

Fistuloclysis: An option for the nutritional management of adult intestinal failure patients in South Africa

by

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Declaration

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English Abstract

Introduction: The development of intestinal failure is the consequence of diverse aetiologies and pathophysiological causes. Fistuloclysis is an effective means of nutritional support in selected intestinal failure patients. This study aimed to investigate the management of adult intestinal failure patients in hospitals in South Africa, determining how practical and acceptable fistuloclysis is.

Methods: The study included three phases. Phase 1 consisted of a retrospective record review of adult patients admitted to Groote Schuur Hospital Intestinal Failure Unit between January 2009 and May 2014. Data collected included demographics, surgical interventions, gastrointestinal anatomy, nutritional management, biochemical markers and intake and output. Phase 2 consisted of a purposefully selected case study report published in a peer-reviewed journal. Phase 3 investigated the current management of type 2 and type 3 intestinal failure patients in South African hospitals, evaluating perceptions and opinions among South African doctors, stoma therapists and dietitians by means of occupation-specific questionnaires.

Results: Phase 1: Seventeen intestinal failure patients receiving fistuloclysis were included in the study. During the fistuloclysis period, the median daily output was 1 478ml with a median of 71% of effluent received back via fistuloclysis. Four patients went home for a median period of 32,5 days on fistuloclysis. There was a statistically significant increase in the median albumin level between day 0 and day 28 of fistuloclysis, however body weight did not improve during this period. Postoperative complications occurred in only three patients. Patients were discharged after a median of 12 days post definitive surgery, with three complicating postoperatively and all patients regaining nutritional autonomy.

Phase 3: Twenty-seven dietitians participated in the survey, the majority (67%) having been involved with patient management in this field for one – five years. All indicated high fistula outputs would be defined as intestinal failure. Only 47% gave the correct definition, with 28% currently utilising fistuloclysis. All respondents agreed

that unsuccessful implementation of fistuloclysis was due to training shortfalls and resistance from clinicians and nursing staff.

Ten stoma therapists entered the survey but only two fitted the inclusion criteria. Both worked in the private sector, with >10 years of experience in the management of intestinal failure patients. Only one of the two proceeded with further questions.

Four doctors managing intestinal failure responded. All respondents indicated high fistula outputs as associated with intestinal failure. The aetiology of intestinal failure indicated was postoperative complications by 75% of the respondents. The majority of respondents (75%) indicated that keeping patients nil by mouth was common practice, 50% of respondents indicated routine usage of pharmacological agents to decrease output or transit time. All respondents gave the correct explanation of fistuloclysis with 50% currently using fistuloclysis.

Conclusion: Fistuloclysis is not superior, but equivalent to conventional methods of intestinal failure management. From this study and other available literature it is evident that fistuloclysis can replace PN support in selected patients. From the different occupation group surveys it is evident that there is a positive perception and awareness of fistuloclysis; however numerous stumbling blocks hamper the wider use of this novel treatment.

Afrikaanse Opsomming

Inleiding: Die ontwikkeling van intestinale versaking is die gevolg van diverse etiologieë en patofisiologiese oorsake. Fistuloklisie is 'n doeltreffende manier van voedingsondersteuning vir geselekteerde pasiënte. Hierdie studie was daarop gemik om die behandeling van volwasse pasiënte met intestinale versaking in hospitale in Suid-Afrika te ondersoek en te bepaal hoe prakties en aanvaarbaar fistuloklisie is.

Metodes: Die studie het bestaan uit drie fases. Fase 1 was 'n retrospektiewe rekordhersiening van volwasse pasiënte wat tussen Januarie 2009 en Mei 2014 in Groote Schuur Hospitaal se eenheid vir intestinale versaking opgeneem is. Data wat ingesamel is, sluit in demografiese gegewens, chirurgiese intervensies, gastro-intestinale anatomie, voedingsbehandeling, biochemiese merkers en vloeistofbalans. Fase 2 was 'n doelgerigte gevallestudie wat gepubliseer is in 'n vaktydskrif. Fase 3 het gebruik gemaak van beroepspesifieke vraelyste om huidige behandeling van pasiënte met tipe 2 en 3 tipe intestinale versaking in Suid-Afrikaanse hospitale te ondersoek, sowel as persepsies en menings oor fistuloklisie onder Suid-Afrikaanse dokters, stomaterapeute en dieetkundiges te bepaal.

Resultate: Fase 1: Sewentien pasiënte met intestinale versaking wat behandel is met fistuloklisie is ingesluit in die studie. Gedurende die fistuloklisietydperk was die mediaan uitskeiding 1 478ml per dag met 'n mediaan van 71% wat teruggeplaas is deur fistuloklisie. Vier pasiënte kon ontslaan word vir 'n mediaantydperk van 32,5 dae op fistuloklisie. Daar was 'n statisties beduidende toename in die mediaanalbumien vlak tussen dag 0 en dag 28 van fistuloklisie, maar liggaamsgewig het nie verbeter nie. Chirurgiese komplikasies het by slegs drie pasiënte voorgekom. Pasiënte is 'n mediaan van 12 dae na chirurgie ontslaan en alle pasiënte het voedingsoutonomie herwin.

Fase 3: Sewe en twintig dieetkundiges het aan die opname deelgeneem. Die meerderheid (67%) het een tot vyf jaar ondervinding gehad in die behandeling van pasiënte. Almal het aangedui dat hoë fisteldreinerings gedefinieer sou word as intestinale versaking. Slegs 47% het die korrekte definisie vir fistuloklisie gegee, terwyl 28% tans daarvan gebruik maak. Al die respondente het saamgestem dat

onsuksesvolle implementering van fistuloklisie te wyte is aan 'n tekort aan opleiding en weerstand van dokters en verpleegpersoneel.

Tien stomaterapeute het deelgeneem, maar slegs twee het voldoen aan die insluitingskriteria. Albei was werksaam in die privaatsektor, met >10jaar ondervinding in die behandeling van hierdie pasiënte. Slegs een het die vraelys verder voltooi.

Vier dokters het die vraelys voltooi. Almal het hoë fisteldreineringsgeassosieer met intestinale versaking. Die etiologie van die intestinale versaking is aangedui as chirurgiese komplikasies deur 75% van respondente. Die meerderheid van respondente (75%) het aangedui dat dit algemene praktyk is om pasiënte nil per mond te hou, terwyl 50% roetinegeweg farmakologiese middels voorskryf om dreinerings- of deurgangstyd te verminder. Al die respondente het die korrekte definisie van die term gegee terwyl slegs 50% tans fistuloklisie gebruik.

Gevolgtrekking: Fistuloklisie is gelykstaande aan konvensionele behandeling van intestinale versaking. Uit die resultate van hierdie studie en beskikbare literatuur is dit duidelik dat fistuloklisie parenterale voeding by gepaste pasiënte kan vervang. Uit beroepsopnames is daar 'n positiewe persepsie en bewustheid van fistuloklisie, maar ook talle struikelblokke wat die wyer gebruik belemmer.

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Contributions by principle researcher and fellow researchers

The principle researcher, Anna-Lena du Toit, developed the idea and the protocol for the research project. The principle researcher undertook all the data collection for analysis. The data was analysed with the assistance of a statistician, Ms T Esterhuizen. The principle researcher interpreted the data and drafted the thesis. The supervisors, Prof R Blaauw and Dr ABT Boutall, provided input at all stages of the project and reviewed the protocol and thesis.

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Abbreviations

CCK: Cholecystokinin

CIF: Chronic Intestinal Failure

CIPO: Chronic Intestinal Pseudo-Obstruction

DJ Flexure: Duodenal-jejunal flexure

EAF: Enteroatmospheric fistula

ESPEN: European Society for Clinical Nutrition and Metabolism

GH: Growth Hormone

GLP-1: Glucagon-like peptide 1

GLP-2: Glucagon-like peptide 2

HPN: Home parenteral nutrition

IF: Intestinal failure

IFALD: Intestinal failure associated liver disease

IM: Intramuscular

IV: Intra-venous

LCT: Long chain triglyceride

MCT: Medium chain triglyceride

PN: Parenteral nutrition

PPI: Proton Pump Inhibitors

PYY: Protein YY

SBS: Short bowel syndrome

SCFA: Short chain fatty acid

CHAPTER 1: INTRODUCTION

Intestinal failure (IF) and the complications and cost associated with parenteral nutrition (PN) support in this patient population are a reality at Groote Schuur Hospital. Owing to the nature and complexity of IF it often requires long-term hospitalisation and PN support to improve or maintain nutritional status, allow for enough time between surgeries for peritoneal adhesions to resolve and time to treat current complications before a patient can be considered for definitive surgery.^(1,2) Internationally, and at Groote Schuur Hospital, specialised units adhere to a waiting time before definitive surgery ranging between six weeks and six months.^(1,2) In a recent cost analysis done by the National Department of Health, PN was found to be under the top 10 pharmacy expenditures, contributing major costs to patient treatment.⁽³⁾ Groote Schuur Hospital started a unit specialising in managing IF patients in 2009 and currently has a six-bed cubicle within the colorectal surgery ward where these patients are managed. Fistuloclysis has been successfully implemented within this unit as a means of nutrition support and in doing so it has been possible to wean patients off PN support and eliminate the cost and negative side effects associated with it. Doctors, nursing staff, stoma therapists and dietitians involved in this unit are familiar with, and experienced in, the field of IF and fistuloclysis.

Fistuloclysis is an effective and feasible way of managing these patients and is often the only alternative to PN support.⁽⁴⁻⁶⁾ Fistuloclysis seems to be an underutilised method of nutrition support within the South African context. The purpose of this study was to describe a cohort of patients where fistuloclysis has been implemented successfully and to investigate how hospitals in South Africa manage IF patients. In addition the feasibility and acceptability of fistuloclysis in the greater setting was investigated. There is limited South African data available with regard to nutritional management of patients. Gathering this data would provide a baseline from which change could be initiated to optimise nutritional care and improve cost effectiveness. The study would also provide information on training needs and equipment available in other institutions. It would be possible to initiate training programmes and protocols to develop individuals to implement fistuloclysis in their care facilities.

An in-depth review of the current literature on IF and the management thereof was undertaken and is presented in Chapter 2 of this thesis. The practical experience of the principle investigator with the day-to-day management of these patients gave rise to the objectives of this study, which are presented together with the research methodology in Chapter 3. Three objectives were identified of which the results are presented in Chapter 4. The objectives of this study were quite diverse and therefore reporting of the results is done individually for each objective. Reporting of data was done in the form of articles, which also included a discussion of the literature and a conclusion. This format also necessitated referencing at the end of each article in Chapter 4. Chapter 5 is a discussion and conclusion section that aims to bring the diverse objectives together in order to draw final conclusions and make informed recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Intestinal failure

The concept of intestinal failure (IF) was first defined by Fleming and Remington in 1981 as “a reduction in the functional gut mass below the minimal amount necessary for adequate digestion and absorption of food”.⁽⁷⁻⁹⁾ This definition of IF has been revised by other authors since to include, among others, duration, stage, degree of impairment, underlying causes etc.⁽⁷⁾ In 2015 The European Society for Clinical Nutrition and Metabolism (ESPEN) published a consensus recommendation on the definition and classification of IF in adults.⁽⁷⁾ This recommendation includes a definition of IF, a functional and pathophysiological classification for acute and chronic IF and a clinical classification of chronic IF (CIF).

According to the ESPEN classification, IF can be defined as the reduction of gut function below the minimum necessary for absorption of macronutrients and/or water and electrolytes, such that intravenous (IV) supplementation is required to maintain health and/or growth.⁽⁷⁾

Balance study techniques, which compare nutrient requirement with nutrient absorption, would be the ideal way to identify and quantify IF in an individual patient.^(7,10) These metabolic studies are however not readily available, therefore the need for IV replacement of nutrients and/or fluids is used as the surrogate marker for the diagnosis of IF.⁽⁷⁾

Micronutrients are not included in the definition, and micronutrient deficiencies alone due to gut impairment are not classified as IF.⁽⁷⁾ In situations where the absorptive ability of the gut is impaired, but not to the degree that IV supplementation of fluid and/or nutrients is required to maintain health and growth, the condition can be referred to as “intestinal insufficiency”.⁽⁷⁾

2.1.1 Functional classification of intestinal failure

IF has been sub-divided into three types based on the onset and expected metabolic impact and outcome.^(7,11,12) The type of IF could predict morbidity, prognosis and financial implications.⁽¹³⁾ **Table 2.1** displays the functional classification of IF.

Table 2.1: Functional classification of intestinal failure

Type	Description	Management
Type 1	<p>Usually self-limiting, short term and often peri-operative.^(13–15)</p> <p>Mechanical intestinal obstruction and non-mechanical ileus.⁽¹⁴⁾</p> <p>Non-mechanical ileus secondary to:</p> <ul style="list-style-type: none"> • Abdominal surgery (15% of post-operative patients).⁽⁷⁾ • Intra-abdominal /retroperitoneal infection or inflammation. • Extra-abdominal causes, such as acute spinal cord injury, head injury, pneumonia, hip fractures and multiple organ failure.^(7,14,16) <p>Less commonly type 1 Intestinal failure could be the result of severe enteric infection, inflammatory bowel disease, radiotherapy or chemotherapy.⁽¹⁴⁾</p>	<p>7 – 14 days Conservative management, nasogastric drainage and might require short term parenteral nutrition support.^(14,16)</p>
Type 2	<p>Not self-limiting, with the exception of patients with simple intestinal fistulation where spontaneous closure may occur with effective nutritional and medical support.⁽¹⁴⁾</p> <p>Sepsis and fistulation are the primary factors associated with type 2 intestinal failure in more than 70% of patients.⁽¹⁴⁾</p> <p>Approximately 10% of patients will also have significant reduction in intestinal length at time of diagnosis.⁽¹⁴⁾</p> <p>Higher incidence of mortality.^(7,14)</p>	<p>Early diagnosis and treatment of abdominal sepsis.</p> <p>Adequate nutrition support, usually in the form of parenteral nutrition.⁽¹⁴⁾</p> <p>Outcome⁽⁷⁾</p> <ul style="list-style-type: none"> ○ 40% - Full intestinal rehabilitation. ○ 10% - Dependency on enteral nutrition (including distal feeding tubes). ○ 50% - Result in Type 3 intestinal failure and requiring home parenteral nutrition.
Type 3	<p>Chronic condition in a metabolically stable patient.^(7,13,15)</p> <p>An estimated 50% of Type 2 intestinal failure patients will develop Type 3 intestinal failure.⁽⁷⁾</p>	<p>Long-term parenteral nutrition support, often for years, with careful monitoring for complications.^(7,13,15)</p> <p>Chronic intestinal failure secondary to benign cause might be a reversible condition with 20% – 50% of patients being weaned of home parenteral nutrition within one to two years of starting.⁽⁷⁾</p>

2.1.2 Pathophysiological classification of intestinal failure

The first classification of IF based on the underlying cause was done in 1991 and has been developed further in the years that followed.^(7,17) The term 'pathophysiological' describes the primary underlying pathology that is responsible for the manifestation of IF.⁽⁷⁾

This classification includes five primary pathologies that would result in IF:⁽⁷⁾ (**Table 2.2**)

- Short bowel syndrome
- Intestinal fistula
- Intestinal dysmotility
- Mechanical obstruction
- Extensive small bowel mucosal disease

Each of these pathologies has multiple possible underlying causes, which will be discussed in further detail.

2.1.2.1 Short bowel syndrome

Short bowel syndrome (SBS) could result from extensive surgical resection due to a number of aetiologies or as a result of congenital diseases of the small intestine.^(7,18–20) The normal length of the small bowel differs significantly, from 300 to 850cm.^(7,12,18,19,21,22) The absorption of carbohydrates and protein takes place mostly in the duodenum and jejunum, while the ileum is responsible for absorption of most lipids bound to bile salts.^(19,20,22) The clinical manifestation of SBS is associated with less than 200cm of the small bowel remaining in continuity, even if the total length of the small bowel including the part that is bypassed or in discontinuity is of normal length.^(7,18,22) Although length of remaining bowel correlates well with a patient's degree of nutritional autonomy; the remaining anatomy, integrity and function of the available bowel, the underlying conditions and the ability of the bowel remnant to adapt is a big determining factor.^(7,12,19–21) Conditions leading to SBS most commonly affect the jejunoileal segment and less commonly the colon.⁽²³⁾ SBS is the leading cause of type 3 IF and accounts for around 75% of adults and 50% of children receiving home parenteral nutrition (HPN) in Europe.⁽⁷⁾

The pathophysiological manner in which SBS causes IF is due to extensive loss of absorptive surface area.^(7,22) **Table 2.2** sets out the most frequent underlying causes leading to the pathophysiological condition.

Table 2.2: Pathophysiological classification of intestinal failure with most frequent underlying causes. (adapted from Pironi *et al.* 2014⁽⁷⁾)

Pathophysiological classification	Most frequent underlying causes *This list is not exhaustive of all causes
Short Bowel Syndrome	<p>Extensive surgical resection for:</p> <ul style="list-style-type: none"> – Mesenteric infarction – Crohn’s disease – Radiation enteritis – Surgical complications necessitating extensive resection – Intestinal volvulus – Abdominal trauma resulting in significant bowel resection – Necrotizing enterocolitis – Complicated intussusception <p>Congenital causes:</p> <ul style="list-style-type: none"> – Gastroschisis – Intestinal malformation – Omphalocele
Intestinal Fistula	<p>Inflammatory</p> <ul style="list-style-type: none"> – Inflammatory bowel disease – Pancreatic disease – Radiation enteritis <p>Neoplastic</p> <p>Infectious diseases</p> <ul style="list-style-type: none"> – Tuberculosis <p>Trauma</p> <p>Presence of foreign bodies</p> <p>Iatrogenic injury</p>
Intestinal dysmotility	<p>Acute</p> <ul style="list-style-type: none"> – Post operative ileus – Systemic inflammatory or neurological reaction associated with critical illness – Ogilvie syndrome (acute colonic non-mechanical obstruction) <p>Chronic intestinal pseudo-obstruction (obstructive symptoms present for at least 6 months)</p> <ul style="list-style-type: none"> – Primary/Idiopathic <ul style="list-style-type: none"> – Neuropathic: inflammatory/degenerative injury to the enteric nervous system – Myopathic: Damage to the smooth muscle – Mesenchymopathy: injury of the interstitial cells of Cajal – Secondary <ul style="list-style-type: none"> – Collagen vascular disease: primary systemic sclerosis, systemic lupus erythematosus, rheumatoid arthritis, mixed connective tissue disorders, – Endocrine disorders: Diabetes, hypothyroidism, hypoparathyroidism, hyperparathyroidism – Neurological disorders: Parkinson disease, Alzheimer disease, Hirschsprung disease – Medication associated: tricyclic antidepressants, anticholinergic agents, ganglionic blockers, anti-Parkinsonian agents, clonidine, phenothiazines – Paraneoplastic: Central nervous system neoplasm, lung microcytoma, bronchial carcinoma – Miscellaneous: <ul style="list-style-type: none"> – Coeliac disease – Infiltrative disorders (amyloidosis, lymphoma) – Alcohol abuse

	<ul style="list-style-type: none"> - Post-infectious processes (bacterial, viral, parasitic) - Radiation - Vascular insufficiency - Metabolic (hypokalaemia, hypomagnesaemia) - Post-surgical - Post-organ transplant
Mechanical Obstruction	<p>Physical obstruction</p> <ul style="list-style-type: none"> - Intussusception - Gallstones - Foreign bodies - Bezoars - Faecal impaction <p>Intrinsic bowel lesions</p> <ul style="list-style-type: none"> - Stenosis or strictures - Neoplastic - Stenosis or strictures secondary to inflammatory bowel disease - Anastomotic stricture <p>Extrinsic bowel lesions</p> <ul style="list-style-type: none"> - Abdominal adhesions secondary to previous surgery or peritonitis - Frozen abdomen - Hernias - Peritoneal metastasis - Volvulus - Congenital bands
Extensive Small Bowel Mucosal Disease	<ul style="list-style-type: none"> - Microvillus atrophy - Intestinal Epithelial Dysplasia - Autoimmune enteropathy - Intestinal lymphangectasia - Protein losing enteropathy - Crohn's disease - Coeliac disease - Radiation enteritis - Chemotherapy related enteritis - Congenital diseases

The three most common types of intestinal resections resulting in SBS are jejunioileal, jejunocolic and jejunostomy.⁽¹¹⁾

2.1.2.1.1 Jejunioileal anastomosis

With a jejunioileal anastomosis, a portion of the jejunum and often a part of the ileum have been resected and the remaining parts are anastomosed.⁽¹¹⁾ Patients retain the terminal ileum, ileocaecal valve and colon.⁽¹¹⁾ The structural adaptation of the ileum is far greater than that of the jejunum and therefore proximal bowel resections are better tolerated.⁽¹⁹⁾ Patients rarely present with major nutrient or electrolyte deficiencies because the remaining ileum and colon will compensate adequately for the resected portion of the bowel.^(11,19) The tight junctions between enterocytes in the ileum are far less permeable than that of the jejunum therefore less water enters the

lumen of the ileum following the ingestion of a hyperosmotic meal.⁽¹¹⁾ Furthermore the colon has great water and electrolyte absorption capability.⁽¹¹⁾ Under normal conditions the colon absorbs approximately 1,9 litres of water per day, but has the potential to absorb up to 5 litres of fluid per day.^(11,21) The colon can also utilise maldigested carbohydrates and proteins through anaerobic bacterial fermentation providing an additional source of nutrition.^(11,12,21,22) Patients with colon continuity can salvage up to 1 000 additional calories per day from unabsorbed carbohydrates.⁽²¹⁾

Most patients with jejunioileal anastomosis have an intact duodenum and part of the jejunum, therefore site-specific digestion is not compromised and development of nutrient deficiency is relatively infrequent.⁽¹¹⁾

Jejunal resection could result in decreased secretion of regulatory hormones by the jejunal cells.⁽¹¹⁾ This could lead to gastric hypersecretion in the acute postoperative stage due to loss of cholecystokinin (CCK) and secretin feedback inhibition mechanisms.^(11,22) Gastric hypersecretion could lead to a decrease in the pH of the proximal intestine with denaturation of pancreatic enzymes and impaired digestion.⁽¹¹⁾ This phase is usually self-limiting, lasting a few weeks to months, and can be treated successfully with proton pump inhibitors (PPI) or an H₂ antagonist.⁽¹¹⁾

2.1.2.1.2 Jejunalcolic anastomosis

Ileal resections generally result in more complicated disease owing to the decreased adaptive capacity of the jejunum.^(11,24) Patients with ileal resections are more likely to present with diarrhoea due to the decreased capacity of the jejunum to absorb water and the added strain on the colon.⁽¹¹⁾ If the colon is also partly resected, in addition to the ileum, diarrhoea symptoms could be worse.⁽¹¹⁾ With ileal resection some of the specific functions of the ileum will be impaired, such as Vitamin B₁₂ absorption and bile salt re-absorption.^(11,19,20) Patients who undergo distal ileum resection (>60cm) should typically be supplemented intramuscularly (IM) with Vitamin B₁₂.^(11,21,22) Ileal resection of >100cm results in a net loss of bile salts and can lead to fat malabsorption, fat-soluble vitamin deficiencies, steatorrhea and choleric diarrhoea.^(11,19-22) In balance studies investigating the result of bowel resection on macronutrient absorption it has been shown that, with a bowel remnant of between 30 and 100cm post duodenal-jejunal (DJ) flexure, carbohydrate and lipid absorption

was decreased to 75% and 50% respectively while protein absorption remained high at 80%.⁽¹⁹⁾

Hormonal mediators of digestion synthesised by enteroendocrine cells in the ileum and colon are also affected by resection.⁽¹¹⁾ Glucagon-like peptide – 1 (GLP-1), Glucagon-like peptide – 2 (GLP-2) and Protein YY (PYY) are up-regulated following ileal resection if the colon remains in continuity.^(11,22,25) GLP-1 and PYY both suppress gastric emptying, gastric acid secretion and small bowel motility.^(11,22,25) Therefore patients with ileal resection, but colon remaining in continuity, have normal gastric emptying and transit time.^(11,22) Gastric acid hypersecretion is less severe after ileal resection than following jejunal resection.^(11,22) An up-regulation of GLP-2, an intestinotrophic peptide hormone, leads to increased villus height and crypt cell proliferation and thus mediates intestinal adaptation following resection.⁽¹¹⁾

2.1.2.1.3 Jejunostomy

Patients with an end-jejunostomy, i.e. ileum and colon resected, have the most profound malabsorptive complications.⁽¹¹⁾ These patients have the same loss of water absorptive capacity as patients with ileum resection, but also lack the water- and electrolyte-absorption ability and energy salvaging capabilities of the colon.^(11,12,21,22)

Patients with less than 100cm of remnant bowel tend to require long-term PN since their stoma output of fluid and salts exceed their intake owing to lack of gastric secretion reabsorption.⁽¹¹⁾ Due to the extent of bowel resection, these patients also lack the specific absorption sites for Vitamin B₁₂ and bile salts.^(11,19,20) Other nutrients that are absorbed in the distal small intestine or colon, like magnesium, will similarly be affected and give rise to the hypomagnesaemia, which is, despite oral magnesium supplementation often observed in these patients.⁽¹¹⁾

Due to the lack of colon, patients with an end-jejunostomy do not experience up-regulation of GLP-1, GLP-2 and PYY and experience increased gastric emptying and intestinal transit.⁽¹¹⁾ This leads to decreased contact time between the nutrients and the mucosa for digestion and absorption.⁽¹¹⁾

All SBS patients will require PN support in the immediate postoperative phase to maintain nutritional status.⁽²³⁾ Some patients can be weaned off PN while others might require long-term PN support. Patients with a very short remnant bowel and patients absorbing less than a third of their intake typically require long-term PN support.

