Guidelines for the Use of **Lanaflex**™ in the Dietary Management of Phenylketonuria

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NUTRICIA
Metabolic Nutrition

Guidelines for the Use of Lanaflex in the Dietary Management of Phenylketonuria

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Disclaimer:

Lanaflex is a medical food intended for use in dietary management of certain Phenylketonuria (PKU) patients ages 12 and over. The following guidelines are provided to help support healthcare professionals involved in the dietary management of PKU patients. Practices may vary from clinic to clinic, and this booklet should serve as guidance, not as strict protocol.

Acknowledgements:

Nutricia North America would like to thank Kathryn Moseley, MS, RD, University of Southern California, for her input and review of these guidelines, and Sommer Gaughan, RD, CSP, The Children's Hospital Colorado, for her contributions to the sample menus.

Guidelines for the Use of Lanaflex in the Dietary Management of Phenylketonuria

INTRODUCTION AND BACKGROUND

INTRODUCTION

In the dietary management of Phenylketonuria (PKU), early institution and maintenance of a strict low phenylalanine (PHE) diet has been shown to be essential to optimize outcome and avoid the potential consequences of poor metabolic control e.g. low IQ and behavioral problems[1]. Protein-rich foods must be virtually eliminated from the diet and a PHE-free medical food must be given to compensate for the resulting deficiencies in the other essential and non-essential amino acids[2].

It is generally accepted that even early-treated PKU adults who have relaxed their diet may be exposing themselves to developing neurological impairments, which may have a negative impact on quality of life. Short attention span, poor short-term memory, impaired visual-motor perception, and defective motor coordination are among the symptoms that may result when plasma PHE concentrations remain elevated.

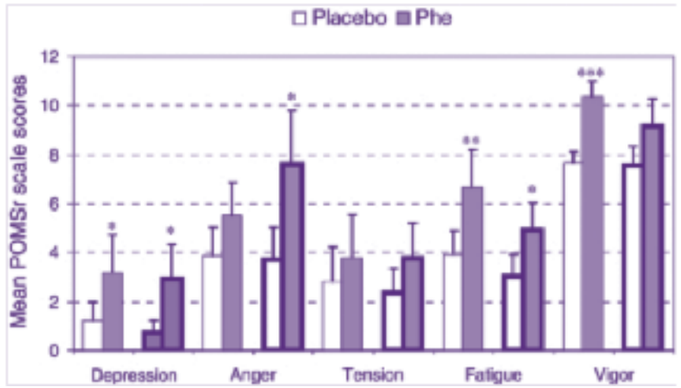
The report of the Medical Research Council Working Party on PKU[1] as well as the NIH Consensus Statement on PKU[3] recommended continuation of dietary management beyond childhood, preferably for life. However, compliance with the PHE-free medical food is not optimal and Prince et al. have reported that less medical food is taken than the amount actually prescribed[4].

Many individuals with PKU relax dietary control as they get older[4,5], or they no longer come to clinic[6], forming a so-called 'off-diet' population in which PHE concentrations are high and nutritional status may be compromised. Individuals often self-restrict high biologic value protein when they come off diet, which can lead to a diet low in essential amino acids and micronutrients, including vitamin B_{12}.[7,8]

There is increasing evidence that high PHE concentrations and/or low brain concentrations of certain other amino acids (specifically tyrosine (TYR) and tryptophan (TRP)) may have negative effects on executive functioning in adult PKU individuals[9,10]. ten Hoedt et al. recently reported on high PHE concentrations directly affecting mood and sustained attention in PKU adults[11] (See Figure 1).

1 Report of the Medical Research Council Working Party on Phenylketonuria. Recommendations on the Dietary Management of Phenylketonuria. *Arch Dis Child.* 1993;68:426-427.
2 Francis D. 1987. Diets for Sick Children. Oxford: *Blackwood Scientific Publications*.
3 National Institutes of Health: Consensus Development Conference Statement on Phenylketonuria: Screening and Management; October 16-18, 2000 http://www.nichd.nih.gov/publications/pubs/pku/sub3.cfm
4 Prince AP, et al. Treatment Products and Approaches for Phenylketonuria: Improved Palatability and Flexibility Demonstrate Safety, Efficacy and Acceptance in US Clinical Trials. *J Inherit Metab Dis*. 1997;20:486-498.
5 Schulz B, et al. Nutrient Intake and Food Consumption of Adolescents and Young Adults with Phenylketonuria. *Acta Paediatr*. 1995;84:743-748.
6 Burton B, et al. Reaching out to the lost generation of adults with early-treated phenylketonuria (PKU). *Mol Genet Metab*. 2010;101(2-3):146-8.
7 Crone MR, et al. Behavioral factors related to metabolic control in patients with phenylketonuria. *J Inherit Metab Dis*. 2005;28:627-637.
8 Vugteveen I, et al. Serum vitamin B12 concentrations within reference values do not exclude functional vitamin B12 deficiency in PKU patients of various ages. *Mol Genet Metab*. 2011;102:13-17.
9 Gentile JK, et al. Psychosocial aspects of PKU: hidden disabilities--a review. *Mol Genet Metab*. 2010;99(S1):S64-7.
10 Brumm VL, et al. Psychiatric symptoms and disorders in phenylketonuria. *Mol Genet Metab.* 2010;99(S1):S59-S63.
References and further reading may be available for this article. To view references and further reading you must purchase this article.
11 ten Hoedt AE, et al. High Phenylalanine concentrations directly affect mood and sustained attention in adults with phenylketonuria: a randomised, double-blind, placebo-controlled, crossover trial. *J Inherit Metab Dis*. 2011;34(1):165-71. Full article and images available at no charge through PubMed.

