived nutrition or eating as being important for their energy, mood and bowel movements, which were all self-determined end-points for their recovery. One patient noted that eating was important to stimulate bowel movements so that they could be discharged. On the other hand, the impact of preoperative nutrition on recovery is less direct and was, therefore, harder to conceptualise. However, upon pondering it most patients felt that it would be important for their recovery.

Preoperative fasting instructions largely resembled those of traditional fasting practices described in the literature with orders to remain NPO from midnight or from 22h00 accounting for 97% of the fasting instructions given and no distinctions being made between fasting from solids and liquids. Cestonara *et al*. found that the above fasting instructions were given to a total of 66% of patients in a public hospital in Brazil, while the remainder received no fasting instruction or were instructed to start fasting after dinner, all with no distinction being made between solids and liquids.[4] Although these orders do not specify absolute fasting times, it could be assumed that fasting from midnight or 22h00 would result in an eight to ten hour fast for patients who are first on the theatre list for the day.

None of the patient participants fasted from solids or liquids for the amount of time recommended by the ERAS guidelines, while a recent study in a hospital in Portugal who had adopted an ERAS protocol reported a compliance rate of 59% with the recommendations for fasting from clear fluids.[76] Cestonara *et al.* reported a median preoperative fasting time from solids and liquids of 16.5 hours and 15.75 hours respectively, while Shime *et al.* reported a median of 12–13 hours for solids and six to nine hours for liquids.[4,41] Therefore, while long preoperative fasting is common, this study showed particularly long fasting times, specifically with regards to fasting from solids, with a median of 16.8 hours. In addition, a 16.8 hour fast is almost double that ordered by doctors if the order of fasting from midnight is extrapolated to indicate an eight-hour fast. This is thought to be due to the early supper time instituted in the hospital, which means that many patients have their last meal at 17h00. Furthermore, patients are rarely the first on the theatre list meaning that their surgery may only take place in the afternoon. Although fasting times for liquids were slightly shorter, with a median of 13.8 hours, 90% of patients consumed tea, coffee or water as their last beverage prior to surgery, all of

which contain little to no calories and insufficient carbohydrates to blunt the metabolic response to fasting.[63]

Cestonara *et al.* reported that 40% of patients experienced more than one fasting period due to delayed surgeries.[4] In our study, 20% of patients experienced delayed surgeries, which accounted for an additional 20.86 hours fasted per patient for each delay.

Knowledge of all HCP disciplines regarding preoperative fasting times was poor with only 43% and 45% knowing the recommended amount of time patients should be kept fasted from fluids and solids respectively, while 52% and 63% of dietitians, surgeons and anaesthetists reported complying or intending to comply with solid and fluid fasting guidelines, respectively. The fact that provider-intended compliance was higher than the knowledge scores may be due to the fact that nurses tended to score lower in the knowledge questionnaire than other HCP disciplines and were not included in the provider-intended question for this practice but were included in the knowledge question. Better knowledge regarding preoperative fasting was associated with increased compliance or intention to comply with the preoperative fasting guidelines. Having read literature or attending a lecture was associated with enhanced intention to comply with the fasting guidelines for clear fluids, while having more experience working with colorectal surgery patients was associated with enhanced intentions to comply with the fasting guidelines for solids. Therefore, knowledge, self-education and experience all positively affected provider intent for this guideline.

Dietitians, surgeons and anaesthetists reported advising patients to fast from solids and fluids for a mean of 9.59 hours (SD 4.6) and 4.3 (SD 4.31) hours respectively, with these means differing significantly from the ERAS guideline of six hours and two hours respectively. Therefore, although significantly different from the ERAS guidelines, HCP-intended compliance was a lot higher than observed compliance, indicating possible system barriers for HCPs intending to implement evidence-based fasting guidelines.

On assessment of the attitude questionnaire, poor outcome expectancy does not seem to be a barrier to provider intent. The majority of HCPs disagreed that ERAS guidelines regarding preoperative fasting are dangerous and that they do not affect recovery. The majority of all HCP disciplines agreed that fasting for too long negatively impacts recovery. This is in line with Shime *et al.'s* study that found that only 5% of anaesthetists perceived there to be no benefit to the patient in implementing novel fasting guidelines.[41] However, further analysis revealed that nurses and those who had not attended a lecture or read literature regarding ERAS were significantly more likely than other HCPs to agree that feeding patients sooner than 12 hours prior to surgery is dangerous. This indicates that nurses' poor outcome

expectancy may be a knowledge-related barrier to implementing this guideline as nurses and those who had not attended a talk or read literature scored significantly lower on the knowledge questionnaire. In addition, HCPs with more experience in their field were significantly more likely to strongly agree that preoperative fasting time doesn't affect recovery. This could reflect a lack of awareness regarding the role of nutrition in surgical recovery in those with more experience in their fields, suggesting that older HCPs may not have been exposed to ERAS principles during their training or university curricula or may have become complacent in staying abreast of the latest literature.

Patient characteristics and guideline characteristics were not highlighted as a barrier, with the majority of dietitians, surgeons and anaesthetists disagreeing that the fasting guidelines do not consider the individual patient and that there is not enough evidence to support reducing perioperative fasting times. Those who had attended a lecture or read literature regarding ERAS were significantly more likely to disagree that there is not enough evidence to support reducing perioperative fasting times, indicating that awareness and knowledge play a role in informing this attitude. Kahoekehr *et al*. also found that guideline characteristics were not a major barrier with only 9% of surgeons not implementing the ERAS guidelines due to perceived lack of evidence; however in Pearsall *et al.'s* study respondents felt that early feeding guidelines are dependent on the patient population.[86,87]

The majority (86%) of all HCP disciplines agreed that fasting times of patients are not always within their control, indicating a lack of self-efficacy informing provider intent with regards to the implementation of this guideline. On further analysis, it was revealed that nurses were more likely to disagree that fasting times are not within their control while all dietitians, surgeons and anaesthetists agreed that fasting times were not always within their control. In addition, those who had attended a lecture or read literature regarding ERAS were significantly more likely to agree with this statement. The higher self-efficacy in nurses is most likely due to the fact that they are present at meal times and have greater active control over when and what patients are fed, whereas dietitians, surgeons and anaesthetists have to rely on passive orders which are carried out in their absence.

It was clear that surgical team culture may also present a system barrier to implementation of ERAS perioperative fasting guidelines. The majority of nurses and dietitians indicated that they leave the decisions about perioperative fasting times up to the patient's doctor and that they follow doctor's orders in the file to see how long to keep a patient fasted before and after surgery; however the majority also indicated that the doctor is not always correct about how long to keep patients fasted before and after surgery. In the qualitative assessment nurses reported that they were not included in the decisions regarding patient feeding. This indicates

a possible hierarchy or power dynamic whereby nurses and dietitians obey doctors' orders even if they do not agree with them and decisions regarding patient care follow a top-down approach as opposed to a collaborative approach. This power dynamic has been documented in other South African health care settings.[98]

While most patients were happy about the amount of time they fasted from liquids and solids, 47% and 40% indicated that they were unhappy or very unhappy about the amount of time they fasted from liquids and solids respectively. The amount of time fasted did not affect patient experiences. This was also found in Cestonara *et al.'s* study in a Brazilian hospital where patient experience of hunger and thirst were not affected by the fasting period.[4] The fact that more patients expressed unhappiness with the amount of time fasted from liquids as opposed to solids was most likely due to the discomfort of thirst and dry mouth. However, some patients were hesitant to complain about their hospital experience due to not wanting to be perceived as ungrateful or due to fear of negative consequences from the hospital staff, even after reassurance of confidentiality and anonymity. Some patients commented that they know they need to fast for their own safety and therefore don't mind.

Compliance with the preoperative carbohydrate loading guideline was poor with none of the participants receiving preoperative carbohydrate loading. In a multicentre study in Europe between 2001 and 2004 found that 75% of patients received preoperative carbohydrates, while a 2011 Swedish study reported a compliance rate of 50.3% for this guideline.[67,75] However, these studies were conducted in hospitals who had already adopted an ERAS protocol.

Although no patients received a preoperative carbohydrate loading drink, 29% of HCPs reported ordering or intending to order such a drink for their patients. This may indicate that although 29% of HCPs would order a carbohydrate drink for their patients if they were able to do so, the current system prevents them from doing so. One of these system barriers may be the lack of a formulated product currently available at the hospital, even though there is a product available on tender contract. Nevertheless, a provider intent of 29% is still low, pointing to the fact that knowledge, attitudes and provider characteristics, which all inform provider intent, may also be barriers to the implementation of this guideline. Indeed, knowledge scores for preoperative carbohydrate loading were poor, with only 33% of HCPs knowing when carbohydrate loading should be given and 31% knowing what type of carbohydrate loading product should be given. Both self-education and training regarding the ERAS guidelines were associated with greater intent to comply with carbohydrate loading guidelines.