SBS with permanent PN dependence is strongly related to a small bowel length of <50cm post duodenum and to the absence of ileum and/or colon in continuity.⁽²⁶⁾ Values separating transient and permanent IF differ according to anatomy and are 100cm for an end-enterostomy, 65cm for a jejunocolic anastomosis and 30cm for a jejunoleocolic anastomosis.⁽²⁶⁾ PN dependence at five years is around 45%.⁽²⁶⁾

Patients with SBS can be classified according to their PN or IV support needs as intestinal insufficiency or IF.⁽²³⁾ Patients with intestinal insufficiency will be able to wean off PN, skip PN days or not require PN support at all and be able to maintain nutritional status through hyperphagia.⁽²³⁾ Hyperphagia is defined as a >1,5-fold increase in caloric requirements over the resting energy expenditure.⁽²³⁾

2.1.2.1.4 Bowel adaptation

Extensive intestinal resection is followed by three phases of adaptation.⁽²⁷⁾

1. The acute phase: This phase starts immediately following resection and last for a period of approximately four weeks.^(22,27) During this stage the intestinal mucosa and peristalsis adjust to the new environment.⁽²⁷⁾
2. The adaptation phase: Lasts for one to two years. Patients usually require PN or enteral nutrition support until adequate intestinal adaptation has occurred to maintain nutritional status without artificial nutritional support.^(22,27)
3. The maintenance phase: During this phase nutrition treatment should be individualised according to patient requirements and deficiencies.^(22,27)

Bowel adaptation usually occurs within the first two years following the last surgical intervention.^(20,22,23) The degree of adaptation is related to the extent of the resection, as well as the anatomy of the remnant bowel.^(20,24,28) Structural and functional changes occur in the remnant bowel which improves nutrient and fluid absorption.^(20,22,24,28) Structural changes include hyperplasia, angiogenesis, bowel

dilation and bowel elongation.^(20,28) A study by Joly *et al.* showed a 35% increase in crypt depth and a 22% increase in number of cells/crypt in the colon of 12 patients with jejunocolic anastomosis.⁽²⁸⁾ Functional changes include increased expression of transporter proteins and exchangers involved in nutrient and electrolyte absorption, as well as an accelerated maturation of enterocytes.^(20,28) This leads to increased digestive and absorptive capacity of the remnant bowel.⁽²⁸⁾ Another functional adaptation is reduced transit time, allowing for slower transit of nutrients through the intestine and thus longer contact time for absorption.⁽²⁸⁾ Patients with ileal resection and colon in continuity have higher plasma levels of PYY that delay gastric emptying and increase transit time.⁽²⁸⁾ A publication by Nightingale *et al.* states that there is no evidence of any functional or structural adaptation in patients with end-jejunosomies, therefore change in nutritional and fluid needs are unlikely with time.⁽²⁵⁾

Factors that play a role in intestinal adaptation include the anatomic features, enteral stimulation, hormones and growth factors.^(28,29) Enteral stimulation is required to maintain gut integrity.⁽²⁸⁾ In the absence of luminal nutrients, mucosal atrophy and a decrease in enzyme and nutrient transporter activity occur, even with adequate calorie and protein provision via PN support.^(28,30) This atrophy is reversible with the re-introduction of enteral nutrition.⁽²⁸⁾ Luminal nutrients enhance bowel adaptation following resection and increased nutrient complexity is associated with improved adaptation.^(20,28,29) Individual nutrients have also been identified to promote adaptation.⁽²⁸⁾ Fat seems to improve bowel adaptation and has been associated with significantly increased bowel weight and villus height in animal studies.⁽²⁸⁾ Long-chain triglycerides (LCT) are superior to medium chain triglycerides (MCT) in promoting hyperplasia following bowel resection.^(28,29) Short chain fatty acids (SCFA) have also been shown to enhance intestinal adaptation, although data are sparse.^(28,29)

Glutamine is a primary fuel source for enterocytes and has been shown to counteract PN-induced intestinal atrophy and improve bowel adaptation when supplemented in PN.^(28,29) Glutamine administered via the enteral route has not shown a positive effect on structural or functional bowel adaptation.^(22,28) Glutamine and growth hormone (GH) has shown some efficacy.⁽²⁸⁾

In terms of intestinotrophic factors, recombinant human GH (somatropin) and GLP-2 analog, teduglutide, are approved for clinical use in adult patients with SBS.^(20,28) GLP-2 is an intestinotrophic peptide which is secreted by the L cells in the terminal ileum and colon in response to the presence of nutrients in the gut lumen and induces structural and functional adaptations in the small bowel.^(20,22)

According to consensus data most of the adaptation occurs within the first two years following resection, although some studies have suggested significant improvement beyond two-years.⁽²⁸⁾ Adaptation after two years is uncommon and limited to a maximum improvement of 5 to 10 % in absorptive capacity.⁽²³⁾ Citrulline is a non-essential amino acid produced exclusively by enterocyte. Plasma levels of citrulline act as a functional marker of intestinal function and levels of <20µmol/L have been found to correlate with PN dependence at two years post resection.^(20,22,24) Inability to wean a patient off PN or IV support after two years has a 95% likelihood of permanent IF.^(20,23,26)

2.1.2.1.5 Short bowel syndrome complications

Complications related to bowel resection can extend to tissues and organ systems beyond the gastrointestinal tract.⁽¹¹⁾

Ileum resections of more than 60 to 100cm usually result in the enteric loss of bile acids exceeding the synthetic capacity, resulting in a decline in the bile acid pool.⁽²⁷⁾ Bile acid malabsorption resulting in bile salt deficiency prevents solubilisation and absorption of fatty acids and results in steatorrhea, malnutrition and fat-soluble vitamin deficiency.^(11,27,30) Decreases in the bile salt concentration of bile acids accompanied by increased secretion of cholesterol into bile, lead to the formation of lithogenic bile which in turn leads to an increased incidence of gallstones.^(19,25) Drugs that are excreted via bile have their action prolonged by the enterohepatic circulation; therefore disruption of this circulation impacts on the bioavailability of drugs.⁽³¹⁾ These drugs include mycophenolic acid, warfarin, digoxin, oral contraceptives, cyclosporine, tacrolimus and statins.⁽³¹⁾ Malabsorption of fat-soluble vitamins also affects the absorption of the drugs that interact with them, for instance warfarin, hydrocortisone, estrogen, other sex hormones and cyclosporine.⁽³¹⁾ This

might become problematic in the setting where patients are dependent on immunosuppressive or oral contraceptive therapy.⁽³¹⁾

Unabsorbed fatty acids bind to intraluminal calcium.^(11,21,22) Calcium would under normal conditions bind to oxalate and be excreted in the stool.^(11,21,22) Furthermore the presence of bile salts in the colon promotes the absorption of oxalate in the colon.⁽¹⁹⁾ Owing to the calcium fatty-acid soaps that form there is a lot of free oxalate available for absorption in the colon.^(11,21) Oxalate is excreted by the kidneys and the increased load could lead to the formation of oxalate kidney stones.^(11,21,25) An estimated 60% of patients with SBS develop hyperoxaluria while up to 25% of patients with jejunocolic anastomosis and <200cm of small bowel remnant present with oxalate kidney stones.^(11,25) Patients with ileal resections and colon in continuity should follow a diet low in oxalate and increase calcium intake.^(11,27) The addition of cholestyramine to bind bile salts in the colon can also be considered.⁽¹⁹⁾

Another consequence of bile salt malabsorption and a diminished bile acid pool is that insufficiently solubilised cholesterol supersaturates bile and leads to cholesterol gallstone formation.⁽¹¹⁾ High levels of bile salts in the colon lead to solubilisation of unconjugated bilirubin and promote the absorption thereof, this leads to a three to 10-fold increase in the bilirubin level in the bile of patients with ileal resections and predisposes them to the formation of pigment gallstones.⁽²⁷⁾ Other contributing factors to gallstone formation are decreased gallbladder contractility and hypersecretion of mucin, a nucleation-promoting protein.⁽¹¹⁾ Gallstones occur in 25 to 45% of SBS patients with cholecystitis developing in up to 10% of patients. A shorter intestinal remnant, Crohn's disease, absence of an ileocaecal valve and long-term PN dependence correlate with higher risk of developing gallstones. Colon continuity plays no role in the prevalence of gallstone formation.⁽¹¹⁾

Although the colon has a much smaller role in terms of absorption compared to the small intestine it has several carrier-mediated transport systems used for colonic absorption of pharmacological agents. Furthermore, drugs that are not completely absorbed in the small intestine might continue to be absorbed in the colon. Rectal delivery of drugs by means of suppositories is an alternative route for the effective administration and absorption of drugs. When a patient has no colon the absorption

site for some drugs are removed. One affected group is drugs with an extended release like β -blockers and antihypertensives.⁽³¹⁾

Drugs delivered in pill or capsule form have the potential to cause obstruction of stomas or strictures if they are not dissolved fully. Particular attention should be paid to erosive drugs that can cause damage to the intestine just proximal to the stoma or stricture if they get stuck. Consideration should be given to change to drugs in liquid formulation, intramuscular formulations or intranasal formulations.⁽³¹⁾

2.1.2.2 High-output fistulae

A fistula is defined as an abnormal communication between two epithelial-lined surfaces.^(2,7,32-35)

There are several ways to classify fistulae, which may be based on the anatomy, physiology or aetiology.⁽³³⁻³⁷⁾ For the purpose of this review, we will focus on the three most common classifications.

Anatomically a fistula is classified according to the segment of gut it originates from and the organs involved.^(7,34,38) A gastrointestinal fistula can develop between the gut and the skin (enterocutaneous), referred to as an external fistula, or between the gut and another adjacent viscus (enteroenteric), referred to as an internal fistula.^(33,36,37,39) The high pressure organ from which the fistulae arise is named first.⁽³⁸⁾

The *physiological* classification of fistulae is based on the output.^(7,36,38,40) Less than 200ml effluent per day is considered low output while 200 to 500ml per day is classified as moderate output.^(7,34,36,37,40) A fistula effluent of more than 500ml per day in the fasted state is considered as a high-output fistula and is associated with a higher morbidity and mortality.^(7,32,34,36,40) Edmunds *et al.* demonstrated a mortality rate of 54% in patients with high output fistulae while patients with low-output fistulae had a mortality rate of 16%. This was supported by Levy *et al.*, who demonstrated a mortality rate of 50% and 26% respectively in patients with high- and low-output fistulae.⁽³⁶⁾

Fistulae can be classified as primary (type 1) or secondary (type 2) according to the *aetiology*.^(33,39) Primary fistulae develop as a result of an underlying disease, while secondary fistulae are the result of insult or injury to a previously healthy bowel.^(33,39)

Table 2.2 lists the possible causes that could result in fistulae. **Table 2.3** lists primary and secondary fistulae causes. An estimated 75% to 85% of fistulae arise from surgical complications.^(7,32,35–37,41–43) These usually present five to 10 days after surgical intervention.^(2,7,32) The remaining 15% to 25% of complications arise from underlying pathology.^(7,42,43)

Crohn's disease is a major contributor to secondary fistula development.^(7,32,42) An estimated 40% of patients with Crohn's disease will develop a fistula in the course of their illness.⁽³²⁾ In developing countries spontaneous fistulisation might occur in the presence of complicated infectious diseases such as abdominal tuberculosis, amoebiasis and typhoid.⁽⁴²⁾

Table 2.3: Causes and risk factors for primary and secondary fistulae^(33,39)

Primary (Type1)	Secondary (Type2)
Crohn's Disease	Risk factors:
Diverticular Disease	– Anastomotic Failure
Malignancy	– Breakdown of repaired enterotomy
Necrotizing Pancreatitis	– Iatrogenic Injury
Radiation Enteritis	– Peritonitis
Bowel obstruction with perforation	– Trauma
Infection:	– Prosthetic Mesh
– Tuberculosis	– Hepatic/renal insufficiency
– Actinomycosis	

An enteroatmospheric fistula (EAF) is a sub-set of fistulae that arise in the setting of an open abdomen with exposed viscera.^(34,35,40,44) Patients with open abdomens present a high risk for the development of fistulae with an incidence of 5 to 19%.⁽⁴⁰⁾ The longer the abdomen remains open with a temporary dressing the higher the likelihood of developing an EAF.⁽⁴⁰⁾ This type of fistula is almost exclusively described in traumatically injured or critically ill patients.⁽⁴⁴⁾ This patient population present with a unique risk for fistulisation due to intentional or unintentional bowel

injury, intra-abdominal infections and decompression for abdominal compartment syndrome.⁽⁴⁴⁾

The pathophysiological manner in which fistulae cause IF is the enteric content being lost through a proximal opening or by bypassing a significant segment of gut in the case of internal enteroenteric fistulae.^(7,33,38) This effectively leads to a situation of 'short bowel'.^(7,42)

Fistula closure can happen spontaneously or by surgical intervention.^(32,42) Generally patients presenting with type 1 intestinal fistulae will require resection of the diseased segment of bowel, while type 2 fistulae have the potential to close spontaneously.⁽³⁹⁾ Dense adhesions form in the abdomen following major abdominal surgery.⁽⁴²⁾ This is usually at its most severe between three weeks and three months following surgery.⁽⁴²⁾ Attempts to re-enter the abdomen during this period could result in further complications.⁽⁴²⁾ It is therefore recommended to postpone surgery, which also allows time for correction of metabolic and nutritional derangements.⁽⁴²⁾

Several factors impact on the likelihood of spontaneous closure of a fistula, as indicated in Table 2.4^(32,36,39,42)

Table 2.4: Factors that impair spontaneous fistulae closure^(32,36,37,39,43)

- Age >65 years
- Malnutrition and transferrin <200mg/dL
- Discontinuity of bowel ends
- Distal obstruction
- Chronic abscess
- Malignancy involving the gastro-intestinal tract
- Organ involved: stomach, duodenum, ileum
- Fistula duration: > 4 – 6 weeks
- Fistula output >500ml
- Etiology: Inflammatory bowel disease, malignancy, radiation enteritis
- Co-morbidities: sepsis, diabetes, renal failure, current chemotherapy or radiation therapy or corticosteroid treatment
- Fistula presentation:
 - External, complex, multiple or end fistula
 - Fistula tract <2cm or defect >1cm

- Eversion of mucosa or distal occlusion
- Poor or diseased adjacent bowel
- Presence of abscess or foreign body
- Presence of abdominal wall defect
- Management errors:
 - Failure to diagnose an anastomotic leak
 - Delay in surgical exploration
 - Attempt to restore intestinal continuity too early
 - Failure to initiate nutrition support

2.1.2.2.1 Nutritional management of high-output fistulae

Up to 70% of patients with fistulae present with malnutrition.^(32,43) The presence of malnutrition can be defined as a 10% loss of body weight and the presence of hypoproteinemia.⁽⁴³⁾ In a study by Fazio *et al.*, albumin levels of >35g/l were associated with no mortality, while patients with serum albumin <25g/l had a mortality rate of 42%.⁽⁴³⁾ This has been confirmed by Visschers *et al.* in 2008 demonstrating no mortality in patients with pre-operative serum albumin levels >25g/l, while 32% of patients with a level <25g/l died.⁽⁴⁵⁾ Serum transferrin levels also have a strong association with mortality and fistula closure.^(43,46)

In a study by Chapman *et al.*, there was a dramatic decrease in mortality associated with a calorie intake of >1 500kCal/day.⁽⁴¹⁾ Mortality decreased from 58% to 16%.⁽⁴¹⁾ Furthermore, patients who, were able to maintain optimal nutrition, defined as >3 000kCal/day, had an even lower mortality rate, 12%, and fistula closure rates approaching 90%.⁽⁴¹⁾ The majority of these patients were maintained on enteral nutrition.⁽⁴¹⁾ Enteral nutrition support is the preferred route of nutrition support, unless it increases fistula output dramatically or causes increased abdominal pain or exacerbates diarrhoea.^(8,32,41) Enteral nutrition as opposed to PN has several advantages, in particular with regard to improved intestinal barrier function and reduced rate of infectious complications.^(2,4) In the patient with IF the part of intestine deprived of nutrition for an extended period of time will have marked atrophy, resulting in disparity between bowel ends and poor quality tissue for anastomosis when restorative surgery is performed.⁽⁴⁾ Bowel absorptive capacity should be sufficient for successful implementation of enteral nutrition support.⁽³³⁾ Patients with

fistulae should be able to tolerate polymeric enteral formula, unless they have less than 120cm of bowel left, have documented intolerance to polymeric feed or are experiencing high fistula output.⁽⁴⁰⁾ In that case patients should be changed to a semi-elemental or elemental enteral product.⁽⁴⁰⁾ The literature suggests absolute contra-indications to enteral nutrition include bowel discontinuity or insufficient bowel length, usually <75cm.^(35,40)

Patients should be allowed to take food or fluids orally if they wish to do so for the psychological benefits derived from this.⁽⁴⁰⁾ Oral intake should be abandoned if fistula output increases to unmanageable levels in terms of volume and electrolyte abnormalities.⁽⁴⁰⁾ Oral intake of large volumes of fluid can stimulate increased losses from the fistula together with high losses of electrolytes.⁽³³⁾ The type of fluid is important and patients should be encouraged to take isotonic fluids orally.^(33,42) The nutritional requirements of patients with high- or low-output fistulae are displayed in **Table 2.5.**

Table 2.5: Nutritional Requirements^(32,35,36,40,41,43)

	Energy	Protein	Micronutrients
Low output Gastro-intestinal fistula	REE or 25kCal/kg/day TE	1 – 1,5g/kg	RDA High risk for VitB ₁₂ , Zn, Mg and selenium deficiency
High output Gastro-intestinal fistula	1,5x REE or 30kCal/kg/day TE	1,5 – 2g/kg	2 x DRI of vitamins and trace elements. 5 x DRI for Vit C and Zn High risk for VitB ₁₂ , Zn, Mg and selenium deficiency

2.1.2.2.2 Pharmacological management of high output-fistulae

Drug therapy plays an important role in the management of high-output fistulae and SBS. It can be divided into antimotility or antisecretory drugs.^(33,41,42)

Antimotility drugs such as loperamide and codeine phosphate can decrease sodium losses by approximately 30%.^(25,33,35) Loperamide should be taken 30 minutes prior to meals.^(20,41)

Antisecretory drugs include PPI and somatostatin or octreotide.^(36,41) The disturbance in the CCK and secretin feedback mechanism in patients with entero-cutaneous

fistula may result in increased gastric hypersecretion.⁽⁴¹⁾ PPIs can be administered to reduce gastric secretions.^(33,36) Somatostatin or somatostatin analogues might be helpful in decreasing gastric secretions and output.^(33,35,36,42) The effectiveness of somatostatin is very limited owing to its extremely short half-life, approximately one to three minutes.^(34,42,43) The somatostatin analogue, octreotide, has a longer half-life of two hours and has shown promise in reducing fistula output by 40% to 93%.^(34,40,42,43) Octreotide can however negatively affect immune function due to GH inhibition.^(34,40) Studies demonstrating an improvement in fistula output with the use of octreotide have failed to show any benefit in terms of efficacy relating to fistula closure.^(36,41,43)

Although reduction in fistula output by means of pharmacotherapy has not shown any benefit in the closure of fistulae, it does provide other advantages in terms of electrolyte imbalances, improved wound care and higher likelihood of tolerating enteral or oral nutrition.^(35,40,41)

Pharmacotherapy aimed at reducing stoma or fistula output could potentially impact on the absorption of other pharmacological formulations.⁽³¹⁾ PPIs and H₂ receptor antagonists can increase or decrease the bioavailability of other drugs.⁽³¹⁾ An increase in the pH of the stomach impairs the absorption of drugs that are weak bases, for example antifungals (ketoconazole, itraconazole, and griseofulvin), antiretrovirals (atazanavir, cefpodoxime, enoxacin and dipyridamole), Vitamin B₁₂ and iron salts.⁽³¹⁾ On the other hand an increase in stomach pH increases the bioavailability of digoxin, nifedipine and alendronate.⁽³¹⁾ If PPIs are used, alternative administration of the affected drugs should be considered.⁽³¹⁾

2.1.2.3 Intestinal dysmotility

The term intestinal dysmotility refers to the presence of a disorder that impairs the propulsion of gut content in the absence of an obstruction. It can be further divided into loco-regional, indicating that an isolated segment is affected (eg. Achalasia and gastroparesis) or multi-regional, involving more than one part of the gastrointestinal tract, often the small intestine. Intestinal dysmotility can present as type 1 IF in the case of acute postoperative ileus or critical illness-associated ileus. Dysmotility often presents as a result of systemic or intra-abdominal inflammation as type 2 IF. CIF,

associated with dysmotility, is referred to as chronic intestinal pseudo-obstruction (CIPO) with the 'pseudo' indicating the absence of an occluding lesion. CIPO can be divided into congenital causes, which are more prevalent in children, or acquired causes, with a higher prevalence in adults.⁽⁷⁾ **Table 2.2** indicates the possible causes of intestinal dysmotility.

Histologically CIPO can be divided into three categories:⁽⁷⁾

- Neuropathies involving the enteric nervous system and/or autonomic nervous system
- Myopathies involving the smooth muscle
- Mesenchymopathies involving the interstitial cells of Cajal.

The primary pathophysiology in intestinal dysmotility that gives rise to IF is the intolerance to oral or enteral nutrition resulting in inadequate nutrient intake. Generally the mucosal surface is preserved. Secondary mechanisms that play a part are the malabsorption of nutrients due to bacterial overgrowth in stagnant bowel loops as well as increased intestinal losses of fluids and electrolytes due to increased secretions in dilated bowel loops. Intestinal resection in an attempt to eliminate symptoms might also play a role.⁽⁷⁾

2.1.2.4 Mechanical obstruction

Mechanical obstruction refers to a physical abnormality occluding the intestine. This could be intraluminal (eg. foreign bodies), intrinsic (eg. stenosis), or extrinsic (eg. frozen abdomen). Furthermore these might be of benign or malignant origin. Possible causes of mechanical obstruction are listed in **Table 2.2**.

It could present as a type 1 IF which presents acutely and resolves within days with conservative management or surgery. It may also present as a type 2 or 3 IF with a prolonged course.⁽⁷⁾

The pathophysiological mechanism of IF due to mechanical obstruction is the spontaneous or prescribed ceasing of oral intake. Secondary to that, increased intestinal losses of fluids and electrolytes into distended bowel loops as well as due to vomiting or increased nasogastric drainage adds to the manifestation of IF.⁽⁷⁾

2.1.2.5 Extensive small bowel mucosal disease

Extensive small bowel mucosal disease refers to a condition where there is intact or almost intact, but inefficient mucosal surface. There is a reduction in nutrient absorption and/or an increase in nutrient loss via the mucosa to the point where the nutritional needs cannot be met.⁽⁷⁾ Possible causative diseases are listed in **Table 2.2**.

2.1.3 Clinical classification of intestinal failure

The ESPEN expert committee involved in the development of the consensus guidelines on IF agreed on the need for a clinical classification of IF to facilitate communication among healthcare professionals as well as for use in clinical practice and standardisation of research. There were no published data available to use as a basis and therefore the classification was based on the experience of the ESPEN expert panel. This classification only refers to type 3 CIF and is based on the average daily IV energy and fluid supplementation requirements of a patient, categorised into 16 subtypes of IF.⁽⁷⁾ **Table 2.6** illustrates the clinical classification of chronic IF.

Table 2.6: Clinical classification of chronic intestinal failure⁽⁷⁾

^a IV energy Supplementation (kCal/kg Body Weight)	^b Volume of IV fluid supplementation			
	≤ 1000 (1)	1001 – 2000 (2)	2001 – 3000 (3)	>3000 (4)
0 (A)	A1	A2	A3	A4
1 – 10 (B)	B1	B2	B3	B4
11 – 20 (C)	C1	C2	C3	C4
> 20 (D)	D1	D2	D3	D4

^a Calculated as daily mean of the total energy infused per week = (energy per day of infusion x number of infusions per week)/7

^b Calculated as daily mean of the total volume infused per week = (volume per day of infusion x number of infusions per week)/7

2.2 Prevalence and prognosis of intestinal failure

Type 1 IF is a relatively common occurrence, a 2010 United Kingdom (UK) survey showed that 93% of in-patients to whom PN was administered received it for <30 days.⁽¹⁵⁾ The majority of these patients required nutrition support secondary to postsurgical complications.⁽¹⁵⁾ The incidence of postoperative ileus can be as high as 15% following intestinal resection.⁽¹⁶⁾

Type 2 and type 3 IF is less common. Surveys of prolonged PN use in hospitals in England have suggested that the incidence of type 2 IF may be as high as 18 per million population per year. This estimate is based on patients requiring PN for at least 14 days.⁽¹⁴⁾ A British survey reported 624 adult patients with IF receiving HPN in 2010.⁽¹⁵⁾

In the UK, Crohn's disease, intestinal ischemia and surgical complications are the major contributing pathologies for patients requiring long-term or HPN support. Data from other European countries and Canada show similar results. The main aetiology for HPN in the United States of America (USA) and Japan is cancer; contributing 42% and 40% respectively. This includes patients with malignant small bowel obstruction, SBS and high-output fistulae due to malignancy.⁽¹⁵⁾

The incidence and prevalence of SBS in adults is not well described owing to the lack of a reliable patient database. Approximately 40 000 adults received HPN or home IV support in the USA in 1992, of these 10 000 had a diagnosis consistent with SBS. In Europe patients receiving HPN are estimated at two to three per million with four per million receiving home IV support. Approximately 35% of these patients had a diagnosis consistent with SBS, therefore the estimated prevalence of SBS in Europe is around 1,4 per million. SBS is generally associated with decreased survival. Survival of adults with non-malignant related SBS is 94% at one year, 70% at five years and 52% at 10 years. Patients with SBS related to radiation for abdominal or pelvic malignancies were slightly lower with 83% at one year and 68% at five years.⁽²³⁾

Several risk factors correlated with a poor prognosis in non-malignant SBS. These include:^(23,26)

- Gastro-intestinal anatomy with an end-jejunostomy.
- Remnant bowel length <50cm.
- Primary diagnosis of arterial mesenteric infarction.
- History of cancer.
- Age >60 years.

Death related to HPN increases with duration of PN support but accounts for only 5-20% of deaths in this patient group.⁽²³⁾

CIPO-associated IF accounts for 20% of adults and children receiving HPN. The complete recovery rates from CIPO is much lower than that of SBS with only 25–50% reported in adults and 25–38% reported in children. Five-year survival for adults requiring HPN secondary to CIPO is 78%.⁽⁷⁾

The prognosis of enterocutaneous fistula is dependent on the patient characteristics, nutritional status, fistula characteristics and other co-morbidities.

