



A guide for the practical implementation of the
Modified Ketogenic Diet (MKD) for the dietary management
of epilepsy and neurometabolic disease.



Vitafo in Association
With You

Supporting education in the
dietary management of rare diseases



This practical guide:

- Is not a substitute for medical care and advice provided by a licensed and qualified healthcare professional. VitaFlo® International Ltd does not accept any responsibility for any loss arising from reliance on information contained in this guide, nor establish or specify particular standards of medical care for the treatment of any conditions referred to. VitaFlo International Ltd does not recommend or endorse any specific tests, procedures, opinions, clinicians or other information that may be included or referenced in this practical guide.
- Is primarily focused on the dietetic application of the ketogenic diet (KD), specifically, the modified ketogenic diet (MKD), not its clinical management. The information provided, although accurate and based on current best practice in the UK at the time of publication, is subject to change as use of the KD evolves.
- Is intended for use as a general aid only by qualified healthcare professionals to implement the KD in children aged over 1 year and adults diagnosed with drug resistant epilepsy or an inherited neurometabolic disorder, for example, Glut-1 Deficiency Syndrome (Glut-1 DS) or Pyruvate Dehydrogenase Deficiency (PDHD), where its use is indicated and evidence based.
- Does not relate to the challenge of the implementation of the KD in infants under 12 months of age. Further guidance from specialist resources should be sought for this group.
- Is not intended for use by patients, or their parents or caregivers.

Written by:

Dietitians at VitaFlo International Ltd.

In collaboration with:

Elizabeth Neal MSc PhD RD, Specialist Ketogenic Dietitian - Matthew's Friends Clinics and Honorary Research Associate, UCL-Institute of Child Health, London, UK.

Abbreviations and definitions

CKD	Classical ketogenic diet
KD	Ketogenic diet
LCT	Long chain triglyceride
LGIT	Low glycaemic index treatment
MAD	Modified Atkins diet
MCT	Medium chain triglyceride
Modified KD's	All modified KD's, i.e. MAD, LGIT and MKD (umbrella term)
MCTKD	Medium chain triglyceride ketogenic diet
MKD	Modified ketogenic diet
Keto-team	A generic description for healthcare professionals (for example, dietitians, clinicians, nurses) involved in the implementation, follow-up and care of patients on a KD.

Throughout this guide, reference is made to other VitaFlo resources for the KD. These are designed for healthcare professional use and can be accessed on the VIA website:

www.vitaflo-via.com/

For information on VitaFlo products for the use in the KD and recipes, please visit the VitaFlo websites:

www.nestlehealthscience.com/vitaflo

www.myketogenicdiet.com



	Introduction - What is a 'modified ketogenic diet'?	1
1.0	Overview of the practical dietary implementation of the MKD for epilepsy and neurometabolic disease	2
2.0	Phase One - Pre-diet preparation and planning	5
3.0	Phase Two - Starting the MKD	9
4.0	Phase Three - Monitoring and follow-up for the MKD	10
5.0	Discontinuing the MKD	11
6.0	References	12
7.0	Appendices	13

Introduction - What is a 'modified ketogenic diet'?

Adaptations to ways of implementing the original, classical ketogenic diet (CKD) to make it more accessible, flexible, simpler and more practical for patients, caregivers and healthcare professionals, whilst still following the fundamental ketogenic diet (KD) principles of strict carbohydrate control, a very liberal fat intake and adequate protein intake, have been evolving since the early 2000s¹⁻⁶.

In the USA, the modified Atkins diet (MAD), based on the low carbohydrate Atkins diet⁷, and the low glycaemic index treatment (LGIT), which incorporates the low glycaemic index for carbohydrate foods⁸ are both described as the 'modified ketogenic diets'⁹. Both have well-defined protocols for their application and management, have been evaluated clinically and are efficacious in the dietary management of drug resistant epilepsy and neurometabolic disease. Of the two, the MAD is used globally the most often, and although implementation is usually as per the original Johns Hopkins protocol, it is also known that in practice, adaptations are made¹⁰.

In the UK and Ireland, the MKD has been shown to be 'a hybrid KD, adopting principles from other established KD protocols and defining new elements unique to the MKD'⁶.