Figure 1



Patient self report (—), Significant other report (▬): ***p ≤ 0.01, **p ≤ 0.05, *p < 0.10

Nutricia North America supports "diet for life" for all patients with PKU. Research has shown that adherence to a well-managed diet plan has the best possible clinical outcomes for patients with PKU. However, diet compliance continues to be a major issue among patients with PKU, often starting in pre-adolescence.

Lanaflex has been developed to address the population of individuals with PKU who are no longer following a PHE-restricted diet or who struggle with a traditional PHE-restricted diet. Lanaflex provides essential amino acids with elevated amounts of tyrosine and tryptophan. The product offers the potential to help control brain and plasma PHE concentrations, support normal nutrient status and impact specific executive brain functions[12].

BACKGROUND AND RATIONALE

Entry of plasma PHE into the brain

Large Neutral Amino Acids (LNAAs†) enter the brain via a specific transporter protein (LAT 1) at the blood-brain barrier (BBB). The transporter is saturated at physiological concentrations of LNAAs, so transport is effectively competitive – LNAAs with higher plasma concentrations and/or with greater affinity for the transporter will enter the brain more efficiently than LNAAs with lower plasma concentrations and/or lesser affinities[13].

Brain LNAA transport in PKU is severely affected because PHE can be present at very high concentrations in plasma, and PHE coincidentally has the highest affinity of any of the LNAAs[14] for the LAT 1 transporter. The overall effect is that brain PHE concentrations are very high in PKU, and entry of other LNAAs is drastically reduced, e.g. TYR and TRP. TYR and TRP are the direct metabolic precursors of the neurotransmitters, dopamine and serotonin, respectively. The neurotoxicity associated with PKU is thought to be a combination of the direct toxicity associated with higher than normal brain PHE concentrations and deficits in concentrations of serotonin and dopamine, due to low brain concentrations of the TYR and TRP precursors[15]. The maximum potential for neurotoxicity will occur when plasma PHE concentrations are at their highest, e.g. in off-diet or non-compliant PKU patients.

† Amino acids considered large neutral amino acids include: phenylalanine (PHE), tyrosine (TYR), tryptophan (TRP), threonine (THR), isoleucine (ILE), leucine (LEU), valine (VAL), methionine (MET), histidine (HIS).
12 Schindeler S, et al. The effects of large neutral amino acid supplements in PKU: an MRS and neuropsychological study. *Mol Genet Metab*. 2007;91:48-54.
13 Pardridge WM. Kinetics of competitive inhibition of neutral amino acid transport across the blood brain barrier. *J Neurochem*. 1977;28:103-8.
14 Oldendorf WJ. Saturation of blood brain barrier transport of amino acids in phenylketonuria. *Archives of Neurol.* 1973;28:45-8.
15 Van Spronsen FJ et al. Brain dysfunction in Phenylketonuria: is phenylalanine toxicity the only possible cause? *J Inherit Metab Dis*. 2009;32(1):46-51.

Evidence is increasing that the goal of PKU treatment might be to normalize cerebral concentrations of large neutral amino acids instead of preventing high brain PHE concentrations alone[16,17].

Lanaflex is designed to help normalize these imbalances by supplying essential amino acids along with significant amounts of TYR and TRP. The product offers the potential to help improve some of the negative effects that high PHE and low LNAA concentrations may have on neurological outcome. Lanaflex contains the full range of essential amino acids, including LNAAs (minus PHE). Increasing the dietary intake of LNAAs will result in higher plasma concentrations of these amino acids, which can then directly compete with plasma PHE at the BBB. Consequently, brain PHE concentrations should be reduced while concentrations of the other essential amino acids, such as TYR and TRP, will be increased.

The benefit of LNAAs is as follows: one is that reduced brain PHE concentrations will mute the negative effect that high brain PHE has on the enzymes that convert TYR and TRP to dopamine and serotonin, respectively. Secondly, higher brain concentrations of TYR and TRP will support production of dopamine and serotonin. Thirdly, a concomitant reduction in brain PHE and increase in TYR and TRP may improve neuropsychologic function[12].

Supplementation of LNAAs (TRP, TYR, MET, LEU, ILE, VAL, HIS and THR) to reduce PHE uptake into the brain in PKU in order to reduce the neurological symptoms associated with PKU was first suggested in the 1970s[18]. Those LNAAs with relatively lower concentrations are supplemented in the product (see Appendix 3).

*Note: Tyrosine is a conditionally essential amino acid in patients with PKU.

Absorption of dietary PHE from the gut lumen

Dietary LNAAs are competitively absorbed from the gut via a specific transporter protein, similar but not identical to that found at the BBB. Another approach to address high plasma PHE concentrations would be to reduce dietary PHE absorption from the gut. Non-PHE LNAAs in the gut lumen at high enough concentrations after meals may reduce PHE absorption.