EAF have a mortality rate of 36–64%, much higher than that of enterocutaneous fistulae. Enterocutaneous fistulae with an intact abdominal wall have a spontaneous closure rate of 50–80%, while EAF require surgical intervention in the majority of cases.⁽⁴⁴⁾

Extensive small bowel mucosal disease causes 25% of CIF cases in children and 5% in adults. In adults the likelihood of reversal of CIF due to extensive small bowel mucosal disease is rare.⁽⁷⁾

In-hospital mortality associated with acute IF is as high as 13%.⁽¹⁶⁾ Patients with CIF secondary to benign causes have a good prognosis with five-year survival rates of 80% in adults and 90% in children.⁽⁷⁾ The outcome of these patients, in terms of rehabilitative ability, treatment-related morbidity and mortality and survival, are however largely dependent on the care and support from an expert specialist team.⁽⁷⁾

In-hospital mortality resulting from type 2 IF is between 9,6% to 13%. Mortality in this patient group were mostly attributable to underlying sepsis, which could be from an intra-abdominal source but also from extra-abdominal sources such as bone, cardiac, central nervous system and central line-associated infections.⁽⁷⁾

2.3 Intestinal failure associated liver disease

Although PN is a life-saving route of nutrition support for patients with IF, it is associated with several side effects, hepatobiliary dysfunction being one of the most

prevalent and severe complications.⁽²⁷⁾ Liver decompensation associated with long-term PN support is referred to as intestinal failure-associated liver disease (IFALD).⁽²⁷⁾ This includes biochemical (increased liver enzymes) and histological (steatosis, cholestasis and cirrhosis) alterations.⁽¹⁸⁾

IFALD is defined as persistently elevated serum transaminases, 1,5 times the upper limit of normal in the presence of SBS. It is often difficult to determine whether the liver dysfunction is a consequence of SBS, nutrition therapy or drug therapy.⁽²⁷⁾

Three types of hepatobiliary disorders are associated with IFALD:^(27,47)

- Steatosis
- Cholestasis
- Gallbladder stones or sludge

Steatosis occurs predominantly in adults and is usually benign, and patients remain asymptomatic. It presents with mild to moderate elevation of aminotransferase (ALT and AST) levels and with a lesser degree of elevation in alkaline phosphatase (ALP) and bilirubin. Typical onset occurs after two weeks of PN therapy and may even return to normal with continuation of PN therapy. Progression to fibrosis and cirrhosis might be a consideration in patients receiving long-term PN support.⁽⁴⁷⁾

Cholestasis predominantly occurs in children, but might also be a complication in adult patients receiving long-term PN support. It is characterised by elevations in ALP, gammaglutamyl transpeptidase (GGT) and conjugated bilirubin with or without clinical jaundice. Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) might also be elevated. Elevated conjugated bilirubin is considered the prime indicator for cholestasis. Cholestasis is a serious complication, which may progress to cirrhosis and liver failure. If PN is stopped before irreversible hepatic damage occurs, complete recovery is expected and levels usually return to normal within one week to two months.⁽⁴⁷⁾

Gallbladder stasis might lead to development of gallstones or gallbladder sludge with subsequent cholecystitis. This condition occurs in both paediatric and adult patients receiving parenteral nutrition support.⁽⁴⁷⁾

Approximately 25 to 100% of adults and children requiring PN support present with elevated liver functions tests.⁽²⁷⁾

2.3.1 Etiology of intestinal failure associated liver disease

2.3.1.1 Duration of parenteral nutrition support

The prevalence of IFALD increase with the duration of PN support.⁽²⁷⁾ Biochemical and histological complications can develop as early as four weeks after starting PN with more serious complications developing later in the treatment, usually after 16 weeks of therapy.⁽¹⁸⁾

An estimated 65% of patients presented with chronic cholestasis after six months of PN support while 37% of patients presented with complicated liver disease following 17 months of PN support. IFALD prevalence was 26% at two years and 50% at six years while 22% of deaths were associated with end-stage liver disease.⁽²⁷⁾

2.3.1.2 Length of bowel remnant

The risk of cholelithiasis increases significantly with a bowel remnant of less than 120cm and if the terminal ileum has been resected.⁽²⁷⁾ A bowel remnant of less than 50cm is associated with a significant increased risk of IFALD.^(47,48) SBS is associated with disruption of enterohepatic circulation and alterations in bile acid metabolism and excretion predisposing patients to the development of IFALD.⁽⁴⁷⁾

2.3.1.3 Bacterial overgrowth

The reduced enterohepatic circulation due to SBS and intestinal stasis occurring secondarily to motility disorders such as CIPO could lead to bacterial overgrowth in the small intestine. Bacterial overgrowth occurs when bacteria normally found in the colon and lower small bowel populates the upper small intestine. It is thought that these bacteria could potentially produce hepatotoxins, which could cause hepatic injury. Bacterial overgrowth may also contribute to cholestasis by promoting deconjugation of bile acids, preventing their reabsorption.⁽⁴⁷⁾

2.3.1.4 Lack of enteral nutrition

Patients who are unable to tolerate any enteral nutrition are more prone to developing IFALD than those who can tolerate even very small amounts. Lack of enteral stimulation reduces hepatocellular bile acid and bile secretion and reduced gallbladder contractility. Biliary sludge could develop as a result of reduced activity. Fasting could also reduce the size of the bile salt pool and bile formation, which contributes to the problem. Reduced secretion of gastrointestinal hormones could also lead to intestinal stasis and subsequent bacterial overgrowth.⁽⁴⁷⁾

2.3.1.5 Recurrent episodes of sepsis

Bacterial and fungal sepsis correlates strongly with cholestasis. Sepsis causes systemic inflammation of the liver due to the release of pro-inflammatory cytokines which result in altered membrane function of the bile canaliculi and subsequent reduced bile flow.⁽⁴⁷⁾

2.3.1.6 Toxic components of parenteral nutrition

Manganese is excreted in the bile and therefore the toxic effect is more pronounced in patients with cholestasis. This is supported by recent evidence showing manganese toxicity in patients on long-term PN support.⁽²⁷⁾

2.3.1.7 Nutritional composition of parenteral nutrition

Studies have shown that the development of hepatic steatosis is primarily due to excessive calorie provision.

Provision of excessive calories is thought to promote hepatic fat deposition by stimulating insulin release, which promotes lipogenesis and inhibits fatty acid oxidation.⁽⁴⁷⁾

2.3.1.7.1 Dextrose

PN formulations that contain little or no fat are thought to promote the development of steatosis. Excessive amounts of carbohydrates will be deposited in the liver as fat, which could lead to the development of steatosis. Also, formulations containing little or no fat could lead to the development of essential fatty acid deficiency which could impair lipoprotein formation and triglyceride secretion, and result in steatosis.⁽⁴⁷⁾

2.3.1.7.2 Amino acids

Taurine deficiency can occur in both infant and adult patients receiving long-term PN. Taurine is necessary to solubilise bile salts and therefore for adequate biliary secretion and ileal reabsorption.⁽⁴⁷⁾

2.3.1.7.3 IV lipid emulsions

Chronic cholestasis and severe IFALD are strongly associated with IV fat intake of >1g/kg/day, however this does not seem to be related to overfeeding *per se*.^(47,48)

The composition of lipid emulsions also plays a role. MCTs are oxidised faster in the liver than LCTs and data suggest LCT-MCT mixtures are less likely to cause hepatic complications than LCTs alone.⁽⁴⁷⁾

The mechanism by which fish oil-based omega 3 fatty acids influence IFALD can be divided into direct and indirect mechanisms. The direct actions include improved bile flow, decreased steatosis and anti-inflammatory and immune modulatory effects. Omega 3 fatty acids attenuate the inflammatory response by causing a shift from the omega 6-derived pro-inflammatory eicosanoids to the anti-inflammatory ones derived from omega 3 fatty acids. Indirect mechanisms include decreased intake of phytosterols and protection against oxidative stress with the addition of Vitamin E to fish oil-based lipid emulsions.⁽⁴⁹⁾

The phytosterol content of IV fat emulsions could also contribute to the development of IFALD.⁽⁴⁷⁾ Phytosterols are structurally similar to cholesterol and derived from plant products in the diet. Only 5 to 10% of phytosterols are absorbed in the small bowel. Phytosterols play an important role in inhibiting the absorption of cholesterol from the gut. In PN, phytosterols are delivered into the circulation and therefore higher than normal levels might be present. Unlike cholesterol, phytosterols cannot be converted into bile acids and therefore the excretion is limited. Levels of phytosterols correlate with the degree of IFALD. Fish oil containing lipid emulsions have lower levels of phytosterols.⁽⁵⁰⁾

2.3.1.8 Carnitine

Carnitine plays an important role in fat metabolism and primary carnitine deficiency has been associated with the development of steatosis. Carnitine supplementation

has been shown to help mobilise hepatic fat stores and prevent steatosis in neonates.⁽⁴⁷⁾

2.3.1.9 Choline

Choline is found in many food items but is not considered an essential nutrient. It is not a component of parenteral nutrition formulations because of the assumed endogenous synthesis from methionine. The conversion of methionine to choline might however be less effective when given parenterally than when it enters the liver via the portal vein.⁽⁴⁷⁾ Steatosis has been shown to resolve with choline supplementation in studies, but it is not commercially available.^(27,47)

2.3.1.10 Cyclic infusion

Cyclic infusion of PN refers to the infusion of PN over a period of <24hours (generally 8–12 hours), thus allowing a rest period from PN.⁽⁴⁷⁾ Continuous infusion of PN could result in hyperinsulinemia and fat deposition in the liver.⁽⁴⁷⁾

Cyclic PN has been shown to lead to reduced serum liver enzyme concentrations and conjugated bilirubin concentrations, when compared to continuous infusion.⁽⁴⁷⁾

2.3.2 Prevention and treatment of intestinal failure associated liver disease

2.3.2.1 Confirm the diagnosis

Drug-induced hepatotoxicity is a possible complication of nearly all drugs metabolised by the liver. Therefore careful re-evaluation of patients' drug charts should be done to rule out known hepatotoxic medications and/or herbal supplements.⁽⁴⁷⁾

Sepsis is common in patients receiving PN support and is often related to central venous access devices. Infections should be treated and measures should be taken to prevent recurrence. If small bowel bacterial overgrowth is suspected, the patient should be treated with appropriate antibiotics.⁽⁴⁷⁾

2.3.2.2 Optimise oral and enteral nutrition

Oral or enteral nutrition improves gut atrophy and preserves the immunologic integrity of the gut, thereby decreasing bacterial translocation and production of cytokines and endotoxins. Enteral or oral nutrition also improves gut motility and reduces intestinal stasis. Enteral or oral intake stimulates CCK secretion, which improves gallbladder contractility and reduces cholestasis and risk of sludge or gallstone formation.^(27,47)

2.3.2.3 Optimise parenteral nutrition

The macronutrient content of the PN formulations should be reviewed and overfeeding avoided at all costs.⁽⁴⁷⁾ Careful consideration should be given to IV lipid emulsion administration, which should be limited to 1g/kg/min and be administered in the form of fish oil-containing lipid emulsions.^(27,47) All sources of carbohydrate delivery should be considered and restricted to less than 5mg/kg/min.⁽²⁷⁾ Carbohydrates and lipids should be provided in a ratio of 70:30 of non-protein energy (NPE).⁽²⁷⁾ Cyclic PN should be considered to allow for a rest period from PN.^(27,47)

2.3.2.4 Pharmacological therapy

Ursodeoxycholic acid is a hydrophilic bile acid that prohibits the absorption of bile salts in the ileum. A dose of 15–30mg/kg/day in long-term PN patients has shown a benefit in terms of lower serum liver enzymes but the long-term benefits are still unknown.^(27,47)

Metronidazole might be beneficial in patients with SBS by preventing small bowel bacterial overgrowth and deconjugation of bile acids.^(27,47)

2.3.2.5 Surgical therapy

2.3.2.5.1 Prophylactic cholecystectomy

Complications associated with cholelithiasis have a higher prevalence amongst patients requiring long-term PN support than among the rest of the population. Prophylactic cholecystectomy is therefore recommended in these patients when laparotomy is being done for other reasons.⁽²⁷⁾

2.3.2.5.2 Bianchi procedure and serial transverse enteroplasty

Both of these surgical techniques have been reported to improve function in patients with intestinal insufficiency.⁽²⁷⁾ The Bianchi procedure is a procedure where the bowel is divided longitudinally and each half is made into a tube.^(20,27) The two tubes are then anastomosed in an end-to-end fashion, the result being doubling of the overall length and absorption surface.^(20,27)

During a serial transverse enteroplasty (STEP) procedure the bowel is stapled at regular intervals so that it takes a zigzag configuration. This increases transit time resulting in better absorption.⁽²⁷⁾

Both of these procedures are associated with 81–89% survival, 47–54% weaning off PN and 82–85% overall improvement in intestinal function.⁽²⁷⁾

2.3.2.5.3 Intestinal transplant

Indications for intestinal transplantation include loss of venous access, recurrent life-threatening central line-associated bloodstream infections and the development of IFALD.⁽⁵¹⁾ Intestinal transplants are considered the only definitive treatment for patients with SBS who failed intestinal rehabilitation.⁽²⁷⁾ Patients with a bowel remnant of less than 50cm and without a colon should be referred to transplant centres as soon as possible as they will most likely be PN dependent.⁽²⁷⁾

When patients are considered for small bowel transplants they should undergo a liver biopsy and if fibrosis or cirrhosis is present, they should be considered for a simultaneous liver and small bowel transplant.⁽²⁷⁾ Intestinal transplantation should only be done in specialised centres able to provide maximal and appropriate medical and surgical therapies.⁽⁵¹⁾ One-year survival for isolated intestinal transplant patients at expert centres is 86–93%.⁽⁵¹⁾

2.4 Fistuloclysis

Enteral nutrition has considerable advantages over PN support, including improved gut barrier function, reduction in infectious morbidity and improved immune function. Reconstructive surgery to restore intestinal continuity is difficult in patients where part of the small intestine has been deprived of enteral nutrition for months in part

due to marked atrophy of the intestine. This leads to inequality in the opposing bowel ends and poor quality of tissue for anastomosis.⁽⁴⁾

Fistuloclysis, enteral feeding via an intestinal fistula, is an effective means of nutritional support.^(35,52) Suitable patients for this approach of nutrition support include those with a distal fistula opening that can be intubated with a balloon retained gastrostomy tube; with no evidence of distal intestinal obstruction; and at least 75cm of small bowel distal to the fistula.^(2,44)

In a series of 12 patients described by Teubner *et al.*, fistuloclysis replaced PN in 11 out of 12 patients by increasing body weight and serum albumin, and decreasing hospital length of stay. There were no complications associated with fistuloclysis and the method was much more cost effective. Nutritional status was maintained for a median of 155 (range 19–422) days until definitive reconstructive surgery could be undertaken in 9 out of the 11 patients. Two patients who did not undergo surgery were maintained on fistuloclysis for nine months. One patient died at home as a result of ischemic heart disease, while the other one did not go for reconstructive surgery due to medical co-morbidity.⁽⁴⁾

In a study by Wu *et al.* published in 2014, the researchers found that fistuloclysis could successfully improve liver function and nutritional status in patients with high-output enteric fistulae. In this study 95 patients met the entry criteria and were enrolled in the study. They were divided into a control group who received enteral nutrition only and a fistuloclysis group who received enteral nutrition and fistuloclysis. The fistuloclysis group were further divided into three groups with regard to the location of the fistula, namely group 1: patients with jejunioileal fistulae; group 2: patients with biliary fistulae; and group 3: patients with duodenal fistulae. Enteral nutrition was administered via the distal fistula or nasojejurally in the case of biliary fistulae. The feeding goal was at least 30kCal/kg/day and 1,5–2g/kg protein/day with an additional 2g of nitrogen for every litre of fistula output. Both groups showed a statistically significant decline in hepatic indexes from baseline to 28 days. Both groups showed an increasing trend in nutritional parameters with the fistuloclysis group showing a statistically significant increase in albumin levels. The fistuloclysis group also showed a significant reduction in fistula output. With regard to the differences between the groups receiving fistuloclysis the biggest improvement in

total, direct and indirect bilirubin and ALP were seen in group 2, i.e. patients with biliary fistulae. The greatest improvement in albumin and total protein was also seen in patients in group 2. Patients in Group 1, i.e. patients with jejunoileal fistulae, showed the least improvement in these parameters. In terms of one-year survival, one patient (2,9%) in the fistuloclysis group died, while 10 patients (16,7%) in the control group were deceased at one-year follow-up.⁽⁶⁾

A study by Coetzee *et al* published in 2014 describes the successful implementation of refeeding enteroclysis in a South African patient cohort managed in a tertiary hospital with a dedicated intestinal failure unit. This study included 20 patients with proximal enteric fistulae. In this publication patients were weaned of PN in a median of 20 days of admission to the unit and patients were maintained on fistuloclysis for a mean of 41 +/- 16 days. The mean output recorded in this study was 1940 +/- 606ml with a mean of 1360 +/- 460ml refeed via the distal limb. Patients did not require supplementary intravenous fluid after the establishment of successful fistuloclysis. When additional fluids or electrolytes were required patients received oral rehydration solution. Twelve patients required additional enteral nutrition with a semi-elemental tube feeds to achieve nutritional goals. Data was not recorded on minor complications such as skin excoriation, leaking of stoma appliances and blockage or feeding catheters.⁽⁵⁾

In the Teubner *et al.* study, the protocol suggests starting with a polymeric feed via fistuloclysis, if a patient develops abdominal pain that lasts for >24 hours after the initiation of enteral feed or the patient has persistent diarrhoea, the enteral feed was changed to a semi-elemental formula. If the problem persisted with semi-elemental formulae, the patient would be changed to elemental enteral feeds. In the Levy *et al.* study, successful fistuloclysis was achieved with elemental formulae. A recent case study published by Wright *et al.* reported feeding a patient successfully by means of fistuloclysis using a 1,5kCal/ml polymeric enteral formula.⁽⁵³⁾

Benefits seen in patients receiving fistuloclysis might have been due to improvement in liver function and nutritional status along with a reduction in fistula output. Using this method of nutrition support has several advantages. Fistuloclysis is more effective in improving liver function than enteral nutrition alone. This may in part be

attributable to CCK, which is produced by the endocrine cells in the duodenum and upper jejunum, and stimulates gallbladder contractility and bile secretion. CCK is excreted in response to fats, proteins and amino-acids in the duodenum. Trypsin-sensitive monitor peptide in the upper intestinal lumen is another potent CCK-releasing factor, but might be lost through the fistula output. Therefore, continuation of the digestive system through fistuloclysis might improve CCK secretion and improve cholestasis.⁽⁶⁾

Fistuloclysis of the enteric effluent provides enzymes, including salivary amylase, gastric pepsin and pancreatic enzymes, as well as bile acids necessary for optimal enteral nutrition utilisation. The fistula effluent also has the perfect pH to activate proenzymes and appropriate enzyme components for optimal enteral nutrition absorption.⁽⁶⁾

In the intact gut, bile acids secreted in the duodenum are absorbed in the terminal ileum and recycled to the liver. In the patient with a fistula, this cycle is interrupted, leading to a lack of bile acids and subsequent malabsorption of fatty acids, phospholipids and fat-soluble vitamins. With fistuloclysis, the enterohepatic circulation of bile acids can be restored with improvement in nutritional status.⁽⁶⁾

Fistuloclysis has the ability to decrease fistula output. High output from enteric fistulae is associated with high fluid and electrolyte loss, resulting in hyponatremia, hypochloremia, hypokalemia, metabolic acidosis/alkalosis and renal dysfunction. Fistuloclysis has an inhibitory effect on upper gastrointestinal secretions. It is speculated that this might be attributable to restoration of bowel continuity and physiological digestive processes.⁽⁶⁾

Fistuloclysis may have several problems associated with the process, including tube-dislodgement and skin corrosion from effluent leaking onto the skin. A rare complication is a 'swallowed' feeding tube, where the feeding tube is ingested into the intestine by peristalsis.⁽⁶⁾

The development of IF is the consequence of diverse etiologies and pathophysiological consequences. The management of IF is a time-consuming

process, which entails long periods of hospitalisation and has profound cost implications. Optimisation of nutritional and medical status is the key goal in the management of these patients, while complications are kept to a minimum to prevent secondary insults. Fistuloclysis is a novel treatment that has been shown in the literature to be effective in maintaining and improving patients' nutritional status to the point where they can undergo definitive surgery. In a resource-scarce environment we need to explore treatment options that are effective in promoting the medical and nutritional status of the patient, while minimising risk to the patient, improving quality of life and reducing cost. Fistuloclysis could be a feasible option for the management of IF in the South African context. The motivation for this study was to present the data from a tertiary institution and to gather information regarding the management of IF in other institutions as well as presenting a purposefully selected case study to describe the procedure and management of a patient receiving fistuloclysis. **Figure 2.1** provides a conceptual framework illustrating the link between these diverse objectives and how it addresses the research question. This information will be valuable in terms of establishing equipment and training needs and the readiness of institutions to adapt to a novel nutritional management solution.

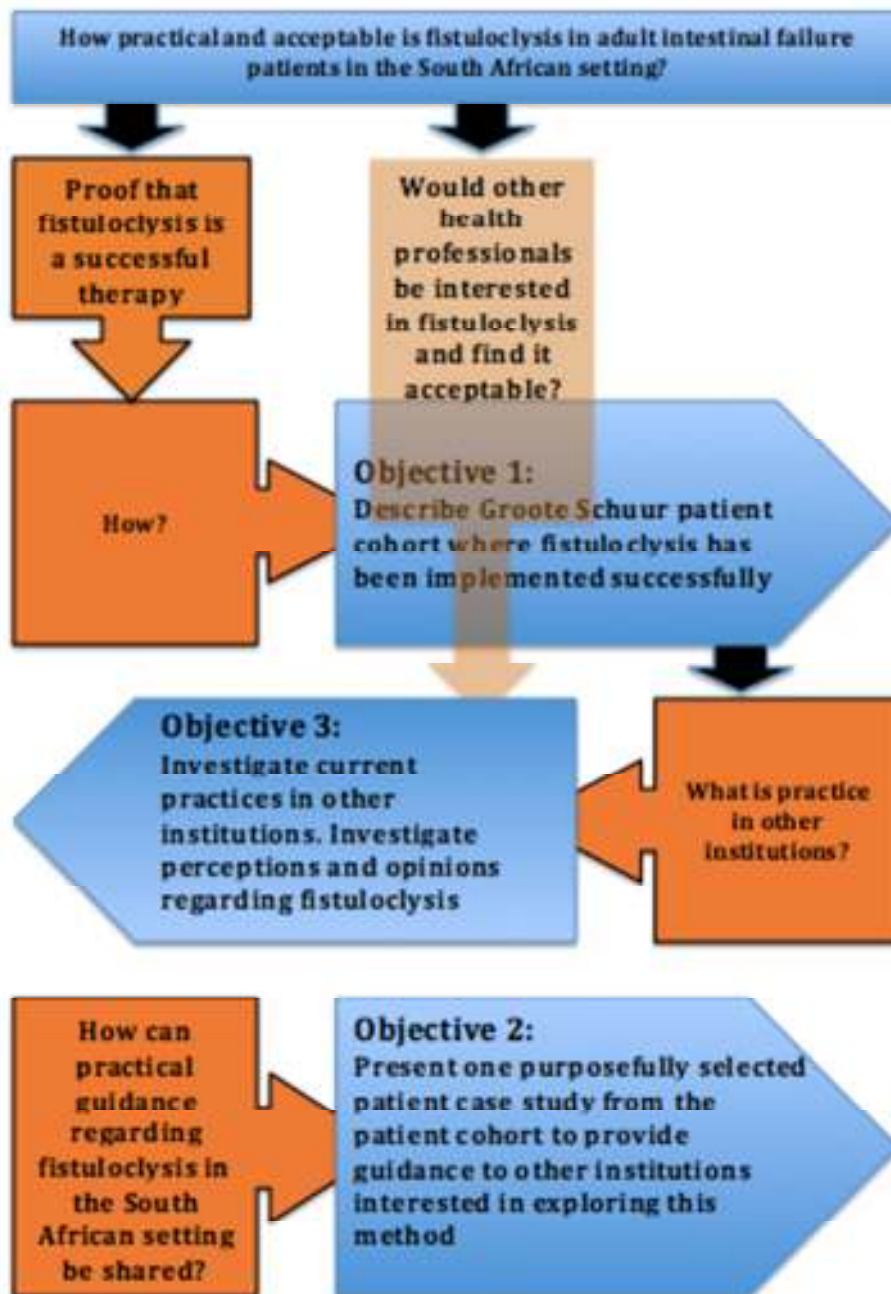


Figure 2.1 Conceptual framework for study objectives

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CHAPTER 3: METHODOLOGY

3.1 Research question

How practical and acceptable is fistuloclysis in adult intestinal failure (IF) patients in the South African setting?

3.2 Research aim

To investigate the management of adult IF patients in tertiary hospitals in South Africa and determine how practical and acceptable fistuloclysis is.

3.3 Study objectives

1. To describe the implementation and management of the IF patient population in Groote Schuur Hospital, where fistuloclysis has been implemented successfully.
2. To present one purposefully selected patient case study.
3. To investigate the current management of type 2 and type 3 IF patients in the tertiary hospitals in South Africa, as well as, the perceptions and opinions regarding fistuloclysis as a management option for this patient population amongst doctors, stoma sisters and dietitians involved in their care.

The methodology for each objective will be discussed separately.

3.4 Objective 1

3.4.1 Study population

Adult patients admitted to Groote Schuur Hospital IF unit between January 2009 and May 2014 were assessed for eligibility, based on set inclusion and exclusion criteria, for inclusion in the study sample.

Inclusion criteria

- Patients older than 18 years of age
- Established type 2 and type 3 IF
- Able to establish fistuloclysis successfully
- Admitted to Groote Schuur Hospital intestinal failure unit between 1 January 2009 and discharged by 31 May 2014.

Exclusion criteria

- Patients younger than 18 years of age
- Unable to establish fistuloclysis successfully
- Patients admitted to and treated in Groote Schuur Hospital IF unit before 1 January 2009 or still in the unit after 31 May 2014.

3.4.2 Study design

The study design was a retrospective record review of the medical data collected from the patient folders.

3.4.3 Study methods

Data was collected retrospectively from patient folders and entered into an Excel spread sheet. All information was collected under patient folder numbers and no personal details were associated with the collected data. Information was collected on demographics, surgical interventions, gastrointestinal anatomy, nutritional management, biochemical markers and intake and output. See **Addendum A** for the data capture sheet.

The Groote Schuur database for IF patients was used to recruit patients for the study. The database captured information on patients admitted to the IF unit between January 2009 and October 2013. Additional patient records were searched for patients admitted between 1 November 2013 and 31 May 2014 to determine additional patients who fitted the inclusion criteria. Fifty-nine patients were identified who were admitted and completed treatment between 1 January 2009 and 31 May 2014. Of those, 22 patients fitted the inclusion criteria. One patient was excluded due to their age being younger than 18 years. Another patient was excluded due to the fact that he withdrew from the treatment option, fistuloclysis, for personal reasons. The medical data of a further three patients were unobtainable and they were therefore excluded from the final study sample. Seventeen patients were included in the final data analysis. (**Figure 3.1**)

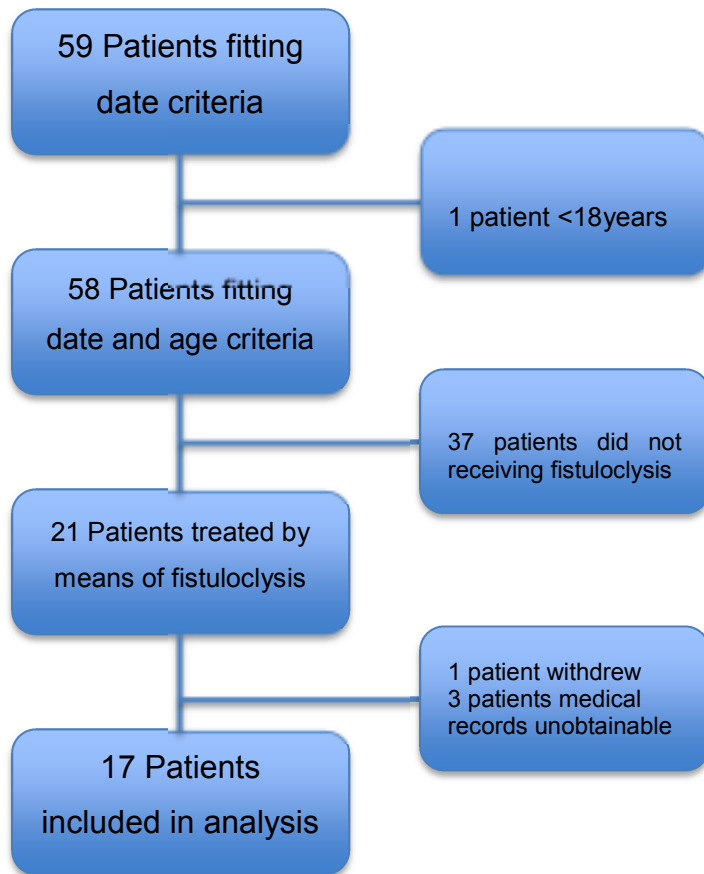


Figure 3.1: Screening process of selecting patients for inclusion

3.4.4 Data management and statistical analysis

- Descriptive statistics were used to report data on patient demographics and characteristics.
- Where patients had more than one episode of fistuloclysis during their admission data were collected and included in the analysis from the longest period of fistuloclysis.
- Patients were regarded as having proximal IF when the length of small bowel from the duodenal-jejunal (DJ) flexure to the first defect or stoma were less than 150cm. Where anatomical terms were given in the medical notes, instead of measurements, mid small bowel or duodenum or jejunum were regarded as proximal small bowel.
- Length of stay in the IF unit was expressed as a median for the patient population.
- Total number of days on parenteral nutrition (PN) in the unit was collected for each patient and expressed as a median for the patient population.

