



Nutritional Response to Chyme Reinfusion in Intestinal Failure

Andrew Xia
Advanced Clinical Dietitian
PhD Candidate



Introducing Chyme

Chyme is a semi-fluid mix of partially digested food redirected through a stoma or fistula.

It consists of digestive fluids, nutrients, and electrolytes - vital for bodily balance.

A low volume of stoma output allows for the safe disposal of chyme without adverse consequences.

The probability of achieving low output increases with a stoma or fistula located further down the gastrointestinal tract.

High, watery stoma/fistula output can cause intestinal failure (IF)

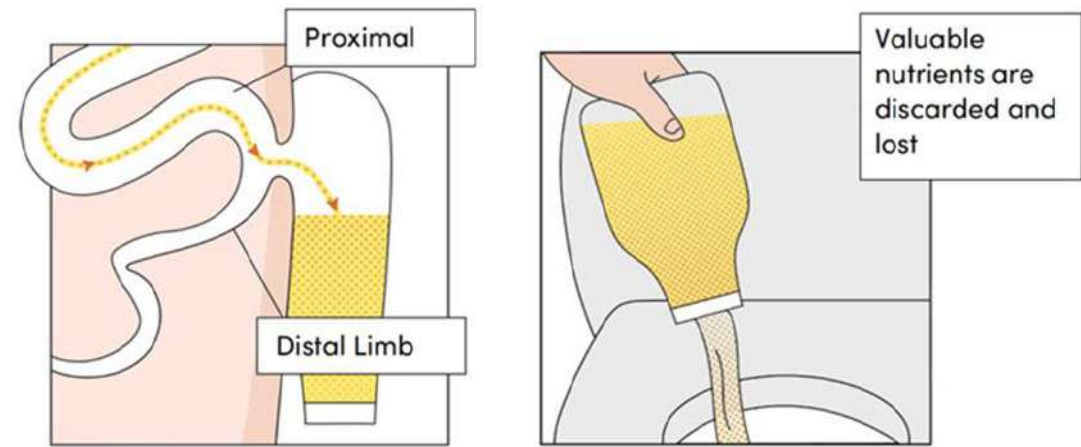


Figure 1. Chyme is collected in the Ostomy Appliance and discarded. The Distal Limb experiences atrophy (shown) from inactivity

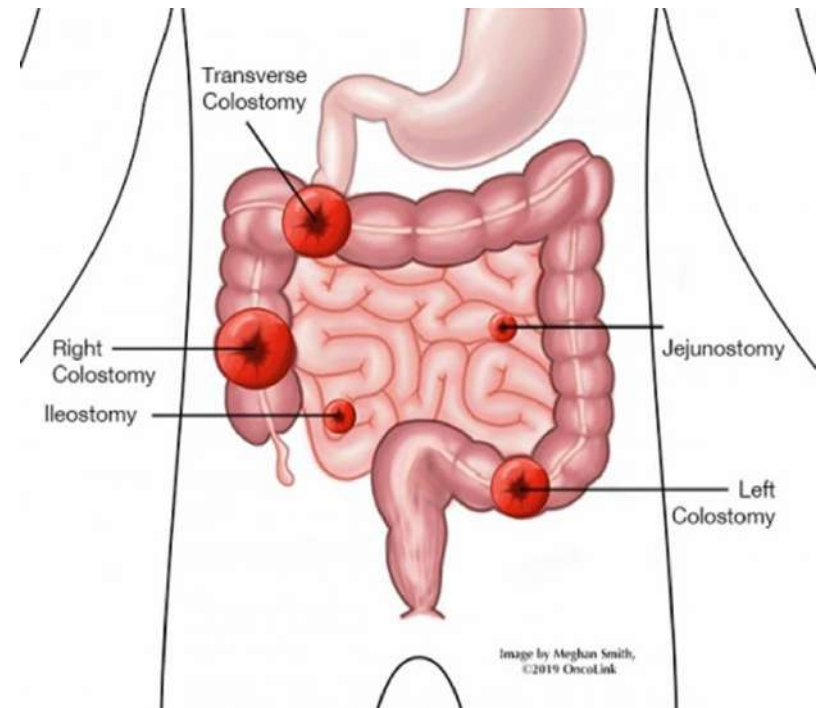
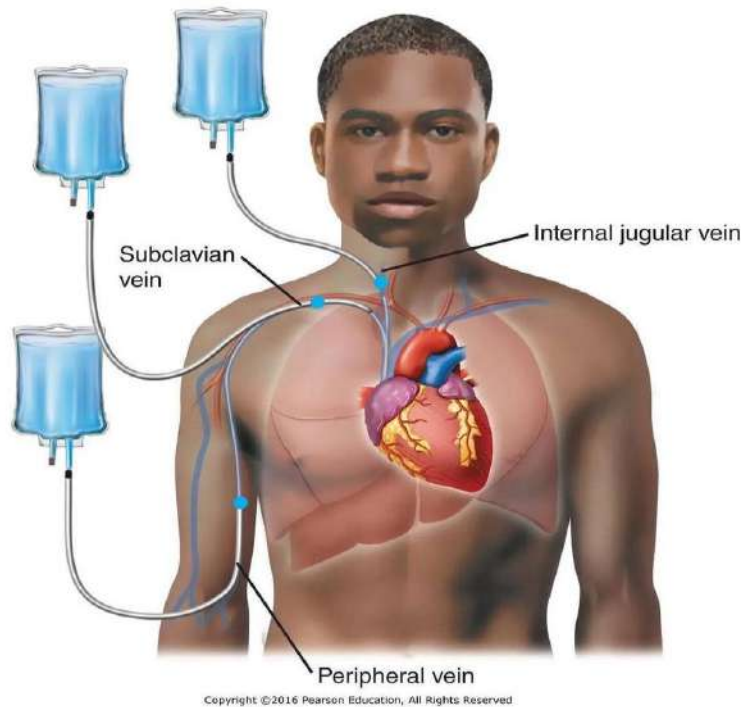


Image by Meghan Smith,
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Nutritional Management of Intestinal Failure

IF defined as gut function reduction, impairing necessary nutrient absorption.

