Guideline

Management of pancreatic exocrine insufficiency (PEI) for adults

Overview

- Pancreatic exocrine insufficiency (PEI) occurs when the pancreas does not produce or transport sufficient digestive enzymes to suitably digest food and drink in the intestine to allow adequate absorption.
- This is treated with pancreatic enzyme replacement therapy (PERT).
- Most patients who require PERT require it for life.
- PERT contains lipase, amylase and proteases.
- All available PERT is pork based. Permission is given for Jewish and Muslim patients to take PERT as there are no alternatives.
- PEI can be tested for with faecal elastase test.
- Normal faecal elastase is >500μg/g faeces.
- A patient taking PERT does not affect the results of faecal elastase unless the polyclonal test is used.
- Low fat diets may exacerbate malnutrition and should be avoided in the vast majority of patients.
- PEI is treated by administration of PERT, which treats amylase, protease and lipase deficiencies, therefore treating carbohydrate, protein and fat malabsorption.
- Initiation of PERT in patients with severe symptoms may unmask diabetes.
- PERT needs to be taken with all food or drink which contains more than very little fat, starch or protein.
- PERT should be swallowed whole during the meal, snack or drink.
- A usual starting dose is two capsules (of Creon 25,000 or Nutrizym 22) with a meal and one with a snack or milky drink.
- If the patient is taking their PERT as recommended and symptoms are not alleviated after three to four days of taking them, they are recommended a dose increase.
- Adjustment of PERT dose is dependent on symptoms of malabsorption being present.
- It is important to look at the distribution of enzymes taken with each meal rather than just the overall amount taken in the day.
- Refer to the ‘PERT for pancreatic insufficiency’ PIL (document ID 12696) on Merlin or the CUH website.
- Swallowing whole capsules is encouraged, if a patient cannot swallow then, they can be opened and taken on a spoonful of fruit puree, jam, tomato sauce or any soft, cold and preferably acidic food.
- To optimise activation of PERT by increasing the pH of the duodenum, it is recommended to consider gastric acid suppressant medication such as a proton pump inhibitor or H2 receptor antagonist.
- For tube fed patients, where oral PERT administration is not suitable, Pancrex V powder® can be given via the feeding tube.

- Pancrex V powder® has 25,000 lipase units per 1g.
- If the patient has reached a dose of 10,000 lipase units/kg/day and is still experiencing symptoms, then other causes should be considered before increasing the dose further, such as bile acid malabsorption, small intestinal bacterial overgrowth or coeliac disease.
- When interpreting symptoms consider other medications being taken such as laxatives, opioids, antibiotics and chemotherapy which can affect the bowels.
- It is usually more important to prioritise enabling people to digest the nutrition they are consuming before encouraging them to consume more.

Contents

1 Scope

For use by health care professionals caring for adult patients with pancreatic exocrine insufficiency (PEI) or suspected PEI in the Anglian Network.

2 Purpose

- To produce consensus and guidelines for the care of adult patients with PEI.
- To minimise the complications that arise as a result of malabsorption due to PEI.
- To improve the nutritional knowledge of patients, carers and healthcare professionals.
- To educate patient/ carer to make food choices appropriate to their dietary recommendations and to take their prescribed PERT in a way to most benefit their health.

3 Definitions

BW	body weight
CF	cystic fibrosis
CFTR	cystic fibrosis transmembrane conductance regulator
CUH	Cambridge University Hospitals NHS Foundation Trust
DIOS	distal intestinal obstructive syndrome
FE1	faecal elastase
GI	gastrointestinal
HPB	hepatobiliary
LCT	long-chain triglyceride
MAR	medicines administration record
MCT	medium-chain triglyceride
NBM	nil by mouth
PEI	pancreatic exocrine insufficiency
PERT	pancreatic enzyme replacement therapy
PIL	patient information leaflet
PPI	proton pump inhibitor
PTH	parathyroid hormone

4 Introduction

Pancreatic exocrine insufficiency is when the pancreas does not produce or transport sufficient digestive enzymes to suitably digest food and drink in the intestine to allow adequate absorption. Exocrine pancreatic insufficiency has a number of aetiologies, including:

- pancreatic resection
- CF
- cancer of the pancreas, ampulla or distal bile duct
- inflammation of the pancreas (pancreatitis)
- pancreatic trauma

These are examples of primary pancreatic insufficiency. Secondary pancreatic insufficiency can occur following gastric and/or duodenal resection, gastric bypass surgery or untreated coeliac disease, as pancreatic stimulation is reduced. More details of the aetiology of PEI is given in the UK consensus Guidelines, 2.1 (Phillips et al 2021).

The PERT replaces or complements production of digestive enzymes by the pancreas. It provides lipase, amylase and proteases (trypsin).

Apart from for people with acute pancreatitis, PERT is usually required for life.

There are various different PERT preparations, including:

- Creon 10,000® – contains 10,000 lipase units per capsule
- **Creon 25,000® – contains 25,000 lipase units per capsule**

- Creon Micro® – contains 5,000 lipase units per scoop
- **Pancrex V® powder – contains 25,000 lipase units per gram**
- Pancrex V 340mg capsules® – contains 8,000 lipase units per capsule
- Pancrex V capsules '125'® - contains 2,950 lipase units per capsule
- **Nutrizym 22® capsules – contains 22,000 lipase units per capsule**

Those shown in **bold** are most commonly used with adult patients in the region. Creon 10,000 is also often used by adults with CF. Note the number of viable lipase units in the products deteriorates over time. The lipase units given above are the number of lipase units per capsule the manufacturers indicate will be viable by the expiry date of the product.

Creon® and Nutrizym® are capsules that contain small beads called microspheres. Inside these beads are the enzymes that are needed to break down (digest) food. These beads are enteric coated, meaning the enzymes are protected from denaturing in the stomach acid and are activated in the higher pH (5.5 and above) of the small intestine. Pancrex V powder® contains the enzymes in a powder (non-coated form) and Pancrex V granules® are also non-enteric coated.

All preparations contain these three enzymes:

- lipase
- proteases (trypsin)
- amylase

The temperature at which PERT should be stored varies between 2 and 8°C and below 25°C, depending on the preparation. This information can be found in the specific medicines information leaflet.

More information can be found about the PERT preparations available in the UK in appendix 1.