- Number of days that PN was continued for after commencement of fistuloclysis was collected and expressed as a median for the patient population.
- The number of days patients were managed on fistuloclysis was collected for each patient and expressed as a median for the patient population.
- Days spend at home on fistuloclysis, if it was applicable, were calculated and expressed as a median for the applicable patients.
- The average fistula/stoma output was calculated for three time periods:
 - Period from admission until discharge from the unit.
 - Period form admission until definitive surgery was performed.
 - Period of fistuloclysis.

The median of all of these were calculated and expressed as a median for the patient population.

- Average fistula/stoma output re-infused daily via fistuloclysis was calculated and expressed as a percentage of the output.
- Days until definitive surgery were collected and expressed as a median for the patient population.
- Days from definitive surgery until discharge from hospital were calculated and expressed as a median for the patient population.
- Body weight was recorded at weekly intervals for the duration of the fistuloclysis period when a measurement was available. The total change in body weight for the period of fistuloclysis was calculated. The rate of weight change was calculated per week. The median values for both weight change and rate of weight change were calculated for the study population.
- The number and type of fistuloclysis catheter-related complications were recorded per patient if it was available in the patient record. The total number of complications for the study population was calculated and expressed as a number per 50 catheter days.
- PN bloods, which include electrolytes, urea, creatinine, calcium, magnesium, phosphate, liver function tests, albumin and a full blood count, is done routine on a Monday and Tuesday in the unit. Biochemistry was recorded on day one, day 14 and day 28 of fistuloclysis, or as close as possible according to the availability of biochemical data. Due to the skewness of the data and the small data set non-parametric statistical analysis were applied. The median for each of the

biochemical measurements at each time point was calculated as well as the minimum and maximum value. The Wilcoxon signed rank test were applied to test for significance with a $p < 0.05$ regarded as significant.

- Patient outcome was reported as discharged alive from hospital or deceased during hospital stay as well as whether the patient regained nutritional autonomy.

3.5 Objective 2

3.5.1 Study population

One patient was purposefully selected from the patient population in objective 1 to present as a case study.

3.5.1.1 Inclusion criteria

Meeting the inclusion criteria under objective 1.

3.5.2 Study design

The case study was presented as a retrospective patient discussion.

3.5.3 Study methods

One patient was purposefully selected and a case study presented in the form of a journal article. No patient name or personal identifiers apart from age and sex were used in writing up the case report. The case study was submitted, peer-reviewed and accepted for publication by the South African Journal of Clinical Nutrition (SAJCN). The case study appeared in South African Journal of Clinical Nutrition 2014;27(4):230-236.

3.5.4 Statistical analysis

Data was reported as a descriptive retrospective case study.

3.6 Objective 3

3.6.1 Study population

Medical doctors, stoma therapists and dietitians working in South Africa who are involved in the management of patients with type 2 and type 3 IF.

3.6.1.1 Inclusion criteria

- Medical doctors currently working in a South African hospital involved in the management of type 2 and type 3 IF patients.
- Stoma therapists currently working in a South African hospital involved in the management of type 2 and type 3 IF patients.
- Dietitians currently working in a South African hospital involved in the management of type 2 and type 3 IF patients.

3.6.1.2 Exclusion criteria

- Medical doctors, stoma therapists and dietitians not currently working in a South African hospital and not involved in the management of type 2 and type 3 IF patients.
- Medical doctors, stoma therapists and dietitians currently working in Groote Schuur Hospital.

3.6.2 Study design

A descriptive observational study of the current management of type 2 and type 3 IF patients in South African hospitals as well as of the perceptions and opinions of doctors, stoma therapists and dietitians working in South African hospitals about fistuloclysis as a treatment option for IF was done.

3.6.3 Study methods

3.6.3.1 General procedure

The data regarding current management of type 2 and type 3 IF patients as well as the perceptions and opinions regarding fistuloclysis as a treatment option amongst medical doctors, stoma therapists and dietitians working in South African hospitals were obtained by means of questionnaires. A separate questionnaire was compiled for each occupational group.

3.6.3.2 Questionnaire development

Separate questionnaires were developed for every occupation group through consultation with professionals currently involved in the management of IF patients in Groote Schuur Hospital, where fistuloclysis has been implemented successfully.

Content validity was ensured through consultation with the various occupation groups. Stoma therapists evaluated the content included in the questionnaire for stoma therapists while the doctor and dietetic questionnaires were evaluated for content by a surgeon working in the area and who is involved in the day-to-day management of intestinal failure patients. After completion of the questionnaire development the same group of people had the opportunity to complete the questionnaires to ensure face validity.

The questionnaires were managed through the web-based system, Survey Monkey. The first page of the survey included a detailed letter giving participants background to the study and the investigators. In an attempt to adhere to the inclusion and exclusion criteria as stipulated above questions were build into the questionnaires that would exit participants from the survey early on if they did not fit the given criteria. If a participant fitted all the inclusion criteria but were unfamiliar with the term “fistuloclysis” they were given a brief explanation and allowed to continue with the survey. All questions required an answer before a participant could move on to the next question. If a participant responded negatively to a question that had questions following onto it the questionnaire skipped to the next unrelated question automatically. (**Addendum B, C, D**)

3.6.3.3 Selection of participants

An electronic mail (e-mail) was sent out via the Association for dietetics in South Africa (ADSA) and the South African Society for Parenteral and Enteral Nutrition (SASPEN) mailing lists to recruit dietitians for participation.

An e-mail was sent out via the South African Stomatherapy Association (SASA) to recruit stoma therapists to participate in the study.

A second e-mail was sent out two weeks after the first to both groups.

Each survey remained open for completion for a period of four weeks.

Surgeons were recruited for participation by sending an e-mail to one representative at each of the following seven academic centres in South Africa that teach medicine, excluding the University of Cape Town (UCT), due to the fact that UCT is affiliated with Groote Schuur Hospital.

- University of Pretoria
- University of Witwatersrand
- University of the Free State

- Sefako Makgatho Health Sciences University (SMU) (Previously MEDUNSA)
- University of Stellenbosch
- University of Kwazulu-Natal
- Walter Sisulu University (Previously University of the Transkei)

The e-mail contained a link to the relevant Survey Monkey questionnaire.

3.6.4 Statistical analysis

The data obtained from Survey Monkey were downloaded in the form of an Excel spread sheet. The data were analysed by the principle investigator and reported as descriptive statistics.

3.7 Ethics

Ethics approval was obtained from the Stellenbosch University Health Research Ethics Committee under ethics reference number S14/09/177.

Due to the retrospective nature of the data collected under objectives 1 and 2 and the anonymity of the data collected the researchers requested a waiver of the informed consent process. For objective 3 questionnaires contained a detailed information sheet explaining the study and the investigators involved. Completion of the questionnaires was done anonymously through Survey Monkey and willingness to participate in the study was regarded as informed consent.

The study was conducted in accordance with the Declaration of Helsinki.

3.7.1 Protocol deviations

3.7.1.1 Objective 3

As per the original protocol surveys were to be sent to a doctor, stoma therapist and dietitian for completion at each of the 13 academic hospitals identified in South Africa. Due to difficulties and time constraints in obtaining permission from the National Department of Health to conduct this research in the identified public hospitals the researchers were forced to deviate from the protocol. Surveys were

sent via societies representing the different occupation groups and through Universities teaching medicine, as explained in the methodology.

Due to the more generalised study population the surveys were conducted over four weeks instead of two as stipulated in the initial protocol to allow for more time to obtain responses.

3.7.1.2 Ethics

Ethics approval from The University of Cape Town Human Research Ethics Committee was waived, by the committee themselves, due to the fact that approval was already obtained from another recognised ethical authority. Institutional approval was obtained from Groote Schuur Hospital for collection of data from patient folders.

CHAPTER 4: RESULTS

4.1 Objective 1

To describe the implementation of fistuloclysis and the management of the intestinal failure patient population in Groote Schuur Hospital, where fistuloclysis has been implemented successfully.

The use of fistuloclysis in an intestinal failure population in a South African tertiary hospital

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Introduction

Intestinal failure (IF) is a complex pathophysiological condition with a diverse aetiology. IF and its complications are associated with significant cost, a large component of which is parenteral nutrition (PN). Owing to the nature and complexity of IF, it often requires long-term hospitalisation and PN support to improve or maintain nutritional status, while allowing for enough time between surgeries for peritoneal adhesions to mature and complications to be treated.^(1,2) Internationally, and at Groote Schuur Hospital, specialised units adhere to a waiting time before carrying out definitive surgery ranging between six weeks and six months.^(1,2) In a recent cost analysis done by the National Department of Health, PN was found to be one of the top ten pharmacy expenditures, contributing a major cost to patient treatment.⁽³⁾ Groote Schuur Hospital started a unit specialising in managing IF patients in 2009 and currently has a six-bed cubicle within the colorectal surgery ward where these patients are managed. Fistuloclysis, i.e. enteral feeding via an intestinal fistula, has been successfully implemented within this unit as a means of nutritional support and in doing so it has been possible to wean patients off PN and eliminate the cost and side effects associated with it.^(4,5) In a series of 12 patients described by Teubner *et al.*, fistuloclysis replaced PN in 11 out of 12 patients by increasing body weight and serum albumin, and decreasing hospital length of stay.⁽⁶⁾ There were no complications associated with fistuloclysis and the method was more cost effective.⁽⁶⁾ In a study by Wu *et al.* published in 2014, the authors found that fistuloclysis could successfully improve liver function and nutritional status in patients with high-output enteric fistulae.⁽⁷⁾

Doctors, nursing staff, stoma therapists and dietitians involved in this unit are familiar with and experienced in the field of IF and fistuloclysis. Fistuloclysis is an effective and feasible way of managing these patients and often the only alternative to PN

support. Although an internationally recognised practice, to the researcher's knowledge this is an underutilised method of nutritional support within the South African context. The purpose of this study was therefore to describe the Groote Schuur Hospital patient population where fistuloclysis has been implemented successfully.

Methods

Study population

Adult patients admitted to Groote Schuur Hospital IF Unit between January 2009 and May 2014 were eligible for inclusion in the study, provided they met the following inclusion criteria.

Inclusion criteria

- Older than 18 years of age
- Diagnosed with established type 2 or type 3 IF
- Fistuloclysis able to be implemented successfully
- Admitted to Groote Schuur Hospital IF unit on or after 1 January 2009 and discharged by 31 May 2014

Study methods and statistical analysis

The study design was a retrospective record review of the medical data collected from the patient folders.

Where patients had more than one episode of fistuloclysis during their admission, data were collected and included in the analysis from the longest period of fistuloclysis. Patients were regarded as having proximal IF if the length of small bowel from the duodenal-jejunal (DJ) flexure to the first defect or stoma were equal to or less than 150cm. Where anatomical terms were given in the medical notes, instead of measurements, mid small bowel, duodenum or jejunum were regarded as proximal small bowel.

Information was collected on demographics, surgical interventions, gastrointestinal anatomy, nutritional management, biochemical makers, and intake and output.

Fifty-nine patients were identified that fitted the time period for admission and completion of treatment between 1 January 2009 and 31 May 2014. Twenty-two

patients out of the 59 were treated by means of fistuloclysis. One patient was excluded owing to age younger than 18 years. Another patient was excluded because he withdrew from the treatment option, namely fistuloclysis, for personal reasons. The medical data of a further three patients were unobtainable and they were therefore excluded from the final study sample. Seventeen patients were included in the final data analysis (**Figure 1**).

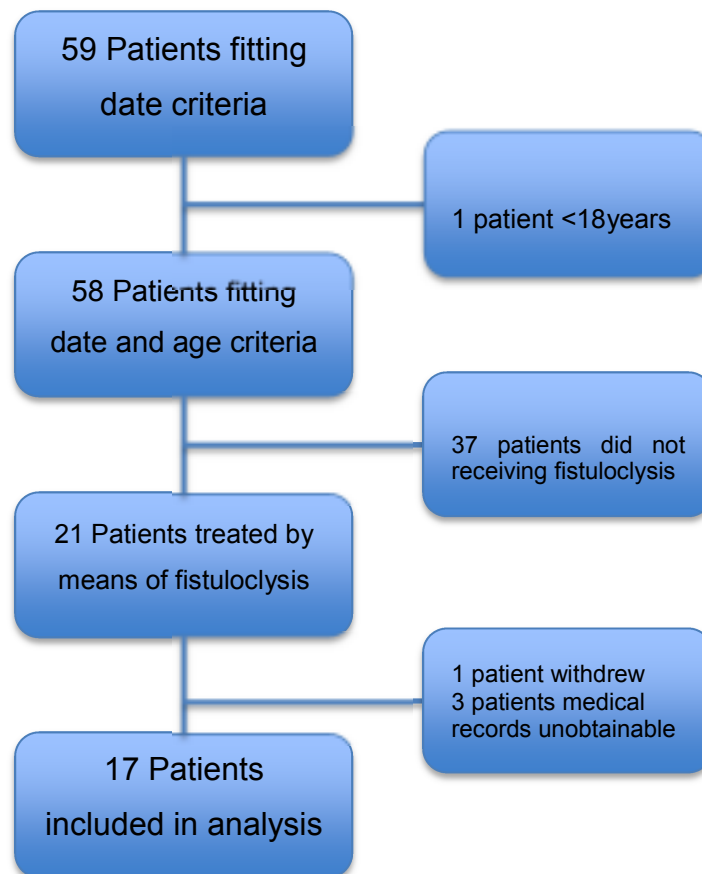


Figure 1: Study population selection process

Owing to the skewness of the data and the small data set non-parametric statistical analysis was applied. Descriptive statistics were used to report data on patient demographics and characteristics.

The length of stay, number of days on PN, and number of days on fistuloclysis in the IF unit were calculated and expressed as a median for the patient population.

The number of days that PN was continued after commencement of fistuloclysis was collected and expressed as a median for the patient population. The number of days

spent at home on fistuloclysis, if applicable, was calculated and expressed as a median.

The average fistula/stoma output was calculated for three time periods:

- Period from admission until discharge from the unit
- Period from admission until definitive surgery was performed
- Period of fistuloclysis

The median of all of these was calculated and expressed as a median for the patient population.

Median fistula/stoma output re-infused daily via fistuloclysis was calculated and expressed as a percentage of the output.

The days until definitive surgery and days from definitive surgery until discharge were collected and expressed as a median for the patient population.

Body weight was recorded at weekly intervals for the duration of the fistuloclysis period if the measurement was available. The total change in body weight for the period of fistuloclysis was calculated. The rate of weight change was calculated per week. The median values for both weight change and rate of weight change were calculated for the study population.

The number and type of fistuloclysis catheter-related complications were recorded per patient if it was available in the patient record. The total number of occurrences of complications for the study population was calculated and expressed as a number per 50 catheter days. The types of catheter-related complications were reported as descriptive statistics.

PN bloods, which included electrolytes, urea, creatinine, calcium, magnesium, phosphate, liver function test (LFTs), albumin and a full blood count, was done routinely on a Monday and Thursday in the unit. Biochemistry was recorded on day one, day 14 and day 28 of fistuloclysis, or as close as possible to these days, according to the availability of biochemical data. The median for each of the biochemical measurements at each time point was calculated, as well as the minimum and maximum values. The Wilcoxon signed rank test was applied to test for significance with a $p < 0.05$, regarded as significant.

Patient outcome was reported as: discharged alive from hospital or deceased during hospital stay as well as whether the patient regained nutritional autonomy.

Results

Seventeen patients were included in the study (**Figure 1**). Patient demographics and characteristics are displayed in **Table 1**. The majority of patients were male (n=13/17, 76,5%) and the median age was 42 years. The most common aetiology of IF was trauma-related (n=5/17, 29,4%). Complications secondary to appendicitis (n=2/17, 11,8%), small bowel obstruction (n=3/17, 17,6%) and iatrogenic bowel injury (n=2/17, 11,8%) also ranked high among causative factors. The majority of patients presented with proximal intestinal failure (n=13/17, 76,5%), defined as the first defect being within 150cm from the DJ flexure. A total of 47% of patients (n=8/17) had an open abdomen. The median time spent in the IF unit was 93 days with a wide range of 31 days to 319 days. During this period patients spent a median of 19 days on PN and 52 days on fistuloclysis (**Table 2**). PN was continued for a median of two days after the start of fistuloclysis. Only one of the 17 patients (n=1/17, 6%) could not be weaned off PN with this approach.

Table 1: Demographics and characteristics of patients (n=17)

	N	%	
Gender	Female	4	23,5%
	Male	13	76,5%
Age (years)	42 (24–72)		
Length of stay in unit (days)	93 (31–319)		
Aetiology	Trauma	5	29,4%
	Appendicitis	2	11,8%
	Small bowel obstruction	3	17,6%
	Iatrogenic injury	2	11,8%
	Abdominal tuberculosis	1	5,9%
	Bowel perforation	1	5,9%
	Mesenteric ischemia	1	5,9%
	Radiation enteritis	1	5,9%
	Anastomotic leak	1	5,9%
Proximal intestinal failure	No	4	23,5%
	Yes	13	76,5%
Open abdomen	No	9	52,9%
	Yes	8	47,1%
Total PN days in IF unit	19 (0–258)		
Days PN after starting fistuloclysis	2 (0–63)		
Able to wean of PN with fistuloclysis?	No	1	5,9%
	Yes	16	94,1%

Receiving additional feed via fistuloclysis?	No	14	82,4%
	Yes	3	17,6%

Table 2: Data on output and fistuloclysis

	N	Median	Minimum	Maximum
Total days on fistuloclysis	17	52	10	128
Days spend at home on fistuloclysis	4	32,5	22	42
Median output for total admission period (ml)	17	1 279	779	3 712
Median output for period from admission until definitive surgery (ml)	17	1 674	969	4 002
Median output for period of fistuloclysis (ml)	17	1 478	900	4 398
Median re-fed for period of fistuloclysis (ml)	17	980	341	1 812
% Effluent re-infused	17	71,26%	17,57%	88,00%

Patients had a median output of 1 674ml per day for the period from admission until definitive surgery, with a range of 969ml–4 002ml. During the period of fistuloclysis the median output was 1 478ml, ranging between 900ml–4 398ml. Patients received a median of 980ml (71%) of effluent back via fistuloclysis during this period (**Table 2**). Most patients received only the effluent via fistuloclysis (n=14/17, 82,4%), however three (n=3/17, 17,6%) patients received additional semi-elemental feeds via fistuloclysis. Four patients were able to go home for a median period of 32,5 days on fistuloclysis.

Complications related to fistuloclysis were reported a total of 80 times (**Table 3**). Complications that were most prevalent were bags leaking (n=30/80, 37,5%), fistuloclysis catheters getting blocked (n=20/80, 25%), and catheters becoming dislodged (n=17/80, 21,25%). This equated to a median of 3,51 complications per 50 fistuloclysis catheter days.

Table 3: Fistuloclysis related complications

Complications	Number (n=80)	Percentage
Leaking stoma bags	30	37,5%
Blocked fistuloclysis catheters	20	25%
Dislodged catheters	17	21,25%
Skin erosion	1	1,25%
Effluent discarded incorrectly	1	1,25%

Clostridium Difficile	1	1,25%
Patient refusing intermittently	5	7,5%
Developed fistula in distal limb	1	1,25%
Obstruction in distal limb	1	1,25%
Stoma prolapse	1	1,25%
Abdominal cramping	1	1,25%

Biochemistry results collected at the three time-intervals are presented in **Table 4**.

Both total bilirubin and conjugated bilirubin medians were within normal range throughout, although some outliers were found. Total bilirubin improved from a median of 8,5 $\mu\text{mol/L}$ to 6,0 $\mu\text{mol/L}$ between day 0 and day 28, the range also improved from 3–30 $\mu\text{mol/L}$ to 2–12 $\mu\text{mol/L}$. Conjugated bilirubin improved slightly from 4 $\mu\text{mol/L}$ on day 0 to 3,5 $\mu\text{mol/L}$ on day 14 and then stayed stable at that level. The range also improved from 1–15 $\mu\text{mol/L}$ to 1-7 $\mu\text{mol/L}$ (**Figure 2**).

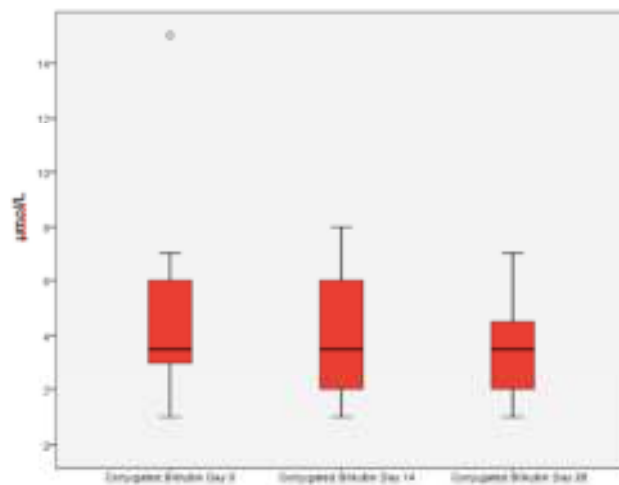


Figure 2: Conjugated Bilirubin

Table 4: Biochemistry results

	Time interval	Normal Value	Median	Minimum	Maximum
Sodium (mmol/L)	Day 0	135-147	135	124	141
	Day 14	135-147	134	127	144
	Day 28	135-147	132	128	141
Potassium (mmol/L)	Day 0	3,3-5,3	4,2	3,2	6
	Day 14	3,3-5,3	4,2	3,6	5,4
	Day 28	3,3-5,3	4,1	2,6	4,7

Urea (mmol/L)	Day 0	2,6–7	6,2	1,7	15,8
	Day 14	2,6–7	6,7	2,1	11,9
	Day 28	2,6–7	4,9	2,8	11,1
Creatinine (µmol/L)	Day 0	64–104	54	22	129
	Day 14	64–104	63	23	183
	Day 28	64–104	59	27	172
Corrected Calcium (mmol/L)	Day 0	2,05–2,56	2,33	1,95	2,85
	Day 14	2,05–2,56	2,40	2,12	2,84
	Day 28	2,05–2,56	2,41	1,83	2,74
Magnesium (mmol/L)	Day 0	0,65–1,1	0,66	0,42	1
	Day 14	0,65–1,1	0,72	0,57	0,84
	Day 28	0,65–1,1	0,70	0,34	0,93
Phosphate (mmol/L)	Day 0	0,8–1,4	1,21	0,44	1,65
	Day 14	0,8–1,4	1,31	0,52	1,59
	Day 28	0,8–1,4	1,15	0,31	1,91
Total Bilirubin (µmol/L)	Day 0	0–21	8,5	3	30
	Day 14	0–21	7	3	13
	Day 28	0–21	6	2	12
Conjugated Bilirubin (µmol/L)	Day 0	0–6	4	1	15
	Day 14	0–6	3,5	1	8
	Day 28	0–6	3,5	1	7
Albumin (g/L)	Day 0	35–52	27*	11	39
	Day 14	35–52	30,5	17	46
	Day 28	35–52	36*	16	45
Alkaline Phosphatase (ALP) (U/L)	Day 0	40–120	161	42	416
	Day 14	40–120	144	56	344
	Day 28	40–120	155,5	45	372
Gamma-glutamyl Transpeptidase (GGT) (U/L)	Day 0	0–60	163	45	406
	Day 14	0–60	99,5	47	500
	Day 28	0–60	125,5	36	592
Alanine Aminotransferase (ALT) (U/L)	Day 0	5–40	25	7	132
	Day 14	5–40	21,5	6	152
	Day 28	5–40	31,5	6	140
Aspartate Aminotransferase (AST) (U/L)	Day 0	5–40	31	8	60
	Day 14	5–40	20,5	13	71
	Day 28	5–40	20,5	12	68
White cell count (x10⁹/L)	Day 0	4–10	12,24	4,94	31,84
	Day 14	4–10	10,97	5,24	23,77
	Day 28	4–10	9,88	5,50	25,10

*p=0.001

The liver function test results are displayed in **Figure 3**. Alkaline phosphatase (ALP) showed a decreasing trend between day 0 and day 14 and then stabilised (**Figure 4**). Gamma-glutamyl transpeptidase (GGT) showed a sharp decrease between day 0 and day 14 and then increased again slightly over the next 14 days (**Figure 5**). Alanine aminotransferase (ALT) decreased over the initial 14 days and then increased to a higher level at day 28, but the median remained within normal range throughout. Aspartate aminotransferase (AST) decreased sharply initially and then remained stable, the median remained within normal range throughout.

There was a statistically significant increase in the median serum albumin level between day 0 and day 28 from 27 g/L to 35 g/L ($p=0.001$) (**Figure 6**). C-reactive protein (CRP) values were not available, but the median white cell count did improve to within normal range between day 0 and day 28, from $12,24 \times 10^9/L$ to $9,88 \times 10^9/L$.