As demonstrated above, Lanaflex may therefore address PHE metabolism in off-diet patients with PKU in two ways – reducing absorption of dietary PHE and therefore plasma PHE concentrations; and restricting the high concentrations of plasma PHE in the brain[12].

Effect of LNAA on neurophysiological status and behavior

Schindeler et al.[12] reported that LNAA supplementation had a positive effect on executive functioning, specifically verbal generativity, cognitive flexibility and non-verbal self-monitoring and working memory. In a separate pilot study, Kalkanoğlu et al. evaluated the effect of PHE-free essential amino acids tablets (enriched with TYR and TRP) on the behavior of intellectually impaired PKU patients and observed significant improvements in concentration[19].

These findings indicate that LNAA may play a role in improving behavioral and intellectual outcome of PKU patients through increasing the availability of TYR and TRP in the brain.

16 Pietz J, et al. Large neutral amino acids block phenylalanine transport into brain tissue in patients with phenylketonuria, *J Clin Invest* 1999;103(8):1169-78.

17 Surtees R, et al. The neurochemistry of phenylketonuria. *Eur J Pediatr*. 2000;159 (S2):S109-13.

18 Andersen AE, et al. Lowering brain phenylalanine concentrations by giving other large neutral amino acids. *Archives of Neurol*. 1976;33:684-6.

19 Kalkanoğlu HS, et al. Behavioural effects of phenylalanine-free amino acid tablet supplementation in intellectually disabled adults with untreated phenylketonuria. *Acta Paediatr.* 2005;94(9):1218-22.

PRODUCT PRESENTATION

Lanaflex is an artificially orange-flavored PHE free medical food containing large neutral amino acids and lysine, carbohydrate, vitamins, minerals and trace elements. The unit size is a 15.8 g stick pack, with 40 stick packs per box. Each stick pack provides 5.2 g protein equivalent (PE).

INDICATIONS FOR USE

Lanaflex is indicated for individuals with proven PKU.

Who should consider taking Lanaflex?

- Patients who are struggling with compliance ("strugglers") and are 12 years of age and older
- Patients who are "off diet" but who would benefit from returning
- Patients who are either BH_4 "responders" or "non-responders"
- Patients who are "off diet" and can no longer follow a traditional PHE-restricted diet
- Patients who predated newborn screening who may benefit from return to diet

NOTE: Individuals with PKU who are successfully managing their diet through the traditional PHE-restricted diet are advised to continue using their current regimen. A traditional PHE-restricted diet has been shown most effective in reducing plasma PHE concentrations and promoting good clinical outcomes.

Caution and Considerations

- Caution is needed regarding the use of Lanaflex or any LNAA product in women who are of childbearing age. Lanaflex is NOT RECOMMENDED for women either planning a pregnancy or who are pregnant. Women of childbearing age who use this product must be counseled about family planning and the need to be on a strict PHE-restricted diet prior to conception and throughout pregnancy. Lanaflex, just like any other LNAA product, is not intended for use in pregnant women with PKU.
- Caution is also needed regarding individuals taking serotonergic medications, e.g., for depression/anxiety (e.g. Paxil®, Prozac®). The product contains relatively large amounts of tryptophan, the natural precursor for the neurotransmitter serotonin, which is the pharmacological target of many psychotropic drugs, e.g. SSRIs. Mental health professionals should be aware that tryptophan in Lanaflex may interact with such drugs resulting in possible over-stimulation of brain serotonin systems. Caution must be taken with patients taking any kind of psychotropic medications (SSRI, MAO inhibitors, methylating agents) who are considering using Lanaflex. Medication should be monitored when starting Lanaflex use.

NUTRITIONAL COMPOSITION

Amino acid profile

In addition to providing the LNAAs to redress the imbalance of high concentrations of PHE in the brain and plasma, the supply of essential amino acids in the product will help ensure adequate dietary intake. All of the essential amino acids (except PHE) are present in Lanaflex. The essential amino acids that are likely to be the most deficient in the diet of an individual taking Lanaflex (i.e. patients who are "off diet"), are provided at higher concentrations to meet this deficit (HIS, MET, TRP and TYR). The amino acid profile used in Lanaflex is a "balanced profile" of amino acids i.e. there are no excessively high or low concentrations of the essential amino acids or lysine (See Appendix 3).

Micronutrients

Vitamins, trace elements and calcium, magnesium and phosphorus have been included in Lanaflex to help support normal nutrient status. Because individuals with PKU who use Lanaflex may be on a relaxed diet, 100% of the usual micronutrient requirements for a patient with PKU would not be required. The level of the micronutrients in Lanaflex is set at a level that meets at least 80% of DRI[20] micronutrient requirements.

20 Dietary Reference Intakes. Food and Nutrition Board. *National Academy Press* 2001.

HOW TO INCORPORATE LANAFLEX INTO A PKU DIET

Please note:

The following are suggested parameters for monitoring; please also refer to your clinic guidelines.

- Dietary intake, including total protein, amino acids and energy
- Plasma amino acids (refer to your clinic lab for reference ranges)
- Monitor PHE and TYR and aim for a low ratio. Sharman et al (2010) advocate a lifetime PHE/TYR ratio of less than 6[21]
- Serum vitamin B_{12} and homocysteine
- Behavior markers: general well-being, mood, energy level, concentration etc.