4.1 Consent for pork-based enzyme preparations

All pancreatic enzyme replacement preparations are pork-based. Most religious leaders give consent for people to take them as there is currently no alternative. Appendix 2 and appendix 3 contain letters from Muslim and Jewish religious leaders respectively advising patients they can use this pork-based medicine as there is no alternative. Consent to take a porcine product should be sought from people who would otherwise avoid pork products.

Other centres have experience of successfully slowly introducing PERT with patients who report a pork allergy that manifests with bowel symptoms.

5 Symptoms of pancreatic exocrine insufficiency

Typical symptoms for a patient with pancreatic insufficiency are:

- loose stools
- oily or fatty stools (stools may be surrounded by an orange oil)
- pale/ floating stools (stools may appear creamy in colour)
- undigested food in the stool
- offensive smelling stools
- large bulky stools
- urgency to open bowels after eating/ receiving an enteral feed
- wind, flatulence or bloating
- post-prandial abdominal pain
- nausea/ colicky abdominal pain
- gastro-oesophageal reflux
- hypoglycaemia in diabetes

Failure to gain weight/ weight loss may occur in the absence of other symptoms and PEI should not be overlooked as a cause. Longer term consequences due to malabsorption include osteoporosis and vitamin deficiencies, especially fat soluble vitamin deficiencies (A,D,E,K).

Steatorrhoea (an increase in fat excretion in the stools) becomes apparent when >90% of exocrine function is lost (Di Magno et al, 1973), but this is a late symptom of malabsorption and fat malabsorption may occur even without abdominal symptoms (Caliari et al, 1996).

6 Testing for pancreatic exocrine insufficiency

Pancreatic sufficiency is commonly measured in clinical practice with a faecal elastase test. This is a test of the pancreatic elastase E1 content of the patient's stools. Note that this test is not accurate on watery stools, due to the dilutional factor which may cause a 'false positive' PEI result. Stool samples for faecal elastase tests can undergo adjustment to standardised water content (Phillips et al 2021). Release of pancreatic enzymes is stimulated by nutrients passing through the duodenum. Therefore if someone is eating little or has post-pyloric feeding, their enzyme stimulation will be reduced, including that of faecal elastase.

Pancreatic elastase E1 (FE1) forms part of the exocrine secretions of the pancreas and remains un-degraded during intestinal transit. Intra-individual variation of FE1 is small and has been shown to reflect the secretory capacity of the pancreas. It can therefore be used as a surrogate marker of pancreatic exocrine sufficiency. A reduced FE1 concentration is usually considered to indicate pancreatic exocrine insufficiency.

- **Normal** FE1 concentration is >500μg elastase/g faeces.

- **Suboptimal pancreatic exocrine function** is FEI concentrations of 200 to 500μg/g (treat if symptomatic, see below)
- **Mild-Moderate** PEI is associated with FE1 concentrations of 100 to 200μg elastase/g faeces.
- **Moderate-Severe** PEI is associated with FE1 concentrations of <100μg elastase/g faeces.

Levels below 500μg/g and above 200μg/g suggest a deviation from optimal pancreatic function. Therefore PERT should be considered if one or more of the following conditions is present:

- loose, watery stools
- undigested food in the stools
- post-prandial abdominal pain
- nausea or colicky abdominal pain
- gastroesophageal reflux symptoms
- bloating or food intolerance

(Genova diagnostics, 2008)

A FE1 can be requested if the diagnosis of PEI is unclear. However, research suggests limited accuracy of FE1 to diagnose PEI after pancreatic surgery (Sabater et al 2016).

Stool samples need to be collected in a stool specimen pot (with a blue lid) and delivered to the biochemistry laboratory as soon as possible and within 48 hours of being provided. They should not be stored in a fridge and should be kept between 4 and 8°C. These samples are processed in batches, therefore results typically take 7 to 10 days to be produced for inpatients and longer for outpatients. Results are listed on the hospital computer system (Addenbrooke's – Epic, Bedford – ICE, Hinchingbrook – ICE, Kings Lynn – ICE, Lister – ICE, Norfolk and Norwich– ICE desktop, PSHFT – ICE, Royal Papworth – Lorenzo/Metavision), West Suffolk Hospital – ICE/ e-Care notes.

6.1 Types of faecal elastase test

The most commonly used FE1 test is the monoclonal version. A patient taking PERT does not affect the results of this test as only the human form of FE1 is detected by the assay. Therefore commencing PERT in a patient with a high index of suspicion for pancreatic exocrine insufficiency should not be delayed while waiting for the FE1 sample to be taken. FE1 is also available as a polyclonal test, the results of this test are increased by PERT consumption (Schneider et al, 2005), therefore if this test is to be used, patients would be advised to provide the sample after at least three days of not consuming PERT.

6.2 Other assessments of PEI

Faecal fat and steatocrit can also be used to measure pancreatic sufficiency but are not commonly used in the region. Faecal fat is a measure of absorption not directly of pancreatic function.

The triolein breath test is an alternative test for PEI that is not currently available in the Anglian region. This involves the fasted patient being administered triolein labelled with either ^{13}C or ^{14}C and levels of labelled CO_2 in the exhaled breath being subsequently measured at regular time intervals; low levels of labelled CO_2 indicate inadequate fat digestion. This test has not been validated and is thought to measure malabsorption, not necessarily specific to PEI.

The appearance of the pancreas on imaging can also be useful in identifying PEI, though it is not diagnostic. Those with the training and knowledge can identify the likelihood of pancreatic sufficiency. PEI is more likely if the pancreatic ducts are dilated, the pancreas is calcified or necrotic and if there is any disease in the head of the pancreas.

In the Anglian region we recommend commencing PERT without the need for specific testing for people with the following:

- a head or body of pancreas tumour
- an ampullary tumour
- planning or following a head of pancreas resection, subtotal or total pancreatectomy
- chronic pancreatitis and dilated pancreatic duct or severe pancreatic calcification and steatorrhoea or malabsorption symptoms
- with severe necrotising pancreatitis

This is because the likelihood of PEI is so high. We therefore only recommend testing for PEI if there is strong clinical suspicion the patient does not have it or they do not want to start PERT without the test.

7 Treating pancreatic exocrine insufficiency

7.1 Diet

Low fat diets may exacerbate malnutrition and should be avoided unless absolutely necessary. Some patients may require a high fat diet if they are nutritionally depleted and have a low appetite. Note that high fat diets generally require higher doses of PERT than moderate fat diets for adequate digestion. Very high fibre diets may absorb enzymes and delay nutrient absorption and therefore are not recommended (Duggan et al, 2010), however, there is no evidence to recommend a reduction in fibre intake for anyone not consuming a very high fibre diet. Regular and detailed nutritional assessment is vital.