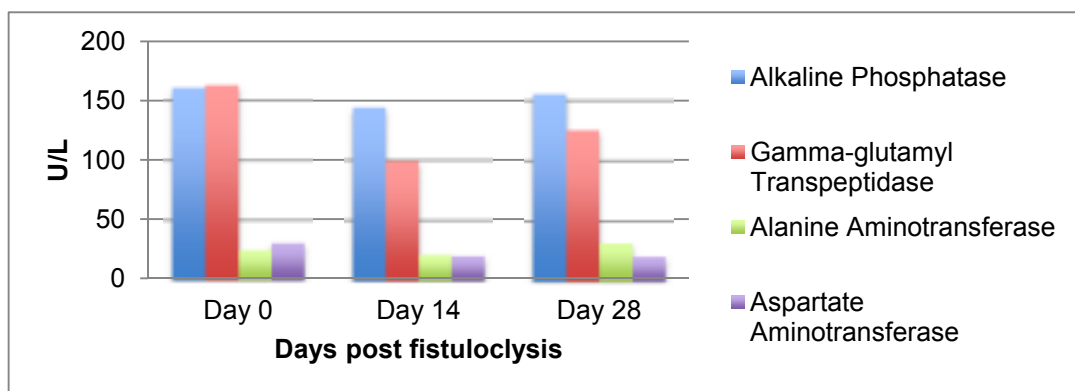


Figure 3: Liver function tests

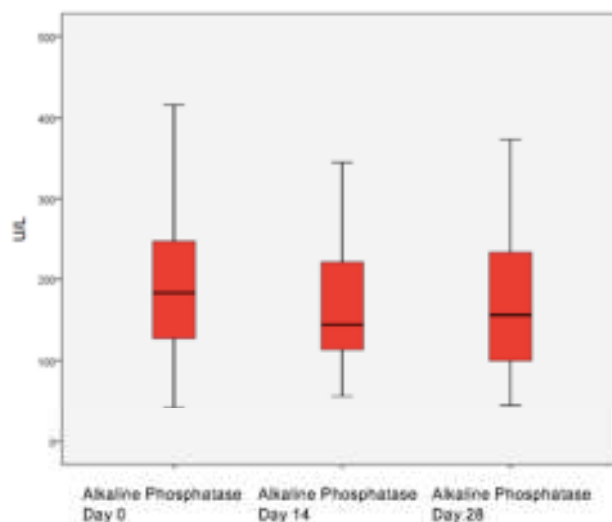


Figure 4: Alkaline phosphatase

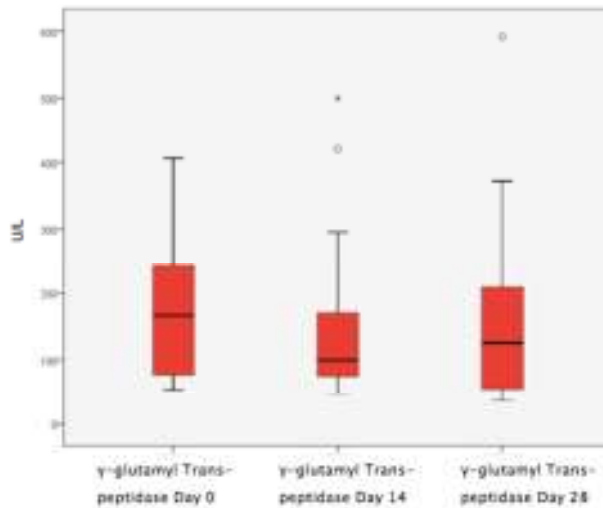


Figure 5: Gamma-glutamyl transpeptidase

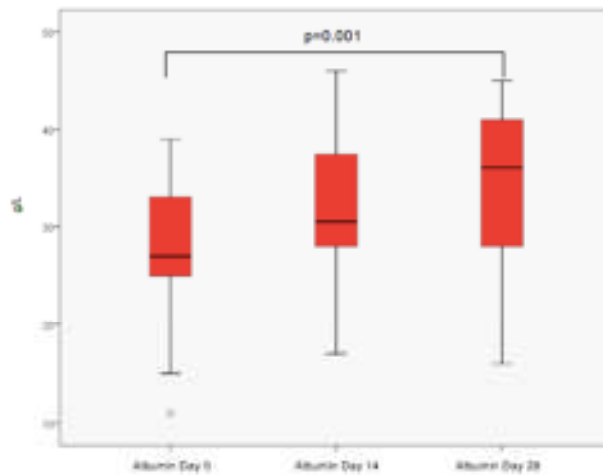


Figure 6: Albumin

Data on body weight was only available for 13 patients (n=13/17). Body weight did not improve during the period of fistuloclysis, but showed a median decrease of 3kg for the period of fistuloclysis at a rate of 300g per week (**Table 5**). The individual patient body weight trends are displayed in **Figure 7**.

Regarding outcome, patients waited a median time of 85 days before definitive surgery. Only 15 patients underwent definitive surgery. None of the patients whose folders were unobtainable died; therefore mortality for all patients managed with fistuloclysis was 10% (n=2/20). The only two deaths in the fistuloclysis group

occurred prior to definitive surgery. Mortality among the 37 patients who were not managed on fistuloclysis was 13,5% (n=5/37). Postoperative complications only occurred in three patients (n=3/15, 20%) and resolved with conservative management in two of these patients (n=2/3, 66%). The third patient had a negative relook laparotomy and subsequently settled. Patients were discharged a median of 12 days post definitive surgery and all patients who underwent definitive surgery regained nutritional autonomy (**Table 6**).

Table 5: Change in body weight (kg)

	Weight difference	Rate of weight change
Median	-3.0	-0.3
Minimum	-15.00	-2.00
Maximum	5.00	0.45

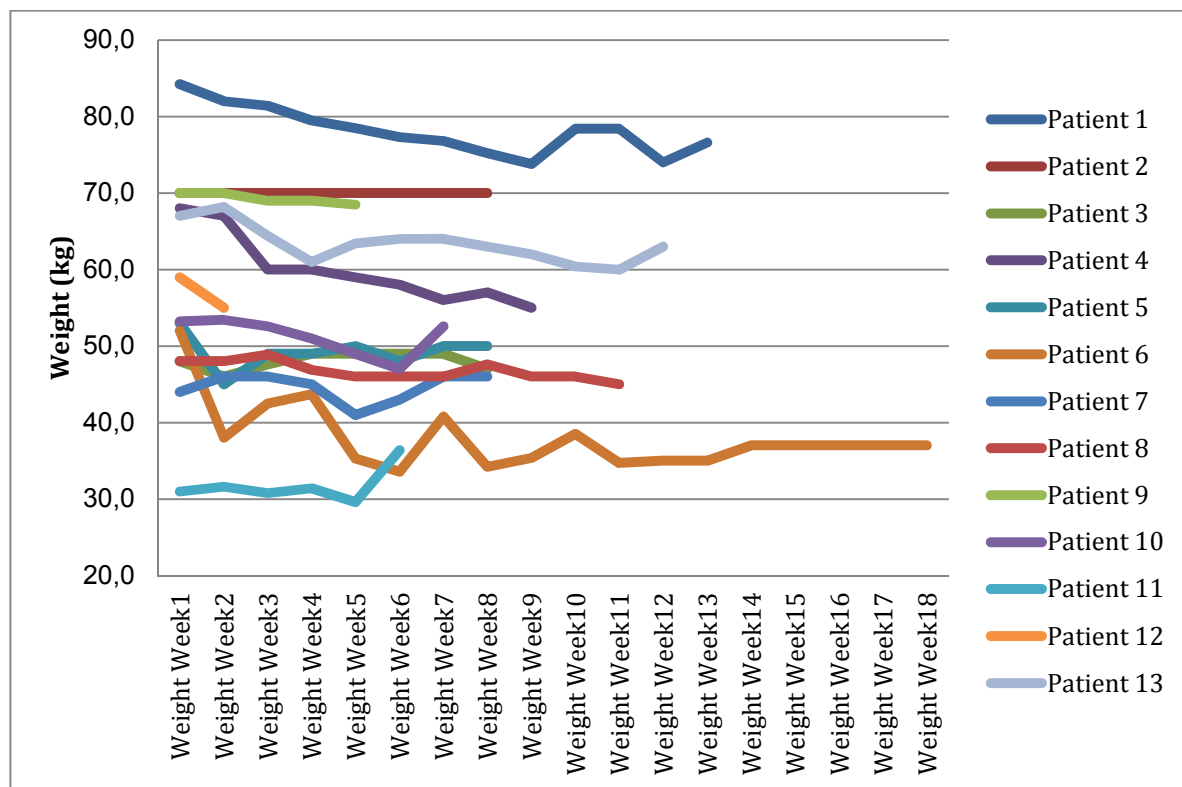


Figure 7: Individual patient weight trends

Table 6: Patient outcome

		N	%
Days until definitive surgery	85 (57–300)		
Complications post definitive surgery	No	12	80%
	Yes	3	20%

Complication	Total	15	
	None	12	80%
	Enterocutaneous fistula	2	13,3%
	Required relook	1	6,7%
	Total	15	
Resolution of complication	Negative relook	1	33,3%
	Spontaneous closure	2	66,6%
	Total	3	
	Deceased	2	11,8%
Outcome	Discharged Alive	18	88,2%
	Total	20	
	Regained nutritional autonomy		
	No	0	0%
	Yes	15	100%
	Total	15	
Days from definitive surgery until discharge	12 (4–79)		

Discussion

The concept of IF was first defined by Fleming and Remington in 1981 as “a reduction in the functional gut mass below the minimal amount necessary for adequate digestion and absorption of food”.^(8–10) In 2015 the European Society for Clinical Nutrition and Metabolism (ESPEN) published recommendations on the definition and classification of IF in adults.⁽⁸⁾ These recommendations include a definition of IF, a functional and pathophysiological classification for acute and chronic IF and a clinical classification of chronic IF. According to the ESPEN classification, IF can be defined as the reduction of gut function below the minimum necessary for absorption of macronutrients and/or water and electrolytes, such that intravenous (IV) supplementation is required to maintain health and/or growth.⁽⁸⁾ Micronutrients were not included in the definition and micronutrient deficiencies alone due to gut impairment are not classified as IF.⁽⁸⁾ IF has been sub-divided into three types based on the onset and expected metabolic impact and outcome.^(8,11,12) Type 1 IF is usually self-limiting, short term and often perioperative.^(13–15) Common causes of type 1 IF include mechanical intestinal obstruction and non-mechanical ileus.⁽¹⁴⁾ Type 1 IF usually resolves within seven to 14 days with conservative management, nasogastric drainage and might require short-term PN support.^(14,16) Type 2 IF is a serious condition associated with a higher incidence of mortality.^(8,14) Patients usually develop type 2 IF as a result of complications of abdominal surgery leading to abdominal sepsis and intestinal fistulation.⁽¹⁴⁾ An estimated 10% of

patients will also have significant reduction in intestinal length at the time of diagnosis.⁽¹⁴⁾ Type 2 IF is usually not self-limiting, with the exception of patients with simple intestinal fistulation where spontaneous closure may occur with effective nutritional and medical support.⁽¹⁴⁾ Type 3 IF refers to a chronic condition in a metabolically stable patient, requiring long-term PN support, often for years, with careful monitoring for complications.^(8,13,15)

According to patient records, a total of 59 patients were treated in the IF unit at Groote Schuur Hospital over a period of five years and four months. According to European data, the prevalence of IF is 18 per million people per year, based on people receiving parenteral nutrition for more than 14 days.⁽¹⁴⁾ If this were extrapolated to the South African context, this would equate to roughly 970 cases of IF in South Africa per year. In the light of these statistics 59 cases over a period of five years and four months might seem minimal for a tertiary hospital with a dedicated IF unit. This number is however only representative of patients who developed complicated IF which progressed to type 2 and type 3 and required expert care in a dedicated unit. This number would not be representative of patients with uncomplicated IF. Furthermore one has to suspect that a large number of patients are being managed in non-dedicated units with unknown results.

Only 17 patients, who fitted the inclusion criteria and were managed on fistuloclysis, were included in the study. It is important to note that one patient declined fistuloclysis as an approach to nutritional management. This patient had been transferred to the Groote Schuur Hospital IF Unit from a private hospital for further management with fistuloclysis. The patient refused fistuloclysis and preferred to be treated in a private treatment facility with conventional methods, which entailed PN to maintain nutritional status. This observation is important since some patients might not find fistuloclysis acceptable.

Trauma has been identified as the leading cause of IF, accounting for 29% of cases in this study. Other aetiologies included small bowel obstruction, iatrogenic injuries and post appendisectomy complications. Based on international data from the United Kingdom (UK) Crohn's disease, intestinal ischemia and surgical complications were the major contributing causes for IF resulting in patients requiring long-term or home parenteral nutrition (HPN).⁽¹⁵⁾ Data from other European countries and Canada show

similar results. The main aetiology for HPN in the United States of America (USA) and Japan is cancer, contributing 42% and 40% respectively.⁽¹⁵⁾ This included malignant small bowel obstruction (SBO), short bowel syndrome (SBS) and high output fistulae due to malignancy.⁽¹⁵⁾ When surgical complications in terms of iatrogenic injuries, anastomotic leaks and complicated appendisectomies were combined in the current study, this resulted in 29% of cases, making trauma and postsurgical complications the leading causes of IF in this patient cohort. It is evident that the population treated at Groote Schuur, and we could probably extend this to the greater South Africa, is based on a different causative factor, namely trauma.

Patients were categorised as having proximal or distal IF based on the level of the most proximal stoma or fistula, the majority of patients in this group presented with proximal IF, 76,5%. The clinical manifestation of SBS is associated with less than 200cm of small bowel remaining in continuity, even if the total length of the small bowel including the part that is bypassed or in discontinuity is of normal length.^(8,17,18) Conditions leading to SBS most commonly affect the jejunioileal segment and less commonly the colon.⁽¹⁹⁾ The pathophysiological manner in which SBS causes IF is due to extensive loss of absorptive surface area^(8,18), while the pathophysiological manner in which fistulae cause IF is due to the enteric content being lost through a proximal opening or by bypassing a significant segment of gut in the case of internal enteroenteric fistulae.^(8,20,21) This effectively leads to a situation of 'short bowel syndrome'.^(8,22) Based on these definitions, the presence of a stoma or fistula at the set level of 150cm would imply a patient being at risk of malnutrition on the basis of SBS and would have had to be treated accordingly. All SBS patients will require PN support in the immediate postoperative phase to maintain nutritional status.⁽¹⁹⁾ Bowel adaptation usually occurs within the first two years following the last surgical intervention and patients would usually require PN or enteral nutrition support during this phase until sufficient adaptation has occurred.^(23,18,19) By applying fistuloclysis, bowel length can be improved by employing the entire available bowel.

Apart from the proximity of the first defect or stoma, a high-output fistula or stoma is commonly associated with PN. The physiological classification of fistulae is based on the output.^(8,24,20,25) Less than 200ml effluent per day is considered low-output while 200–500ml per day is classified as moderate output.^(8,26,24,27,25) A fistula effluent of

more than 500ml per day in the fasted state is considered as a high-output fistula and is associated with a higher morbidity and mortality.^(8,28,26,24,25) Edmunds *et al.*, demonstrated a mortality rate of 54% in patients with high-output fistulae while patients with low-output fistulae had a mortality rate of 16%.⁽²⁴⁾ This was supported by Levy *et al.*, who demonstrated a mortality rate of 50% and 26% respectively in patients with high- and low-output fistulae.⁽²⁴⁾ The median daily output for the period from admission until definitive surgery for the current group was 1 674ml, well above the 500ml that defines a high-output fistula. Patients with fistulae should be able to tolerate polymeric enteral formula, unless the patient has less than 120cm of bowel left, documented intolerance to polymeric feed or experience high fistula output.⁽²⁵⁾ In the case of fistuloclysis where there is distal bowel available the presence of a high-output fistula becomes less threatening to the patient's nutritional status, provided it can be implemented successfully. In the current study 94% of patients could be weaned off PN successfully by using fistuloclysis to recruit all or most of the available gut. This was possible with re-infusion of 71,25% of effluent. PN could be stopped a median of two days after initiation of fistuloclysis. Patients were maintained on fistuloclysis for a median of 52 days. In a series of 12 patients described by Teubner *et al.*, fistuloclysis replaced PN successfully in 11 out of 12 patients.⁽⁶⁾ Nutritional status was maintained for a median of 155 (range 19–422) days until definitive reconstructive surgery could be undertaken.⁽⁶⁾

According to the literature suitable patients for this approach of nutritional support include those with a distal fistula opening that can be intubated with a balloon-retained gastrostomy tube, with no evidence of distal intestinal obstruction and with at least 75cm of small bowel distal to the fistula.^(2,29) It should however be considered that the colon can also utilise maldigested carbohydrate and protein through anaerobic bacterial fermentation providing an additional source of nutrition.^(11,12,18,30) Patients with colon continuity can salvage up to 1 000 additional calories per day from unabsorbed carbohydrates.⁽³⁰⁾

A total of eight patients had open abdomens which presents a high risk for the development of fistulae with an incidence of 5–19%.⁽²⁵⁾ An enteroatmospheric fistula (EAF) is a sub-set of fistulae that arise in the setting of an open abdomen with exposed viscera.^(5,25,26,29) The longer the abdomen remains open with a temporary

dressing the higher the likelihood of developing an EAF.⁽²⁵⁾ This type of fistula is almost exclusively described in traumatically injured or critically ill patients.⁽²⁹⁾ This patient population present with a unique risk for fistulation due to intentional or unintentional bowel injury, intra-abdominal infections and decompression for abdominal compartment syndrome.⁽²⁹⁾

A very important finding from this study was the ability to send four patients home for a median of 32,5 days. Despite the very high output, patients were able to maintain nutrition and fluid status outside the hospital without IV fluid or nutrients. Owing to the poor socioeconomic circumstances of a large portion of patients in the South African public hospital sector, HPN is almost impossible to achieve safely. Therefore patients presenting with IF would be confined to hospital if they require PN or IV fluid as part of their treatment. In this patient population, where the median length of stay was 93 days in the unit, the ability to discharge patients for almost a third of the time not only impacts on hospital cost and bed availability, but also plays an important role in the mental health and social circumstances of the patient. It should however be noted that patients should have the social support structure to cope at home and the ability to get back to hospital fast in an emergency.

Only 80 fistuloclysis-related complications were reported in this study, equating to 3,51 complications per 50 fistuloclysis catheter days. An important limitation of the study is the retrospective data collection. Only complications noted in patient notes or nursing processes could be included and it is therefore possible that a significant number of complications were not picked up owing to poor documentation. Leaking stoma bags were the most prevalent complication of fistuloclysis in this study. It should be noted that leaking stoma devices is not directly caused by fistuloclysis but is rather a result of the technique applied in the South African setting, due to the fact that specific stoma pouches are not available. This necessitates the need to punch a hole in the stoma pouch to feed the catheter through which compromises the integrity and predisposes it to leakage.

PN support for patients with IF is associated with several side effects, hepatobiliary dysfunction being one of the most prevalent and severe complications.⁽³¹⁾ Liver decompensation associated with long-term PN support is referred to as intestinal

failure associated liver disease (IFALD).⁽³¹⁾ This includes biochemical (increased liver enzymes) and histological (steatosis, cholestasis and cirrhosis) alterations.⁽¹⁷⁾ IFALD is defined as persistently elevated serum transaminases, 1,5 times the upper limit of normal in the presence of SBS.⁽³¹⁾ It is often difficult to determine whether the liver dysfunction is a consequence of SBS, nutrition therapy or drug therapy.⁽³¹⁾ Three types of hepatobiliary disorders are associated with IFALD namely steatosis, cholestasis and gallbladder stones or sludge.^(31,32) Steatosis occurs predominantly in adults, is usually benign and patients remain asymptomatic.⁽³²⁾ It presents with mild to moderate elevation of aminotransferase (ALT and AST) levels and with a lesser degree of elevation in ALP and bilirubin. Typical onset occurs after two weeks of PN therapy and may even return to normal with continuation of PN therapy. Progression to fibrosis and cirrhosis might be a consideration in patients receiving long-term PN support. Cholestasis predominantly occurs in children but might also be a complication in adult patients receiving long-term PN support. It is characterised by elevations in ALP, GGT and conjugated bilirubin with or without clinical jaundice. ALT and AST might also be elevated. Elevated conjugated bilirubin is considered the prime indicator for cholestasis. Cholestasis is a serious complication, which may progress to cirrhosis and liver failure. If PN is stopped before irreversible hepatic damage occurs, complete recovery is expected and levels usually return to normal within one week to two months. Gallbladder stasis may lead to development of gallstones or gallbladder sludge with subsequent cholecystitis. This condition occurs in both paediatric and adult patients receiving PN support.⁽³²⁾

In the current study biochemistry done on day 0 of fistuloclysis revealed some of the characteristics of IFALD with elevated LFTs. Median bilirubin remained within normal limits, but some patients did present with high levels and the aim was to improve on that. This aim was achieved, as is evident in the improvement of the range with the maximum value for total bilirubin within the normal range and the maximum for conjugated bilirubin just above the cut-off level of 6 μmol . It did not reach statistical significance, but the median LFTs showed a downward or static trend following the initiation of fistuloclysis and withdrawal of PN. (**Figure 3, Figure 4, Figure 5**)

Apart from PN and duration of PN support, length of bowel remnant plays a role with an increased risk of cholelithiasis with a remnant bowel of less than 120cm and if the

terminal ileum is resected.⁽³¹⁾ A bowel remnant of less than 50cm is associated with a significant increased risk of IFALD.^(32,33) SBS is associated with disruption of enterohepatic circulation and alterations in bile acid metabolism and excretion predisposing patients to the development of IFALD. Bacterial overgrowth occurs when bacteria normally found in the colon and lower small bowel populates the upper small intestine. It is thought that these bacteria could potentially produce hepatotoxins, which could cause hepatic injury. Bacterial overgrowth may also contribute to cholestasis by promoting deconjugation of bile acids, preventing their reabsorption. Furthermore, patients who are unable to tolerate any enteral nutrition are more prone to developing IFALD than those who can tolerate even very small amounts. Lack of enteral stimulation reduces hepatocellular bile acid and bile secretion, and reduced gallbladder contractility. Biliary sludge could develop as a result of reduced activity. Bacterial and fungal sepsis also correlates strongly with cholestasis. Sepsis causes systemic inflammation of the liver due to the release of pro-inflammatory cytokines which result in altered membrane function of the bile canaliculi and subsequent reduced bile flow.⁽³²⁾ This should be taken into account since many of these factors could be present in IF patients and would influence liver parameters. If PN could, however, be removed from the equation and replaced with fistuloclysis, this could aid in improving liver parameters by means of a number of mechanisms.

Studies show that fistuloclysis is more effective in improving liver function than enteral nutrition alone. This may in part be attributable to cholecystokinin (CCK), which is produced by the endocrine cells in the duodenum and upper jejunum, stimulating gallbladder contractility and bile secretion. CCK is excreted in response to fat, protein and amino-acids in the duodenum. Trypsin-sensitive monitor peptide in the upper intestinal lumen is another potent CCK-releasing factor, but might be lost through the fistula output. Therefore restoring continuity of the digestive system through fistuloclysis might improve CCK secretion and improve cholestasis. Fistuloclysis provides enzymes, including salivary amylase, gastric pepsin and pancreatic enzymes, as well as, bile acids necessary for optimal enteral nutrition utilisation. The fistula effluent also has the perfect pH to activate proenzymes and appropriate enzyme components for optimal enteral nutrition absorption. In the intact gut, bile acids secreted in the duodenum are absorbed in the terminal ileum and

recycled to the liver. In the patient with a fistula or when the distal part of the small bowel is in discontinuity this cycle is interrupted, leading to a lack of bile acids and subsequent malabsorption of fatty acids, phospholipids and fat-soluble vitamins. With fistuloclysis, the enterohepatic circulation of bile acids can be restored with improvement in nutritional status.⁽⁷⁾

In the current study there was a statistically significant increase in serum albumin between day 0 and day 28 ($p=0.001$). This should, however, be interpreted in conjunction with sepsis indicators to ensure true reflection of nutritional status. The only available indicator in the current study was white cell count, which improved from $12,24 \times 10^9/L$ on day 0 to within the normal range, namely $9,88 \times 10^9/L$, at day 28. The increase in serum albumin was associated with a decrease in white cell count therefore it cannot be concluded that the improvement was associated with an improvement in nutritional status alone. Teubner *et al.* and Wu *et al.* both reported improvement in nutritional status associated with fistuloclysis, and this included significant increases in serum albumin levels.^(6,7)

There was a median decrease in body weight of 3 kg during the period of fistuloclysis at a median rate of 300g body weight loss per week. When the individual weight changes were considered, as displayed in **Figure 6**, this was influenced by a weight loss of 15kg in one individual who had been in the unit for an extended period. A number of patients showed static weight trends and some showed improvements in weight. Patients are often admitted to the IF unit following aggressive fluid resuscitation, it is therefore not unexpected that there will be an initial decrease in weight as excessive fluids are mobilized. This should however stabilize followed by an improvement in weight. This improvement was not observed in this patient cohort. Hydration status could account for small fluctuations observed in body weight. Furthermore these patients are confined to the hospital environment where mobilization is often limited resulting in inadequate replenishment of lean body mass. Despite the median decrease in weight, patients still underwent successful definitive surgical intervention with minimal complications. It could therefore be argued that the loss of weight observed did not have clinical significance in this patient cohort.

There were only two deaths in this group of patients who were managed by means of fistuloclysis. None of the patients whose medical notes were unobtainable passed away, bringing the total available mortality data to 20 patients (n=2/20, 10%). This was in keeping with the mortality rate of 13,5% among the 37 patients who were not managed with fistuloclysis. This correlated well with literature reporting in-hospital mortality resulting from type 2 IF as between 9,6%-13%.⁽⁸⁾ In the current study, both patients who died succumbed prior to undergoing definitive surgery. One patient died as a result of respiratory arrest secondary to a suspected pulmonary embolism while the other death was due to pneumonia. Three patients developed complications after definitive surgery. This included two patients who developed anastomotic leak and enterocutaneous fistulae, which resolved spontaneously. One patient required a relook laparotomy on the basis of on going abdominal symptoms, which proved negative. The patient subsequently had an uneventful postoperative course.

The data presented here was extrapolated from the same database as a study previously published by Coetzee *et al.*⁽³⁴⁾ Due to different study periods, inclusion criteria and missing patient folders there were however significant differences between the final patient cohorts. The research questions and statistical analysis and interpretation of the data were also significantly different between the studies.

Conclusion

From this study and other available literature, it is evident that fistuloclysis can successfully replace PN support in selected patients suitable for this approach. Despite the fact that improvement in LFTs and bilirubin, which remained within normal limits, did not reach statistical significance and patients lost a median of 3kg during the period of fistuloclysis, the patients were weaned off PN and underwent surgery with acceptable complications and all attained digestive autonomy. The main aim in the management of IF is to perform definitive surgery successfully with minimum postoperative complications and that was achieved well in this study.

Although it cannot be concluded that fistuloclysis is superior to conventional methods of management of IF, it can be stated that it is at least equal. Furthermore, fistuloclysis was associated with minor complications, while PN is far more precarious in terms of risk for line sepsis and development of IFALD. Fistuloclysis is

less costly and has the potential to be done safely in the home environment, which would allow for patient discharge prior to definitive surgery in selected cases.

Fistuloclysis is a novel method of nutritional support for a complicated patient population. It is associated with fewer complications and reduced costs when compared with conventional methods, and it produces comparable outcomes in terms of mortality and postoperative complications. Fistuloclysis should be considered as a treatment modality for patients with IF in other care facilities with the available expertise and commitment within the multidisciplinary team.

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4.2 Objective 2

To present one purposefully selected patient case study

Nutritional management of a complicated surgical patient by means of fistuloclysis.

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Nutritional management of a complicated surgical patient by means of fistuloclysis

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Keywords: fistuloclysis, nutritional management, complicated surgical patient

Due to the complexity of the case, the format of patient information, followed by discussion at the appropriate point of the case study, has been adopted.

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Introduction

A fistula is defined as an abnormal communication between two organs, an organ and the skin, or an organ and a wound.¹ Up to 70% of patients with fistulae present with malnutrition.¹ Enteral nutrition (EN) has considerable advantages over parenteral nutrition (PN) support, including improved gut barrier function, a reduction in infectious morbidity and improved immune function.² EN support remains the preferred route of nutrition support in patients with fistulae, unless it causes a significant increase in fistula output, abdominal pain or exacerbates diarrhoea.¹ Fistuloclysis, i.e. enteral feeding via an intestinal fistula, is an effective means of providing nutritional support to these patients and can replace the need for PN support.³

Case study (days 0-65)

A 30-year-old male, with no significant past medical history, was admitted to hospital with multiple gunshot wounds to the abdomen.

On admission to hospital, he underwent a damage control laparotomy, where he was found to have complete transection at the duodenojejunal (DJ) flexure, a transverse colon perforation, a splenic laceration, a left kidney injury, multiple small bowel perforations and arterial bleeding. The DJ flexure and colonic injuries were repaired primarily, a left nephrectomy was performed, the arterial bleed ligated and packed, and the small bowel tied off. The patient was transferred to the intensive care unit (ICU) on ventilation and inotropic support, with an open abdomen. The patient's anthropometry on admission to the ICU was an estimated height and weight of 1.75 m and 75 kg, respectively, with a normal body mass index (BMI) of 24.5 kg/m². PN support was started on day 1 of ICU admission, according to The European Society for Clinical Nutrition and Metabolism guidelines on PN with respect to intensive care.⁴ The PN prescription provided 20 kcal/kg non-protein energy (NPE) with 1.7g/kg protein, which included 0.4 g/kg of intravenous (IV) glutamine.