Despite the lack of knowledge, the majority (68%) of HCPs agreed that preoperative carbohydrate loading aids in recovery, 79% agreed that it helps the patient psychologically to feel less hungry and 74% disagreed that it doesn't influence recovery. This indicates that although knowledge regarding this subject was poor, the majority of HCPs displayed positive attitudes towards the beneficial effects of this intervention, therefore the primary reason for the lack of provider intent is most likely a lack of knowledge regarding the guideline and not a negative attitude. Indeed, HCPs who had attended a lecture or read literature regarding ERAS were significantly more likely to agree that a carbohydrate drink aids in recovery.

Contrary to the findings of Maessen *et al*. that compliance with the postoperative ERAS guidelines was the lowest, in this study the guideline for postoperative resumption of feeding was the guideline with the highest compliance, with 73% of patients being fed within 4–24 hours after surgery and 75% of HCPs reporting compliance or intended compliance with this guideline.[75] The reported compliance with this guideline in the ERAS setting ranges between 57.5% up to 84.3% in some studies.[67,75,76] The median postoperative fasting time of 15.83 hours was similar to that of 15.67 hours found by Cestonara *et al.* in a Brazilian hospital.[4]

Although dietitians, surgeons and anaesthetists reported that they would advise patients to fast for a median of six hours after surgery, the majority (69%) of doctor's orders did not specify the time at which feeding should commence, while only 14% correctly specified feeding on the day of surgery. Only 26% and 40% of HCP participants knew the recommended minimum (four hours) and maximum (24 hours) postoperative fasting times of patients, respectively. Those who had knowledge regarding recommended postoperative times, as well as those who had received training regarding the ERAS guidelines and those who had more experience in their field were more likely to report compliance with this guideline. This indicates that although HCP knowledge regarding this guideline is poor and doctor's orders for postoperative resumption of feeding do not necessarily specify postoperative feeding within the recommendations of the ERAS guidelines, provider intent and implementation of this guideline are comparable. This could mean that system barriers do not impede the implementation of this guideline and that doctor's orders do not necessarily determine postoperative fasting time. This is confirmed by the fact that all surgeons and anaesthetists claimed that they do not always have control over how long patients are fasted for. It is most likely that feeding of patients within 24 hours after surgery is an accepted institutional practice, as was found in Brazil and most probably driven by nurses' established postoperative care practices.[4]

Although the majority (71%) of HCPs agreed that eating as soon as possible after surgery optimises recovery, the majority (72%) still felt that eating too soon after surgery will result in complications and that bowel sounds indicate readiness to tolerate oral nutrition. Listening for

the return of bowel sounds is a practice which began around 1905 with the belief that bowel sounds indicate return of GIT motility following abdominal surgery.[99] This practice persists to this day in many surgical departments around the world.[14,36,37,99] In fact, early postoperative bowel sounds indicate uncoordinated contractions of the small intestine, which regains motility within 4–24 hours post-surgery and does not reflect the return of normal GIT motility which can take up to seven days post-surgery.[99] Despite the delayed return of full GIT motility postoperatively, early feeding (within 4–24 hours postoperatively) has been shown to be well tolerated and safe and return of bowel sounds are not associated with the ability to tolerate oral feeding.[34,99] These persistent beliefs could be a result of lack of knowledge and may present a barrier to implementation of this guideline. On further investigation, it was found that surgeons were significantly more likely to disagree that eating too soon after surgery results in complications, indicating that enhanced knowledge may positively influence this belief.

In addition, all but one participant received their first feed via the oral route and the remaining via the nasogastric route; however this was due to inability to feed orally. All doctors' orders prescribed oral feeds as the first postoperative feed, indicating that oral feeding is used as a first option in the study hospital and nasogastric tubes are not routinely placed during surgery. This is in contrast to other hospitals without an ERAS protocol, where nasogastric tubes are placed routinely and left in place for 1-5 days post surgery.[36]

Despite relatively good compliance with early feeding of patients via the oral route, advancement of feeds to a full oral diet was still in line with traditional practices, with 69% of participating patients' doctors prescribing liquids and 90% of patient participants receiving liquids as their first oral feed post-operatively. In addition, only 9% of HCPs reported compliance or intent to comply with this practice, making this the practice with the lowest reported compliance and the majority (55%) of HCPs indicated that they advise a slow progression to a full oral diet starting with clear fluids. This guideline also scored the lowest on the knowledge questionnaire, with only 12% of HCPs knowing that patients can go straight to a full oral diet and 71% of HCPs thinking that patients should be transitioned slowly to a full oral diet starting with water or clear fluids and then progressing to full fluids, puree foods, soft foods and finally solids. All HCPs who answered incorrectly reported non-compliance with this guideline. Therefore, knowledge had an important influence on provider intent.

Although 70% of HCPs disagreed that the post-operative feeding guidelines are not careful enough, 71% felt that transitioning slowly to a full oral diet prevents complications. This belief, along with poor knowledge regarding this guideline, were most likely contributors to the lack of provider intent. On further analysis it was found that all surgeons disagreed that transitioning slowly to a full oral diet prevents complications and their attitude regarding this differed

significantly from the other disciplines. Once again, this indicates that enhanced knowledge would positively affect beliefs of poor outcome expectancy.

Most patients (53%) indicated that they were unhappy or very unhappy about the amount of time they had to fast after surgery. Patients expressed more discontent regarding post-operative fasting times as opposed to preoperative fasting times, most likely due to the fact that patients understood that preoperative fasting was important for their safety and were therefore willing to comply. However, they deemed their post-operative nutrition as important for their recovery and had been given no explanation of why post-operative fasting was imposed on them. This could indicate that patients would be compliant with ERAS postoperative feeding guidelines and willing to eat soon after surgery; however, it is uncertain whether patients would feel pressurised to eat too much too soon as was found by Pearsall *et al.* in 2016.[80]

5.3 KNOWLEDGE

At the time of the study, no official training had been conducted in the hospital regarding the ERAS guidelines. Only 9% of HCPs claimed to have received official training regarding ERAS and 38% of HCPs reported to be self-educated regarding ERAS, either via having read literature or attending a lecture. The official training received by HCPs was mostly reported by anaesthetists as training incorporated into their university curriculum.

The mean knowledge score for all HCP disciplines was poor at 36% (SD 27.7, n = 58). Whilst there is no available literature testing the knowledge of HCPs regarding the ERAS guidelines, lack of awareness of novel fasting guidelines have been reported to be between 13 and 16% in HCPs.[40,41]

Knowledge scores increased as HCP qualifications increased, with nurses having the lowest knowledge scores with a mean of 18% and surgeons having the highest with a mean of 78%. While level of qualification may play a role, exposure to the ERAS guidelines differs between professions and this seems to be a factor in determining knowledge. The ERAS guidelines themselves were published in the World Journal of Surgery and research informing the guidelines has tended to focus on fast-track surgery, specifically in colorectal surgical patients, therefore surgeons specialising in GIT surgery will be more likely to have been exposed to ERAS and fast-track surgery concepts in the literature and through conference attendance. Indeed, all surgeons included in the study had attended lectures or read literature regarding the ERAS guidelines. In addition, since the ERAS guidelines include a range of guidelines for intra-operative anaesthesia and perioperative pain management and are endorsed by IASMEN, anaesthetists are also more likely to have come across the ERAS guidelines or

research regarding fast-track surgery principles as this is pertinent to their daily practice. Indeed, 70% of anaesthetists included in the study had been exposed to the ERAS guidelines through attending lectures or reading literature.

Nurses would be unlikely to be exposed to enhanced recovery principles within their practice without having received specific training. This is reflected in the fact that only 14% of nurses had been exposed to the ERAS guidelines through lecture attendance or literature. Dietitians would most likely come across the nutritional principles of ERAS in their university curriculum if they were recently qualified or perhaps if they practice in surgical wards or have an interest in surgical nutrition. Although only one dietitian in this study was assigned to service the GIT surgical wards, all dietitians do weekend work in the surgical wards and ICU and therefore may have been exposed to ERAS principles too. On examination, 38% of dietitians claimed to have been exposed to ERAS guidelines through literature or attending lectures.

Therefore, it seems that the main determinant of knowledge scores is the exposure of HCPs to the ERAS concepts through attending a lecture or reading literature. Indeed, having attended a lecture or read literature regarding ERAS resulted in significantly higher knowledge scores, with a mean knowledge score of 60.3% in those who had attended a lecture or read literature regarding ERAS. Interestingly, having received training regarding the ERAS guidelines did not result in better knowledge scores. This is most likely due to the fact that those trained were mostly anaesthetists so the training most likely focused on the anaesthesiology-related guidelines and not the nutrition-related guidelines. Additionally, age and experience showed a significant negative relationship with knowledge, suggesting that older or more experienced HCPs may not have been exposed to ERAS principles during their training or university curricula or may have become complacent in staying abreast of the latest literature.