7.2 PERT

PEI is treated by administration of PERT, which treats amylase, protease and lipase deficiencies, therefore treating carbohydrate, protein and fat malabsorption.

Note that initiation of PERT in patients with severe symptoms may unmask diabetes (O'Keefe et al, 2001). This is because without adequate carbohydrate digestion (due to a lack of amylase), less glucose will be released into the blood, preventing or reducing a potential significant blood glucose level rise above the normal range. Facilitating adequate carbohydrate digestion (with PERT) increases blood glucose levels. If the patient is not able to adequately control this rise in glucose levels, they will have unmasked undiagnosed diabetes or poor glucose tolerance which would be treated in the usual way. This mechanism can also increase blood glucose levels in someone with already diagnosed diabetes.

8 Beginning a patient on PERT

8.1 Orally

It is the prescriber's choice (in conjunction with the patient) which PERT preparation patients are initially commenced on, more detail about the different preparations available can be found in appendix 1. Note there is a theoretical concern over the phthalate content of PERT for a developing foetus or young baby. It is therefore advisable to recommend Nutrizym 22 for pregnant and lactating women as they are documented to be phthalate free. It is especially important that these women have adequate PERT during this time to prevent malabsorption and inadequate nutrition for the developing foetus/ baby. Efficacy and safety of PERT during pregnancy and breastfeeding has not been confirmed but is routinely given (Phillips et al 2021). It is important to avoid malabsorption in pregnancy and breast feeding.

A patient will begin on a dose which will usually be lower than the final continued dose. It should gradually be increased from the starting dose until symptoms are alleviated. Sufficient PERT provides enough enzymes for adequate digestion of starches, proteins and fats consumed. The most prominent malabsorbtion symptoms are displayed with fat malabsorption, and higher doses of PERT are required for digestion of high fat foods, but consideration should also be given to the starch and protein content of food and drink, particularly those with a low fat content. Without the pancreas there will still be amylase produced in the mouth and proteases produced in the stomach to digest some of the carbohydrate and protein content of the diet respectively, but not enough to gain adequate nutrition from them. Generally the higher the fat content of the food/drink, the more PERT is required for digestion. However, low fat diets are very rarely recommended or required for symptom management.

PERT needs to be taken with all food or drink which contains more than very little fat, starch or protein. Most patients can manage to adequately dose PERT

by taking more with foods containing cheese, chocolate or pastry or that are fried/ roasted and do not need more detailed nutritional information than that.

PERT is recommended to be swallowed whole during the meal, snack or drink. The efficacy of PERT can be increased by spreading the dose through the meal rather than taking them all at the start. If the PERT was not taken during a meal, snack or milky drink due to forgetting to do so and it is remembered afterwards then it can be taken but the efficacy of this decreases with time after the nutrition has been consumed and is unlikely to be of benefit after half an hour. PERT should not be taken with a hot drink as this could damage the enzymes, but a cool/ room temperature drink may make it easier to swallow the capsules. It is good practice to give patients an information sheet regarding their PERT when they are commenced on this.

Refer to the 'PERT for pancreatic insufficiency' PIL (document ID 12696) – see the associated documents section.

The following is a guide to starting doses for an adult:

- Creon 10,000®, four to five per meal, two to three per snack (Creon 10,000® is usually only used by adults who struggle to swallow the larger capsules)
- Creon 25,000®, two per meal, one to two per snack
- Nutrizym 22®, two per meal, one to two per snack
- Pancrex V capsules®, four to five per meal, two to three per snack (Pancrex V capsules® are usually only used by adults who struggle to swallow the larger capsules)

The amount for each meal/ snack should be selected depending on the size and estimated nutritional content of the meal consumed. The choice of which PERT preparation to take needs to take into account the lipase units the patient requires and the number and size of capsules the patient feels able to swallow. Precise lipase units per grams of fat consumed are not required. An example is given in appendix 4.

8.1.1 Swallowing problems

If a patient cannot swallow the capsules, they can be opened and taken on a spoonful of fruit puree, jam, tomato sauce or any softer textured, cool (preferably acidic) food. The capsule should be opened, the contents put on the spoon of food and swallowed immediately, not left to stand. This should then be washed down with a cool/ room temperature drink to ensure that no granules remain in the mouth where they can cause ulcers. Granules should not be chewed or crushed as this damages the enteric coating, meaning the enzymes can be damaged by the stomach acid and are therefore less effective. The enzymes can also begin digesting much higher in the GI tract causing ulcers. Please refer to the 'Information for people who are unable to swallow their pancreatic enzyme capsules whole' PIL (document ID 34300) – see the associated documents section.

8.1.2 Micronutrients

A patient with pancreatic insufficiency may also require a multivitamin and/or mineral supplement. If the patient has been advised to take these then they need to take pancreatic enzymes with them. It is therefore usually best to take the vitamin or mineral supplement at a meal/snack time.

Suboptimal dietary intakes, increased nutritional requirements, impaired nutrient binding in the gut, increased losses and malabsorption can all decrease micronutrient levels in patients with PEI.

High risk patients could be considered to have vitamin supplementation as a matter of course. Armstrong et al (2007) also found lower levels of vitamin E and selenium and elevated PTH in post pancreaticoduodenectomy patients when compared to healthy controls. They recommend regular monitoring of micronutrient status and appropriate supplementation. In practice many of these patients are supplemented with Vitamins A, D, E and K, though there are no clear guidelines as to when levels should be checked. It seems appropriate to check serum levels of these micronutrients when a patient has had a period of malabsorption, particularly if they also had a poor intake, then correct as required.

Vitamin B12 requires protease digestion for activation in the gut so it can be absorbed in the terminal ileum. If a patient is not secreting adequate protease due to PEI they can therefore develop vitamin B12 deficiency. However, there is no evidence of vitamin B12 deficiency being common in the chronic pancreatitis population.

Data suggests that premature loss of bone density may occur in chronic pancreatitis due to malabsorption, poor diet, a lack of sunlight on the skin, immobility and with some patients a smoking history. Regular bone density (DEXA scan) assessment, lifestyle education (diet, exercise, smoking cessation) and vitamin D and calcium supplementation should be considered (Duggan et al, 2012), there are further details in the Dietary management of chronic pancreatitis guideline. National guidelines suggest that everyone should consider 400iu vitamin D, especially in the winter months (SACN 2016). There is a high prevalence of osteoporosis and osteopenia in people with pancreatic disease. It is best practice to routinely monitor bone mineral density in people with pancreatic diseases (Phillips et al 2021).