Nine relook laparotomies were performed while the patient was in the ICU. A feeding jejunostomy was placed at the second relook in an attempt to obtain a secure enteral feeding route distal to the duodenal injury. The primary repair to the duodenum broke down and required re-repair, making successful gastric feeding at that point potentially impossible. The feeding jejunostomy was complicated by necrosis, and was eventually removed at the last re-look laparotomy. The patient had developed a frozen abdomen with fistulae, presumably from the initial duodenal injury and site of the feeding jejunostomy.

After 38 days in ICU, the patient was weighed on a bed scale. A weight of 64 kg was recorded, equating to a BMI of 21 kg/m², still within the normal range. He was discharged to the intestinal failure unit on day 65 post injury on PN, with an open abdomen with vacuum dressing, multiple enteroatmospheric fistulae (EAF) and a sacral bed sore.

Discussion with respect to the case study (days 0-65)

A fistula arising from the gut to any other part of the body is referred to as a gastrointestinal fistula, while that between the gut and the skin is an enterocutaneous fistula (ECF).¹ An EAF is a subset of an ECF that arises in the setting of an open abdomen with exposed viscera.^{1,5} An ECF can develop due to complications of injury, intra-abdominal surgery (75-85% of cases),¹ malignancy, inflammatory bowel disease, post-radiation therapy for malignancy or due to distal obstruction.⁶ Crohn's disease is a major contributor to spontaneous fistula development, and 40% of patients with this condition will develop a fistula in the course of their illness.¹ Patients with an open abdomen present a high risk for the development of fistulae, with an incidence of 5-19%.⁴

Over the past 30 years, with improvements in wound and skin care, the management of sepsis, and the provision of safe and effective nutritional support and appropriate timing of surgical intervention, the associated mortality of ECFs has been reduced from 65% to 10%.⁷ Mortality rates associated with EAF still remain around 10%.⁸

SASPEN Case Study: Nutritional management of a complicated surgical patient by means of fistuloclysis

Table 1: Subtypes of intestinal failure^{1,2}

Type	Description	Management
Type 1	Self-limiting, short term and often perioperative Common causes include non-mechanical ileus (post surgery, intra-abdominal sepsis, spinal cord injury, head injury, extra-abdominal sepsis and multi-organ failure), and mechanical intestinal obstruction	Settles within 7-14 days with conservative management, nasogastric drainage and parenteral nutrition support
Type 2	High incidence of mortality Usually not self-limiting Often secondary to abdominal sepsis and intestinal fistulation	Early diagnosis and treatment of abdominal sepsis and adequate nutrition support, usually in the form of parenteral nutrition
Type 3	50% of patients with type 2 intestinal failure develop type 3 intestinal failure	Long-term parenteral nutrition support

Table 2: Nutrition requirements

Descriptor	Energy	Protein	Micronutrients
Open abdomen ³	25-35 kCal/kg NPE	1.5-2.5 g/kg plus 2l p1 effluent	
Low-output gastrointestinal fistula ⁴	25 kCal/kg TE	1-1.5 g/kg	
High-output gastrointestinal fistula ⁴	At least 30 kCal/kg TE	1.5-2 g/kg plus 2 g l effluent	2 x DRIs for vitamins and trace elements. Up to 5 x DRIs for vitamin C and zinc. At high risk of vitamin B ₁₂ , zinc, magnesium and selenium deficiency
Short bowel syndrome ^{11,14}	PN: 32 kCal/kg TE ¹⁰ EN: Up to 60 kCal/kg TE ¹⁰	PN: 1-1.5 g/kg ¹⁰ EN: 1.5-2 g/kg ¹⁰	Typically requires doses higher than the DRI for healthy individuals. Depends on the remaining gastrointestinal anatomy, e.g. ileum resection with vitamin B ₁₂ malabsorption

DR: dietary reference intake; DRI: dietary reference intake; NPE: non-parenteral energy; PN: parenteral nutrition; TE: total energy

An EAF requires surgery in order to close, while an ECF type of fistula with an intact abdominal wall has a spontaneous closure rate of 50-80%.⁷

Fistulae are classified according to output.⁴ Less than 200 ml effluent per day is considered to be low output, while 200-500 ml per day is classified as moderate output.⁸ An ECF effluent of more than 500 ml per day is considered a high-output fistula and is associated with high morbidity and mortality.^{1,8} Therefore, the treatment and management of patients with fistulae focuses on addressing sepsis, improving nutritional status, excluding distal obstruction and reducing fistulae output.⁹

Reducing fistulae output can be achieved by slowing the gastrointestinal transit with loperamide and codeine, optimising luminal absorption with isotonic feeding and reducing enteric secretions.⁷ Somatostatin is a naturally occurring peptide hormone, with an inhibitory effect on gastrointestinal secretions.¹ However, it has a half-life of only 1-2 minutes, and therefore requires constant infusion in order to be effective.¹⁰ Synthetic somatostatin analogues have been developed with a longer half-life, making intermittent administration possible.² Octreotide is one such analogue.⁴ Although similar to somatostatin, the receptor-binding properties are not the same, and their action might not be equivalent.² It was found in a meta-analysis and systematic review published in 2012 that both somatostatin and octreotide increased the likelihood of spontaneous fistula closure, and were effective in reducing time to closure.⁸

However, closure of the fistulae tract largely depends on the anatomy of the fistulae tract, and not only the output.⁹ The review data did not show a mortality benefit.⁸ Somatostatin appeared to be superior to octreotide in improving outcome.⁸ Side-effects associated with the use of somatostatin and somatostatin analogues include nausea, abdominal cramps, loose stools, mild steatorrhea and flatulence.⁸ These side-effects start within hours of the first dose and appear to be dose dependent, but usually subside spontaneously within the first few weeks of treatment.⁸ There is an increased risk of gallstones developing in patients treated with somatostatin.⁸ Octreotide is often recommended in the literature for use in the management of ECF patients, but the literature is not consistent and larger randomised control trials are needed.

Intestinal failure can be defined as a condition resulting from obstruction, dysmotility, surgical resection, congenital defect or disease-related loss of absorptive ability, and is characterised by the inability to maintain protein energy, fluid, electrolytes or micronutrient balance.^{11,12} Patients usually require supplementary PN and/or N fluid to maintain nutrition and fluid status (Table 3).¹⁰

Case study (days 65-112)

This patient would have been classified as a type 2 intestinal failure while in the ICU because of his multiple fistulae and the long duration of his intestinal failure.

SASPEN Case Study: Nutritional management of a complicated surgical patient by means of fistuloclysis

Table III. Nutrition delivery

Nutrition	Days 42-68 (PN)	Days 74-113 (PN)	Days 114-124 (EN)	Days 125-138 (EN and PN)	Days 140-170 (PN)	Days 171-184 (EN)	Days 225-246 (oral)
Volume (ml)	2 400	2 400	1 000	2 600	2 620	2 000	-
Total energy (kCal/kg)	36	41	22	50	44	38	84
Non-protein energy (kCal/kg)	27	31	16	40	33	31	68
Protein (g/kg)	2.2	2.6	1.4	2.6	2.7	1.7	4
Glutamine (g/kg)	0.3	0.4	0.58	0.45	0.3	-	-
Lipid (g/kg)	0.8	0.9	0.5	1.5	1	1.1	-
Carbohydrate	3.3 mg/kg/minute	3.8 mg/kg/minute	2.75 g/kg	6 g/kg	4 mg/kg/minute	5.5 g/kg	-
Na (mmol)	116.5	116.5	35	77.7	115.5	70	-
K (mmol)	52.5	52.5	51	91	60	102	-
Cl (mmol)	130.5	130.5	83	145.7	165.5	166	-
PO ₄	21.2	21.2	48	65.7	21.5	42.5	-
Water-soluble vitamins	2 x RDA	2 x RDA	At least 1 x RDA	At least 2 x RDA	2 x RDA	At least 1 x RDA	At least 1 x RDA
Fat-soluble vitamins	1 x RDA	1 x RDA	At least 1 x RDA	At least 1 x RDA	1 x RDA	At least 1 x RDA	At least 1 x RDA
Trace elements	2 x RDA	2 x RDA	At least 1 x RDA	At least 2 x RDA	2 x RDA	At least 1 x RDA	At least 1 x RDA

Cl, chloride; EN, enteral nutrition; K, potassium; Na, sodium; PN, parenteral nutrition; PO₄, phosphate; RDA, recommended dietary allowance; TE, total energy

Table IV. The patient's biochemistry

Days post admission	Normal value	Day 72	Day 80	Day 90	Day 112	Day 123	Day 134	Day 171	Day 182	Day 188	Day 245	Day 258
Urea (mmol/l)	2.6-7	3.3	2.1	6.5	5.1	2	6.2	6.4	7.9	6.5	3.8	4.8
Creatinine (µmol/l)	64-104	88	70	53	51	68	68	80	115	93	96	101
Total bilirubin (µmol/l)	0-21	7	12	9	3	3	3	8	5	4	9	9
Conjugated bilirubin (µmol/l)	0-6	3	6	3	2	<1	<1	-	2	2	3	2
Alkaline phosphatase (U/L)	40-120	96	148	173	91	83	250	444	175	141	99	83
γ-glutamyl transferase (U/L)	0-80	35	-	73	28	15	86	183	46	47	50	15
Alanine transaminase (U/L)	5-40	16	31	31	6	12	27	112	15	18	21	12
Aspartate transaminase (U/L)	5-40	8	26	28	6	16	29	113	14	13	13	15
Albumin (g/l)	35-52	17	20	21	17	14	14	29	27	29	37	39

His PN regimen was calculated to compensate for his fistula losses and open abdomen, using his last actual weight of 64 kg. Energy requirements were calculated with the aim of providing 25-35 kCal/kg NPE and 1.5-2.5 g/kg protein. Protein losses from the open abdomen were also taken into consideration.¹² Protein losses from an open abdomen are estimated to be approximately 29 g/l, while fistula losses contain approximately 2 g of protein per litre (Table 3).¹³ An average output of 730 ml/day was recorded from the open abdomen, inclusive of fistula losses. Protein losses from the open abdomen calculated at 29 g/l equated to 21 g of protein. Therefore, the PN regimen had to provide 96-160 g of protein (1.5-

2.5 g/kg), plus an additional 21 g/kg to compensate for the losses, i.e. 117-181 g protein/day. The patient received 140 g protein per day, which included 20 g of glutamine (Table III). The patient was kept nil per os and only received PN support.

The patient remained on this PN regimen until he developed a central line-associated blood stream infection (CLABSI) requiring removal of the central line on day 68. It is practice to remove the central line in our intestinal failure unit while the CLABSI is being treated, and to reinsert a central line for recommencement of PN once the patient has been afebrile for 48 hours. During this period, patients only receive IV fluids via a peripheral line to maintain hydration status

and oral intake, as tolerated. The patient's weight had deteriorated to 55 kg on day 68 of treatment.

On day 74 of treatment, six days later, his PN was restarted on the same regimen as before, and he was allowed to continue the full ward diet (providing approximately 1 800 kCal TE and 80 g protein), as tolerated. Patients with ECF should be allowed to eat orally if they wish to do so because of the psychological benefit that is derived from it.⁸ Oral intake should be abandoned if the fistula output increases to unmanageable levels in terms of volume and electrolyte abnormalities.⁸ His appetite was poor and he had ongoing episodes of vomiting.

The biochemistry, repeated on days 80 and 90, showed ongoing deranged liver function tests and hypoalbuminaemia (Table IV). The deranged liver enzymes were thought to be owing to prolonged PN support, as well as ongoing sepsis.¹¹ His PN regimen included a fish oil-containing lipid emulsion. Lipids were restricted to < 1 g/kg and he was started on cyclic PN over 18 hours. His oral intake was encouraged in an attempt to optimise the enteral route, in order to improve his deteriorating liver function tests (Table IV).¹⁰

The patient underwent a fistulogram on day 93 in order to delineate the anatomy of the gastrointestinal tract. The fistulogram showed approximately 60 cm of small bowel distal to the most distal fistula with colon in situ and no distal defects or obstructions. At this stage, he had an average fistula output of 800 ml/day and vomited 400 ml/day on average. He had a gastroscopy to rule out a gastric outlet obstruction as the cause of the ongoing vomiting, but a mechanical or functional cause was not found. On day 95 post injury, the distal fistula was cannulated and the patient was started on fistuloclysis. PN support continued on the same regimen, with negligible oral intake (< 150 kCal taken by mouth).

The fistula effluent re-infusion was started at 21 ml/hour via the fistuloclysis catheter, and increased daily until all of the effluent was being re-infused. By re-infusing the fistula output, the losses via a fistula are eliminated and there is no need to compensate for them. The length of the bowel available for absorption and enteral intake need to be taken into consideration when calculating energy requirements and the need for ongoing PN support. Seventeen days after starting fistuloclysis, day 112 post injury, the liver enzymes normalised. Despite ongoing PN support, his albumin remained low at 17 g/l (Table IV).

Discussion with respect to the case study (days 66-112)

The process of a fistulogram refers to the injection of contrast into the most distal fistula through a thin catheter. X-rays of the abdomen are then taken to assess the flow of contrast and exclude any distal

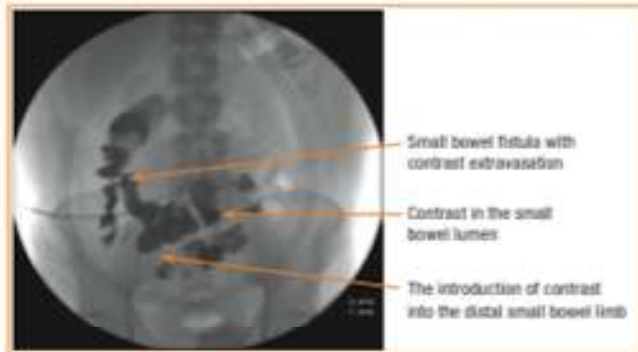


Figure 1: Fistulogram demonstrating the free flow of contrast distal to the fistula or stoma to exclude distal obstructions or fistulae prior to commencing fistuloclysis.



Figure 2: The insertion of a Foley's catheter and preparation of the skin.



Figure 3: The insertion of a Foley's catheter and the accompanying preparation.

obstruction or fistulae, and to determine the location of the fistula and the length of the distal bowel (Figure 1). If a patient is deemed to be a suitable candidate for fistuloclysis, a catheter is inserted into the fistula (Figures 2 and 3).

The skin is sprayed to protect it against the stoma or fistula effluent. A Foley's catheter is inserted into the stoma or fistula, and advanced down the distal limb for fistuloclysis.

The stoma or fistula is covered with a suitable stoma bag and the Foley's catheter inserted and secured through a hole in the bag. A feed administration set is connected to the catheter. The double lumen catheter makes simultaneous administration of the enteral feed and enteric content possible.

Fistuloclysis refers to enteral feeding via an intestinal fistula, and is an effective means of providing nutritional support.¹⁶ Suitable patients for this approach include those with a distal fistula opening that can be intubated with a balloon-retained gastrostomy tube, no evidence of distal intestinal obstruction and at least 75 cm of small bowel distal to the fistula.¹

Fistuloclysis successfully replaced PN in 11 of 12 patients in a series described by Teubner et al, and increased body weight and serum albumin, as well as decreasing hospital length of stay.² Complications were not associated with fistuloclysis, and the method was considerably more cost-effective.¹ The nutritional status was maintained for a median of 155 days (a range of 19-422) until definitive reconstructive surgery could be undertaken in nine of the 11 patients.¹ Two patients who did not undergo surgery were maintained on fistuloclysis for nine months.² One patient died at home due to ischaemic heart disease, while the second could not undergo reconstructive surgery because of medical co-morbidities.²

Wu et al found that fistuloclysis could successfully improve liver function and overall nutritional status in patients with high-output enteric fistulae.³ Ninety-five patients met the entry criteria in this study² and were enrolled. They were divided into a control group who received EN only, and a fistuloclysis group who received EN and fistuloclysis. Patients in the fistuloclysis group were further divided into three subgroups with regard to the location of the fistula: group 1, patients with jejuno-ileal fistulae; group 2, patients with biliary fistulae and group 3, patients with duodenal fistulae. EN was administered into the distal fistula or nasojejurally in the case of biliary fistulae. The feeding goal was at least 30 kCal/kg/day and 1.5-2 g/kg protein/day, with an additional 2 g of nitrogen for every litre of fistula output. Both groups showed a statistically significant decline in hepatic indexes from baseline to 28 days. Similarly, there was an increasing trend with regard to the nutritional parameters in both groups. The fistuloclysis group showed a statistically significant increase in albumin levels. The fistuloclysis group also demonstrated a significant reduction in fistula output. With respect to differences between the groups receiving fistuloclysis, the biggest improvement in total and direct and indirect bilirubin and alkaline phosphatase was seen in group 2, i.e. in patients with biliary fistulae. The greatest improvement in alanine transaminase and total protein was also seen in patients in group 2. Patients in group 1, i.e. patients with jejuno-ileal fistulae, showed the least improvement with respect to these parameters. In terms of one-year survival, one patient (2.9%) in the fistuloclysis group died, while 10 patients (16.7%) in the control group died at one year follow-up. In terms of survival time, the fistuloclysis plus EN group was significantly (*p*-value 0.045) superior when compared to the group of patients who received EN only.

Fistuloclysis, as a method of nutrition support, has several advantages.² Benefits seen might be because of the improvement in liver function and nutritional status, together with a reduction in fistula output.¹ Up to 70% of patients with fistulae have malnutrition.¹ EN support is the preferred route of nutrition support, unless it

increases fistula output dramatically, causes increased abdominal pain or exacerbates diarrhoea.¹ Fistuloclysis could eliminate some of the limitations associated with enteral feeding.

Fistuloclysis also has a better positive impact on liver function tests than EN alone.² This may, in part, be attributable to cholecystokinin (CCK) which is produced by the endocrine cells in the duodenum and upper jejunum.² CCK stimulates gallbladder contractility and bile secretion.² CCK is secreted in response to fat, protein and amino acid in the duodenum.² Trypsin-sensitive monitor peptide in the upper intestinal lumen is another potent CCK-releasing factor, but it might be lost through fistula output.² Therefore, supporting the digestive system through fistuloclysis might improve CCK secretion, and thereby enhance cholestasis.²

Additionally, fistuloclysis provides salivary amylase, gastric pepsin and pancreatic enzymes, as well as bile acid which is necessary for optimal EN utilisation.² The fistula effluent also has the perfect pH to activate proenzymes and appropriate enzyme components for optimal EN absorption.² Bile acid in the intact gut is secreted in the duodenum, absorbed in the terminal ileum and recycled to the liver.² This cycle is interrupted in the patient with a fistula, leading to a lack of bile acid and the subsequent malabsorption of fatty acid, phospholipids and fat-soluble vitamins.² The enterohepatic circulation of bile acid can be restored with fistuloclysis, and improvements in nutritional status achieved.²

High output from enteric fistulae is associated with high fluid and electrolyte losses, resulting in hyponatraemia, hypochloreaemia, hypokalaemia, metabolic acidosis or alkalosis and renal dysfunction.² Fistuloclysis has the ability to decrease fistula output, probably through an inhibitory effect on upper gastrointestinal secretions.² It is speculated that this might be attributable to the restoration of bowel continuity and physiological digestive processes.¹

Case study (days 113-157)

The patient developed another episode of CLABSI, and the central line was removed again on day 113 of treatment. His oral intake remained poor, and in an attempt to meet the requirements enterally, and to avoid the need for ongoing PN, he was started on a semi-elemental enteral feed via the fistuloclysis catheter. He also started on enteral glutamine at 0.6 g/kg oral administration. The prescribed amount of feed was 2 300 kCal TE (45 kCal/kg actual bodyweight) and 112 g (2.2 g/kg actual bodyweight) protein. On average, the patient only received 1 000 kCal total energy and 44 g of protein, less than 50% of the prescribed daily calories and protein. The semi-elemental feed was high in medium-chain triglycerides to optimise the energy absorptive capacity of the colon in view of the very short distal small bowel remnant available for feeding.¹⁴ The patient's oral intake from the ward diet and supplements remained negligible (< 150 kCal taken by mouth). He continued to receive the recommended dietary allowance for fat-soluble and water-soluble vitamins and trace elements intravenously.

The patient passed 3-5 loose stools per day, and tested negative for *Clostridium difficile* on day 118. He maintained his weight at 52 kg, but his albumin deteriorated to 14 g/l. His liver function tests normalised off PN support (Table IV). After 20 days of fistuloclysis and semi-elemental feeds via the distal limb, day 133 in total, the patient was restarted on supplemental PN, while continuing fistuloclysis and additional semi-elemental enteral feeds, as previously defined.

He had a repeat computed tomography scan on day 140, and was found to have only 10 cm of small bowel distal to the most distal fistula. Fistuloclysis and the additional feeds were stopped, and the patient was restarted on full PN support (Table III). During this period of fistuloclysis (53 days), he had an average fistula output of 1 000 ml per day, of which 75% was re-infused via fistuloclysis. The PN regimen contained a 100% soybean lipid emulsion and his liver enzymes deteriorated significantly (Table IV). His albumin remained low and his weight remained stable at 52 kg.

On day 157 post injury, he went to theatre for surgery. Intraoperatively, there were very dense adhesions, with a fistula 80 cm distal to the DJ flexure and a chronic abscess cavity. There was 40 cm of small bowel with multiple iatrogenic enterotomies secondary to mobilisation of the segment distal to the proximal fistula. A decision was made to resect the 40 cm segment. An iatrogenic serosal injury to the second part of the duodenum was primarily repaired. The two ends were brought out as a double-barrel stoma, and enterotomies distal to the stoma were also repaired primarily. Post surgery, the patient's gastrointestinal anatomy was 80 cm of small bowel proximally and 40 cm of small bowel distally to a double-barrel stoma, with the ileocaecal valve and the colon in situ. Skin closure was achieved, but the abdominal wall was left open. A new tunnelled central line was placed. Owing to the short remnant of small intestine, 120 cm in total, the patient was classified as a short bowel syndrome (SBS) patient.

Discussion with respect to the case study (days 113-157)

SBS refers to a condition in which patients present with malabsorption-related diarrhoea, dehydration, electrolyte disturbances and malnutrition secondary to poor digestive and absorptive capacity, as a result of a reduced functional intestinal area.^{11,12} SBS is often a result of surgical resection, but can also be caused by other conditions that influence absorptive capacity in the absence of surgical resection, including radiation enteritis, chronic intestinal pseudo-obstruction and congenital villus atrophy.¹² Intestinal failure due to SBS is mostly due to massive intestinal loss as a result of surgery, trauma or infarction. Less commonly, it is associated with congenital defect or loss of absorptive surface as a result of disease.⁹

Normal lengths of small bowel differ significantly, from 300-850 cm.³ Evidence suggests that patients with less than 200 cm of small bowel are likely to develop intestinal failure, a number that is of little significance in practice.³ Although the length of remaining bowel correlates with a patient's degree of nutritional autonomy,

the location of the resection and condition of the remaining bowel also play a role.^{11,12} SBS accounts for nearly 80% of long-term PN patients^{11,12} since all SBS patients require PN support in the immediate postoperative phase to maintain nutritional status.¹⁰ Some patients can be weaned off PN, while others might require long-term PN support.²⁹

Case study (days 158-190)

The patient continued PN postoperatively and had very poor oral intake. On day 14 post surgery, day 171 of treatment in total, he developed another episode of CLABSI and the central line was removed and PN stopped. On biochemistry review, his liver enzymes remained increased, but albumin had improved to 29 g/l (Table IV).

A nasogastric tube was placed and the patient was started on a semi-elemental enteral feed, the distal stoma was cannulated and the patient restarted fistuloclysis. He was weaned onto a standard polymeric feed within five days and oral intake was encouraged (Table III). Twenty-five days post surgery, day 182 in total, his weight improved to 53 kg and his albumin was 27 g/l. The liver function tests improved (Table IV).

He was discharged home 33 days post surgery, day 190 of treatment in total, on oral supplements and fistuloclysis. He required two readmissions for dehydration in the month following discharge. During this time, he maintained his weight and his albumin improved to 38 g/l. At his second readmission, he remained in hospital awaiting definitive surgery. He coped well with oral intake and twice took the full ward diet and additional oral supplements, providing 84 kCal/kg TE and 4 g/kg protein, while he continued fistuloclysis.

Discussion with respect to the case study (days 158-190)

Patients with a very short remnant bowel and patients absorbing less than a third of their intake typically require long-term PN support, while others might be able to maintain nutritional status through hyperphagia.¹⁰ Hyperphagia is defined as a >1.5-fold increase in calories over resting energy expenditure.¹⁰

Woolf et al found that SBS patients absorbed approximately 62% of delivered energy. The absorption of fat, carbohydrate and protein was 54%, 61% and 81%, respectively.¹¹ Calorie provision, of up to 60 kCal/kg bodyweight/day via the enteral route might be necessary to maintain body weight with a protein intake of 1.5-2 g/kg.¹⁴ If the colon is intact, the delivery of large amounts of carbohydrate can improve the energy balance through short-chain fatty acid production in the colon.^{11,12}

Case study (days 191-396)

The patient underwent definitive surgery 247 days post his initial injury. His weight was stable at 53 kg and his albumin had improved to 37 g/l. The liver function tests were all normal. His postoperative gastrointestinal anatomy was 120 cm of small bowel, with ileocaecal valve and colon in situ. He was discharged on day five postoperatively

on an oral intake with oral supplementation. Oral supplementation was provided in the form of three servings of a polymeric powdered supplement, providing 690 kCal TE and 30 g protein.

He had been on fistuloclysis for 128 days in total, and was managed as an outpatient for 28 days during his total hospital stay of 252 days. He had an average stoma or fistula output of 1 400 ml per day, on average of which 60% was re-infused via fistuloclysis. During the total period of fistuloclysis, he had seven documented incidences of fistuloclysis catheter-related complications, limited to tube dislodgement or blockage of the catheter in this patient. Other possible catheter-related complications included skin corrosion from effluent leaking onto the skin, as well as a very rare complication of a "swallowed" feeding tube, in which the feeding tube was ingested into the intestine by peristalsis.² It is unknown if feeding tubes delay the spontaneous healing of fistulae.³

At follow-up five months post discharge (day 396 post injury), the patient's weight improved to 67 kg. By then, he had regained nutritional autonomy. At the time of writing this, he was awaiting surgical repair of a large ventral hernia secondary to his open abdomen.

Conclusion

The nutritional management of patients with grade 2 and grade 3 intestinal failure remains a challenge. Nutritional intervention and successful nutritional rehabilitation are often limited by the ability to provide long-term PN support. Owing to line sepsis, limited vascular access, PN-associated liver disease and cost, PN is not always a sustainable solution. Fistuloclysis has been demonstrated to be safe and effective in this group of patients, and should be considered an alternative way of providing adequate nutrition support to suitable patients.

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4.3 Objective 3

To investigate the current management of type 2 and type 3 intestinal failure patients in the tertiary hospitals in South Africa, as well as the perceptions and opinions regarding fistuloclysis as a management option for this patient population amongst doctors, stoma sisters and dietitians involved in their care.