The aim of incorporating Lanaflex into the PKU diet is to help normalize plasma amino acid levels in patients who are not following a PHE-restricted diet or who are struggling.

Mixing Lanaflex:

Lanaflex is designed to be consumed as a small, chilled drink with meals. To reconstitute Lanaflex, add one stick pack to 60 mL (approx. 2 fl oz) of chilled water and shake. Lanaflex can be taken in a more concentrated form i.e. paste, but the individual would need to consume extra water or drink with it to prevent an osmotic effect.

Lanaflex should be distributed over the day in three or more portions and consumed in conjunction with a protein-containing meal.

Dosage:

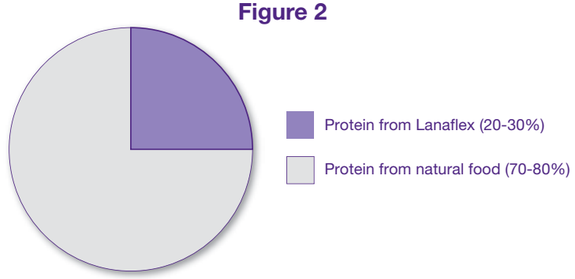
Lanaflex is available in 15.8 g stick packs, each pack contains 5.2 g PE.

The recommended starting dosage of Lanaflex is 0.8 g Lanaflex powder/kg bodyweight per day. For most individuals this dose calculates to 2-4 packs of Lanaflex per day. As noted above, Lanaflex should be distributed over the course of the day in conjunction with a protein-containing meal.

CALCULATING A DIET WITH LANAFLEX

Lanaflex is designed to work in combination with a "relaxed" low-PHE diet, whereas 70-80% of the individual's protein requirement will come from natural/normal foods and 20-30% from Lanaflex. However, many individuals combine Lanaflex with traditional PKU medical food.

Figure 2



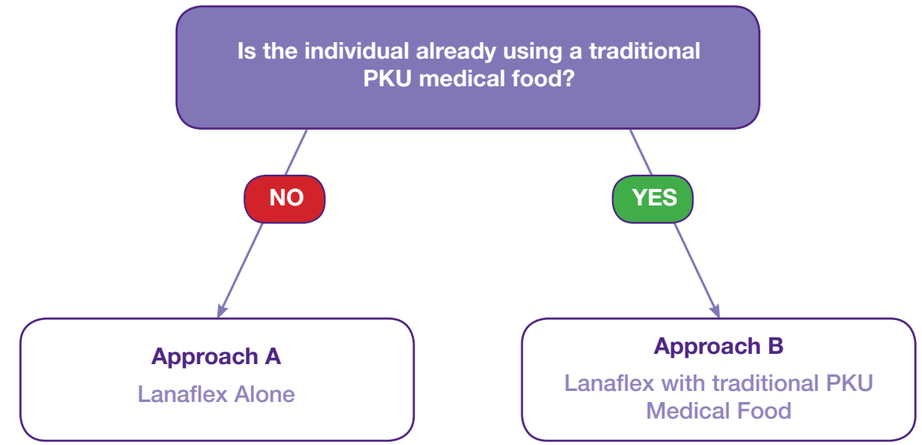
21 Sharman R, et al. A preliminary investigation of the role of the phenylalanine:tyrosine ratio in children with early and continuously treated phenylketonuria: toward identification of "safe" levels. *Dev Neuropsychol.* 2010;35(1):57-65.

Protein requirement is calculated based on ideal body weight. The following table provides guidance based on 80/20 and 70/30 diet approaches.

Table 1

Weight, kg	g Protein/ kg	Protein per day	80% of total protein from food	20% of total protein from Lanaflex	Suggested number of Lanaflex packets per day	70% of total protein from food	30% of total protein from Lanaflex	Suggested number of Lanaflex packets per day
50	1	50	40	10	2	35	15	3
55	1	55	44	11	2	39	16	3
60	1	60	48	12	3	42	18	3
65	1	65	52	13	3	45	20	4
70	1	70	56	14	3	49	21	4
75	1	75	60	15	3	53	22	4
80	1	80	64	16	3	56	24	4-5