Resulting in dehydration, weight loss, malnutrition and micronutrient deficiencies.

Parenteral Nutrition (PN) is often used to prevent and/or address these issues.

- Potential complications:
 - Infections,
 - Metabolic issues
 - High cost
 - Higher hospital mortality
 - Longer hospital stay.

Chyme Reinfusion Therapy

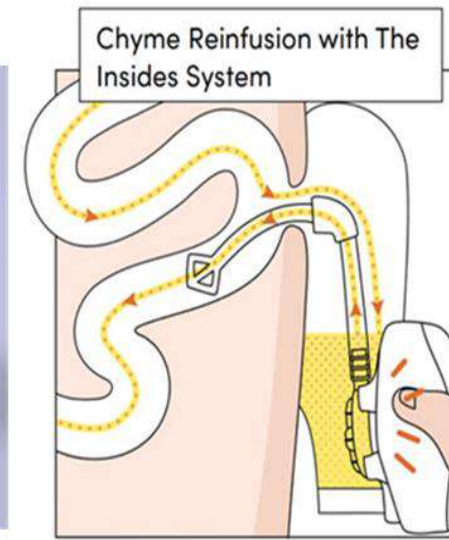


Figure 2. Chyme Reinfusion with The Insides System enables patients to recycle Chyme at both hospital and home, when needed.

- Chyme reinfusion therapy (CRT) reintroduces the collected chyme from the stoma bag back into the lower portion of the unused gut
 - Using an automatic portable pump system
- Studies demonstrated CRT can lead to
 - Earlier return to oral eating
 - Reducing dependence on PN
 - Restoring optimal intestinal function
 - Mitigating central line infections



Figure 6. Male, 21 years old, hospitalization 27 days, CR at home 153 days.

Picot D, Layec S, Seynhaeve E, Dussaulx L, Trivin F, Carsin-Mahe M. Chyme Reinfusion in Intestinal Failure Related to Temporary Double Enterostomies and Enteroatmospheric Fistulas. *Nutrients*. 2020;12(5).

Sharma P, Davidson R, Davidson J, et al. Novel chyme reinfusion device for gastrointestinal fistulas and stomas: feasibility study. *The British Journal of Surgery*. 2020 Aug;107(9):1199-1210. DOI: 10.1002/bjs.11516. PMID: 32304225.

Indications for Chyme Reinfusion Therapy

Chyme Reinfusion Indications	Number of Patients
High stoma or fistula output	269
IF with short (in-circuit) bowel length	247
Proximally located double enterostomy	56
Fluid and electrolyte disturbances	45
Malnutrition and poor weight gain	23
Liver dysfunction and central line–related complications	12
Metabolic derangements	8
Bowel rehabilitation and preparation for stoma reversal	2



Dietary Practice during CRT

Variations in nutrition support methods during CRT:

- Oral nutrition only
- Oral eating supplemented with EN and/or PN.

Dietary practices reported in studies:

- Two studies advocate for a low residue diet during oral intake.
- One study recommends pureed food to prevent refeeding tube clogging.
- Majority of studies do not detail average oral and supplemental EN intake during CRT.

[Nutrients](#). 2020 Aug; 12(8): 2357.

Published online 2020 Aug 7. doi: [10.3390/nu12082357](https://doi.org/10.3390/nu12082357)

PMCID: PMC7468734

PMID: [32784602](https://pubmed.ncbi.nlm.nih.gov/32784602/)

Nutritional Status and Quality of Life in Hospitalised Cancer Patients Who Develop Intestinal Failure and Require Parenteral Nutrition: An Observational Study

[Marina Plyta](#),^{1,2} [Pinal S. Patel](#),¹ [Konstantinos C. Fragkos](#),¹ [Tomoko Kumagai](#),² [Shameer Mehta](#),^{1,2} [Farooq Rahman](#),^{1,2} and [Simona Di Caro](#)^{1,2,*}

80% of hospitalised cancer patients with IF in the UK were at risk of malnutrition, exhibiting reduced appetite and poor oral intake.

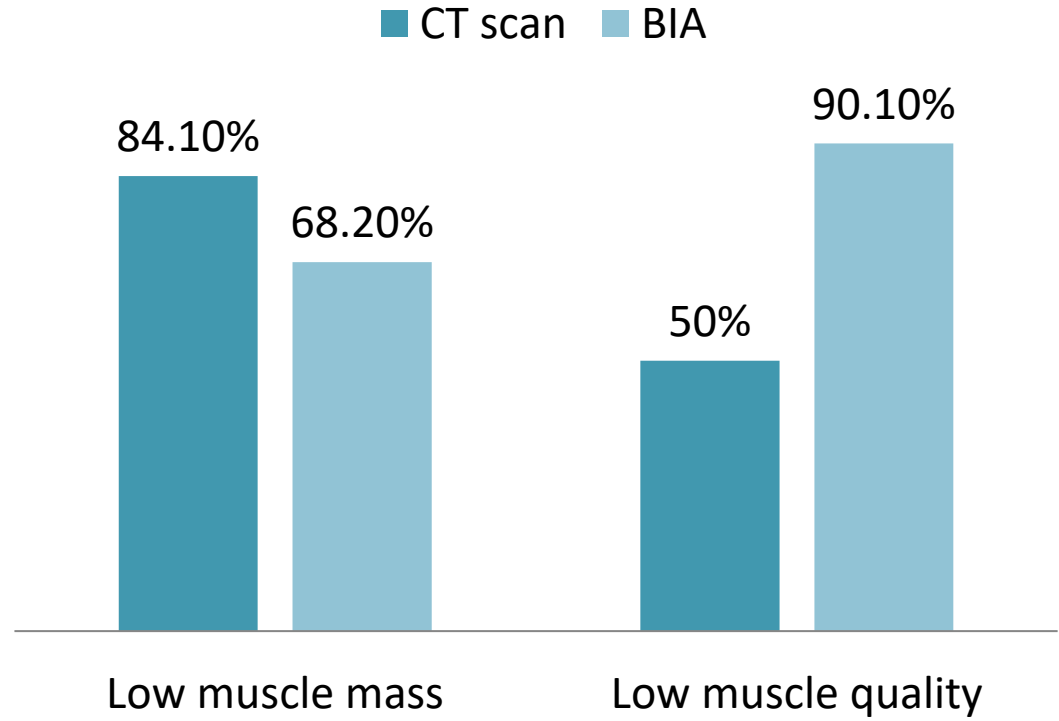
- This inadequate intake exacerbates the risk of essential nutrient deficiencies.
- Rapid development of these deficiencies can significantly impact patient health and recovery outcomes.