Due to the very poor response rate to the questionnaires distributed to doctors and stoma therapists the results for these two groups will only be discussed briefly in subsections 4.3.2 and 4.3.3, after the article on the responses of dietitians in section 4.3.1.

4.3.1 Responses from dietitians

The current management of intestinal failure patients in South African hospitals by dietitians, and their opinions and perceptions regarding fistuloclysis as a treatment option

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Introduction

Intestinal failure (IF) and the complications and cost associated with parenteral nutrition (PN) support in this patient population are a reality in the South African context. Owing to the nature and complexity of IF, it often requires long-term hospitalisation and PN support to improve or maintain nutritional status, allow for enough time between surgeries, and time to treat current complications before a patient can be considered for definitive surgery.^(1,2) In a recent cost analysis done by the National Department of Health, PN was found to be one of the top 10 pharmacy expenditures, contributing major costs to patient treatment.⁽³⁾

Fleming and Remington first defined the concept of IF in 1981 as “a reduction in the functional gut mass below the minimal amount necessary for adequate digestion and absorption of food”.⁽⁴⁻⁶⁾ The definition of IF proposed by Fleming and Remington has since been revised by other authors to include, among others, duration, stage, degree of impairment, underlying causes etc. In 2015 the European Society for Clinical Nutrition and Metabolism (ESPEN) published recommendations on the definition and classification of IF in adults. These recommendations included a definition of IF, a functional and pathophysiological classification for acute and chronic IF, and a clinical classification of chronic IF. According to the ESPEN classification, IF can be defined as the reduction of gut function below the minimum necessary for absorption of macronutrients and/or water and electrolytes, such that intravenous (IV) supplementation is required to maintain health and/or growth.⁽⁴⁾ The need for IV replacement of nutrients and/or fluids is used as the surrogate marker for the diagnosis of IF in the absence of readily available complex metabolic studies.^(4,7)

Micronutrients are not included in the definition, and micronutrient deficiencies alone due to gut impairment are not classified as IF. In situations where the absorptive ability of the gut is impaired, but not to the degree that IV supplementation of fluid and/or nutrients is required to maintain health and growth, the condition can be referred to as “intestinal insufficiency”.⁽⁴⁾

Fistuloclysis, i.e. feeding of intestinal effluent via a distal intestinal fistula or stoma, is an effective and feasible way of managing patients with IF and is often the only alternative to PN support.^(8,9) Enteral nutrition (EN), apart from being less costly, has considerable advantages over PN support.⁽¹⁰⁾ The advantages include improved gut barrier function, reduction in infectious morbidity and improved immune function.⁽¹⁰⁾

In a resource-scarce environment we need to explore novel treatment options that are effective in promoting the medical and nutritional status of patients, while minimising risk, improving quality of life and reducing cost. The researchers believe that fistuloclysis is a feasible, but underutilised, option for the management of IF in the South African context. The motivation for this study was to gather information regarding the management of IF in other institutions as well as the opinion and perceptions of dietitians regarding fistuloclysis. This information will be useful in terms of establishing equipment and training needs and the readiness of institutions to adapt to a novel nutritional management solution.

Methods

Study population

Dietitians working in South Africa who are involved in the nutritional management of type 2 and type 3 IF patients were included in the study population. Dietitians not currently actively involved in the nutritional management of IF patients were excluded. Dietitians currently working at Groote Schuur Hospital were also excluded since the investigators were acquainted with the management of IF patients at this institution and the aim of the survey were to determine the management of this patient population in other institutions. Indeed, the principle investigator is responsible for the nutritional management of IF patients at this institution.

Study design and methods

A descriptive observational study of the current management of type 2 and type 3 IF patients in South African hospitals, as well as of the perceptions and opinions of dietitians about fistuloclysis as a treatment option for IF was done by means of a self-administered questionnaire.

The questionnaire was developed in consultation with professionals currently involved in the management of IF patients in Groote Schuur Hospital where fistuloclysis has been implemented successfully. The questionnaire was managed through the web-based system, Survey Monkey, and contained an introduction page giving the potential respondents a background to the study and the investigators. In an attempt to adhere to the inclusion and exclusion criteria questions were built into the questionnaire that would exit the respondents from the survey early if they did not fit the criteria. If respondents did fit the inclusion criteria but were not familiar with the term fistuloclysis they were given a brief explanation and allowed to continue with the survey. All questions required an answer before the participant could proceed to the next question. If a participant responded negatively to questions that had other questions following them the questionnaire automatically skipped to the next unrelated question. The survey was planned to take approximately 15 minutes to complete.

An e-mail containing a link to the Survey Monkey questionnaire was sent out via the Association for Dietetics in South Africa (ADSA) and the South African Society for Parenteral and Enteral Nutrition (SASPEN) mailing lists to recruit dietitians for participation. A second e-mail was sent out two weeks after the first as a reminder. The survey remained open for completion for a total of four weeks.

Statistical analysis

The data obtained from Survey Monkey were downloaded in the form of an Excel spread sheet. The data were analysed by the principle investigator and reported as descriptive statistics.

Ethics

Ethics approval was obtained from the Stellenbosch University Health Research Ethics Committee (Reference # S14/09/177).

Questionnaires were completed anonymously through Survey Monkey and willingness to participate in the study was regarded as informed consent.

Results

Twenty-seven dietitians participated in the survey. The spread of private to public sector as well the level of care they were involved in is displayed in **Figure 1**. There was almost a 50:50 split between participation from the public and private sectors with the majority of respondents from the public sector being situated in secondary or tertiary healthcare institutions.

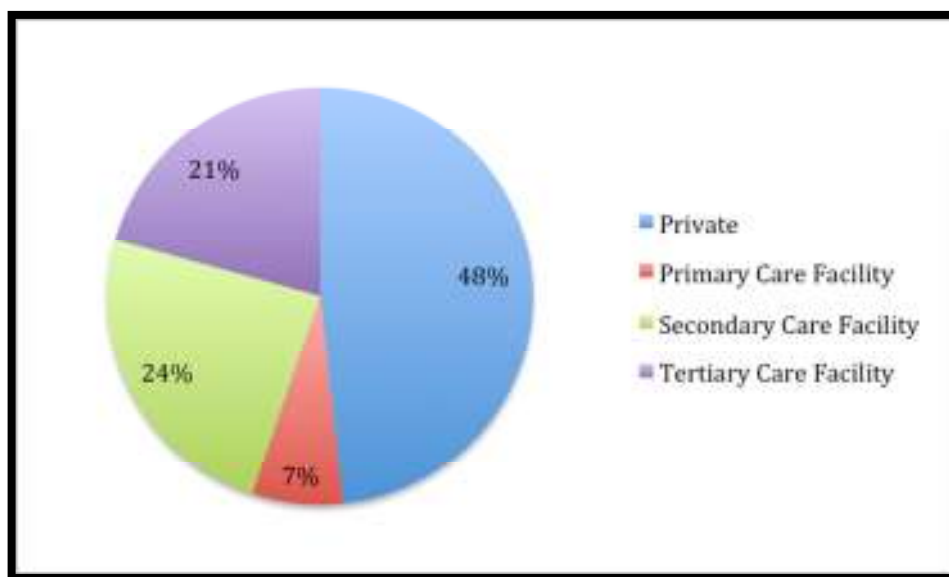


Figure 1: Area of occupation and level of care of respondents

Six respondents were excluded from the survey since they were not directly involved in the nutritional management of IF patients in their current practices. The 21 respondents currently involved in the management of IF patients continued with the survey. The respondents' years of experience in the field of IF are displayed in **Figure 2**. The majority of respondents, i.e. 67%, had been involved with patient management in this field for one to five years.

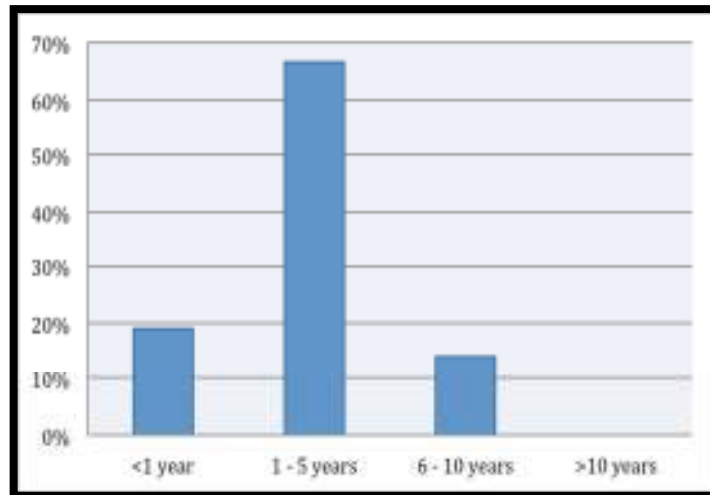


Figure 2: Respondents' years of experience in the management of intestinal failure patients

Respondents were given eight options of clinical conditions or presentations and were asked to indicate which of these they would regard as IF (more than one option could be indicated). The results are displayed in **Figure 3**. Only 18 out of 21 respondents answered this question and continued with the survey. All of the respondents indicated that high fistula outputs (n=18/18, 100%) would be defined as IF, while ileus (n=11/18, 61%), short bowel syndrome (n=12/18, 67%) and bowel obstruction (n=14/18, 78%) were also often indicated as IF.

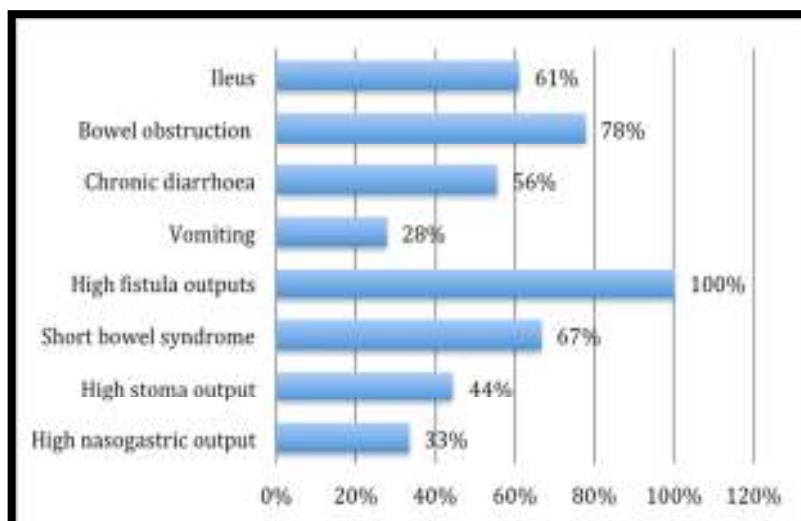


Figure 3: Conditions regarded as intestinal failure by respondents

Seventeen of the 18 respondents answered the question regarding whether they were familiar with the term fistuloclysis. If they answered “yes” to this question, they

were asked to provide a short explanation of what they understood by this term. Eleven of the 17 respondents indicated that they were familiar with the term, but three of them did not give any explanation and were therefore regarded as not being familiar with the term. This resulted in the majority (n=9/17, 53%) of respondents not knowing what fistuloclysis was. The data were analysed for the 47% (n=8/17) who responded that they were familiar with the term fistuloclysis to determine which area of care they practice in (**Figure 4**). The majority of the respondents familiar with the term fistuloclysis were situated in the public sector in tertiary hospitals. All eight participants who indicated that they were familiar with the term gave a correct explanation regarding what they understood by the term fistuloclysis.

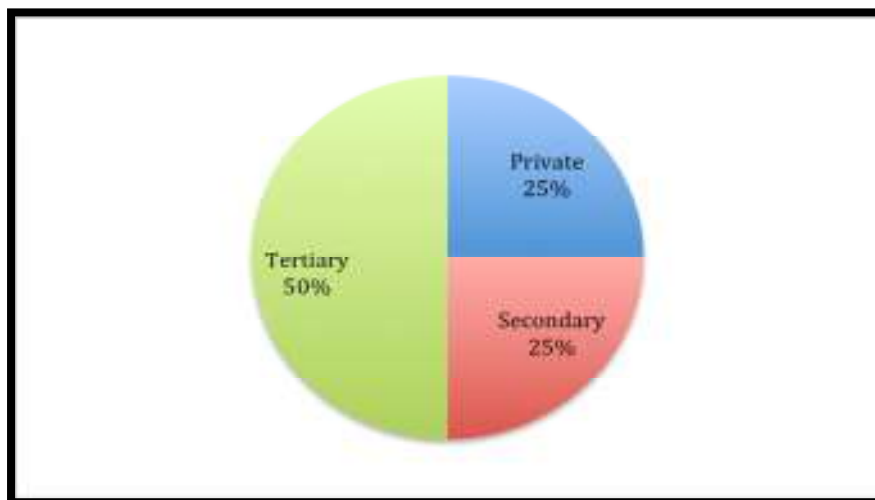


Figure 4: Distribution of dietitians familiar with the term fistuloclysis

Fourteen respondents responded to the question whether they had ever used fistuloclysis before in their current or previous settings. Of them, 43% (n=6/14) had used it before. Notably, 50% of respondents who were familiar with the term had never used fistuloclysis before as a treatment method. Of the 14 respondents only four (n=4/14, 28%) were using fistuloclysis in their current settings. Of these two (n=2/4, 50%) were in the public sector in secondary hospitals, while one was in a tertiary institution (n=1/4, 25%) and one in the private sector (n=1/4, 25%). Two indicated that they had only used it on one or two patients in the preceding two years and did not have much experience with it. Three of the four (n=3/4, 75%) using fistuloclysis thought it was a practical and achievable option for nutrition support. One respondent said *"If it is something that is effective then it would be great if it*

became more common practice. I must admit I have not researched it but will definitely after this survey.” The three respondents indicated that patients experienced fistuloclysis as an acceptable mode of nutrition support. One comment was: “Our patient actually preferred it to the TPN. She found the TPN catheter site very uncomfortable”

PN was indicated as the treatment modality most commonly used in institutions where fistuloclysis was not done or when fistuloclysis was not possible for an individual patient. All of the respondents (n=12/12) indicated that they used PN either as a first line treatment early in the management course, or would revert to PN if other methods like EN or oral intake failed. Failing of enteral or oral nutrition seemed to be regarded as an increase in output from the stoma or fistula above a tolerable level.

Respondents were given five common stumbling blocks for the successful implementation of fistuloclysis and were asked to indicate which were applicable in their opinion/institution. Reasons associated with failure to implement fistuloclysis are presented in **Figure 5**. All the respondents agreed that lack of training (n=12/12, 100%) contributed to the unsuccessful implementation of fistuloclysis in their institutions. The second most prevalent reason was resistance from clinicians and nursing staff (n=9/12, 75%), with lack of equipment (n=7/12, 58%) ranked third.

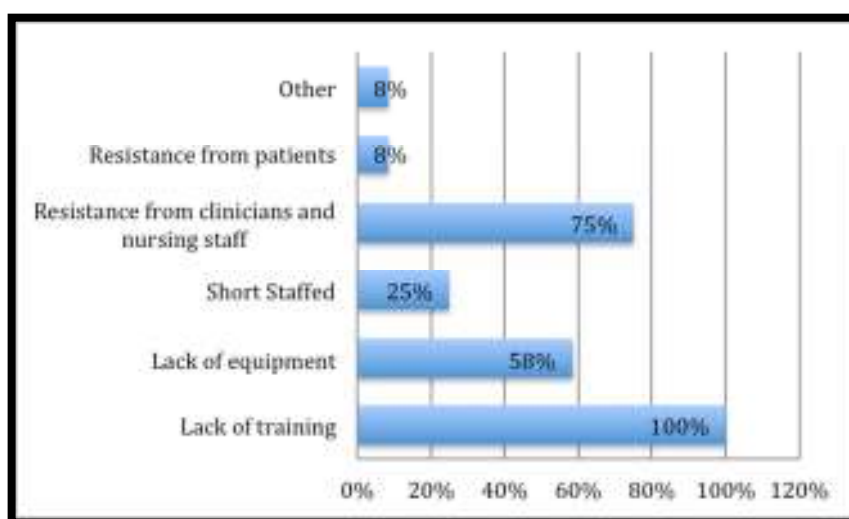


Figure 5: Reasons identified for unsuccessful implementation of fistuloclysis

All respondents agreed that they would consider fistuloclysis as a method of nutrition support if they had more information and a protocol available to guide the process.

Discussion

There are currently 4 250 dietitians registered with the Health Professions Council of South Africa (HPCSA). The South African Society for Parenteral and Enteral Nutrition (SASPEN), which represent dietitians working in the field of clinical dietetics, has around 200 registered members. Furthermore, although South African statistics are not available, IF appears to only involve a small percentage of the population. Data from hospitals in England estimated that the incidence of IF might be as high as 18 per million of the population per year, this was based on patients receiving PN support for at least 14 days.⁽¹¹⁾ If this were extrapolated to the South African context the number would amount to roughly 970 patients per year. It could therefore be postulated that the number of dietitians working in the field of clinical dietetics and with IF patients is quite limited. This may be the reason for the small number of responses received. The initial study methodology was aimed at investigating only the practices at other tertiary institutions, which would have produced a maximum of 11 responses; therefore the response rate of 27 is regarded as successful and fairly representative of current clinical practice. There was good representation within the 27 participants of the public as well as private healthcare sectors. Most participants from the public setting were involved in care at secondary and tertiary level where management of IF patients are expected.

What dietitians regard as IF is a diverse number of clinical presentations and conditions resulting in increased losses and decreased absorption of nutrients. This is in line with the definition of IF provided ESPEN. ESPEN classifies IF according to a functional and pathophysiological classification.⁽⁴⁾ The functional classification subdivides IF into three types, based on the onset and expected metabolic impact and outcome.^(4,12,13) Type I IF is often acute, short-term and usually self-limiting, resolving within 14 days on conservative management.^(11,14-16) Type II IF refers to a prolonged acute condition usually occurring in metabolically unstable patients and requires the care of a multidisciplinary team, with intravenous supplementation for weeks or months.⁽¹¹⁾ Type III IF refers to a chronic condition in a metabolically stable patient, which could be irreversible and might require intravenous support for months or

years.^(4,11,14) The pathophysiological classification includes five primary pathologies: short bowel syndrome (SBS), intestinal fistula, intestinal dysmotility, mechanical obstruction and extensive small bowel mucosal disease.⁽⁴⁾

When asked to indicate conditions that can be regarded as IF, 67% of the respondents indicated that they associate SBS with IF. SBS could result from extensive surgical resection due to a number of indications or as a result of congenital disease of the small intestine.^(4,17–19) Clinical manifestation of SBS is associated with less than 200cm of small bowel remaining in continuity.^(4,17,20) Although the length of the remaining bowel correlates with a patient's degree of nutritional autonomy, the remaining anatomy, the integrity and function of the available bowel, the underlying condition and the ability of the bowel remnant to adapt are big determining factors.^(4,13,18,19,21) The pathophysiological manner in which SBS causes IF is due to extensive loss of absorptive surface area.^(4,20) SBS is the leading cause of type 3 IF and accounts for around 75% of adults receiving home parenteral nutrition (HPN) in Europe.⁽⁴⁾

Intestinal fistula is defined as an abnormal communication between two epithelium-lined surfaces.^(2,4,8,22–24) Classification of fistulae can be done on the basis of the anatomy, physiology or aetiology.^(8,23–26) Anatomically, a fistula is classified according to the segment of gut it originates from and the organs involved.^(4,24,27) The physiological classification for fistulae is based on output and defines less than 200ml per day as low output, while 200–500ml per day is classified as moderate output.^(4,24–26,28) Effluent of >500ml per day in the fasted state is considered a high-output fistula.^(4,22,24,25,28) Fistulae can be classified as primary (type 1) or secondary (type 2) according to the aetiology.^(23,29) Primary fistulae develop as a result of underlying disease, while secondary fistulae are the result of insult or injury to previously healthy bowel.^(23,29) The most common cause of intestinal fistulae are surgical complications, amounting to 75–85% of cases.^(4,8,22,25,26,30–32) The remaining 15–25% of fistulae arise from the underlying pathology, with Crohn's disease being a major contributor.^(4,31,32) The pathophysiological manner in which fistulae cause IF is by the loss of enteric content through a proximal opening or by bypassing a significant segment of gut in the case of internal enteroenteric fistulae.^(4,27,23) All respondents agreed and indicated that a high-output fistula is associated with IF.

The term intestinal dysmotility refers to the presence of a disorder that impairs the propulsion of gut content in the absence of an obstruction.⁽⁴⁾ It can be further divided into loco-regional, indicating an isolated segment is affected (eg. Achalasia, gastroparesis) or multi-regional, involving more than one part of the gastrointestinal tract, often the small intestine.⁽⁴⁾ Intestinal dysmotility can present as type 1 IF in the case of acute postoperative ileus or critical illness associated ileus.⁽⁴⁾ Dysmotility often presents as a result of systemic or intra-abdominal inflammation as type 2 IF.⁽⁴⁾ Chronic IF associated with dysmotility is referred to as chronic intestinal pseudo-obstruction (CIPO) with the 'pseudo' indicating the absence of an occluding lesion.⁽⁴⁾ The primary pathophysiology in intestinal dysmotility that gives rise to IF is the intolerance to oral or enteral nutrition, resulting in inadequate nutrient intake.⁽⁴⁾ Generally the mucosal surface is preserved.⁽⁴⁾ Secondary mechanisms that play a part are the malabsorption of nutrients due to bacterial overgrowth in stagnant bowel loops, as well as increased intestinal losses of fluids and electrolytes due to increased secretions in dilated bowel loops.⁽⁴⁾ Causes of IF correctly indicated by respondents that could be classified as intestinal dysmotility included ileus (61%), vomiting (28%) and high nasogastric output (33%)

Mechanical obstruction refers to a physical abnormality affecting the intestine.⁽⁴⁾ This could be intraluminal (eg. foreign bodies), intrinsic (eg. stenosis), or extrinsic (eg. frozen abdomen).⁽⁴⁾ Furthermore these might be of benign or malignant origin.⁽⁴⁾ It could present as a type 1 IF which presents acutely and resolves within days with conservative management or surgery. It might also present as a type 2 or 3 IF with a prolonged course.⁽⁴⁾ The pathophysiological mechanism of IF due to mechanical obstruction is the spontaneous or prescribed ceasing of oral intake.⁽⁴⁾ Secondary to that, increased intestinal losses of fluids and electrolytes into distended bowel loops as well as losses due to vomiting or increased nasogastric drainage adds to the manifestation of IF.⁽⁴⁾ Vomiting and high nasogastric output, indicated by respondents, as causes for IF, could also be the clinical manifestation of bowel obstruction. Furthermore, bowel obstruction per se was indicated as a cause of IF by 78% of respondents.

Extensive small bowel mucosal disease refers to a condition where there is intact or almost intact but inefficient mucosal surface.⁽⁴⁾ There is a reduction in nutrient

absorption and/or an increase in nutrient loss via the mucosa to the point where the nutritional needs cannot be met, e.g. coeliac disease, radiation enteritis and protein-losing enteropathy.⁽⁴⁾ Chronic diarrhoea was correctly indicated as IF by 56% of respondents.

Only 47% of respondents were familiar with the term fistuloclysis and could give a correct explanation, with the majority of them currently working in tertiary hospitals. No literature could be obtained regarding international surveys evaluating the knowledge and practices of dietitians, specifically with regard to the nutritional management of complicated surgical patients. One available study evaluated the knowledge and attitudes of surgical trainees towards nutrition support and compared it to the knowledge and attitudes of dietitians working in the same field.⁽³³⁾ This study asked a series of multiple-choice questions related to nutrition in the surgical patient as well as the attitudes of respondents regarding nutrition.⁽³³⁾ The finding from this survey was that dietitians generally scored higher than surgical trainees in the knowledge questions, i.e. 88% versus 47%.⁽³³⁾ The knowledge of trainees improved with years of experience with the highest scores achieved by trainees with >3years of experience at 58%.⁽³³⁾ With regard to attitudes towards nutrition support, 100% of dietitians felt that they had adequate knowledge, while only 47% of surgical trainees were confident about this.⁽³³⁾ Despite the fact that fistuloclysis is successfully implemented internationally, there is no literature available which specifically evaluates the knowledge and practices of the multidisciplinary team with regard to fistuloclysis to which our findings could be compared. This study therefore adds useful information to identify gaps and barriers in the implementation of fistuloclysis in the South African context.

On further investigation, it was determined that 50% of respondents who were familiar with the term fistuloclysis had never used it before. This is a positive finding since it indicates awareness concerning fistuloclysis. Since training and resistance from nursing staff and clinicians were indicated as the two leading reasons for unsuccessful implementation of fistuloclysis, awareness could potentially be turned into practice through appropriate training and advocacy.

Although six out of 14 respondents had used fistuloclysis in practice before, only four were at that time using the method, but indicated it was not a regular procedure in their institutions. Surprisingly, two of the four respondents using fistuloclysis at that time were situated in secondary hospitals within the public sector. This was an unexpected finding, since the assumption would be that patients with IF would be managed at a higher level. It is encouraging that fistuloclysis can be successfully implemented at this level. The respondents did indicate that this was not the norm for nutritional management at their institution and that it had only been done in respect of one or two patients over a two-year period. All the dietitians who had used it before found it to be successful and well received by patients.

Nutrition support via the PN route was indicated as the route of choice most often used by respondents, either as a first line treatment or after enteral or oral nutrition had failed. Respondents indicated that they regarded enteral or oral nutrition to be unsuccessful if they experienced an increase in the fistula or stoma output. In the case of IF, the preferred mode of nutrition delivery would depend largely on the underlying cause, and the responses could be regarded as in accordance with evidence-based guidelines. All SBS patients will require PN support in the immediate postoperative phase to maintain nutritional status.⁽³⁴⁾ SBS with permanent PN dependence is strongly related to a small bowel length of <50cm post duodenum and to the absence of ileum and/or colon in continuity.⁽³⁵⁾ Values separating transient and permanent IF differ according to anatomy and are 100cm for an end-enterostomy, 65cm for a jejunocolic anastomosis and 30cm for a jejunoileocolic anastomosis.⁽³⁵⁾ Bowel adaptation usually occurs within the first two years following the last surgical intervention.^(19,20,34) The degree of adaptation is related to the extent of the resection as well as the anatomy of the remnant bowel.^(19,36,37) Structural and functional changes occur in the remnant bowel that improves nutrient and fluid absorption.^(19,20,36,37) There is no evidence of any functional or structural adaptation in patients with end-jejunostomies, therefore change in nutritional and fluid needs are unlikely with time.⁽³⁸⁾ According to consensus data most of the adaptation occurs within the first two years following resection, although some studies have suggested significant improvement beyond two-years.⁽³⁶⁾ Adaptation after two years is uncommon and limited to a maximum improvement of 5–10% in absorptive capacity.⁽³⁴⁾ In the case of fistulae enteral nutrition support is the preferred route of

nutrition support, unless it increases fistula output dramatically or causes increased abdominal pain or exacerbates diarrhoea.^(5,22,30) Bowel absorptive capacity should be sufficient for successful implementation of enteral nutrition support, and patients with fistulae should be able to tolerate polymeric enteral formula, unless the patient has less than 120cm of bowel left, have documented intolerance to polymeric enteral feed or experiences high fistula output.^(23,28) In that case, the patient should be changed to a semi-elemental or elemental enteral product.⁽²⁸⁾ The literature suggests that absolute contraindications to enteral nutrition include bowel discontinuity or insufficient bowel length, usually <75cm.^(8,28) This however might not be an absolute in practice. In the case of intestinal dysmotility and bowel obstruction, the primary pathophysiology resulting in IF is the inability to successfully utilise the enteral or oral route, therefore PN would be indicated as the primary route of nutrition support.⁽⁴⁾ The same would apply in the case of extensive small bowel mucosal disease, where intestinal nutrient absorption is completely impaired and the enteral or oral route becomes futile.⁽⁴⁾

All respondents indicated that they would consider using fistuloclysis as a means of nutrition support if they could gain the knowledge through training and had protocols available to guide the process.