8.1.3 Patient information sheet

The ‘PERT for pancreatic insufficiency’ PIL (document ID 12696) on Merlin or the CUH website can be used to further inform a patient about the enzymes and their administration. This can also be useful for a patient who has been taking PERT for quite some time but not had this information provided at commencement of the PERT administration. It is recommended that each patient taking PERT is given this information sheet and it is explained to them.

8.2 For patients fed with an enteral tube feed

Semi-elemental feeds require less PERT to be digested and absorbed than polymeric feeds, therefore it is recommended to change any patient with PEI to a semi-elemental feed where possible (Phillips et al 2021). When considering a choice of feeds it is sensible to take into consideration the total fat content, the grams of fat per calorie, the percentage of fat as LCT, the patient's nutritional requirements, the patient's fluid needs and tolerance and the length of the carbohydrate chains within the feed.

To optimise activation of PERT by increasing the pH of the duodenum, it is recommended to consider gastric acid suppressant medication such as a proton pump inhibitor or H2 receptor antagonist.

Some patients requiring PERT with oral nutrition require less or none with a semi-elemental tube feed and concurrent gastric acid suppression. It is reasonable to begin a semi-elemental feed and gastric acid suppression without PERT and monitor the patient's condition for the need for PERT, if their usual PERT dose is low or they have not had PERT before and pancreatic damage is suspected to be minimal.

Most patients fed with Emsogen as their enteral feed do not need PERT to digest this adequately, the fat is 83% MCT, the nitrogen is in the form of amino acids and the carbohydrate is glucose. It is notable that this is less energy dense than most alternatives.

Patients who are NBM with a jejunal feed will stimulate their pancreas much less than usual so will have an increased need for PERT because of this.

For patients who require PERT with their enteral tube feed, information on commencing this is given below.

8.2.1 Patients who are eating

If a patient can swallow capsules but is receiving nutrition via a gastric feeding tube for another reason, then it is better the patient swallows capsule enzymes as their PERT administration. The capsules are enteric coated and therefore act more efficiently in the right part of the bowel when compared to the powder, where the enzymes are not protected. Patients with delayed gastric emptying, swallowing difficulties or NBM would not be suitable for oral PERT administration.

A reasonable starting dose would be capsules containing 20,000 to 30,000 lipase units at the start and end of the feed and every two to three hours while the feed is running and they are awake. Efficacy can be increased by administering the enzymes hourly where this is practical for the patient/ carer/ staff. Usually hospitalised patients with oral PERT administration would have any night time PERT doses administered as a powder via their feeding tube by nursing staff to minimise sleep disturbance.

8.2.2 PERT via a feeding tube

Patients where PERT administration taken by mouth is not suitable would usually have Pancrex V powder® via the feeding tube. Pancrex V powder® has 25,000 lipase units per 1g powder.

Unless the patient usually takes high doses of capsule enzymes, they would usually begin with a dose of 2g Pancrex V powder® every two to three hours (that the feed is running) down the feeding tube. 2g of powder is a level scoop of a 2.5ml measuring spoon (the small end), this is dissolved in 10 to 20ml water and flushed down the tube; the feed is then immediately restarted. Nothing else should be flushed down the tube between the feed and the Pancrex V powder® flush, to increase the mixing of the feed and PERT (Phillips et al 2021).

In practice, it is impractical for patients to wake every two to three hours at home to administer PERT via their feeding tube on a long term basis. Therefore, most people would have a daytime only feed. However, it is possible to consider a PERT dose just before they go to bed at night and another when they wake, without needing them during the night when someone is on a semi-elemental feed and requiring low PERT doses. Especially where the impact on quality of life is significant. It is important they can still digest and absorb adequate nutrition, there needs to be an awareness that giving the Pancrex in this manner is likely to result in reduced digestion and absorption. This must be balanced with practicalities for the patient/ carers.

Appendix 5 gives an example of the PERT dose with an enteral feed for a patient. Detail of monitoring and increasing doses for patients on an enteral feed is given in the monitoring a patient on PERT section below.

If a patient is bolus fed (and unable to swallow) then the PERT would be prepared as it would for a pump driven feed and given with each bolus as it would with a meal or a snack. The dose would begin as described above for a supplement and then titrated up as described below. It is also an option to add Pancrex V powder® to a bottle of an oral semi-elemental sip feed (eg Vital 1.5® or Peptisip®), shake it well and administer this as a bolus. If Pancrex V powder® is mixed with liquids or feeds the resulting mixture should not be allowed to stand for more than one hour prior to use (EMC, 2022). This would usually only be given into the stomach, not the jejunum due to the risk of dumping symptoms.

Gastric acid denatures non-enteric coated PERT preparations more rapidly, therefore patients being given these into their stomach are particularly likely to benefit from a PPI/H2 antagonists to reduce the acid secreted.

If a patient is fed with a gastric tube of 16-Fr or greater, they may benefit from enteric coated PERT granules suspended in a viscous, acidic (pH <4.5) vehicle (eg Fortijuce, Fresubin Jucy, Ensure Plus Jucy). PERT delivered in this way will be more protected from deactivation by the stomach acid. It is not recommended to deliver granule PERT preparations via a tube of less than 16-Fr as they are more likely to be blocked by this.

8.2.3 Adding Pancrex V powder® to the feed

If symptoms cannot be controlled with usual Pancrex V powder® administration and dose escalation then adding the Pancrex V powder® to the feed should be considered. There is no published evidence for this but it is increasingly being done in the UK with no adverse effects reported and efficacy demonstrated.

Once something is added to the feed, it should be hung straight away and for a maximum of four hours (Phillips et al, 2021), due to potential microbial contamination concerns. Pancrex V powder® can be added to any feed except Peptisorb® (1kcal/ml) as this causes the feed to split. It is encouraged to add Pancrex V Powder® to a peptide feed as less will be required for adequate digestion than with a polymeric feed.