Body composition in patients with type 2 intestinal failure

Maja Kopczynska MBBCh¹ | Maria P. Barrett RD¹ | Anabelle Cloutier MD¹ | Kirstine Farrer MPhil¹ | Michael Taylor¹ | Sorrel Burden PhD^{1,2} | Simon Lal PhD^{1,2}



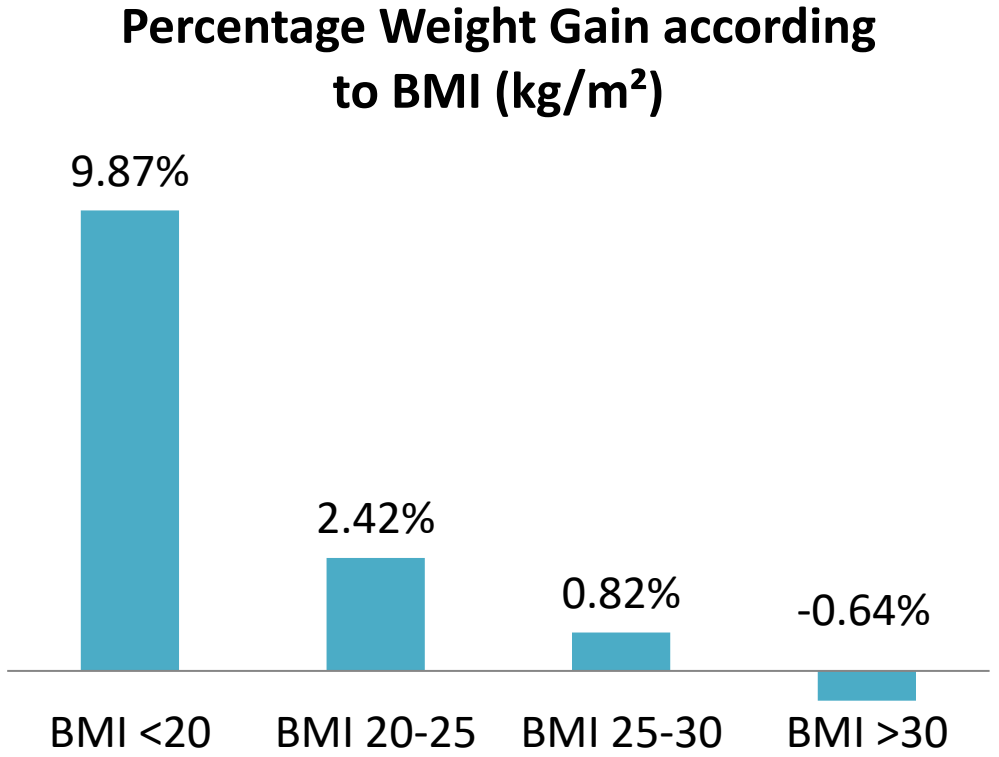
44 patients: 36.4% Fistula; 40.9% Short bowel syndrome

Kopczynska M, Barrett MP, Cloutier A, Farrer K, Taylor M, Burden S, Lal S. Body composition in patients with type 2 intestinal failure. Nutr Clin Pract. 2022 Feb;37(1):137-145. doi: 10.1002/ncp.10745. Epub 2021 Jul 16. PMID: 34270136.

Weight Gain in Chyme Reinfusion Therapy

A French study by Picot et al. in 2020 reported nutritional outcomes of 306 consecutive patients undergone CRT from January 2000 to December 2018:

Weight increased by 3.5 + 8.4% (p < 0.0001) during CRT

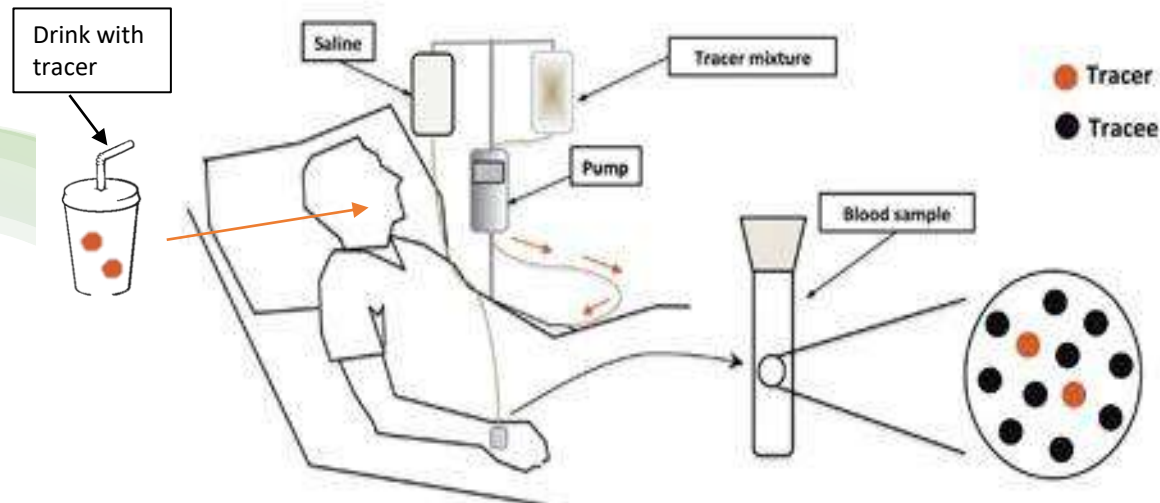


Picot D, Layec S, Seynhaeve E, Dussaux L, Trivin F, Carsin-Mahe M. Chyme Reinfusion in Intestinal Failure Related to Temporary Double Enterostomies and Enteroatmospheric Fistulas. Nutrients. 2020;12(5).