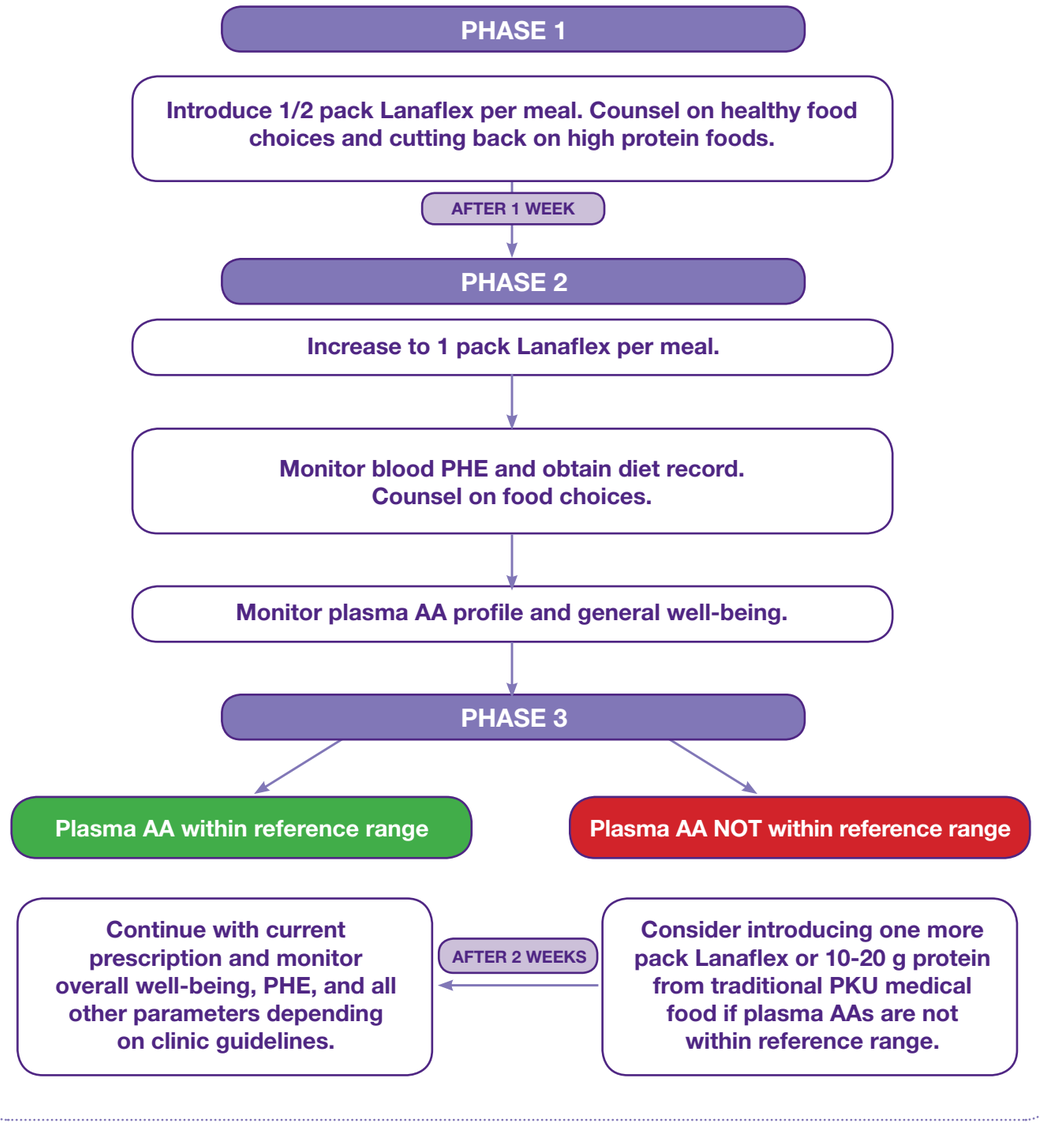
PHASING LANAFLEX INTO THE DIET REGIMEN



APPROACH A (Lanaflex alone):

Use this nutrition management approach for individuals who

- Are not using any traditional PKU medical food,
- Are not on any form of PHE-restricted diet, e.g. "Off diet" individuals, late diagnosed/never treated, or
- Either have not or only partially responded to BH_4 drug therapy and are not currently on any traditional PKU medical food.



Calculating Daily Protein Needs From Lanaflex And Natural Food

Step 1: Determine total daily protein requirement based on ideal body weight. Recommended daily protein intake for an adult is 0.8 – 1 g protein/kg ideal body weight. Refer to table 1 for guidance.

Example: Establish and fill daily prescription for 27 yo male, 70 kg ideal body weight

70 kg x 1 g = 70 g total protein

Step 2: Determine amount of Lanaflex per day. Provide 20-30% of total protein from Lanaflex. One pack Lanaflex provides 5.2 g protein equivalent. Energy contribution from Lanaflex is minimal.

Refer to table 1 for protein guidance.

Example:

70 g total protein x 20% = 14 g PE from Lanaflex.

14 g Lanaflex = ~ 3 packs

Step 3: Determine protein from normal foods. The remainder (70-80%) of protein requirement will come from natural foods.

Example:

70 g total protein – 14 g protein from Lanaflex = 56 g

Introduction of Lanaflex Into the Diet

Introduce Lanaflex gradually into the diet. As always, consider patient preferences.

Phase 1: Start with ½ pack per meal for one week, then increase to 1 pack per meal. Counsel on healthy food choices and cutting back high protein foods.

Phase 2: After one week, increase to 1 pack Lanaflex per meal.