To reduce the wastage of feed it is recommended to add it to 200ml bottles of oral sip feed eg Vital 1.5® (by Abbot). The powder can be added directly to the bottle and shaken well, then administered as a bolus or put into a flexitainer and administered via pump. The bolus would usually only be given into the stomach, not the jejunum due to the risk of dumping syndrome symptoms. The Pancrex V powder® can also be added to the volume of a feed that will be delivered over four hours, shaken well and delivered via pump. Improved mixing can be achieved by adding the powder to a small volume of water first and adding that to the feed once it is well mixed. If the powder is mixed with liquids or feeds, the resulting mixture should not be allowed to stand for more than one hour prior to use (EMC, 2022).

8.2.4 PERT via a feeding tube when Pancrex V powder® is unavailable

Enteric coated PERT granules are likely to block fine bore feeding tubes (Shlieout et al, 2011). If Pancrex V powder® is unobtainable then the following method should be used (adapted from Ferrie et al 2011) for jejunal feeding tubes.

- Open required number of Creon/ Nutrizym capsules to meet the patient's dose.
- Grind the granules into a powder.
- Mix the contents of the capsules with 8.4% sodium bicarbonate solution, 2.5ml per Creon 25,000/ Nutrizym 22 capsule. This breaks down the enteric coating of the capsules.
- Leave the mixture to stand for ten minutes.
- Stop the feed.
- Bolus the mixture through the feeding tube.
- Restart the feed if required.
- For frequency of administration see guidelines above.

There is likely to be some loss of enzyme activity with this method, therefore doses need to be adjusted to compensate. This method may also be used for small-bore gastric feeding tubes where the above method of administering the

whole granules through the tube is not suitable due to the chances of the whole granules blocking the tube.

9 Monitoring a patient on PERT and adjusting doses

Adjustment of PERT dose is dependent on symptoms of malabsorption being present. When assessing their efficacy you would check (usually by asking the patient):

- stool frequency, texture, colour, appearance, presence of oil, floating/ difficult to flush, flatulence, abdominal pain. **A change in these twice in a week is enough to warrant an adjustment of PERT**
- weight gain/ loss – assessed in relation to nutritional intake
- micronutrient status (in the longer term)
- adherence to PERT administration recommendations, dose adjustment, any foods/ drinks without PERT, timing of PERT administration
- check for drugs that may mask symptoms including anti-diarrhoeals and opiates
- check for drugs or foods that may loosen stools such as laxatives, chemotherapy, metformin, very high fibre diet, high levels of artificial sweeteners
- check with patients that their PERT has not been left somewhere hot, eg a windowsill, trouser pocket or in a car, and that they are in date
- check if taking PPI/ H2 antagonist

Patients should be taught to alter their own dose to improve their symptoms (Ramo et al, 1989), where possible.

9.1 Patients taking capsule enzymes (Creon®/ Nutrizym 22®/ Pancrex V capsules®)

If the patient is taking their enzymes as recommended and symptoms are not alleviated after three to four days of taking them, the patient is recommended to increase the dose.

First check the patient is not omitting PERT with something they should be taking it with, eg snacks or milky drinks; if they are, then this should be corrected before increasing doses. The decision of where to make the first increase will depend on what the patient is eating and the pattern of intake across the day.

Often, the dose will initially increase at the main meal of the day. However, some patients have larger/ fattier snacks and smaller meals, they would therefore need to increase with snacks first. Judgement needs to be made by a rough assessment of the nutrition to PERT ratio through the day.

If this initial increase is not effective after another three to four days then increase the dose at another meal/snack, depending on the clinician's judgement, then another three to four days later if still ineffective. If the patient is at home then these adjustments are more likely to be made weekly. Sometimes

this information can be delivered a few stages at a time, eg if this increase has not resolved symptoms by a given time, then the patient can be instructed to make a further increase in their dose 'somewhere else'.

If the patient is able to understand the basic fat content of their foods then they can adjust the doses accordingly as they will need higher doses for larger and fattier meals and snacks. Self-adjustment should be encouraged in most patients. Where possible inpatient self-medicating should be discussed with the ward and encouraged as this enables the best timing of PERT administration and learning by the patient as well as reducing tasks required by nursing staff in line with the Self-administration of medications (SAM) policy.

As a guide, try to avoid increasing the dose by more than 80,000 lipase units per day in one go (ie by not more than 8x 10,000 capsules, or 3x 25,000 or 22,000 capsules). This is typically by no more than one capsule per meal at a time. There are times where low doses are taken and symptoms are significant where greater increases are required.

9.1.1 What to do if increased doses and still have symptoms

It is important to look at the distribution of enzymes taken with each meal as well as the overall number taken in the day. Adjustments should be made in relation to amount of fat, starchy carbohydrate and protein in the food eaten.

If the patient is still experiencing symptoms and has reached a dose of 10,000 lipase units per kg body weight per day then other factors should be considered before increasing the dose of PERT further.

If not already prescribed, the patient may benefit from being prescribed a PPI/H2 Antagonist (eg omeprazole/ lansoprazole/ ranitidine) – this increases the pH of the stomach and means the enteric coating around the capsules is more likely to be removed and the enzymes become available for action (Proesmans & De Boeck, 2003). It also provides a more optimal pH in the bowel for native enzyme and PERT activity. A patient does not need to wait until the 10,000iu/ kg have been reached to be started on a PPI, or have their PPI dose increased, many patients will benefit from this at a lower PERT dose.

Following GI surgery (including Whipple's and total pancreatectomy) patients are typically taking a PPI for life to prevent ulcers at their anastomoses. A standard PPI dose would be 20 to 40mg omeprazole per day or 15 to 30mg/d of lansoprazole (SPC, 2023). Splitting the PPI dose into two divided doses can increase its efficacy.

It is also important to check the patient is taking the enzymes appropriately and laxatives are not the cause of loose stools. Other causes of loose stools should also be investigated at 10,000iu lipase/kg/day (or before if indicated), for example, small bowel bacterial overgrowth, bile acid malabsorption, infections, coeliac disease, lactase deficiency, other food intolerances, antibiotic or chemotherapy related diarrhoea. If the patient is experiencing malabsorbative

symptoms at higher doses of PERT, it is worth considering a semi-elemental or elemental supplement or feed, if not already being used, that will require less or no enzymes to digest them.
Some patients benefit from loperamide or codeine to improve their symptoms; these will also slow down the bowel and give more time for the PERT to work. Patients on high dose opiate painkillers usually require laxatives. PERT doses should not be reduced to treat constipation as this will lead to malnutrition.

9.1.2 Micronutrient levels over time

It is important to bear in mind that a patient who has been malabsorbing for some time is likely to have depleted their stores of fat-soluble micronutrients and may benefit from having their serum levels checked and replaced if required. This is particularly likely if they have had pancreatic or GI resections.