Protein Metabolism

- ASPEN-FELANPE Clinical Guidelines recommend a protein intake of 1.5 to 2.0 g/kg/day.
 - For high output fistula, the intake may increase to 2.5 g/kg/day.
- Picot et al. report: 1.5 g/kg/day from oral and/or supplemented EN during CRT.
- CRT has been reported to increase body weight in patients with T2IF.
- Does CRT promote protein absorption and anabolic metabolism in the unused part of the intestine?
- Would any dietary strategies complement CRT in protein digestion, absorption and whole-body balance?
 - May lead to an improvement of muscle mass and quality

The Stable Isotope Tracer Technique: A Simple Explanation



A method used to track the journey of specific substances within a system, such as the human body.



Think of it as giving a nutrient a GPS tracker to understand its journey through the body.



What's an Isotope? A variant of a chemical element with a different number of neutrons but the same number of protons.



Stable Isotopes don't decay over time, hence are safe to use in the body.



By 'tagging' a nutrient with a stable isotope, we can track its path, understand how it's used, and determine when it leaves the body.

Protein Digestion and Amino Acid Absorption

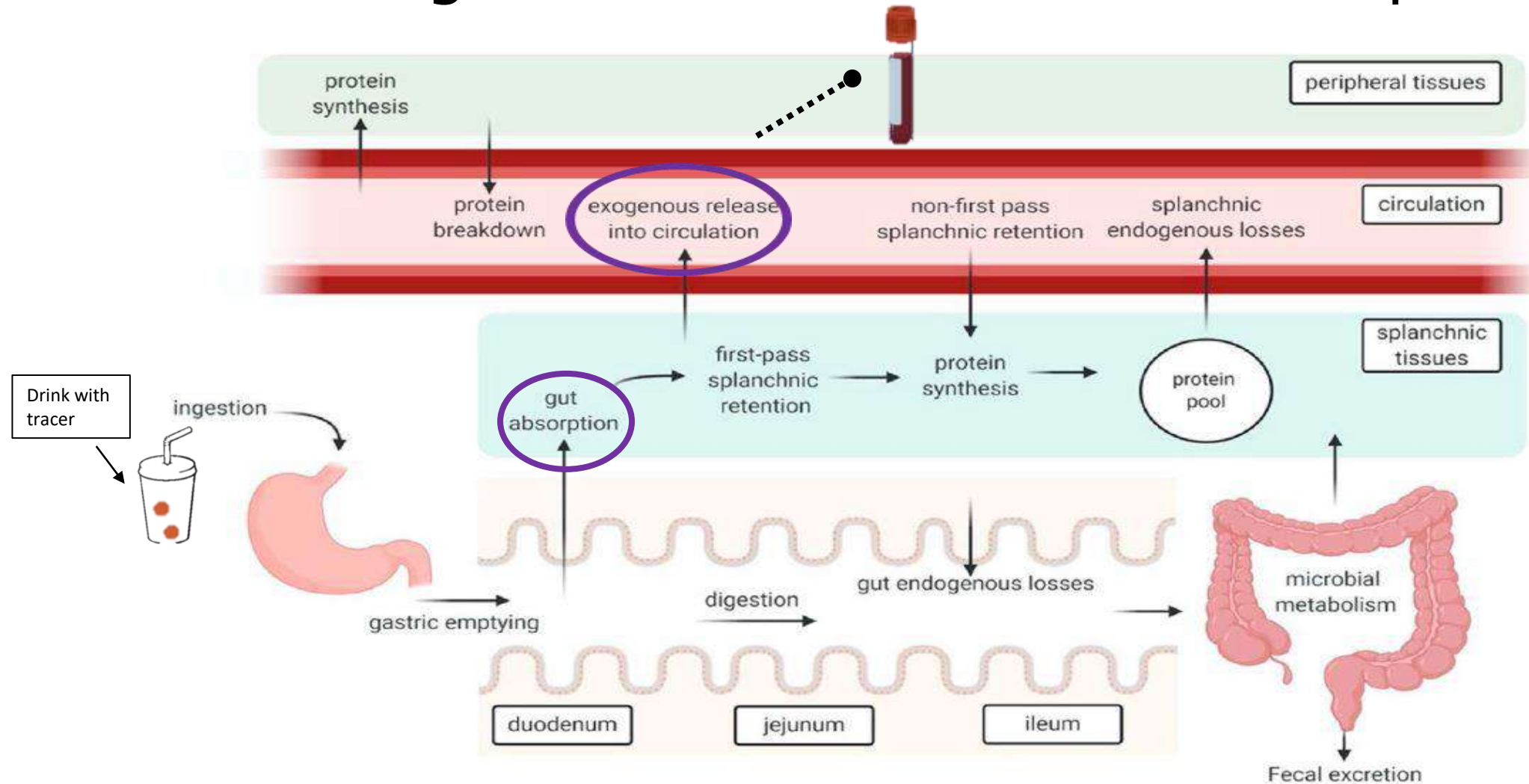


Fig. 1. Schematic representation of various processes and compartments involved in gut amino acid absorption and amino acid release in the circulation.

Trommelen, J., Tomé, D., van Loon, L.J.C. (2021) Gut amino acid absorption in humans: Concepts and relevance for postprandial metabolism. *Clinical Nutrition Open Science*, 36, 43-55. <https://doi.org/10.1016/j.nutos.2020.12.006>.

Influence of Chyme on the Microbiota

Short chain fatty acids (SCFA), namely acetate, propionate, and butyrate, are generated by colonic bacteria from undigested carbohydrates (usually soluble fibre):

- Fuel colonocytes.
- Supply the body up to 750–1000 kcal/day.
- Stimulate colonic sodium absorption, potentially decreasing diarrhoea.

However, in patient with IF:

Fibre intake is limited due to concerns about increased stoma/fistula output, potentially worsening hydration status and nutrient absorption.

Could chyme, rich in soluble fibre, be beneficial to patients undergoing CRT?