5.4 ATTITUDES

General attitudes of HCPs regarding the ERAS perioperative nutrition guidelines did not point to any obvious barriers in relation to poor outcome expectancy, with 88% of dietitians, surgeons and anaesthetists disagreeing that they are nervous to follow the guidelines due to the possibility of adverse outcomes. In addition, 85% of all HCP disciplines indicated that they disagreed that the ERAS guidelines are not practical in their setting and apply more to a developed healthcare setting, indicating that system barriers or characteristics of the guidelines are not perceived as a major barrier to implementation.

Certain studies have pointed to nurses as a barrier to implementation of ERAS and novel fasting guidelines. In particular, lack of nursing staff time and nursing culture have been

mentioned as barriers by Pearsall *et al.* and Kahokehr *et al.*[86,87] However, 85% of nurses indicated that they disagree that they don't have time or are too busy to worry about their patients' nutrition and all nurses disagreed that they are not concerned with their patients nutritional intake. However, some HCPs did mention workload and lack of nursing staff as a barrier to implementation. Importantly, research has shown that although this is a common perceived barrier, nursing workload in fact decreases with ERAS implementation.[100]

The attitudes of dietitians regarding the ERAS guidelines have not been reported in the literature, however this study found that dietitians view themselves as being responsible for championing the cause of perioperative nutrition in the hospital, with all dietitians indicating that they are responsible for educating other members of the multidisciplinary team regarding perioperative nutrition, and 77% indicating that they play the biggest role in nutrition advocacy, while 85% felt it is not solely their responsibility to implement ERAS. This indicates that although dietitians feel strongly that they are responsible for championing this cause, they cannot do it alone and rely on co-operation and buy-in from the rest of the multidisciplinary team and the institution. This also highlights the importance of an ERAS team, comprising all relevant members of the multidisciplinary team, to help champion the ERAS cause.

5.5 BARRIERS AND RECOMMENDATIONS FOR OVERCOMING BARRIERS

Quantitative assessment of the barriers to implementing the specific guidelines highlighted lack of training and knowledge regarding the guidelines, lack of co-operation of the multidisciplinary team or negative surgical team culture and other system-specific barriers such as lack of a nutritional risk screening tool, lack of a carbohydrate loading product and the unpredictability of the surgery schedule as barriers.

Qualitative assessment of the barriers further confirmed and elaborated on these themes and revealed additional barriers to implementation.

The most commonly cited barrier was lack of co-operation of the multidisciplinary team, followed by lack of staff training and knowledge. ERAS guidelines are unique in that they are multidisciplinary and multimodal in nature, thereby relying on good cooperation and cohesiveness of all members of the multidisciplinary team in order for them to be implemented. This is regarded as the greatest risk of failure of ERAS programmes and the greatest challenge in implementing such programmes and therefore, great emphasis needs to be placed on strengthening multidisciplinary cooperation in order for the implementation of an ERAS programme to be successful.[57,77]

Negative organisational culture or surgical team culture and resistance to change were also a common system barrier mentioned and this was confirmed by some of the findings of the quantitative questionnaire. Doctors' attitudes, inertia, and the conservative mindset of surgeons were all mentioned as barriers.

Human resource constraints were the third most cited barrier to implementation. Constraints for human resources were mentioned in terms of increased workload on nurses; lack of sufficient dietitians, especially on weekends; lack of a dedicated ERAS champion or project coordinator; and kitchen staffing problems. Although nursing staff workload does not increase with the implementation of an ERAS programme, a plan will have to be made to ensure preoperative meals for patients even when the kitchen is not in operation.[100] In addition, early post-operative feeding of patients may be a challenge due to set meal times in the hospital that are often spaced far apart, meaning that patients may have to wait until the following meal time for their first post-operative meal. Each ward is equipped with a refrigerator and a microwave so meals can be sent up to the wards before closing time and reheated for patients when needed. Snacks for post-operative patients can be delivered each morning and kept on ward level or shelf stable snacks can be kept in the ward for longer periods of time. Most of the carbohydrate loading products are shelf stable until opened and can therefore be kept in the ward and administered by the nurses or dietitians without any involvement needed from the kitchen. The effect on workload of other staff members may need to be monitored but the following of a protocol by all members of the multidisciplinary team is thought to create more efficiency by streamlining processes.

Financial constraints were also cited as a barrier, however as one anaesthetist correctly noted, although there are costs involved in implementing an ERAS programme, implementation results in nett cost savings to the institution, and in this case the government.[16] Some dietitians were concerned with the cost of obtaining specialised feeds for preoperative carbohydrate loading, however, there are products available on government tender which are in line with the ERAS specifications and therefore can be ordered using the budget available to the hospital dietetics department for such feeds. The dietetics department budget is limited and may not allow for procurement of large amounts of preoperative carbohydrate loading drinks for all preoperative patients. This may mean that a separate multidisciplinary ERAS budget, which provides for the costs of preoperative carbohydrate loading products, needs to be instituted in order to precisely monitor the costs of ERAS programme implementation and the associated savings. Alternatively, the dietetics department budget could be increased to allow for procurement of such products, however this would detract from the multidisciplinary nature

of the intervention and would not allow for an accurate representation of ERAS costs and related savings to the entire hospital system.

The hospital did not have an official ERAS programme or perioperative feeding protocol in place at the time of the study. This was mentioned as an institutional barrier by HCPs. Indeed, a hospital policy would help to guide practice and training of HCPs and enhance co-operation amongst member of the multidisciplinary team.

The unpredictability of the surgery schedule was a common barrier cited in the qualitative assessment and is also commonly reported in the literature.[15,41,86] Although the lack of a set surgery time may complicate preoperative fasting instructions, more liberal fasting guidelines would allow for feeding of patients in spite of the unpredictability of their surgery time as patients could be given clear liquids up to two hours prior to surgery and patients on the afternoon list could be given breakfast. Even if their surgery were to be pushed forward, it would not have to be cancelled altogether but perhaps just delayed by a maximum of two hours, depending on when the patient last had something to drink.

Lack of knowledge was not surprising considering that 91% of participants had not received official training regarding the guidelines. However, knowledge accretion is the essential first step into translating knowledge into practice, a process also known as knowledge translation.[14] Therefore, the lack of training of the multidisciplinary team regarding ERAS is a major barrier. Both knowledge and attitudes inform provider intent, which if poor can be a barrier to implementation.

Lack of awareness about the importance of nutrition was also mentioned as a barrier; however, the attitude questionnaire showed that HCPs had good awareness about the importance of nutrition for recovery. This should, however, be reinforced with training and regular re-education of the multidisciplinary team.

Poor outcome expectancy with regards to fear of negative GI side effects, monitoring for complications and transportation back to the hospital were all mentioned as barriers. However, education regarding the safety and lowered risk of complications with implementation of the ERAS guidelines would perhaps help to change these beliefs.

As mentioned in previous studies, the more complex nature of the ERAS fasting instructions was mentioned as a barrier as some HCPs felt that the instructions may not be understood or may cause confusion.[41] This may present a barrier, especially considering the language gap between some HCPs and their patients. However, strategies can be developed to overcome this, for example developing educational tools to explain fasting instructions to patients.

Although patient characteristics were not found to be a barrier in the quantitative assessment, the qualitative assessment revealed that some anaesthetists felt that patients' poor access to nutrition or poor general health of the patient population may present a barrier to compliance. This was also mentioned in Pearsall *et al.'s* study as a factor effecting early post-operative feeding.[86]

The findings of this study highlight the various barriers to implementation of the ERAS guidelines as well as the current practices in a public hospital in South Africa with no ERAS programme in place. This knowledge will help to guide future implementation programmes and allow for interventions to be targeted appropriately.

CHAPTER 6:
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSION

This study showed that the implementation of the ERAS perioperative nutrition guidelines in a tertiary hospital in South Africa are poor and that traditional perioperative nutrition practices are still largely used within the context of a hospital that has not yet adopted these guidelines. Extended preoperative fasting from both liquids and solids are routinely imposed on patients, despite there being no evidence to support this practice. In addition, patients are not screened for nutritional risk prior to surgery, do not receive nutritional support to optimise their nutritional status prior to surgery, do not receive a preoperative carbohydrate loading product and post-operatively are made to transition slowly via multiple consistencies to a full oral diet. The lack of hospital policy formalising perioperative nutritional practices, as well as the lack of education and awareness of the ERAS perioperative nutrition guidelines amongst HCPs, are all major barriers to the implementation of evidence-based best practice. Lack of co-operation of the multidisciplinary team, resistance to change, negative surgical team culture, and the unpredictability of the surgical schedule all present major barriers.

Despite this, a handful of positive practices relating to evidence-based perioperative nutrition are already being well implemented and indicate an entrenched positive institutional culture towards weighing of patients on admission, post-operative oral feeding and post-operative early feeding of patients, which just need further reinforcement. In addition to these entrenched practices, good awareness of the importance of nutrition amongst the multi-disciplinary team and positive attitudes of HCPs towards the ERAS guidelines make the possibility for a bright future of ERAS implementation possible.