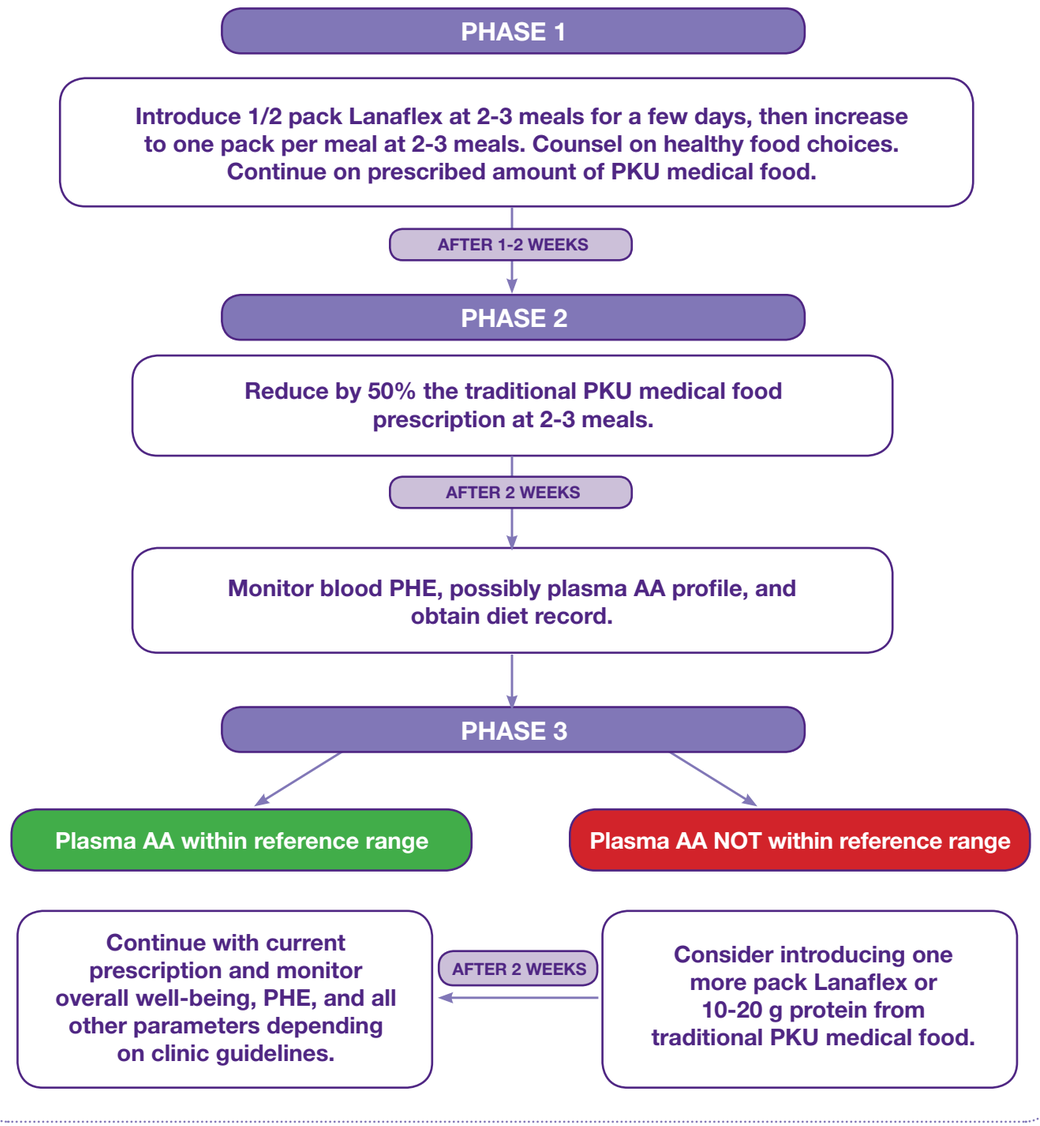
After two weeks, monitor blood PHE and obtain diet record. Counsel on healthy food choices and cutting back high protein foods if necessary.

Phase 3: After additional two weeks, obtain plasma AA profile. Monitor for general well-being (mood, signs of depression, concentration etc.). If plasma AAs are outside reference range and/or patient reports behavioral issues, consider introducing one more pack Lanaflex or 10-20 g protein from traditional PKU formula. Counsel on healthy food choices and reducing high protein foods.

APPROACH B (Lanaflex with traditional PKU Medical Food):

Use this nutrition management approach for individuals who are on some form of a traditional PKU diet, but not compliant, and who

- Are struggling to achieve optimal blood PHE control,
- Want to reduce traditional PKU medical food intake, or
- Want to add more normal food choices to their diet



Introduction of Lanaflex Into the Diet

Refer to established diet prescription for patient and consider patient's preferences.

Introduce Lanaflex gradually into the diet.

Phase 1: Add ½ pack of Lanaflex at 2-3 meals to the current diet prescription without changing prescription for protein from natural sources or PKU medical food. Increase to 1 pack of Lanaflex at 2-3 meals within about one week.

Phase 2: After 1-2 weeks and if patient is feeling well, consider cutting back on 10 g protein from traditional PKU medical food prescription at 2-3 meals OR allow for more natural protein.

Phase 3: After two weeks, monitor blood PHE, obtain diet record and possibly plasma AA profile. Monitor overall well-being. If plasma AAs are outside reference range and/or patient reports behavioral issues, consider introducing one more pack Lanaflex or 10-20 g protein from traditional PKU formula.

RESPONSE TO THERAPY AND MONITORING

Depending on individual circumstances, patients may respond with stabilized or reduced blood PHE concentrations, lower PHE/TYR ratio, and/or report feeling better. Plasma amino acids should be within reference range.

Please also see comments on behavioral assessment below.

Monitoring

It is imperative that individuals who consume Lanaflex continue to be supervised by clinicians and be carefully monitored.