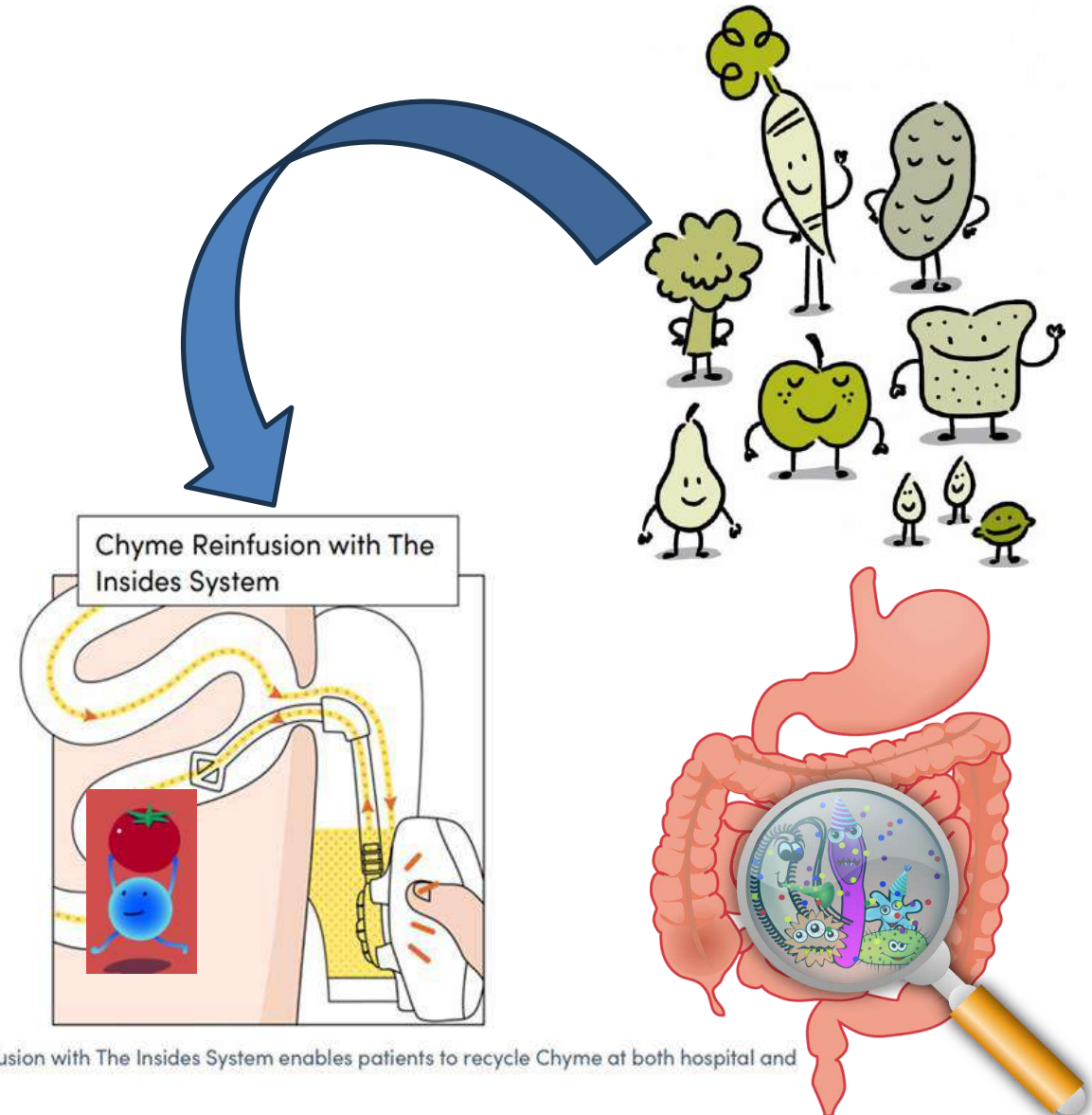
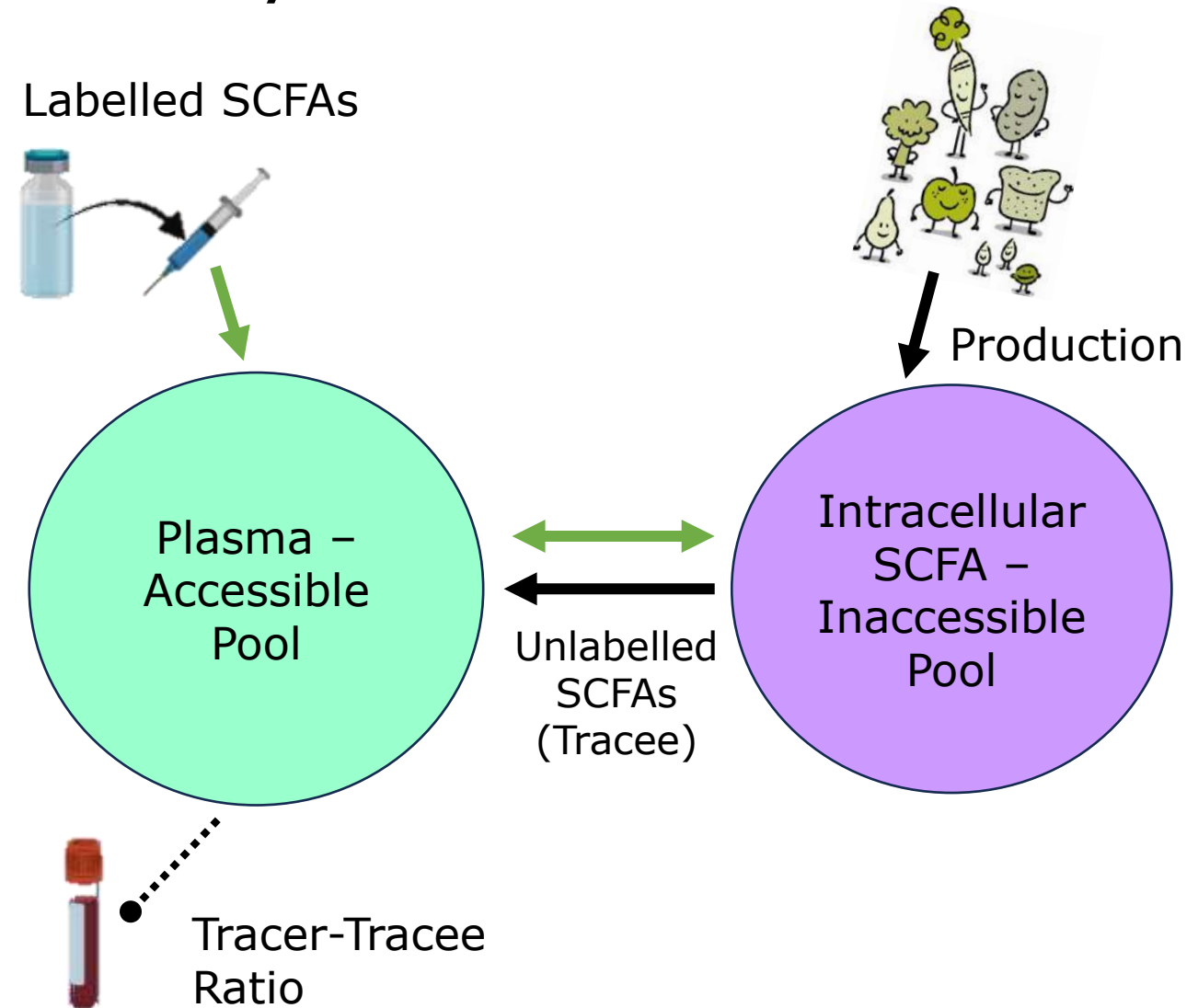