High compliance with ERAS guidelines are essential to achieving the best outcomes possible for patients and the mere adoption of an ERAS protocol is not enough to do this.[67,75,77,101] By understanding the barriers to implementation in a public hospital in South Africa, one can begin to develop targeted strategies to introducing the ERAS programme into such a setting in order to ensure best compliance and best outcomes for the patients and the institution.

6.2 RECOMMENDATIONS FOR PRACTICE

1. In order for ERAS to be successfully implemented, the hospital needs to formalise an ERAS policy and provide formal training for all members of the multi-disciplinary team.

2. Multidisciplinary co-operation can be enhanced by assigning a champion from each discipline of the multidisciplinary team. The champions are responsible for educating members within their department and the champions can meet monthly to discuss and iron-out issues and enhance communication between the different disciplines.
3. Monitoring of the implementation of the guidelines and associated outcomes via an audit system as well as regular re-education of the multidisciplinary team are essential to improving compliance.
4. The hospital should meet with all stakeholders in order to find a system for streamlining processes and eliminating certain logistical barriers such as kitchen closing times and surgical scheduling. This may require setting up a budget and finding funding to improve or update certain processes within the hospital.

6.3 STUDY LIMITATIONS

The patient questionnaire was purposefully kept limited in order to reduce participant burden, which resulted in a select number of closed-ended questions being used to assess patient experiences. This meant that a thorough qualitative assessment of patient experiences and the possible implications of these results for future implementation of ERAS was beyond the scope of this study. Further insight into patient experiences may be achieved in future research via open-ended questions or qualitative assessment of patient experiences using in-depth interviews or focus group discussions.

Although, the use of only weight and height measurements as determinants of change in nutritional status limited the interpretation of such changes, these measurements along with the NRS-2002 tool were used as these best reflect what would be practical to implement in this setting. In addition, nutritional risk, as measured by the NRS-2002, has been independently associated with clinical outcomes and the outcomes of these measurements therefore provided clinically significant data that was sufficient for the aims of this study. Although the use of bioelectrical impedance or other such technologies would have provided further insight into body composition changes over the period of admission, this was not necessary in order to measure changes in nutritional risk.

The qualitative evaluation of barriers was asked via one open-ended question which limited the extent of the answers given. Although a more detailed qualitative evaluation of the barriers to implementing ERAS were beyond the scope of this study this could be a topic for future research and could shed more light on certain aspects such as surgical team culture and hierarchical structure, which could not be fully described in this study.

The self-reported nature of the HCP questionnaires and the logistical issues with maintaining a controlled environment whilst the questionnaires were being administered could have introduced an element of bias. The addition of an observational checklist to objectively assess practices and the interpretation of the reported practices as provider intent are thought to control for this to some extent.

Lastly, even though 75% of eligible surgeons participated in the study, the number of surgeon participants was small (n=3) and therefore results should be interpreted with caution.

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ADDENDA

ADDENDUM A: PATIENT SCREENING FORM

Screening: Patient

1. Is the patient 18 years or over?

		Tick (√)
A	Yes	
B	No	

2. Is the patient booked for an elective surgery in the surgical schedule book? (non-emergency)

		Tick (√)
A	Yes	
B	No	

3. Does the surgery constitute resection of any part of the rectum, colon or small bowel?

		Tick (√)
A	Yes	
B	No	

4. Does the patient speak either English, Afrikaans or Xhosa?

		Tick (√)
A	Yes	
B	No	

If you answered yes to all four questions you may proceed to enrol the patient in the study.

ADDENDUM B: NUTRITIONAL RISK SCREENING TOOL

Participant number	P-
Ward	
Date	

Table 1 Initial Screening		**Yes**	**No**
1	Is BMI < 20.5?		
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill? (e.g. in intensive therapy)		
Yes: If the answer is "Yes" to any question, the screening in Table 2 is performed. **No:** If the answer is "No" to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventative nutritional care plan is considered to avoid the associated risk status.			

Table 2 Final Screening			
Impaired nutritional status		**Severity of disease (≈ increase in requirements)**	
Absent **Score 0**	Normal nutritional status	Absent **Score 0**	Normal nutritional requirements
Mild **Score 1**	Wt loss > 5% in 3 mths or Food intake below 50-75% of normal requirement in preceding week	Mild **Score 1**	Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*, Chronic hemodialysis, diabetes, oncology
Moderate **Score 2**	Wt loss > 5% in 2 mths or BMI 18.5-20.5 + impaired general condition or Food intake 25-60% of normal requirement in preceding week	Moderate **Score 2**	Major abdominal surgery*, stroke*, Severe pneumonia, hematologic malignancy
Severe **Score 3**	Wt loss > 5% in 1 mth (> 15% in 3 mths or BMI < 18.5 + impaired general condition of Food intake 0-25% of normal requirement in preceding week	Severe **Score 3**	Head injury* Bone marrow transplantation* Intensive care patients (APACHE > 10)
Score:	**+**	**Score:**	**= Total score**
Age	if ≥70 years add 1 to total score above		= **age-adjusted score**
Score ≥ 3: the patient is nutritionally at-risk and a nutritional care plan is initiated **Score < 3:** weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.			

ADDENDUM C: STANDARD OPERATING PROCEDURE: WEIGHT AND HEIGHT MEASUREMENT

A: Weight

1. Measurement is done using electronic scale provided by the researcher
2. Calibrate the scale to zero
3. Request participant to remove all shoes, socks and jewellery.
4. Participants should be weighed wearing their hospital gown only.
5. The participant should be positioned standing with both feet equally in the centre of the scale platform.
6. Hands should be at the sides and head facing forwards looking straight ahead.
7. The participant should not lean against anything
8. Once the participant is positioned correctly, wait for the measurement displayed on the scale to stabilize and capture the measurement given to the nearest 0.1kg.

B: Height

1. Measurement is done using a stadiometer provided by the researcher.
2. Request the participant to remove all shoes, socks and hair accessories or hats to ensure that nothing is covering the head.
3. The participant should stand up straight with heels together and feet flat on the floor. Body weight should be evenly distributed.
4. The back of the head, shoulder blades, buttocks and heels should be touching the wall.
5. Legs should be kept straight and knees together with arms relaxed at sides.
6. Align the head in the Frankfort horizontal plane.
7. Lower the stadiometer head piece so that it rests firmly on top of the participant's head, with sufficient pressure to compress the hair.
8. Take the measurement at maximum inspiration by instructing the participant to take a deep breath.
9. Capture the measurement to the nearest 1mm.

ADDENDUM D: OBSERVATIONAL CHECKLIST

Observational Checklist:

Part 1: On admission

Participant number	P-
Ward	
Date of admission	

Weight as measured by researcher (kg)	
Height as measured by researcher (cm)	
BMI as calculated by researcher (kg/m^2)	
Nutritional risk score as calculated on NRS 2002	

	Tick (√)	Yes	No	Comments
1.	Was the patient weighed on admission?			

If "Yes" please answer question 2 and 3. If "No" continue to question 4.

	Tick (√)	Yes	No	Comments
2.	Was the patients' weight recorded in the file?			

	Tick (√)	Nurse	Doctor	Dietitian	Other	Comment
3.	Who weighed the patient?					

		Comments
4.	Which surgery has the patient been booked for?	

		Date	Time	Comments
5.	What is the scheduled date and time of the surgery?	__ __/__ __/ 2015	__h__	

	tick	Malignancy	Non-malignant tumor	Appendicitis	Traumatic injury	Other
6.	What is the patients' active diagnosis?					

	Tick (more than one)	HIV	TB	Diabetes	Cancer	Hypertension	CVD	Other
7.	Please list any comorbidities as given in the patient file (If none specify under "other")							

	Tick (√)	Yes	No	Comments
8.	Has the patient been referred to a dietitian?			

Observational Checklist:
Part 2: Day of surgery

Participant number	P-
Ward	
Date of surgery	

	Tick (√)	Yes	No	Comments
1.	Did the patient's surgery take place on the day which it was scheduled?			

If "No", please answer question 2. If "Yes", continue to question 3.

		1	2	3	4	5	Other
2.1	How many times was the patients surgery delayed? (If more than 5 specify under "other")						

		1	2	3	4	5	Other
2.2	For each surgery that was delayed please indicate amount of hours spent NPO awaiting surgery	___ hrs	___ hrs	___ hrs	___ hrs	___ hrs	

		Patient complication	Another surgery took precedence	Lack of beds in aftercare ward	Lack of availability of surgical staff	Other
2.3	What is the reason for the delayal of surgery? (please tick 1 reason for each surgery that was delayed)					

	Tick (√)	Yes	No	Comments
2.	Has the patient been referred to a dietitian?			

	Tick (√)	Yes	No	Comments
3.	Has the patient been seen by a dietitian?			

		Number of hours
4.	How long has the patient been NPO from solids?	

		Number of hours
5.	How long has the patient been NPO from liquids?	

	Tick (√)	Yes	No	Comments
6.	Did the Doctor/ surgeon give specific orders for NPO prior to surgery?			