Conclusion and recommendations

It is evident from the responses that dietitians are positive about the concept of fistuloclysis and are willing to apply it in patient care. It would have been valuable to have had sufficient information available regarding the opinions and perceptions of nursing staff and doctors on fistuloclysis, as this would have provided a more comprehensive picture regarding the management of these complex surgical cases. Based on the available data, we can however confirm that the employment of fistuloclysis in the management of adult IF patients in South African hospitals is underutilised. There is awareness among dietitians participating in this study regarding fistuloclysis as a treatment modality. Lack of training has been identified as one of the biggest stumbling blocks in the successful implementation of fistuloclysis. This could be addressed through training and protocol development. The training and protocols should include doctors and nursing personnel since nursing and clinician resistance have been identified as stumbling blocks in the implementation of

fistuloclysis, whereas they could play a pivotal role in the successful execution thereof.

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4.3.2 Responses from stoma therapists

The current management of intestinal failure patients by stoma therapists in South African hospitals, and their opinions and perceptions regarding fistuloclysis as a treatment option.

Results

There were ten responses to the survey from stoma therapists. Out of the 10, seven were excluded due to the fact that they indicated that they were currently working at Groote Schuur Hospital. Out of the three eligible for inclusion one was not currently responsible for the management of intestinal failure (IF) patients and were subsequently excluded. This left two stoma therapists who were working in the private sector. Both had >10years experience in the management of intestinal failure patients. Only one of the two proceeded with further questions, the other one did not finish the questionnaire.

This therapist was familiar with the term fistuloclysis and gave the correct explanation of the term. *"A means of re feeding. i.e. insertion of proximal limb efflux back into the distal limb. It is a successful and cost effective method of nutritional support for patients who would otherwise require parental feeding."* This therapist had been involved in the placement of a fistuloclysis catheter before and believed he/she had the skill and knowledge to successfully do it. They are currently using fistuloclysis as a means of nutrition support at the private institution where the therapist was employed and gave a correct explanation of the process that is followed: *"The distal limb is intubated with a Foley catheter. A stoma appliance /fistula bag is attached to the fistula to collect the efflux from the proximal limb. The output is collected and then strained using a stainless steel sieve. The sieved contents are put into an enteral feeding bag and connected to a giving set. The set is attached to the Foley catheter and the feed is introduced slowly into the distal limb. A drop monitor is required. Prior to re-feeding - patency of the distal limb must be confirmed."* Complications associated with fistuloclysis identified by the respondent were tube dislodgement, blocked tubes, bags leaking and blocked giving sets. Stumbling blocks in the successful implementation of fistuloclysis identified by the

respondent were lack of training of staff and staff shortage. The respondent indicated that he/she would be interested in using fistuloclysis as a means of nutrition support if there were a detailed protocol available.

4.3.3 Responses from doctors

The current management of intestinal failure patients by doctors in South African hospitals, and their opinions and perceptions regarding fistuloclysis as a treatment option.

Results

There were four responses on the survey for doctors managing intestinal failure. Bearing in mind that only eight centres were contacted, this is a 50% response rate and was regarded as good. With regard to the area the doctors worked in, there was a 50:50 split between participants practising in both the private and public sector (n=2/4, 50%) and in the public sector only (n=2/4, 50%). All four respondents fitted all of the inclusion criteria and continued with the survey. With regard to years of experience, one respondent had one to five years' experience (n=1/4), while 50% had between six and ten years' experience (n=2/4). The other respondent indicated >10years' experience.

When asked what they would define as intestinal failure (IF), 25% indicated high nasogastric drainage (n=1/4), 50% indicated high stoma losses (n=2/4), 75% indicated short bowel syndrome (n=3/4) and all respondents indicated high fistula outputs. Chronic diarrhoea, bowel obstruction and ileus were not associated with intestinal failure by any of the respondents. None of the respondents had a dedicated IF unit at their facility.

The aetiology of IF indicated was postoperative complications by 75% of the respondents (n=3/4) and trauma indicated by one respondent (n=1/4, 25%).

Two out of four respondents indicated a waiting period of six to twelve weeks at their institution before a patient would be considered for definitive surgery. The other two indicated slightly longer periods of 13-18 weeks and >24 weeks respectively.

With regard to keeping patients nil by mouth, 75% of respondents indicated that this was common practice in their facilities (n=3/4). The reason for keeping patients nil by mouth was associated with fistula output in all cases. Three out of the four indicated that a fistula output of >1 000ml over 24hours would be regarded as too high while

the other respondent indicated that patients with a fistula output of 500-999ml would be kept nil by mouth.

Two out of the four respondents (50%) indicated that it was routine practice to prescribe pharmacological agents to decrease output or transit time. Both indicated the use of Loperamide, with the dosage ranging between two tablets per day and up to a maximum of 16 tablets per day. One of the two respondents indicated that Codeine Phosphate is commonly used at a dosage of 30mg per os 12 hourly up to a max of 120mg per os 12 hourly. One of the two respondents indicated that octreotide has been used, but not often enough for him or her to remember the dosage while the other one indicated using it at a dosage of 100 micrograms 6 hourly.

All four respondents indicated that they were familiar with the term fistuloclysis and gave an explanation inline with the correct definition of the term. When asked whether they thought it was a practical and achievable option for nutrition support in a South African context, 50% said yes (n=2/4) and 50% disagreed (n=2/4). One responded motivated his positive response with the following statement: *"It is very poorly understood by nursing and practically difficult to do but TPN for more than a month is a disaster with a very high mortality in our institution. Refeeding is almost certainly a better option when this can be avoided"*. One of the respondents, who said no, had the following to say: *"In my setting there is no specialised wards or dedicated nurses. I know this has been achieved at GSH and I am in awe! These are labour intensive patients and without a dedicated ward or unit the patients in my setting (State) would not get the fistuloclysis performed. We battle just with input and output charting!"*

Two of the four respondents said that they were currently using fistuloclysis in their hospitals; the one respondent stated that he or she has only managed to achieve this in private practice and not in the public sector. The second respondent worked in the public sector. They stated the following with regard to the process followed:

- *"The tube is placed via a gastrostomy distal to the fistula and feeding is started in incremental fashion until predicted nutritional requirement is met and TPN is then withdrawn. The idea is to see if this type of feeding can replace TPN"*

- *"I have only managed to achieve this in the private sector. It is done in a High care or ICU setting. We try and decrease output, with medications mentioned before, they are all on TPN. CT to confirm no collections amenable to percutaneous drainage. The patient's anatomy is visualised by radiology or endoscopy. We ensure there is no distal obstruction to the efferent limb. A catheter is placed into the efferent limb and confirmed under fluoroscopy. Feeding is commenced with a kangaroo pouch, and sieving of the effluent by the nurses. We start refeeding at 10ml per hour and increase slowly as tolerated."*

All four of the respondents agreed that they would use fistuloclysis if there were more information and support available.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

The European Society for Clinical Nutrition and Metabolism (ESPEN) definition of intestinal failure (IF) states that it can be defined as the reduction of gut function below the minimum necessary for absorption of macronutrients and/or water and electrolytes, such that intravenous (IV) supplementation is required to maintain health and/or growth. From the literature it is evident that IF can be the result of several aetiologies each with a unique pathophysiological cause that manifests as a single pathology. The management of these patients, both nutritionally and medically is very challenging and costly. Conclusions drawn from the study to achieve objective 1,2 and 3 will now be discussed.

5.1 Objective 1

A total of 59 patients with IF were treated in the specialised IF unit at Groote Schuur Hospital in Cape Town between 1 January 2009 and 31 May 2014. Seventeen patients, who underwent treatment with fistuloclysis, fitted the inclusion criteria and had accessible medical records.

- As expected in the South African context, trauma and postsurgical complications were identified as the leading causes of IF in this patient population, contributing to 29% of the cases each.
- 94% (n=16/17) of the patients could be weaned off PN with fistuloclysis in the current group therefore it can be concluded that fistuloclysis is a feasible option for the nutritional management of IF patients in the South African setting.
- The biochemical data from this patient cohort suggests that fistuloclysis could improve liver parameters. This finding is supported by the available literature.
- Fistuloclysis could potentially improve serum albumin levels, as supported by other available literature. Albumin levels should however be interpreted in conjunction with inflammatory markers.
- There was a median decrease in body weight during the period of fistuloclysis. The clinical significance of this finding is however unknown since complication rates remained minimal.
- Managing patients with fistuloclysis makes pre-operative discharge of selected patients possible while conventional treatment by means of PN

would not have been conducted successfully outside of a hospital facility in the South African context.

- Mortality and morbidity data from this patient cohort were comparable with that of patients receiving conventional treatment. Therefore fistuloclysis does not increase mortality or morbidity risk.
- Overall the data presented from the patient population managed with fistuloclysis at Groote Schuur Hospital correlate well with the available literature and prove that fistuloclysis can be implemented successfully in a public hospital with limited resources in the South African setting.

5.2 Objective 2

This objective represents a purposefully selected case study of a patient who presented with type 2 IF following an abdominal gunshot.

- Fistuloclysis can be managed successfully for an extended period of time and gives the option of discharge home prior to definitive surgery in selected patients.
- Infusion of only a percentage of fistula effluent can still result in adequate gain in nutritional and fluid status.
- Fistuloclysis is associated with minor, but manageable, catheter related complications.

5.3 Objective 3

- From the surveys done among the different occupations groups of surgeons, stoma therapists and dietitians it was evident that there was awareness about the treatment modality.
- There are numerous stumbling blocks hampering the wider use of this novel treatment.
- There was a difference in opinion among the healthcare professionals participating in the surveys regarding the feasibility of fistuloclysis in the South African setting. The doctors' responses were mixed, with 50% agreeing and 50% disagreeing regarding the feasibility of fistuloclysis. All dietitians and stoma therapists participating in the survey agreed that it is feasible in the South African setting.

- Stumbling blocks identified were:
 - Nursing workload
 - Lack of dedicated units
 - Resistance from doctors and nurses
 - Lack of training
 - Lack of information and protocols
- Based on the explanation from the various occupation groups of the process followed prior to starting fistuloclysis and on how to place the catheter it appeared as if the technical understanding was present but that there might be a lack of practical experience and confidence.

It was evident from the successful management of patients at Groote Schuur Hospital that fistuloclysis is feasible in the South African context. From the responses received from healthcare workers it was clear that there is an awareness of not only the concept of fistuloclysis but also the numerous stumbling blocks that would hamper the successful implementation of fistuloclysis. All of these can be addressed by appropriate training that could improve the utilisation of this treatment modality. The published case report could serve as some guidance to centres which wish to implement fistuloclysis to treat in their IF patients.

5.4 Recommendations

The following recommendations flow from this study:

1. Fistuloclysis as a method of nutritional support is a more cost-effective approach than conventional PN and may be as effective in achieving the same clinical result in suitable patients. Therefore, a concerted effort needs to be made to raise the awareness around fistuloclysis.
2. More dedicated treatment units should be available for the management of IF patients. Groote Schuur Hospital is currently the only facility with a dedicated unit. Ideally, each province within South Africa should have at least one referral centre that can manage these complex patients.
3. Training needs of staff should be addressed by means of occupation-specific training material to improve the successful utilisation of fistuloclysis.
4. Training material aimed at the patient level also needs to be developed to ensure patient cooperation and improved adherence to the treatment.

5. Research should be done to investigate the cost associated with treatment of intestinal failure patients as well as outcomes such as mortality, length of stay in hospital, postoperative complications, etc. in a dedicated IF unit as against a general unit. It could be hypothesised that the cost of a dedicated unit would be cancelled out by reduction in treatment cost and improved patient outcomes.
6. Research should be done regarding the patient's perspective on fistuloclysis. Looking specifically at how acceptable patients find it as a treatment modality.
7. There is possibly a need for the establishment of an intestinal failure interest group that should ideally be driven by a centre where there is experience with the treatment modality.

5.5 Limitations of the study

This study had the following limitations:


1. The retrospective patient record review led to limitations in the types of data collected, as well as unavailability of some data.
2. The small sample size led to limitations in terms of meaningful statistical analysis and interpretation of results.
3. Poor response from doctors and, in particular, stoma therapists limited the information available to make recommendations with regard to perceptions and opinions in these occupation groups, as well as the training and equipment needs in the public and private healthcare setting.

CHAPTER 6: ADDENDA

6.1 Addendum A: Data capture sheet

Gender (0 = female, 1 = male)							
Age (years)							
Admission date							
Discharge date							
Nr of days in ICU							
Pathology							
GIT Anomy							
0 = Proximal I, 1 = distal I							
Open abdomen (0 = no, 1 = yes)							
Total days on PN in ICU							
PN days after start of fistuloclysis							
Date fistuloclysis started							
Date fistuloclysis ended							
Total days on fistuloclysis							
receiving enteral enteral feeds via							
fistuloclysis (0 = no, 1 = yes)							
Type of enteral feed administered (0 = Polymeric, 1 = Semi-elemental)							
Day of definitive surgery							
Definitive surgery							
Complications							
Definitive surgery until discharge (days)							
Biochemistry after starting fistuloclysis	D0	Change	D14	Change	D28	T.Chang	
Na		C		C			
K		C		C			
urea		C		C			
Creatinine		C		C			
Corr Calcium		C		C			
Magnesium		C		C			
Phosphorus		C		C			
T. bilir		C		C			
C.Bilir		C		C			
Albumin		C		C			
ALP		C		C			
GGT		C		C			
ALT		C		C			
AST		C		C			
CRP (if available)		C		C			
WCC		C		C			
Daily intake and output (ml)	D0	D1	D2	D3	D4	D5	D6
NGT/Ventil							
Other							
Stoma/Fistula out							
Fistuloclysis in							
% Fistuloclysis	0/N/0	0/N/0	0/N/0	0/N/0	0/N/0	0/N/0	0/N/0
Weekly weight (kg)	W1	W2	W3	W4	W5	W6	W7
Weight							
% gain		0/N/0	0/N/0	0/N/0	0/N/0	0/N/0	0/N/0
Recorded catheter related complications	D0	D1	D2				
(0 = complication 0 = no complication)							
Fistuloclysis stopped due to bag leaking problems							
Outcome							
0 = d/c alive, 1 = deceased in hospital							
0 = enteral autonomy, 1 = req supplementation via PN/EN							

6.2 Addendum B



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

You are invited to participate in a research study which is being conducted as part of a master's degree through the University of Stellenbosch with involvement of Grootte Schuur Hospital Colo-rectal surgery department. The principle investigator is Anna-Lena du Toit, a registered dietitian at Grootte Schuur Hospital, with Prof R Blaauw and Dr A Boutall as study leader and co-study leader. Ethics approval has been obtained from the Health Research Ethics Committees of the University of Stellenbosch and the University of Cape Town.

The aim of the study is to investigate the management of adult intestinal failure patients in hospitals in South Africa and to determine how practical and acceptable fistuloclysis is in the South African setting. Other study objectives include describing a patient population where fistuloclysis has been implemented successfully, as well as a purposefully selected case study to describe the management of an individual patient with fistuloclysis.

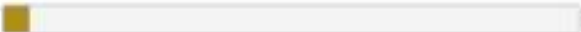
Completion of the survey will be regarded as informed consent. Completion of the survey will take approximately thirty (30) minutes.

Any queries can be directed to the principle investigator, Anna-Lena du Toit at Anna-Lena.duToit@westerncape.gov.za


Thank you for participating in this survey.

Kind regards,

Anna-Lena du Toit RD(SA)

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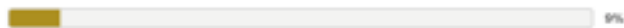
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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you working in the private or public sector?

- Public
- Private
- Public and Private



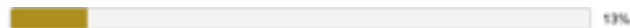
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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please indicate the level of care you are working in.

- Primary level facility
- Secondary level facility
- Tertiary level facility



Prev Next

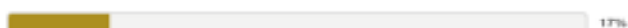




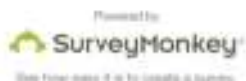
The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you working at Groote Schuur Hospital?

- Yes
- No



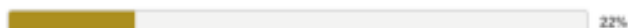
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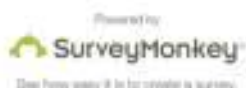
The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you involved in the management of patients with intestinal failure?

- Yes
- No



Prev Next

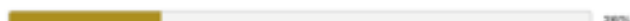




The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

For how long have you been actively involved in the management of intestinal failure patients?

- <1 year
- 1 - 5 years
- 5 - 10 years
- >10 years



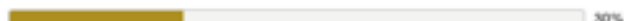
Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What would you define as intestinal failure? Please select all that is applicable.

- High nasogastric outputs
- High stoma outputs
- Short bowel syndrome
- High fistula outputs
- Vomiting
- Chronic diarrhoea
- Bowel obstruction
- Ileus



Prev Next

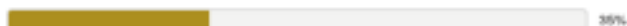




The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you have a dedicated intestinal failure unit in your institution?:

Yes
 No



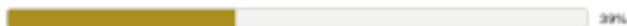
Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Approximately how many patients do you manage with intestinal failure in a year?:

- None
- 1 - 5
- 6 - 10
- 11 - 15
- >15



Prev Next





The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What is the most common etiology of intestinal failure in your institution?

- Post operative complications eg. iatrogenic injuries, anastomotic leaks
- Trauma
- TB
- Inflammatory bowel disease
- Chemo- or radiation related complications
- Other (please specify)



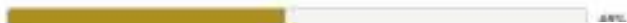
Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What is the general waiting period before you would consider to operate again on a patient with intestinal failure

- <6 weeks
- 6 - 12 weeks
- 13 - 18 weeks
- 19 - 24 weeks
- >24 weeks



Prev Next





The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Is it common practice in your institution to keep patients with intestinal failure nil by mouth?

Yes
 No



Prev Next

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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What would you consider to be indications to keep a patient with intestinal failure nil per mouth? Please select all that is applicable.

- Stoma output 800 - 999ml/24hrs
- Stoma output 1000 - 1500ml/24hrs
- Stoma output >1500ml/24hrs
- Fistula output 200 - 500ml/24hrs
- Fistula output 500 - 999ml/24 hrs
- Fistula output >1000ml/24 hrs



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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you routinely prescribe pharmacological agents to decrease fistula/stoma output to decrease transit time?

Yes
 No



Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Which drugs do you commonly use to decrease stoma or fistula output? Please indicate the dosage.

Loperamide:
Codeine:
Phosphate:
Octreotide:
Other (please specify name and dose):



Prev Next





The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you familiar with the term fistuloclysis?

Yes
 No



Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.


Give a brief explanation of your understanding of the term fistuloclysis?

Empty text input area for providing a brief explanation of the term fistuloclysis.



Prev Next





The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

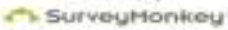
In your opinion, is fistuloclysis a practical and achievable option for nutrition support in adult patients with intestinal failure in South Africa?

No

Please motivate your answer

83%

Prev Next

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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you currently use fistuloclysis as a means of nutrition support in your institution?

Yes
 No

87%

Prev Next

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The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please provide a short summary of the process followed (including tests/procedures performed before commencement).



Prev Next



The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

If you do not use fistuloclysis would you consider using this method in your patients if you had more information and support available?



Prev Next





The current management of intestinal failure patients by doctors in South-African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.


Thank you for participating in this survey



Prev Done



6.3 Addendum C



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

You are invited to participate in a research study which is being conducted as part of a master's degree through the University of Stellenbosch with involvement of Grootte Schuur Hospital Colo-rectal surgery department. The principle investigator is Anna-Lena du Toit, a registered dietitian at Grootte Schuur Hospital, with Prof R Blaauw and Dr A Boutall as study leader and co-study leader. Ethics approval has been obtained from the Health Research Ethics Committees of the University of Stellenbosch and the University of Cape Town.

The aim of the study is to investigate the management of adult intestinal failure patients in hospitals in South Africa and to determine how practical and acceptable fistuloclysis is in the South African setting. Other study objectives include describing a patient population where fistuloclysis has been implemented successfully, as well as a purposefully selected case study to describe the management of an individual patient with fistuloclysis.

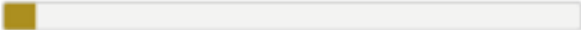
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Any queries can be directed to the principle investigator, Anna-Lena du Toit at Anna-Lena.duToit@westerncape.gov.za


Thank you for participating in this survey.

Kind regards,

Anna-Lena du Toit RD(SA)

6%

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The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you currently working in the public or private sector?

- Public Sector
- Private Sector
- Public and Private



Prev Next



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please indicate at what level of care you are working

- Primary Care Facility
- Secondary Care Facility
- Tertiary Care Facility



Prev Next





The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you working at Grootte Schuur Hospital?

Yes

No

22%

Prev Next

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The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you involved in the management of intestinal failure patients?

Yes

No

20%

Prev Next

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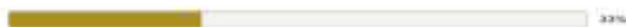
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The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

For how long have you been actively involved in the management of intestinal failure patients?

- <1 year
- 1 - 5 years
- 6 - 10 years
- >10 years



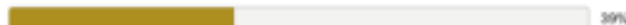
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The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you familiar with the term fistuloclysis?

- Yes
- No



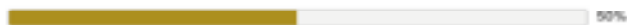
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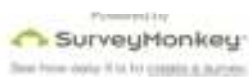


The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What do you understand under the term fistuloclysis?



Prev Next



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Have you ever placed/been involved in the placement of a fistuloclysis catheter?

Yes
 No



Prev Next





The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you believe that you have enough skills and resources available to successfully manage intestinal failure patients on fistuloclysis?

Yes
 No



Prev Next



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please provide a short summary of the lack of training and/or resources at your institution.

[Empty text input area]



Prev Next





The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you currently using fistuloclysis successfully in your institution?

Yes
 No



Prev Next



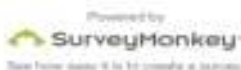
The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please provide a short summary of the process followed and products/equipment used.

[Empty text input area]



Prev Next





The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What complications do you associate with fistuloclysis?

- Tube dislodgement
- Blocked tubes
- Bags leaking
- Blocked giving sets

Other (please specify)



Prev

Next



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What in your opinion are the stumbling blocks in using fistuloclysis as a means of nutrition support?

- Lack of training
- Lack of staff
- Lack of appropriate equipment
- Resistance from clinicians and dietitians
- Resistance from patients

Other (please specify)



Prev

Next





The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Would you consider using fistuloclysis in patients with intestinal failure if you had more information and a protocol available to guide the process?

Yes
 No



Prev Next



The current management of intestinal failure patients by stoma therapists in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.


Thank you for participating in this survey



Prev Done



6.4 Addendum D



The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

You are invited to participate in a research study which is being conducted as part of a master's degree through the University of Stellenbosch with involvement of Groote Schuur Hospital Colo-rectal surgery department. The principle investigator is Anna-Lena du Toit, a registered dietician at Groote Schuur Hospital, with Prof R Blaauw and Dr A Boutal as study leader and co-study leader. Ethics approval has been obtained from the Health Research Ethics Committees of the University of Stellenbosch and the University of Cape Town.

The aim of the study is to investigate the management of adult intestinal failure patients in hospitals in South Africa and to determine how practical and acceptable fistuloclysis is in the South African setting. Other study objectives include describing a patient population where fistuloclysis has been implemented successfully, as well as a purposefully selected case study to describe the management of an individual patient with fistuloclysis.

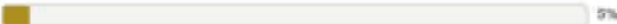
Completion of the survey will be regarded as informed consent. Completion of the survey will take approximately thirty (30) minutes.

Any queries can be directed to the principle investigator, Anna-Lena du Toit at Anna-Lena.duToit@westerncape.gov.za


Thank you for participating in this survey.

Kind regards,

Anna-Lena du Toit RD(SA)

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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you working in the public or private sector?

- Public
- Private
- Public and Private



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please indicate which level of care you are working in.

- Primary Care facility
- Secondary Care facility
- Tertiary Care facility



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you working at Grootte Schuur Hospital?

- Yes
- No



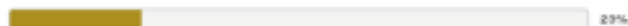
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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you involved in the management of intestinal failure patients?

- Yes
- No



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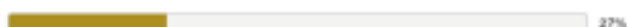




The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

For how long have you been actively involved in the management of intestinal failure patients?

- <1 year
- 1 - 5 years
- 5 - 10 years
- >10 years



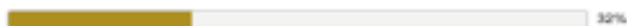
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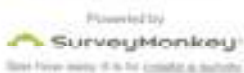
The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What would you define as intestinal failure? Please select all that is applicable.

- High nasogastric output
- High stoma output
- Short bowel syndrome
- High fistula outputs
- Vomiting
- Chronic diarrhea
- Bowel obstruction
- Ileus



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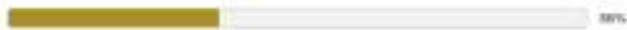




The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Are you familiar with the term fistuloclysis?

Yes
 No



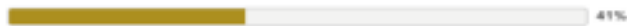
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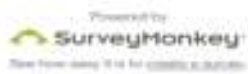
The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What do you understand under the term fistuloclysis? Please give a short explanation:

[Empty text input area for explanation]



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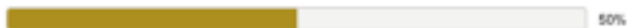




The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Have you ever used fistuloclysis as a means of nutrition support? (in your current or previous institution)

Yes
 No



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you currently use fistuloclysis as a means of nutrition support in your institution?

Yes
 No



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Please provide a short summary of the process followed and characteristics of patients in which you would apply fistuloclysis.



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Do you ever give additional enteral feeds via the fistuloclysis catheter?

Yes
 No



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What type of formula do you use via the fistuloclysis catheter and why? (Polymeric, Semi-elemental, Elemental)



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

In your opinion, is fistuloclysis a practical and achievable option for nutrition support in patients with intestinal failure?

Please motivate your answer



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What complications do you associate with fistuloclysis? Please choose all the applicable options.

- Tube dislodgement
- Blocked tubes
- Bags leaking
- Blocked giving sets

Other (please specify)



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

In your opinion, do patients experience fistuloclysis as an acceptable method of nutrition support?

- Yes
- No

Please motivate your answer



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

In patients not suitable for fistuloclysis or in institutions where fistuloclysis is not used as a means of nutrition support what approach do you follow in the nutritional management of intestinal failure patients? (include type of diet/feed/NPO, parenteral nutrition support, requirements used etc)



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

What in your opinion are the stumbling blocks in using fistuloclysis as a means of nutrition support?

- Lack of training
- Lack of equipment
- Short staffed
- Resistance from clinicians and nursing staff
- Resistance from patients

Other (please specify)



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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Would you consider using fistuloclysis in patients with intestinal failure if you had more information and a protocol available to guide the process?

Yes
 No



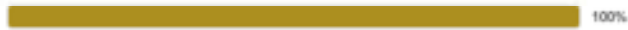
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The current management of intestinal failure patients by dietitians in South African hospitals and their opinions and perceptions regarding fistuloclysis as a treatment option.

Thank you for participating in this survey



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