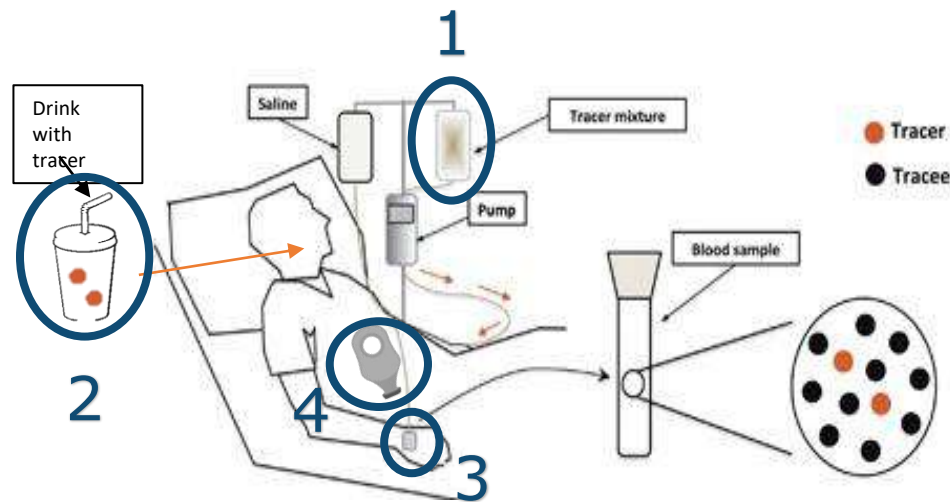
Figure 2. Chyme Reinfusion with The Insides System enables patients to recycle Chyme at both hospital and home, when needed.

Whole-body Short Chain Fatty Acids Production

- Our collaborator at Texas A&M University focus on the accessible pool: systemic circulation
- Developed a novel pulse approach to measure:
 - SCFA whole-body production rates
- Estimate SCFA kinetics and pool sizes in the inaccessible pool
 - Potentially represents the area where SCFAs from intestinal bacteria drain into.
- Method involves:
 - IV administration of SCFA tracer pulse
 - Repeated blood sampling to track SCFA levels



Stable Isotope Tracer Investigation Day: Procedure Overview



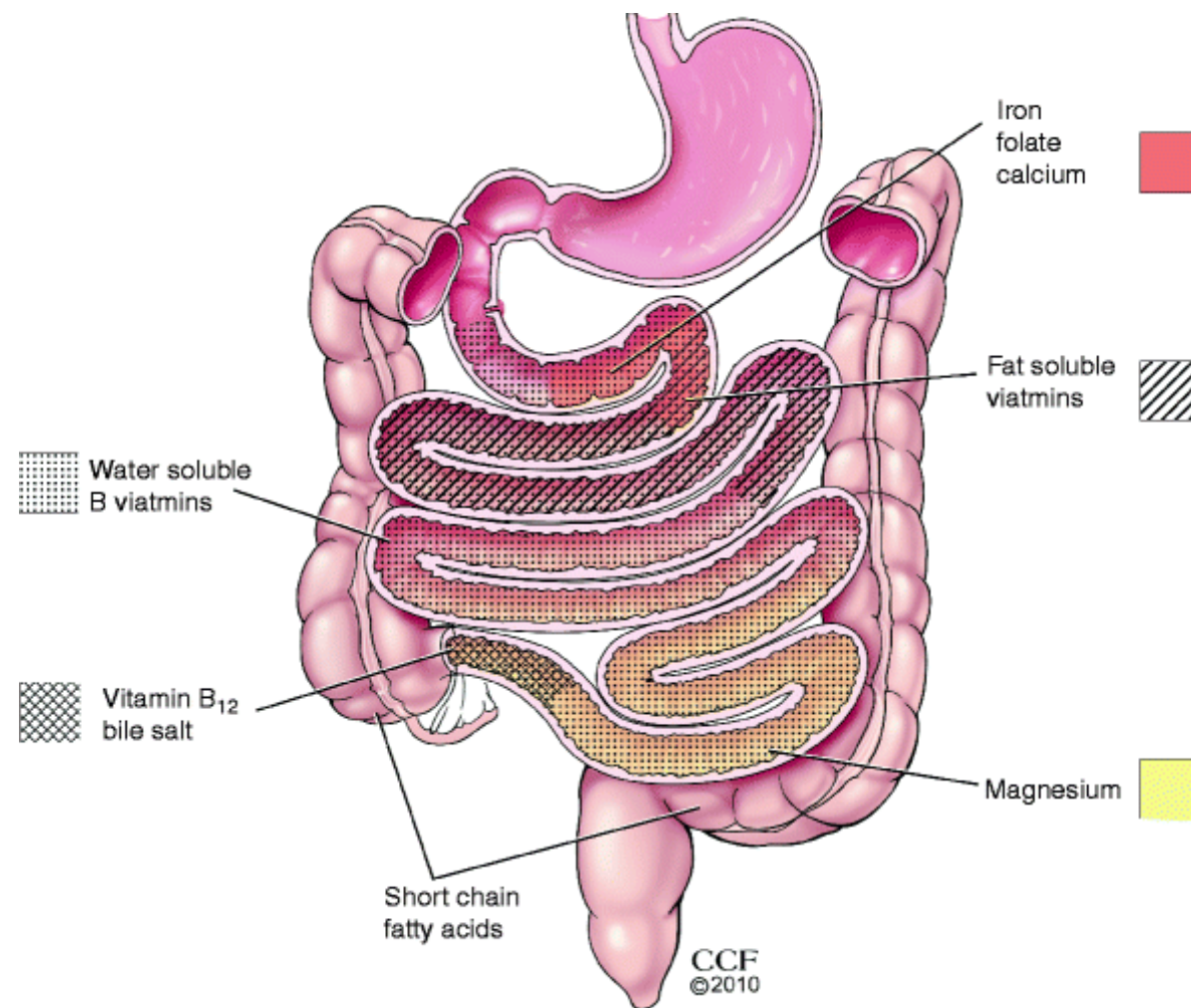
1. Administering the IV stable isotope infusion enhance tracer background.
2. Sipping a nutritional supplement drink with added tracer-enriched spirulina powder over 5 hours.
3. Arterialised-venous blood will be drawn every hour to track the appearance of stable isotope tracers (e.g. Phe, Tyr and SCFAs).
4. Collect chyme samples to determine the amount of tracers being reintroduced from the stoma bag to the gut's distal limb.