If "Yes" please answer question 8. If "No" please continue to question 9.

		Number of hours
7.	What was the Doctor's/surgeons orders for NPO prior to surgery?	

	Tick (√)	Yes	No	Comments
8.	Did the patient receive a carbohydrate drink prior to surgery?			

If "Yes" please answer question 10 and 11. If "No" this questionnaire is now completed.

	Tick (√)	Apple juice	Oros	A formulated nutritional product with 12% maltodextrin	Other (specify)
9.	What carbohydrate drink did the patient receive?				

Notes:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Observational Checklist:
Part 3: First enteral feed following surgery

Participant number	P-
Ward	
Date	

Weight as measured by researcher (kg)	
Height as measured by researcher (cm)	
BMI as calculated by researcher (kg/m^2)	
Weight loss since baseline measurement (kg)	
Weight loss since baseline measurement (%)	

		Comments
1.	Which surgery was performed?	

	Tick (√)	Yes	No	Comments
2.	Did any complications occur during surgery?			

If yes, Please answer question 3. If no, continue to question 4.

		Comments
3.	Please name the complications that occurred during surgery	

	Tick (√)	Yes	No	Comments
4.	Did any complications occur after surgery?			

If yes, Please answer question 5. If no, continue to question 6.

		Comments
5.	Please name the complications that occurred after surgery.	

	Tick (√)	Yes	No	Comments
6.	Has the patient been referred to a dietitian post-surgery?			

	Tick (√)	Yes	No	Comments
7.	Has the patient been seen by a dietitian post-surgery?			

		Number of hours after surgery	Route of first enteral feed. Please circle	Comments
8.	First enteral feed post-surgery		NGT/OGT/NJT/PEG/JEJ/ORAL/OTHER	

If oral, please answer question 9. If not oral, continue to question 10.

		Consistency of first oral feed. Please circle	Number of hours post-surgery	Comments
9.	First oral feed post-surgery	Liquid/ solid		

		Number of hours after surgery	Route	Consistency	Comments
10.	What was the Doctor's/surgeons orders for starting enteral feeding after surgery				

If enteral feeding was delayed for more than 24 hours post-surgery please answer question 11

	Tick (√)	Yes	No	Comments
11.	Was there a medical reason for delaying enteral feeding post-surgery?			

If yes, please provide the reason in the comments box.

ADDENDUM E: PATIENT QUESTIONNAIRE

Patient questionnaire

Part 1: Day of surgery

Participant number	P-
Ward	
Date	

		Date	Time	Comments
7.	When was the last time you ate solid food?	___/0__/2015	__h00	

		Full diet	Puree food	Semi/soft food	Other	Comments
8.	What was the last solid food that you ate?					

9.	How do you feel about the amount of time you had to fast from solid food before surgery?			
				

Please refer patient to ADDENDUM A and circle relevant experience chosen above.

				Circle
10.	Do you believe that your food or nutrition before surgery will affect how well or quickly you recover after surgery?			
Yes	No	I'm not sure	Comments_____ _____	

		Date	Time	Comments
11.	When was the last time you drank liquids?	___/0__/2015	__h00	

	Tick	Juice	Tea/coffee	Water	Supplement	Other	Comment
12.	What was the last liquid that you drank?						

13.	How do you feel about the amount of time you had to fast from liquids before surgery?			
				

Please refer patient to ADDENDUM A and circle their choice on this form.

Patient questionnaire

Part 2: After first post-op enteral nutrition

Participant number	P-
Ward	
Date	

		Date	Time	Comments
1.	When was the first time you ate or drank something after surgery?	___/0__/2015	__h00	

	Tick	Water	Tea/ coffee	Juice	Supplement	Full diet	Puree food	Semi/soft food	Other	Comment
2.	What was the first thing you ate/drank after surgery?									

3.	How do you feel about the amount of time you had to fast after surgery?			

Please refer patient to ADDENDUM A and circle their choice on this form.

				Circle
4.	Do you believe that your food or nutrition after surgery will or has affected how well you recover?			
Yes	No	I'm not sure	Comments_____ _____	

ADDENDUM F: PATIENT EXPERIENCE CARD

			

ADDENDUM G: INFORMED CONSENT FORM: PATIENTS

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:

An Assessment of the Implementation of the Perioperative Nutrition ERAS Guidelines in Elective Colorectal Surgery Patients in a Tertiary Hospital in South Africa

REFERENCE NUMBER:

S14/10/250

PRINCIPAL INVESTIGATOR:

Jessica Kotlowitz

ADDRESS:

23 Shanklin Crescent
Camps Bay
8005

CONTACT NUMBER:

0827831549

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

- The study will include all patients that are having planned surgery on their colons or rectums (part of the large intestines) during the study period at Tygerberg Hospital.
- ERAS guidelines are a set of guidelines that were released to help patients recover better from surgeries. Some of these guidelines are to do with the nutrition of the patient, for example that the patient should only fast for 6 hours before the surgery. This study aims to find out which of these nutrition related guidelines are being practiced in Tygerberg Hospital and how the patients feel about the practices. It also aims to find out if there are any problems which stop these guidelines from being followed. If we can understand the problems standing in the way of hospitals in South Africa following these guidelines we can think of ways to overcome them to improve the recovery of patients.
- A total of 30 patients at Tygerberg hospital are expected to take part in this study.
- The researcher will ask you a few questions before and after your operation to see when you last ate or drank and how that made you feel. The researcher will also want to weigh and measure you when you are admitted for your operation and ask you a few questions about your illness and changes in eating or weight and then again after your operation. The researcher will follow up with you every day that you are in the hospital to read your file and speak to your nurses and doctors.

Why have you been invited to participate?

- You have been invited to take part in this research study as you can help us to understand how you as a patient feel about the ERAS nutrition guidelines to see if our patients need and want these guidelines to be carried out in the hospitals. By following you through the process of your operation we can see what problems take place that prevent these guidelines from being carried out. Since you are one of these patients, your cooperation and participation will be much appreciated.

What will your responsibilities be?

- You will be asked to answer a few short questions before and after your operation about when you last ate or drank and how that made you feel. You will be weighed and measured by the researcher and asked about your illness and any weight loss or changes in eating. You will also be watched by the researcher from time to time before and after your operation and all your medical notes written by the doctors and nurses in your file will be read by the researcher and may be used. You will only be withdrawn from the study if you request to stop participating.

Will you benefit from taking part in this research?

- There are no personal benefits to you for taking part in this study. The results of this study may help patients in the future by helping these guidelines to be introduced and carried out in South African hospitals so that patients can recover quicker from their surgeries.

Are there any risks involved in your taking part in this research?

- There are no risks to you in taking part in this research.

If you do not agree to take part, what alternatives do you have?

- You are free to refuse to take part in this research at the beginning of the study or at any point during the study. If you choose not to take part, you will not be treated differently in any way.

Who will have access to your medical records?

- The information about you that is taken from your files and medical records will remain anonymous. We will give you a special identification number to identify so that we never need to put your name on any of our forms. Only the researcher will know who you are while taking your information. All your information which the researcher writes down will be kept locked up at the University of Stellenbosch for 5 years and will then be destroyed. Any personal information about you will be protected and kept private from the public. The results from this study may be published in an article in a scientific journal and will be part of a Masters' thesis that will be read by examiners and other students from the University of Stellenbosch. The results of this study will not show the identity or any personal information of any of the participants that took part. Auditors or research ethics committee members may need to inspect research records however your name will not be on these records.

Will you be paid to take part in this study and are there any costs involved?

No you will not be paid to take part in the study. There will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

- You should inform your family practitioner or usual doctor that you are taking part in a research study.
- You should also inform your medical insurance company that you are participating in a research study.
- You can contact Jessica Kotlowitz at tel. 082 783 1549 if you have any further queries or encounter any problems.
- You can contact the Health Research Ethics Committee at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by your study doctor.
- You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I ……. agree to take part in a research study entitled (insert title of study).

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (place) ..... on (date) ……..…….. 2015.

....

Signature of participant **Signature of witness**

Declaration by investigator

I (name) ……..…… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.

Signed at (place) ..... on (date) ……..…….. 2015.

....

Signature of investigator **Signature of witness**

ADDENDUM H: HCP QUESTIONNAIRE: ANAESTHETISTS AND SURGEONS

Healthcare worker questionnaire: Anaesthetists and surgeons

Participant number	HCP-
HCP type	GIT surgeon/ anaesthetist
Date	

Section A: Demographic information

1. Please indicate your gender

		Tick (√)
A	Male	
B	Female	

2. Please indicate your date of birth

Day	Month	Year

3. How long have you been practicing in your current profession or specialization?

Years		Months	

4. How long have you been working with elective colorectal surgery patients?

Years		Months	

5. Have you received any formal training regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

If yes, please answer question 6. If No, continue to question 7.

6. Please indicate where you received this training, by which professional or organization and for how many hours you were trained.