Some centres routinely give a multivitamin and mineral supplement to all patients with PEI but there are no national guidelines for this. In the Anglian region we recommend and A-Z multivitamin and mineral supplement lifelong to everyone who has had a Whipples or total pancreatectomy as they will have increased risk of vitamin and mineral deficiencies. These should be bought over the counter and are advised to be taken with food and therefore PERT. There are significant consequences of micronutrient deficiencies including night blindness, osteopenia, osteoporosis and reduced wound healing and immune function.

9.2 Patients receiving Pancrex V powder®

If the patient is still experiencing symptoms on a dose of 2g every three hours, the frequency of administration would be increased to every two hours. If symptoms persist then the Pancrex V® dose would be increased to 3g every two hours while feeding, as well as at the start and end of the feed.

If, after 48 hours on this dose, the patient is still experiencing symptoms of insufficiency then the dose should be increased to 4g every two hours. This process should be continued in 1g increments until the patient has reached a daily dose of 10,000 lipase units per kg/ BW. If the patient is still experiencing symptoms and has reached a dose of 10,000 lipase units per kg body weight per day, a PPI/H2 antagonist (eg omeprazole/ lansoprazole/ ranitidine) should be considered if not already prescribed. It is also important to check the patient is not prescribed laxatives. Patients may need loperamide ± codeine phosphate to reduce gut transit time, and give more time for the Pancrex V® to work, especially initially. However consideration should be given to other causes of symptoms such as small intestinal bacterial overgrowth, bile acid malabsorption, coeliac disease, infective diarrhoea, antibiotics and other medications.

It may not always be practical to give the PERT every two hours the feed is running. If it is given less frequently it is likely higher doses will be required.

Note if a patient's feed rate is increased or they are changed to a more concentrated formula, their PERT dose is likely to need to be increased in line with this. The dietitian could calculate the fat to PERT ratio in a well-tolerated feeding regimen and maintain that ratio with a new regimen as a guide to an increase in PERT dose but consideration must also be given to protein and complex carbohydrate content. The same principles will apply with reducing the rate of a feed or changing it for a less concentrated formula.

There is no data on the effect on the enteral tube of long term PERT administration through it.

If patients are still experiencing symptoms of malabsorption or failing to gain weight/ losing weight then they may benefit from a change of PERT preparation.

9.3 Maximum dose of enzymes

There is no maximum dose of PERT (Phillips et al 2021).

If a dose of 10,000 lipase units/ kg body weight/ day is to be exceeded then other measures such as the patient taking a PPI/H2 antagonists and checking they are taking the medications correctly, they have not been left somewhere hot or damaged in another way, should first be considered. There has been historical concern regarding the possibility of fibrosing colonopathy with high doses of PERT in people with CF, however a recent study has shown that the incidence of fibrosing colonopathy in people with CF in the US is now very low with current guidelines and PERT quality standards (Chiuve et al 2023).

If more pancreatic enzymes are taken than needed for adequate digestion or they pass through the patient too quickly, eg in the case of diarrhoea, patients can get irritation of the anus as the enzymes digest the anal passage as they pass. If this occurs, patients should discuss this with their doctor, a barrier cream applied after each bowel motion may help to reduce the irritation (EMC 2023). They should also discuss this with their dietitian to review their dosage and distribution of PERT and consider taking a PPI/H2 antagonists, as described above.

The documented most frequent side-effects of PERT are nausea, vomiting, and abdominal discomfort. Further details of rarer side effects can be found in the leaflet accompanying the individual PERT preparations. PERT is not associated with any significant complications (Phillips et al 2021)

9.3.1 Cystic fibrosis

It is thought that if patients with CF rapidly increase their enzyme dose, this may increase their risk of developing DIOS. Other risk factors include inadequate dose of PERT, poor adherence to taking PERT and dehydration. DIOS is a complete or incomplete obstruction in the terminal ileum or proximal colon. This

is caused by the increased viscosity of intestinal mucus and prolonged intestinal transit time of people with CF causing a build-up of mucus, blocking the progress of the faeces in the bowel. It is therefore thought that CF patients benefit from taking PERT at a lower dose even when they are fasting as this helps to digest the mucus and reduce the risk of DIOS. A suggested dose would be between one capsule of Creon 10,000 every three to four hours to one of their usual type of enzyme capsule (of any number of lipase units) every four to six hours or a 2.5ml spoonful of Pancrex V powder every six hours via a feeding tube for patients who cannot take PERT via mouth.

DIOS can present acutely as intestinal obstruction or sub acutely with intermittent abdominal pain and constipation. If a patient does develop DIOS then their PERT dose should not be reduced as the PERT helps to break down the mucus and alleviate the problem as well as reducing the chances of recurrence. It is usually treated with gastrografin/ Kleen Prep and/ or N-acetyl cysteine. Following this the patient needs a review of their PERT and diet to check adherence to PERT regimen, dosage, fluid and fibre intake. Non-constipating anti-nausea medication is recommended. If DIOS may be present, it is important that their CF centre is contacted immediately, they are likely to then accept them as an inpatient. Prompt action reduces the likelihood surgical corrections will be required.

CFTR modulators are now available to people with CF in the UK. These correct some of the genetic defects originally detected. This can lead to people with CF experiencing less PEI symptoms when adherent with these lifelong medications. However, these modulator therapies are not yet suitable for all CF genetics and not everyone who is eligible for them can tolerate the side effects and are not able to continue with the treatment. It is not possible to test if someone has decreased PERT requirements. Usual advice is once on modulators, to consider trial of one fewer PERT capsule per main meal for a week and monitor bowel symptoms closely. If successful, this is then slowly decreased with regular monitoring from a dietitian until a suitable level is found. If a patient reports not requiring any PERT since starting CFTR, faecal elastase is checked.

10 Oral nutritional supplements

Oral nutritional supplements can be a help to patients who have lost weight through their disease. PERT needs to be taken with oral supplements containing fat.

- PERT does not usually need to be taken with Fortijuce®, Fresubin® Jucy or Ensure® Plus Juce if they are sipped slowly, over at least an hour, but does if they are drunk over a short time period.
- Less PERT is needed with semi-elemental sip feeds and Elemental 028 Extra®.
- Very fat dense options such as Calogen®/ Procal®/ Fresubin® 5kcal require large doses of PERT for adequate digestion and are less likely to be well absorbed so their use is generally discouraged in this patient

group. However, if it is felt that these are the best products for the patient to use then it is important to ensure that they take sufficient amounts of PERT with them to adequately digest them.