	STUDY PERIOD							
	Enrolment	Allocation	Post-allocation				Close-out	
Time points	Diagnosis of T2IF post bowel resection	Suitable for CRT	Day 0	Day 1	Day 10	Day 21	CRT ceased / Day 22	
Enrolment								
Initial eligibility screen	X							
Full eligibility screen		X						
Informed consent		X						
Intervention								
CRT				—————→				
Assessments								
Stable isotope Investigation			X			X		
Anthropometry measurements			X		X	X		
Diet Records			X		X		X	

Micronutrient Deficiencies in Intestinal Failure

Micronutrient deficiencies in patients with IF may arise due to compromised absorption and limited oral intake.

- Damage to the intestinal lining leads to reduced nutrient absorption capabilities.
- Symptoms like nausea, vomiting, abdominal pain, or anorexia contribute to limited oral intake.
- Fat soluble vitamins: A, E and D
- Vitamin B12 especially with terminal ileum resection.
- Minerals: Iron, Zinc, Copper and Selenium



Inflammation and Micronutrients

Acute Intestinal Failure

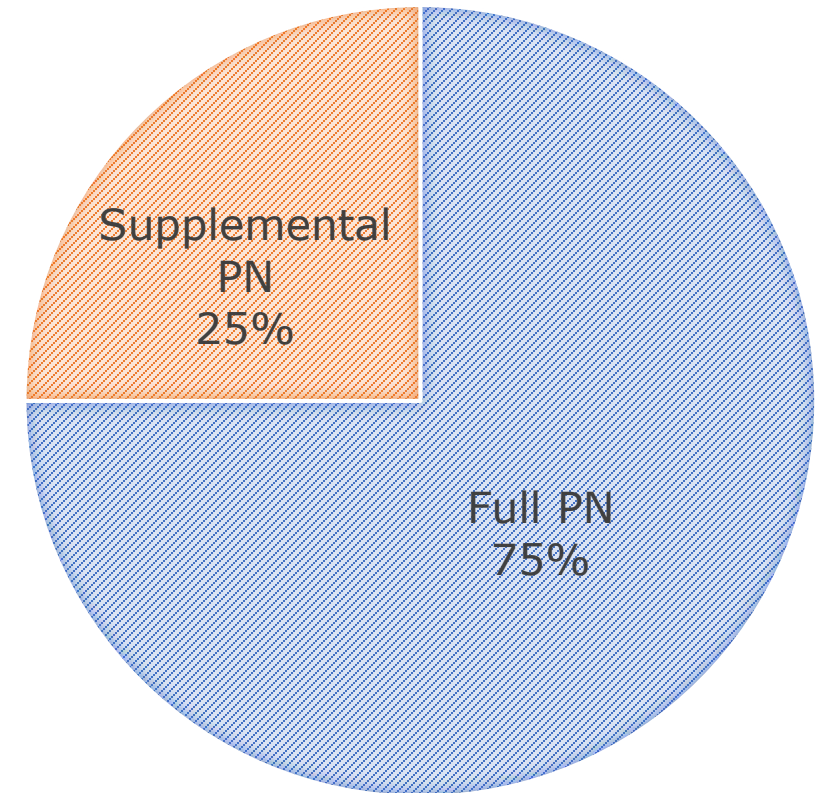
Systemic Inflammatory Response

Impacts Micronutrient Distribution and
Increases Demand

Alters Serum Conc. and Depletes Total
Body Reserves

Micronutrients in Parenteral Nutrition

- Parenteral nutrition (PN) is frequently utilised to deliver essential nutrients intravenously in acute IF cases.
- However, PN solutions may not always offer optimal micronutrient levels, and some nutrients may be omitted entirely.
- In Europe, Australia, and New Zealand, 1 $\mu\text{mol/d}$ of iodine is standardly added to PN, a practice not commonly followed in the United States.
- Inadequate supplementation can lead to nutrient deficiencies.
- Ikomi, Cole, and their research indicated that 85% of children on long-term PN had depleted iodine levels, and 33% developed hypothyroidism after a median duration of 27 months (range: 11-77 months).



Reintam Blaser A, Ploegmakers I, Benoit M, Holst M, Rasmussen HH, Burgos R, et al. Acute intestinal failure: International multicenter point-of-prevalence study. *Clinical Nutrition*. 2020;39(1):151-8.

- Deficiencies found not only during PN administration but also after weaning off PN.
- Deficiency occurrence after weaning off PN may depend on the severity of malabsorption caused by IF.
- However, most studies on this subject have focused on children with IF.
- Published data among adults with IF are limited.