	Training program 1	Training program 2 (only complete if more than one)	Training program 3 (only complete if more than one)
Place			
Training provider			
Number of hours trained			

7. Have you read any literature or attended any talks regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

Section B: Knowledge

The following questions are multiple choice questions. Please choose one option only. Choose the most appropriate option. Please do not guess answers. If you do not know the answer please indicate so.

1. How many hours should a patient be kept fasted or NPO from solid food before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	No fasting is necessary	
C	6 hours	
D	24 hours	
E	I don't know	

2. How many hours should a patient be kept fasted or NPO from clear fluids before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	2 hours	
C	No fasting is necessary	
D	6 hours	
E	I don't know	

3. After elective colorectal surgery what is the soonest that a patient should be allowed to eat?

		Tick (√)
A	4 hours	
B	12 hours	
C	Immediately after waking up	
D	24 hours	
E	I don't know	

4. After elective colorectal surgery what is the longest time one should wait before allowing a patient to eat?

		Tick (√)
A	4 hours	
B	1 week	
C	48 hours	
D	24 hours	
E	I don't know	

5. How should a patient progress to a full oral diet after elective colorectal surgery?

		Tick (√)
A	Water → Clear fluids → Full fluids → Puree diet → Soft diet → Full oral diet	
B	Clear fluids → Full fluids→Puree diet → Soft diet → Full oral diet	
C	They can go straight to a full oral diet as tolerated	
D	Nasogastric tube feeding→Clear fluids→Full fluids→Puree diet → Soft diet → Full oral diet	
E	I don't know	

6. A patient should receive the following 2-3 hours prior to elective colorectal surgery

		Tick (√)
A	A carbohydrate drink	
B	They should not receive anything 2-3 hours prior to surgery	
C	A glass of water	
D	A high protein drink	
E	I don't know	

7. When a patient is booked for elective colorectal surgery what does the ERAS guidelines suggest one should screen for in terms of perioperative nutrition?

		Tick (√)
A	No screening is necessary	
B	Diabetes	
C	Malnutrition	
D	Anaemia	
E	I don't know	

8. If a patient is malnourished prior to elective colorectal surgery what should you do?

		Tick (√)
A	Cancel the surgery until the patient has gained weight	
B	Give the patient nutrition advice so that they can gain some weight before surgery	
C	Nothing. The patients' nutritional status does not affect the surgery	
D	Refer the patient to the dietitian to help improve their nutritional status before surgery	
E	I don't know	

9. What type of carbohydrate drink should a patient ideally receive before surgery?

		Tick (√)
A	They shouldn't receive a carbohydrate drink	
B	Any clear fluids	
C	Apple juice	
D	A formulated nutritional product with 12% maltodextrin	
E	I don't know	

Section C: Attitudes

Please indicate the extent to which you agree or disagree with the following statements by circling the desired box. Questions regarding patients refer specifically to elective colorectal surgery patients.

1. A patients' nutritional status prior to elective colorectal surgery has an influence on their recovery after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

2. It is important for patients to be well nourished before surgery so that they recover well.

Strongly agree	Agree	Disagree	Strongly disagree

3. Improving a patients' nutritional status in the weeks leading up to surgery is a useful intervention to improve surgical outcomes.

Strongly agree	Agree	Disagree	Strongly disagree

4. The fasting time of patients before surgery has no bearing on their post-surgery recovery.

Strongly agree	Agree	Disagree	Strongly disagree

5. Allowing patients to eat sooner than 12 hours before surgery is dangerous.

Strongly agree	Agree	Disagree	Strongly disagree

6. ERAS guidelines about patient fasting times do not take the individual patient into account and do not allow for the physicians best judgement in a specific situation.

Strongly agree	Agree	Disagree	Strongly disagree

7. There is not enough evidence to suggest that reducing perioperative fasting times is beneficial to patients.

Strongly agree	Agree	Disagree	Strongly disagree

8. ERAS guidelines are not practical to implement in our setting and apply more to a developed healthcare system.

Strongly agree	Agree	Disagree	Strongly disagree

9. I am nervous to follow the ERAS guidelines in case it causes an adverse outcome in one of my patients.

Strongly agree	Agree	Disagree	Strongly disagree

10. The time a patient is kept NPO is not always within my control.

Strongly agree	Agree	Disagree	Strongly disagree

11. The guidelines regarding postoperative resumption of full oral diet are not careful enough.

Strongly agree	Agree	Disagree	Strongly disagree

12. It is important for a patient to eat as soon as possible after surgery in order to optimize recovery.

Strongly agree	Agree	Disagree	Strongly disagree

13. It is important to not fast patients for too long as this will have a negative effect on their recovery.

Strongly agree	Agree	Disagree	Strongly disagree

14. Allowing patients to eat too soon after surgery will result in complications.

Strongly agree	Agree	Disagree	Strongly disagree

15. Transitioning patients slowly to a full oral diet prevents complications.

Strongly agree	Agree	Disagree	Strongly disagree

16. Bowel sounds indicate that a patient is ready to tolerate oral nutrition after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

17. A carbohydrate drink before surgery aids in the patients' recovery.

Strongly agree	Agree	Disagree	Strongly disagree

18. A carbohydrate drink is not going to make a difference to the patients' recovery after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

19. A carbohydrate drink helps the patient psychologically to feel less hungry before surgery.

Strongly agree	Agree	Disagree	Strongly disagree

Section D: Practices

1. How long do you advise your patients to abstain from solids prior to elective colorectal surgery?

Hours	

2. How long do you advise your patients to abstain from liquids prior to elective colorectal surgery?

Hours	

3. How do you progress your patients to a full oral diet post elective colorectal surgery?

_____
_____
_____
_____

4. How long do you advise your patients to wait before eating after surgery?

Hours	

5. What is the earliest you will advise a patient to eat or drink something after elective colorectal surgery?

Hours	

6. What is the longest you will advise for a patient to be kept fasted/ NPO after elective colorectal surgery?

Hours	

7. Do you screen elective colorectal surgery patients for malnutrition prior to booking them for surgery?

Yes	No	Comments

8. Do you refer elective colorectal surgery patients to a dietitian prior to surgery if you find that they are malnourished?

Yes	No	Comments

9. Do you request a carbohydrate drink for patients prior to surgery?

Yes	No	Comments

10. In your opinion, what are the barriers to implementing the ERAS perioperative nutrition guidelines in Tygerberg Hospital?

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

ADDENDUM I: HCP QUESTIONNAIRE: NURSES

Healthcare worker questionnaire: Nurses

Participant number	HCP-
HCP type	Professional nurse
Date	

Section 1: Demographic information

1. Please indicate your gender

		Tick (√)
A	Male	
B	Female	

2. Please indicate your date of birth

Day	Month	Year

3. How long have you been practicing in your current profession or specialization?

Years		Months	

4. How long have you been working with elective colorectal surgery patients?

Years		Months	

5. Have you received any formal training regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

If yes, please answer question 6. If No, continue to question 7.

6. Please indicate where you received this training, by which professional or organization and for how many hours you were trained.

	Training program 1	Training program 2 (only complete if more than one)	Training program 3 (only complete if more than one)
Place			
Training provider			
Number of hours trained			

7. Have you read any literature or attended any talks regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

Section B: Knowledge

The following questions are multiple choice questions. Please choose one option only. Choose the most appropriate option. Please do not guess answers. If you do not know the answer please indicate so.

1. How many hours should a patient be kept fasted or NPO from solid food before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	No fasting is necessary	
C	6 hours	
D	24 hours	
E	I don't know	

2. How many hours should a patient be kept fasted or NPO from clear fluids before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	2 hours	
C	No fasting is necessary	
D	6 hours	
E	I don't know	

3. After elective colorectal surgery what is the soonest that a patient should be allowed to eat/drink?

		Tick (√)
A	4 hours	
B	12 hours	
C	Immediately after waking up	
D	24 hours	
E	I don't know	

4. After elective colorectal surgery what is the longest time one should wait before allowing a patient to eat/drink?

		Tick (√)
A	4 hours	
B	1 week	
C	48 hours	
D	24 hours	
E	I don't know	

5. How should a patient progress to a full oral diet after elective colorectal surgery?

		Tick (√)
A	Water → Clear fluids → Full fluids → Puree diet → Soft diet → Full oral diet	
B	Clear fluids → Full fluids→Puree diet → Soft diet → Full oral diet	
C	They can go straight to a full oral diet as tolerated	
D	Nasogastric tube feeding→Clear fluids→Full fluids→Puree diet → Soft diet → Full oral diet	
E	I don't know	

6. A patient should receive the following 2-3 hours prior to elective colorectal surgery

		Tick (√)
A	A carbohydrate drink	
B	They should not receive anything 2-3 hours prior to surgery	
C	A glass of water	
D	A high protein drink	
E	I don't know	

7. When a patient is booked for elective colorectal surgery what does the ERAS guidelines suggest one should screen for in terms of perioperative nutrition?