- Carbohydrate modular supplements can work well including Maxijul® and Polycal®; they do not need to have PERT with them to be digested and absorbed.

Products with an MCT based fat source can be a useful addition to the diet of a person with PEI. They need less or no PERT to adequately digest them. MCT Procal® (Vitaflo) and Liquigen® (Nutricia) contain 99% and 97% of their fat as MCT respectively. Sixty seven per cent and 70% of the fat in Vital 1.5 kcal (Abbott) and Peptamen® (Nestle) is MCT respectively. However, 80% and 96.2% respectively of the carbohydrates are polysaccharides and therefore require amylase for digestion.

It is important that patients are taking their PERT correctly and in adequate amounts with their diet and supplements. If the focus of nutritional input is on increasing their nutritional intake without providing the enzymes to digest it, patients can struggle with the increase in intake but not be able to fully digest and absorb it or benefit from it. It is usually better to prioritise enabling them to digest the nutrition they are having and to then increase their intake if required.

11 Prescribing

Though dietitians are often best equipped with the nutritional knowledge to advise on PERT administration, they cannot prescribe it on patient drug charts unless they are a registered supplementary prescriber. In practice, doctors often ask the dietitian to write on the drug chart their recommendations and then they will sign it. At CUH, the medications can be ordered on Epic. This is done by creating a new order, filling out the details of dosing and timing and then clicking ‘save work’ and leaving a note to ask the doctors or other authorised prescriber to sign it if they are happy with it.

Adjustments to PERT by a dietitian requires a local agreement protocol. Speak to Laura McGeeney (at CUH) or the pharmacy department in your trust for more information on this.

12 Monitoring compliance with and the effectiveness of this document

New staff will be trained as per this guideline.

The key standard of this document is that patients with PEI will have it managed as per these guidelines.

The lead pancreatic dietitian will be responsible for this guideline, monitoring, reviewing results of monitoring and putting into place relevant action points and required training.

This standard will be monitored by checking the dietetic notes entries for patients being treated for PEI at CUH. This will be several times a week for dietitians new to the HPB team, with decreasing frequency as the dietitian progresses, by reviewing any reported incidents if they occur and, if felt required from this information gathered, an internal audit. The guideline is written to support all managing PEI in the Anglian Network, monitoring the effectiveness of the guideline beyond CUH is to be determined in each setting.

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EMC Lansoprazole 30mg gastro-resistant capsules Last updated on emc: 07 Feb 2023 Available from: https://www.medicines.org.uk/emc/product/14551/smpc

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14 Associated documents

14.1 Policies & guidelines

- Dietary management of chronic pancreatitis
- Self-administration of medications (SAM)

14.2 Patient information leaflets

- PERT for pancreatic insufficiency (document ID 12696)
  - Merlin
  - CUH website
- Information for people who are unable to swallow their pancreatic enzyme capsules whole (document ID 34300)
  - Merlin
  - CUH website.

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Appendix 1: PERT preparations available in the UK

Name	Lipase	Amylase	Protease	Temp stored	Pharmaceutical form	Lipase per amylase	Lipase per protease
Creon® Micro (per 100 mg granules, equivalent to one measuring spoonful)	5,000	3,600	200	< 25°C	Enteric-coated (acid-resistant) minimicrospheres	1.39	25.00
Creon® 10 000	10,000	8,000	600	< 25°C	Enteric-coated (acid-resistant) minimicrospheres within gelatine capsules	1.25	16.67
Creon® 25 000	25,000	18,000	1,000	< 25°C	Enteric-coated (acid-resistant) minimicrospheres within gelatine capsules	1.39	25.00
Pancrex V® powder (per g)	25,000	30,000	1,400	< 25°C	Powder	0.83	17.86
Pancrex V® capsules ‘125’	2,950	3,300	160	Store in a refrigerator (2°C - 8°C)	Hard gelatine capsule	0.89	18.44
Pancrex V® 340mg capsules	8,000	9,000	430	Store in a refrigerator (2°C - 8°C)	Capsule containing non-enteric coated granules	0.89	18.60
Nutrizym 22® capsules	22,000	19,800	1,100	< 25°C	Hard gelatin capsule containing enteric coated pancreatin minitablets	1.11	20.00

Appendix 2: Letter from Imam regarding enzymes for Muslims

CR165

THE LONDON CENTRAL MOSQUE TRUST
& THE ISLAMIC CULTURAL CENTRE

A Registered Charity
146, PARK ROAD, LONDON NW8 7RG
TEL: 0171-724 3363 (10 Lines) FAX: 0171-724 0493

Ms Julie Burns
Medical Information Executive
Solvay Healthcare
Hamilton House
Gaters Hill
West End
Southampton
Hampshire SO18 3JD.

5.6.1996

Thank you for your letter of 30th May, 1996.

The answer to your inquiry is as follows:

A medicine consisting of substances which Muslims are prohibited from consuming cannot be given general approval for use by Muslims. Usually, there are several medicines and approaches to curing a disease or illness. If medicines which do not contain prohibited substances are available then they should be prescribed. If, and only, if no other medicines than the ones containing the prohibited substances are suitable to cure the illness or disease in the opinion of the physician, then the medicine containing the prohibited substances should be prescribed and taken by the patient. This is allowed as stated in verse 3 Chapter 5 of the Holy Quran.

Yours sincerely

Abdul Halim mohamed

Dr Abdul Halim Mohamed
Imam

Appendix 3: Letter from Rabbi regarding enzymes for Jewish people

CR166

Beth Din, London
Court of the Chief Rabbi
Manchester Beth Din

RECEIVED
17 DEC 2002

A. Adler, B.Pharm, M R Pharm.S
172 Whitehall Road
Gateshead
Tyne and Wear
NE8 1TP
(0191) 478 2244

Consultant pharmacist to the London and Manchester Beth Din

Solvay Healthcare
Mansbridge Road
West End
SOUTHAMPTON

12 December 2002

Dear Miss Stone,

Thank you for your letter.

I am pleased to confirm that the Creon range of products may be used by Jewish patients even though it contains Pancreatin of animal origin. This is because the animal substances therein are not present in an edible state.

I hope that this will serve to reassure Jewish patients taking this product.

Yours sincerely,

A. Adler

Appendix 4: An example oral diet and PERT doses

Example of a 50kg patient. She takes Creon 25,000®.