Figure 1. Prevalence of micronutrient deficiencies during transition from PN to EN. Bar chart shows percentage of patients with deficiencies during transition from PN to EN. *IDA*, iron deficiency anemia.

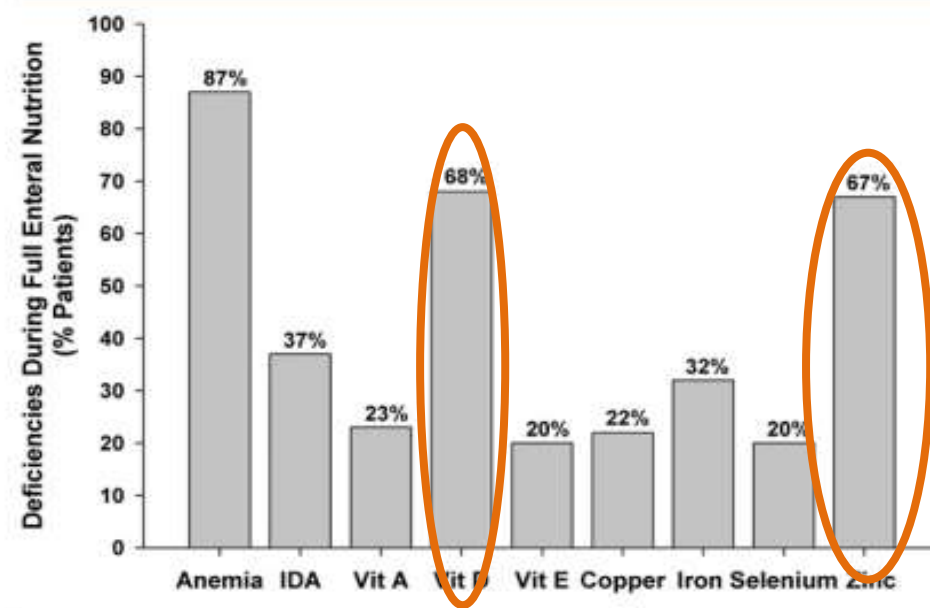
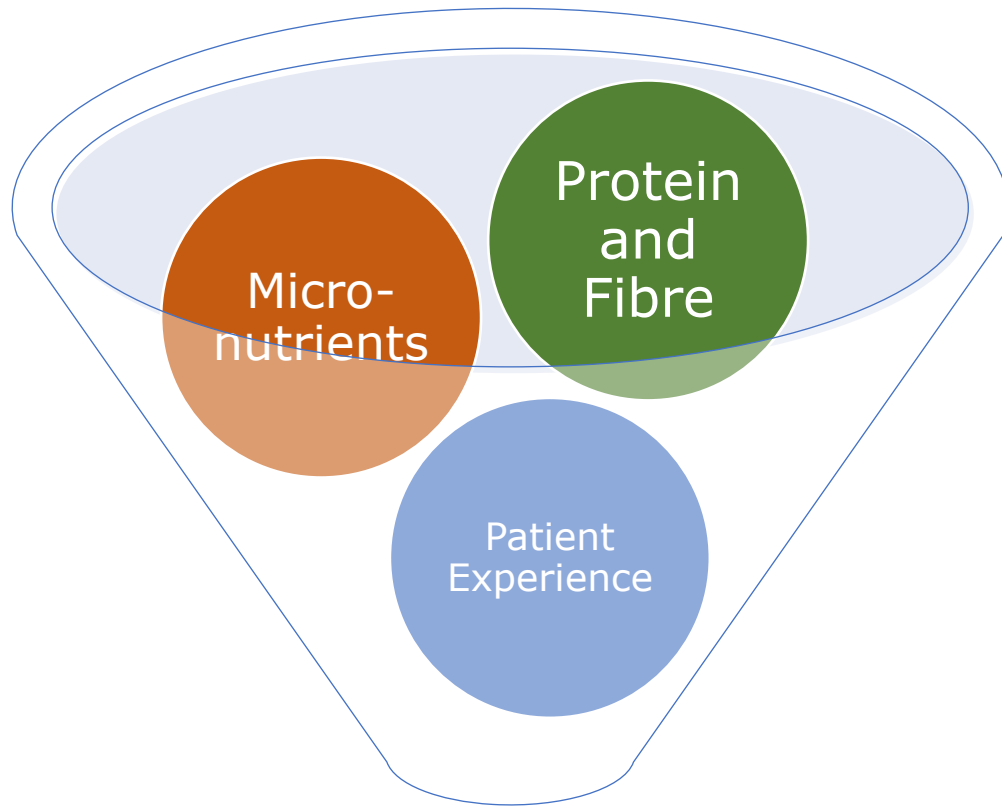


Figure 2. Prevalence of micronutrient deficiencies during full EN. Bar chart shows percentage of patients with deficiencies during full EN. *IDA*, iron deficiency anemia.

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Full eligibility screen		X						
Informed consent		X						
Intervention								
CRT				—————→				
Assessments								
Stable isotope Investigation			X			X		
Anthropometry measurements			X		X	X		
Diet Records			X		X		X	
Blood sample for analysis of selected micronutrients			X				X	
Chyme sample for analysis of selected micronutrients			X				X	
Participant experience							X	

**nutRitional rEsponse TO chyme Reinfusion
thERapy (RESTORE) in patients with type 2
intestinal failure in New Zealand**



Dietary Strategies



Next Steps in Our Research Journey



- **Current Accomplishments:**

- Obtained HDEC and Locality approvals.
- Successfully secured some funding.
- Formed a collaborative partnership with Texas A&M University for stable isotope compounding, pyrogen testing, and sample analysis.

- **On the Horizon: Recruitment!!**

We are looking for potential participants
across New Zealand

Research Team and Collaborators



Prof. Rozanne Kruger



Prof. David Rowlands



Prof. Gil Hardy



Prof. Ian Bissett



Prof. Nicolaas Deutz



A/Prof. Gabriella Ten Have



Thank you

Any questions?

andrewx@adhb.govt.nz

021 140 7970