		Tick (√)
A	No screening is necessary	
B	Diabetes	
C	Malnutrition	
D	Anaemia	
E	I don't know	

8. If a patient is malnourished prior to elective colorectal surgery what should you do?

		Tick (√)
A	Tell the doctor to cancel the surgery until the patient gains weight	
B	Give the patient nutrition advice so that they can gain some weight before surgery	
C	Nothing. The patients' nutritional status does not affect the surgery	
D	Refer the patient to the dietitian to help improve their nutritional status before surgery	
E	I don't know	

9. What type of carbohydrate drink should a patient ideally receive before surgery?

		Tick (√)
A	They shouldn't receive a carbohydrate drink	
B	Any clear fluids	
C	Apple juice	
D	A formulated nutritional product with 12% maltodextrin	
E	I don't know	

Section C: Attitudes

Please indicate the extent to which you agree or disagree with the following statements by circling the desired box. Questions regarding patients refer specifically to elective colorectal surgery patients.

1. It is important for patients to be well nourished before surgery so that they recover well.

Strongly agree	Agree	Disagree	Strongly disagree

2. The fasting time of patients before surgery has no influence on their post-surgery recovery.

Strongly agree	Agree	Disagree	Strongly disagree

3. Allowing patients to eat sooner than 12 hours before surgery is dangerous.

Strongly agree	Agree	Disagree	Strongly disagree

4. ERAS perioperative nutrition guidelines would not work in South Africa.

Strongly agree	Agree	Disagree	Strongly disagree

5. The time a patient is kept NPO is not always within my control.

Strongly agree	Agree	Disagree	Strongly disagree

6. I leave the decisions about how long to keep a patient NPO before and after surgery up to the patients' doctor.

Strongly agree	Agree	Disagree	Strongly disagree

7. I am too busy to worry about the patients' nutrition before and after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

8. I do not take notice of what or when the patients eat or drink.

Strongly agree	Agree	Disagree	Strongly disagree

9. I follow the doctors' orders in the file to see how long to keep a patient NPO before and after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

10. The doctor is always correct about how long to keep a patient NPO before and after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

11. It is important for a patient to eat as soon as possible after surgery in order to optimize recovery.

Strongly agree	Agree	Disagree	Strongly disagree

12. It is important to not fast patients for too long as this will have a negative effect on their recovery.

Strongly agree	Agree	Disagree	Strongly disagree

13. Allowing patients to eat too soon after surgery will result in complications.

Strongly agree	Agree	Disagree	Strongly disagree

14. Transitioning patients slowly to a full oral diet prevents complications.

Strongly agree	Agree	Disagree	Strongly disagree

15. Bowel sounds indicate that a patient is ready to tolerate oral nutrition after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

16. A carbohydrate drink before surgery aids in the patients' recovery.

Strongly agree	Agree	Disagree	Strongly disagree

17. A carbohydrate drink is not going to make a difference to the patients' recovery after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

18. A carbohydrate drink helps the patient psychologically to feel less hungry before surgery.

Strongly agree	Agree	Disagree	Strongly disagree

Section D: Practices

1. Do you weigh elective colorectal surgery patients when they get admitted to the ward?

Yes	No	Comments

2. Do you refer elective colorectal surgery patients to a dietitian prior to surgery if you find that they are underweight?

Yes	No	Comments

3. Do you request a carbohydrate drink for patients prior to surgery?

Yes	No	Comments

4. In your opinion, what are the barriers to implementing the ERAS perioperative nutrition guidelines in Tygerberg Hospital?

_____
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ADDENDUM J: HCP QUESTIONNAIRE: DIETITIANS

Healthcare worker questionnaire: Dietitians

Participant number	HCP-
HCP type	Dietitian
Date	

Section 1: Demographic information

1. Please indicate your gender

		Tick (√)
A	Male	
B	Female	

2. Please indicate your date of birth

Day	Month	Year

3. How long have you been practicing in your current profession or specialization?

Years		Months	

4. Do you currently work with elective colorectal surgery patients?

		Tick (√)
A	Yes	
B	No	

If "Yes" please answer question 5. If "No" please continue to question 6.

5. How long have you been working with elective colorectal surgery patients?

Years		Months	

6. Have you received any formal training regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

If yes, please answer question 7. If No, continue to question 8.

7. Please indicate where you received this training, by which professional or organization and for how many hours you were trained.

	Training program 1	Training program 2 (only complete if more than one)	Training program 3 (only complete if more than one)
Place			
Training provider			
Number of hours trained			

8. Have you read any literature or attended any talks regarding the ERAS (Enhanced Recovery After Surgery) guidelines?

		Tick (√)
A	Yes	
B	No	

Section B: Knowledge

The following questions are multiple choice questions. Please choose one option only. Choose the most appropriate option. Please do not guess answers. If you do not know the answer please indicate so.

1. How many hours should a patient be kept fasted or NPO from solid food before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	No fasting is necessary	
C	6 hours	
D	24 hours	
E	I don't know	

2. How many hours should a patient be kept fasted or NPO from clear fluids before elective colorectal surgery?

		Tick (√)
A	12 hours	
B	2 hours	
C	No fasting is necessary	
D	6 hours	
E	I don't know	

3. After elective colorectal surgery what is the soonest that a patient should be allowed to eat?

		Tick (√)
A	4 hours	
B	12 hours	
C	Immediately after waking up	
D	24 hours	
E	I don't know	

4. After elective colorectal surgery what is the longest time one should wait before allowing a patient to eat?

		Tick (√)
A	4 hours	
B	1 week	
C	48 hours	
D	24 hours	
E	I don't know	

5. How should a patient progress to a full oral diet after elective colorectal surgery?

		Tick (√)
A	Water → Clear fluids → Full fluids → Puree diet → Soft diet → Full oral diet	
B	Clear fluids → Full fluids→Puree diet → Soft diet → Full oral diet	
C	They can go straight to a full oral diet as tolerated	
D	Nasogastric tube feeding→Clear fluids→Full fluids→Puree diet → Soft diet → Full oral diet	
E	I don't know	

6. A patient should receive the following 2-3 hours prior to elective colorectal surgery

		Tick (√)
A	A carbohydrate drink	
B	They should not receive anything 2-3 hours prior to surgery	
C	A glass of water	
D	A high protein drink	
E	I don't know	

7. When a patient is booked for elective colorectal surgery what does the ERAS guidelines suggest one should screen for in terms of perioperative nutrition?

		Tick (√)
A	No screening is necessary	
B	Diabetes	
C	Malnutrition	
D	Anaemia	
E	I don't know	

8. If a patient is malnourished prior to elective colorectal surgery what should you do?

		Tick (√)
A	Cancel the surgery until the patient has gained weight	
B	Give the patient nutrition advice so that they can gain some weight before surgery	
C	Nothing. The patients' nutritional status does not affect the surgery	
D	Refer the patient to the dietitian to help improve their nutritional status before surgery	
E	I don't know	

9. What type of carbohydrate drink should a patient ideally receive before surgery?

		Tick (√)
A	They shouldn't receive a carbohydrate drink	
B	Any clear fluids	
C	Apple juice	
D	A formulated nutritional product with 12% maltodextrin	
E	I don't know	

Section C: Attitudes

Please indicate the extent to which you agree or disagree with the following statements by circling the desired box. Questions regarding patients refer specifically to elective colorectal surgery patients.

1. A patients' nutritional status prior to elective colorectal surgery has an influence on their recovery after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

2. It is important for patients to be well nourished before surgery so that they recover well.

Strongly agree	Agree	Disagree	Strongly disagree

3. Improving a patients' nutritional status in the weeks leading up to surgery is a useful intervention to improve surgical outcomes.

Strongly agree	Agree	Disagree	Strongly disagree

4. The fasting time of patients before surgery has no bearing on their post-surgery recovery.

Strongly agree	Agree	Disagree	Strongly disagree

5. Allowing patients to eat sooner than 12 hours before surgery is dangerous.

Strongly agree	Agree	Disagree	Strongly disagree

6. ERAS guidelines about patient fasting times do not take the individual patient into account and do not allow for the physicians best judgement in a specific situation.