Her diet history is as follows with the approximate grams of fat they contain and recommended Creon® capsules shown:

Breakfast:
Weetabix x2, whole milk (250ml) & sugar
cup of coffee with milk (11g fat)
2 Creon 25,000

Mid morning snack:
1 x packet of crisps (10g fat)
2 Creon 25,000

Lunch:
tuna sandwich (2 slices with mayo and butter)
1 x apple (25g fat)
5 Creon 25,000

Mid afternoon snack:
Mars bar or similar (15g fat)
3 Creon 25,000

Evening meal:
2oz meat, vegetables and 4 egg sized potatoes with 1 tsp butter
Bowl of custard with skimmed milk (25g fat)
5 Creon 25,000

Bedtime snack:
crackers x 3, with butter cheese (15g fat) **3 Creon 25,000**

The rough ratio of fat: PERT = 1 capsule per 5g fat. You can use this information to balance the distribution of Creon through the day.

The guideline initial maximum dose for this patient would be 20 capsules of Creon 25,000® per day. This is calculated by 50(patient's weight in kg) x 10,000 (lipase units per kg/d) = 500,000 lipase units/d in total and 500,000÷25,000 (lipase units per Creon capsule) = 20 Creon x 25,000® per day. Once this is reached and patient is still having symptoms, consider other causes of symptoms.

Appendix 5: An example feeding regime and PERT doses

Example of a 65kg patient whose requirements are 2000kcal and 70-80g protein per day. The patient is referred to you already on full NG feeds as shown below. If you are building up the feed at the beginning then use the example PERT regime for day 1 shown below during the build-up and then for day one of the target regime.

100mls/ hour x 20 hours Nutrison Standard (with a four hour break)

This example has been designed for a patient who cannot swallow and therefore requires Pancrex V powder® via the enteral feeding tube.

Example regime
Change the patient onto Nutrison Advanced Peptisorb at 100mls/hr x 20 hours (with a four hour break)

Monitor the patient's bowels and tolerance of the feed. If they appear to have normal stools and are tolerating the feed then continue with the current regime and monitor their weight.

If the patient experiences malabsorption symptoms then Pancrex V Powder® would be recommended.

The Pancrex V powder® needs to be prescribed on the drug chart/ MAR by doctors or other authorised prescriber. It can help nursing staff to make the timings clearer if you also write the Pancrex V powder® on the feeding regime.

Day 1 –
The four hour break is from 10:00 -14:00hrs
14:00 2g of Pancrex V powder and commence feed
17:00 2g of Pancrex V powder
20:00 2g of Pancrex V powder
23:00 2g of Pancrex V powder
02.00 2g of Pancrex V powder
05.00 2g of Pancrex V powder
08.00 2g of Pancrex V powder
10.00 2g of Pancrex V powder and cease feeding (flush feed off as usual)

This gives a daily dose of 16g Pancrex V powder® per day (16x25,000 = 400,000 lipase units/d). For this Pt it is 400,000÷65= 6154iu lipase per kg per day.

Note each time the Pancrex V powder® is given, it should be mixed with 20mls of water, the feed should be stopped and the Pancrex V® solution flushed down the feeding tube. Then the feed restarted immediately (unless it is the end of the feed in which case it is flushed off as usual).

The patient needs to be monitored for approximately 48 hours as described in the monitoring a patient on PERT section above. If the patient is still malabsorbing after this time then the dose needs to be increased as shown below.

Day 3 –
The four hour break is from 10:00 -14:00hrs

14:00	2g of Pancrex V powder and commence feed
16:00	2g of Pancrex V powder
18:00	2g of Pancrex V powder
20:00	2g of Pancrex V powder
22:00	2g of Pancrex V powder
00:00	2g of Pancrex V powder
02.00	2g of Pancrex V powder
04.00	2g of Pancrex V powder
06:00	2g of Pancrex V powder
08.00	2g of Pancrex V powder
10.00	2g of Pancrex V powder and cease feeding (flush feed off as usual)

This gives a daily dose of 22g Pancrex V powder® per day (22x25,000 = 550,000 lipase units/d). For this patient it is 550,000÷65= 8,462iu lipase per kg per day.

Again the patient needs to be monitored for approximately 48 hours as described in the monitoring a patient on PERT section above. If they seem to be absorbing then they can stay at this dose. If the patient is still malabsorbing after this time then the dose needs to be increased as shown below.

Day 5 –
The four hour break is from 10:00 -14:00hrs

14:00	3g of Pancrex V powder and commence feed
16:00	3g of Pancrex V powder
18:00	3g of Pancrex V powder
20:00	3g of Pancrex V powder
22:00	3g of Pancrex V powder
00:00	3g of Pancrex V powder
02.00	3g of Pancrex V powder
04.00	3g of Pancrex V powder
06:00	3g of Pancrex V powder
08.00	3g of Pancrex V powder
10.00	3g of Pancrex V powder and cease feeding (flush feed off as usual)

This gives a daily dose of 33g Pancrex V powder® per day (33x25,000 = 825,000 lipase units/d). For this Pt it is 825,000÷65= 12,692iu lipase per kg per day.

As this increase in the dose has exceed the initial maximum dose (26g/d), they may benefit from being prescribed a PPI/H2 Antagonists (e.g. omeprazole/ lansoprazole/ ranitidine). It is also important to check the patient is not prescribed laxatives. These measures should be tried before increasing the does further and other causes of loose stools should be investigated if this is

occurring. If the dose is increased further this should be done cautiously and with careful monitoring and discussion with the pancreatic dietitians. It is common to need more PERT with a gastric feed.

Again the patient needs to be monitored for approximately 48 hours as described in the monitoring a patient on PERT section above. If they seem to be absorbing then they can stay at this dose. If the patient is still malabsorbing after this time, they will need an increase in dose, suggested to be 3.5g every 2 hours the feed is running.

As there is no enteric coating on the Pancrex V powder®, it is not protected from the action of stomach acid and you lose some enzyme activity. It is therefore relatively common to need to exceed the 10,000iu per kg per day. However 20,000iu lipase per kg per day should not generally be exceeded without discussion with pancreatic specialist dietitians.

If the patient can swallow capsules during waking hours, they may be okay to omit the Pancrex doses during waking hours and only require the daytime doses as above, taking oral PERT during the waking hours.

This is only an example patient, each will have their own initial maximum dose and level at which they are absorbing the feed they are given.