We recommend, as a general guide, that the following be obtained before an individual starts on Lanaflex and while consuming the product:

- Routine blood biochemistry including plasma PHE, other amino acid concentrations and prealbumin.
- Consider paying close attention to the PHE/TYR ratio. Research suggests that a low lifetime ratio may be more important than blood PHE alone when assessing executive functioning[21]. Sharman et al (2010) advocate a lifetime PHE/TYR ratio of less than 6.
- Nutritional assessment including dietary intake, especially total protein, body weight, BMI etc.
- Behavioral assessment

The frequency of monitoring will depend on the metabolic center and their specific protocol for managing the 'relaxed' or less restricted diet. Additional assessments might be required depending on each center's guidelines for treatment and management.

Genetic Metabolic Dietitians International (GMDI) offers MetabolicPro, the only web-based nutrient analysis software program designed for use by metabolic dietitians. All foods in the database contain complete amino acid data, making it the valuable tool for analyzing diets of patients with amino acid and organic acid disorders. More information can be found at www.gmdi.org.

Behavioral assessment:

Several healthcare professionals advocate now or report using behavioral assessment tools for monitoring metabolic patients. Hence, blood PHE concentrations may no longer be the only measurement for therapy success and evaluation. A group of ten psychologists and one psychiatrist in the United States with expertise in neuropsychological assessment and PKU proposed a Uniform Assessment Method for PKU[22]. Resources, specially designed for the general practitioner, can be found on http://gmpsych.org.

Another valuable resource for assessment tests can be found at www.pearsonassessments.com.

22 Waisbren S, et al. Screening for cognitive and social-emotional problems in individuals with PKU: tools for use in the metabolic clinic. *Mol Genet Metab*. 2010;99(S1):S96-9.

Sample Menu 1

Diet prescription for an adult, 55 kg

Protein, total	56 g
From natural food	40
From Lanaflex	15.6
Energy	1500 kcal

Nutrient Analysis*

Protein, total	56.2 g
From natural food	40.6 g
From Lanaflex	15.2 g
PHE	1814 mg
Fat	21.7 g
Carbohydrate	286 g
Energy	1517 kcal

*Nutrient analysis determined using USDA database information through ESHA. In cases where actual PHE amount was not available, mg of PHE was determined using 1 g protein = 50 mg PHE.

Breakfast:
- 1 cup Cornflakes
- ½ cup 1% Milk
- ½ cup Fresh Blueberries
- 2 slices 100% Whole Wheat bread
- 1 tbsp Strawberry Preserves
- 1 pack Lanaflex

Snack:
- ½ cup Low Fat Yogurt
- 1 medium Banana

Lunch:
- Vegetable Sandwich
  ½ Whole Wheat Pita
  2 tbsp Hummus
  4 slices Cucumber
  2 slices Tomato
  1 leaf Romaine Lettuce
- 1 oz Hard Pretzels
- 1 medium Apple
- 1 pack Lanaflex

Dinner:
- Vegetable Stir-Fry
  1 cup Brown Rice, cooked
  ½ cup Mixed Vegetables
  ¼ cup Mushrooms, cooked
  1 tbsp Peanuts, chopped
- Mixed Salad
  1 cup Spinach
  3 Cherry Tomatoes
  2 tbsp Carrots, grated
  1 tbsp Italian Salad Dressing
- 1 Pack Lanaflex

If more calories are needed, add non-protein products such as oils, honey and jam.

Sample Menu 2

Diet prescription for an adult, 60 kg

Protein, total	65 g
From natural food	50
From Lanaflex	15.6
Energy	1750 kcal

Nutrient Analysis*

Protein, total	66.8 g
From natural food	51.2 g
From Lanaflex	15.6 g
PHE	2349 mg
Fat	42.5 g
Carbohydrate	278 g
Energy	1720 kcal

*Nutrient analysis determined using USDA database information through ESHA. In cases where actual PHE amount was not available, mg of PHE was determined using 1 g protein = 50 mg PHE.

Breakfast:
- 1 cup Oatmeal, plain cooked w/water
- 2 tbsp Dried Cranberries
- 1 tbsp Sliced Almonds
- 1 tbsp Honey
- ¼ cup 1% Milk
- 1 pack of Lanaflex

Snack:
- 1 medium Apple
- 1 tbsp Natural Peanut Butter

Snack:
- ½ cup Low-Fat Yogurt
- 1 Granola Bar, crunchy

Lunch:
- Vegetable Wrap
  Whole Wheat Tortilla
  1 slice Provolone Cheese
  4 slices Cucumber
  2 slices Tomato
  ½ cup Portabella Mushrooms, grilled
  1 leaf Romaine Lettuce
- 1 oz Hard Pretzels
- 1 pack of Lanaflex

Dinner:
- Loaded Potato
  1 large Baked Potato, w/skin
  ½ cup Broccoli, steamed
  2 tbsp Cheddar, shredded
  1 tbsp Sour Cream, light
- Mixed Salad
  1 cup Spinach
  3 Cherry Tomatoes
  2 tbsp Carrots, grated
  1 tbsp Italian Salad Dressing
- 1 pack of Lanaflex

If more calories are needed, add non-protein products such as oils, honey and jam.