Strongly agree	Agree	Disagree	Strongly disagree

7. There is not enough evidence to suggest that reducing perioperative fasting times is beneficial to patients.

Strongly agree	Agree	Disagree	Strongly disagree

8. ERAS guidelines are not practical to implement in our setting and apply more to a developed healthcare system.

Strongly agree	Agree	Disagree	Strongly disagree

9. I am nervous to follow the ERAS guidelines in case it causes an adverse outcome in one of my patients.

Strongly agree	Agree	Disagree	Strongly disagree

10. The time a patient is kept NPO is not always within my control.

Strongly agree	Agree	Disagree	Strongly disagree

11. The guidelines regarding postoperative resumption of full oral diet are not careful enough.

Strongly agree	Agree	Disagree	Strongly disagree

12. It is important for a patient to eat as soon as possible after surgery in order to optimize recovery.

Strongly agree	Agree	Disagree	Strongly disagree

13. It is important to not fast patients for too long as this will have a negative effect on their recovery.

Strongly agree	Agree	Disagree	Strongly disagree

14. Allowing patients to eat too soon after surgery will result in complications.

Strongly agree	Agree	Disagree	Strongly disagree

15. Transitioning patients slowly to a full oral diet prevents complications.

Strongly agree	Agree	Disagree	Strongly disagree

16. Bowel sounds indicate that a patient is ready to tolerate oral nutrition after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

17. A carbohydrate drink before surgery aids in the patients' recovery.

Strongly agree	Agree	Disagree	Strongly disagree

18. A carbohydrate drink is not going to make a difference to the patients' recovery after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

19. A carbohydrate drink helps the patient psychologically to feel less hungry before surgery.

Strongly agree	Agree	Disagree	Strongly disagree

20. I leave the decisions about how long to keep a patient NPO before and after surgery up to the patients' doctor.

Strongly agree	Agree	Disagree	Strongly disagree

21. I follow the doctors' orders in the file to see how long to keep a patient NPO before and after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

22. The doctor is always correct about how long to keep a patient NPO before and after surgery.

Strongly agree	Agree	Disagree	Strongly disagree

23. It is my responsibility to educate the rest of the multidisciplinary team about correct perioperative nutrition practices.

Strongly agree	Agree	Disagree	Strongly disagree

24. I, as a dietitian, play the biggest role in the multidisciplinary team in advocating for correct perioperative nutrition practices for my patients.

Strongly agree	Agree	Disagree	Strongly disagree

25. It is not solely my responsibility to implement ERAS perioperative nutrition guidelines in my patients.

Strongly agree	Agree	Disagree	Strongly disagree

Section D: Practices:

If you are not currently working with elective colorectal surgery patients, please answer the following questions in terms of "what you would do" with these patients or have done in the past when working with them.

1. How long do you advise your patients to abstain from solids prior to elective colorectal surgery?

Hours	

2. How long do you advise your patients to abstain from liquids prior to elective colorectal surgery?

Hours	

3. How do you progress your patients to a full oral diet post elective colorectal surgery?

_____
_____
_____
_____

4. How long do you advise your patients to wait before eating after surgery?

Hours	

5. What is the earliest you will advise a patient to eat or drink something after elective colorectal surgery?

Hours	

6. What is the longest you will advise for a patient to be kept fasted/ NPO after elective colorectal surgery?

Hours	

7. Do you screen elective colorectal surgery patients for malnutrition on admission?

Yes	No	Comments

8. Do doctors/nurses refer elective colorectal surgery patients to you if they find they are malnourished prior to surgery?

Yes	No	Sometimes	Comments

9. Do you order a carbohydrate drink for patients prior to surgery?

Yes	No	Comments

10. What carbohydrate drink is available for patients at Tygerberg hospital? Please tick

Apple juice	A formulated nutritional product	Energade	Other	Comments

11. Are elective colorectal surgery patients referred to you for early postoperative enteral nutrition?

Yes	No	Comments

12. In your opinion, what are the barriers to implementing the ERAS perioperative nutrition guidelines in Tygerberg Hospital?

_____
_____
_____
_____
_____
_____

ADDENDUM K: INFORMED CONSENT FORM: HCPS

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM: HEALTHCARE WORKERS

TITLE OF THE RESEARCH PROJECT:
An Assessment of the Implementation of the Perioperative Nutrition ERAS Guidelines in Elective Colorectal Surgery Patients in a Tertiary Hospital in South Africa

REFERENCE NUMBER:

S14/10/250

PRINCIPAL INVESTIGATOR:

Jessica Kotlowitz

ADDRESS:

23 Shanklin Crescent
Camps Bay
8005

CONTACT NUMBER:

0827831549

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

- The study will be conducted at Tygerberg hospital and will include all professional nurses, GIT surgery consultants, and anaesthetists working in wards A1, D2 and D5 at the time of the study as well as all dietitians. A total of 63 anaesthetist, 56 nurses, 2 surgeons and 15 dietitians will be recruited for the study.
- This project aims to find out if the ERAS perioperative nutrition guidelines are being followed at Tygerberg Hospital in elective colorectal surgery patients. The study aims to discover the various barriers to following these guidelines by exploring the attitudes, knowledge and practices of the various healthcare professionals working with these patients, as well as observing practices in the unit. Finding out about these barriers will allow us to gather information to help direct funding for education on ERAS so that ERAS can be successfully implemented in South African hospitals and therefore help improve patient outcomes and enhance recovery. The study also aims to describe the patients' experience of the ERAS perioperative nutrition guidelines in order to better understand how patients feel about these interventions.
- The study will require you to answer a short written questionnaire. The researcher will be present while you are answering the questionnaire in case you have any questions or there is something you don't understand.

Why have you been invited to participate?

You have been invited to participate in this research study as the participation of healthcare workers can help us to understand the practices, attitudes and knowledge regarding the ERAS perioperative nutritional guidelines and any barriers which you perceive to prevent the proper implementation of these guidelines in elective colorectal surgery patients. Since you work with these patients, your participation will be much appreciated.

What will your responsibilities be?

You will be responsible for filling in a short written questionnaire during one of your tea or lunch breaks or at the end of your weekly team meeting. The questionnaire will aim to evaluate your knowledge, attitudes and practices regarding the ERAS perioperative nutritional guidelines as well as any perceived barriers. The questionnaire will take you 10-15 minutes to complete and will be completely anonymous. Your notes in the patients' files and charts will also be observed as part of the study. Auditors or research ethics committee members may need to inspect research records however your name will not be on these records. You will only be withdrawn from the study if you request to stop participating.

Will you benefit from taking part in this research?

There are no personal benefits to you for taking part in this research. The results of this research may benefit patients in the future by improving the implementation of the ERAS guidelines in tertiary hospitals in South Africa.

Are there any risks involved in your taking part in this research?

There are no risks to you in taking part in this research.

If you do not agree to take part, what alternatives do you have?

You are free to refuse to take part in this research at the beginning of the study or at any point during the study. If you choose not to participate, you will not be discriminated against in any way.

Will you be paid to take part in this study and are there any costs involved?

No you will not be paid to take part in the study. There will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

- You can contact Jessica Kotlowitz at tel 0827831549 if you have any further queries or encounter any problems.
- You can contact the Health Research Ethics Committee at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by your study doctor.
- You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I ……. agree to take part in a research study entitled (insert title of study).

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (place) ..... on (date) …….. 2015.

....

Signature of participant **Signature of witness**

Declaration by investigator

I (name) …… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.

Signed at (place) ..... on (date) …….. 2015.

....

Signature of investigator **Signature of witness**

ADDENDUM L: STELLENBOSCH UNIVERSITY HEALTH RESEARCH ETHICS COMMITTEE APPROVAL

UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot • your knowledge partner

Approval Notice
New Application

09-Dec-2014
Kotlowitz, Jessica J

Ethics Reference #: S14/10/250

Title: **Assessment of the implementation of the peri-operative nutrition ERAS guidelines in elective colorectal surgery patients in a tertiary hospital in South Africa.**

Dear Ms Jessica Kotlowitz,

The **New Application** received on **29-Oct-2014**, was reviewed by members of **Health Research Ethics Committee 1** via Expedited review procedures on **09-Dec-2014** and was approved.
Please note the following information about your approved research protocol:

Protocol Approval Period: **09-Dec-2014 -09-Dec-2015**

Please remember to use your **protocol number** (S14/10/250) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:
Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.
Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

If you have any questions or need further assistance, please contact the HREC office at 219389156.

Included Documents:
Protocol
Declaration_Kotlowitz
HREC Checklist

ADDENDUM M: RESEARCH APPROVAL LETTER TYGERBERG HOSPITAL

Western Cape Government
Health

Tygerberg Hospital

REFERENCE: Research Projects
ENQUIRIES: Dr G Marinus
TELEFONE: 021 938-6267

ETHICS NO: S14/10/250

Assessment of the implementation of the peri-operative nutrition ERAS guidelines in elective colorectal surgery patients in a tertiary hospital in South Africa.

Dear Ms Kotlowitz

PERMISSION TO CONDUCT YOUR RESEARCH AT TYGERBERG HOSPITAL

In accordance with the Provincial Research Policy and Tygerberg Hospital Notice No 40/2009, permission is hereby granted for you to conduct the above-mentioned research here at Tygerberg Hospital.

DR D ERASMUS
CHIEF EXECUTIVE OFFICER
Date: 10 February 2015

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tel: +27 21 938-6267 fax: +27 21 938-4890
Private Bag X3, Tygerberg, 7505
www.capegateway.gov.za

ADDENDUM N: CONFLICT OF INTEREST

Janine Kriel is employed by Fresenius Kabi South Africa as a clinical nutrition sales representative. She is not working in a management position and her current position had no impact on this descriptive observational study. The research project was conceptualised with the rest of the authors while Janine was a clinical dietitian at Tygerberg Hospital.