Sample Menu 3

Diet prescription for an adult, 75 kg

Protein, total	76.4 g
From natural food	60.8
From Lanaflex	15.6
Energy	2100 kcal

Nutrient Analysis*

Protein, total	76.4 g
From natural food	60.8 g
From Lanaflex	15.6 g
PHE	2860 mg
Fat	40.4 g
Carbohydrate	381 g
Energy	2156 kcal

*Nutrient analysis determined using USDA database information through ESHA. In cases where actual PHE amount was not available, mg of PHE was determined using 1 g protein = 50 mg PHE.

Breakfast:

- 2 cups Cornflakes
- 6 oz 1% Milk
- 1 medium Banana
- 1 packet Lanaflex

Snack:

- 1 cup Grapes
- 1 Granola Bar, crunchy

Snack:

- 6 oz Low-Fat Yogurt
- Trail Mix:
  ½ cup Dried Cranberries
  2 Tbsp Almonds, sliced

Lunch:

- Turkey Sandwich:
  2 oz Deli Turkey
  1 Large Whole Wheat Pita
  4 slices cucumber
  1 Leaf Romaine lettuce
  2 Slices Tomato
- 2 oz Pretzels
- 1 packet Lanaflex

Dinner:

- 1 ¼ cup Whole Wheat pasta
- ½ cup Marinara Sauce
- Sauteed Vegetables
  1 cup Sliced Zucchini and Squacsh
  ½ Tbsp Olive oil
- 1 Whole Wheat Dinner Roll
- 2 Tsp Butter
- 1 packet Lanaflex

If more calories are needed, add non-protein products such as oils, honey and jam.

Resources:

Eat Right Stay Bright is an anticipatory guidance tool, developed by The Children's Hospital of Denver, to aid health-care professionals in the treatment of patients with PKU. Visit **nutricialearningcenter.com** to download the guide.

Appendix 3

Lanaflex Nutrition and Ingredients Information:

Nutrition Information:

Nutrients	Per Sachet (15.8 g)	Per 100 g
Calories	40	253
Protein Equivalent, g	5.2	33
Fat, g	0.16	1
Carbohydrate g	4.4	28
Amino Acids, g		
L-Histidine	0.92	5.85
L-Isoleucine	0.46	2.92
L-Leucine	0.46	2.92
L-Lysine	0.46	2.92
L-Methionine	0.92	5.85
L-Threonine	0.46	2.92
L-Tryptophan	0.92	5.85
L-Tyrosine	0.92	5.85
L-Valine	0.46	2.92
Vitamins		
Vitamin A IU, (mcg R.E.)	892 (268)	5644 (1695)
Vitamin D IU, (mcg R.E.)	135 (3.4)	852 (21.3)
Vitamin E IU, (mg α T.E.)	7.4 (5)	46.9 (31.5)
Vitamin K, mcg	32.7	207
Thiamine, mg	0.36	2.3
Riboflavin, mg	0.38	2.4
Vitamin B_6, mg	0.65	4.1
Vitamin B_{12}, mcg	1.3	8
Niacin, mg	2.2	14.2
Folic Acid, mcg	197	1246
Pantothenic Acid, mg	1.9	12.2
Biotin, mcg	9.8	61.9
Vitamin C, mg	25.1	159
Choline, mg	165	1045
Inositol, mg	32.1	203

Minerals	Per Sachet (15.8 g)	Per 100 g
Calcium, mg	474	2998
Phosphorus, mg	456	2888
Magnesium, mg	122	775
Iron, mg	5.9	37.6
Zinc, mg	3.7	23.2
Manganese, mg	0.73	4.6
Copper, mcg	332	2100
Iodine, mcg	52.3	331
Molybdenum, mcg	14.9	94.2
Chromium, mcg	10.6	66.9
Selenium, mcg	23.1	146
Sodium, mg (mEq)	4.9 (0.21)	31 (1.3)
Potassium, mg (mEq)	3.5 (0.09)	22 (0.56)
Chloride, mg (mEq)	0.25 (0.008)	1.6 (0.05)

Ingredients:

Sugar, Calcium Phosphate, Artificial Flavors, L-Histidine, L-Tryptophan, L-Tyrosine, Tricalcium Phosphate, Magnesium Acetate, L-Lysine Acetate, N-Acetyl-L-Methionine, L-Leucine, L-Methionine, L-Threonine, L-Valine, L-Isoleucine, Choline Bitartrate, Guar Gum, Soy Lecithin, Citric Acid, L-Ascorbic Acid, M-Inositol, Ferrous Sulfate, Artificial Sweetener (Acesulfame K), DL-Alpha-Tocopheryl Acetate, Zinc Sulfate, Nicotinamide, Manganese Sulfate, Calcium-D-Pantothenate, Cupric Sulfate, Pyridoxine Hydrochloride, Riboflavin, Vitamin A Acetate, Folic Acid, Artificial Color (Beta Carotene), Potassium Iodide, Chromium Chloride, Sodium Selenite, Sodium Molybdate, Phylloquinone, D-Biotin, Cholecalciferol, Cyanocobalamin.

Guidelines for the Use of **Lanaflex**™ in the Dietary Management of Phenylketonuria

For more information or product samples, please contact us.

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ZLANHCP 07/12