Examples of amendments to the recognised KD protocols include¹⁻⁶:

- Evaluation, control and monitoring of energy intake.
- Use of carbohydrate with a low glycaemic index.
- Allowing slightly more carbohydrate.
- Weighing of foods to accurately determine portion sizes, rather than estimating visually or using household measures.
- Use of a food choices (or exchange) system to regulate fat and carbohydrate intake.
- Incorporation of medium chain triglyceride (MCT).

Reasons for making such changes can be to:

- Customise a dietary prescription to ensure it meets the unique dietary and nutritional requirements of an individual.
- Reflect the diversity of local or national healthcare provision and availability of resources.
- Accommodate the social circumstances of patients and caregivers, and their ability to undertake a KD.

Formal clinical evaluation of the efficacy of the MKD in the dietary management of epilepsy and neurometabolic disease in comparison to other KD protocols, has yet to be undertaken⁶.

- **This practical guide describes an approach to implementing the MKD based on sources of information including peer reviewed publications¹⁻⁶, training materials and expert opinion from dietitians in the UK, Europe and the USA.**
- **It is acknowledged that dietetic practice of the MKD varies globally. The calculations and examples provided are intended for illustration only, and are not advocating a definitive method of implementation.**

1.0 Overview of the practical dietary implementation of the MKD for epilepsy and neurometabolic disease

Macronutrients and micronutrients in the MKD

Carbohydrate: This is strictly limited, and is prescribed as a maximum amount in grams per day, on an individual patient basis. Approaches used to assign a daily carbohydrate intake include:

- Calculating grams per day as a percentage of daily energy requirements, for example, 3 - 5% (or even 10-20%, if pre-MKD carbohydrate intake was very high)⁶.
- Using a set amount of carbohydrate, for example, between 15 - 30g per day⁶.
- Prescribing the same quantities as per the MAD protocol, based on age (children, 10g; adolescents, 15g and adults, 20g)^{7,9}.

Daily carbohydrate intake can be counted up as 'grams of carbohydrate' from weighed portions of foods, or converted into carbohydrate 'food choices', each containing a set amount of 1g or 5g carbohydrate per weighed amount of food (see **Food Choices** section, page 3).

Carbohydrate is evenly distributed throughout the daily meal plan⁶, included at each meal and snack, and always taken with fat.

Foods naturally low in carbohydrate, and with a low glycaemic index, such as leafy and salad vegetables, berry fruits, seeds* and nuts* are commonly used to supply this macronutrient in the MKD, and as a source of fibre.



Fat: A very high fat intake of at least 65% of daily energy requirements is essential, both to promote ketosis and meet energy needs⁷. To help achieve this, the original MAD protocol, encourages an 'ad lib' consumption of foods high in fat, such as butter, oils, mayonnaise and double (heavy) cream, with advice on the consumption of appropriate quantities, determined using household measures⁷.

- For the MKD, a structured, individualised, approach is typically used, with 65-80% of the patients daily energy requirement used to calculate a target fat intake in grams per day.
- The target daily fat intake can be counted up as 'grams of fat' from weighed portions of high fat foods, or converted into fat 'food choices', each containing a set amount of 10g fat per weighed amount of food (see **Food Choices** section, page 3).
- Fat is consumed at regular intervals throughout the day, as part of a daily meal plan⁶.



Protein: moderate-sized portions of high protein foods, such as meat, poultry, fish, cheese and eggs, are advised, to avoid excessive consumption that may potentially reduce fat intake and compromise ketosis. Depending on keto-team policy, protein intake may be more formally regulated and specific guidance given on weighing and measuring of foods to regulate serving sizes⁶.

Note: Plant-based (vegan) sources of protein, for example, soya, tofu, mycoprotein, lentils, beans, nuts* and seeds* can be used in the MKD. Any inherent carbohydrate needs counting as part of the daily intake (see **Food Choices** section, page 3).



Micronutrients: a fully comprehensive, daily supplement is recommended to meet requirements adequately⁶.

* Whole nuts and seeds should be avoided by young children and only used under healthcare professional direction in those with feeding difficulties.

The food choices system in the MKD

A food choices system is commonly used in the MKD^{2-4,6}.

This approach can help regulate and achieve appropriate macronutrient and energy intakes. Advantages for patients and caregivers include flexibility with food variety and selection, having a structure to follow, and guidance on how much should be eaten at each meal and snack throughout the day.

A food choice is a portion of food (in grams or a household measure) that contains a defined amount of one macronutrient (for example, 1g or 5g carbohydrate or 10g fat) or a combination of macronutrients (for example, 2g carbohydrate and 5g fat).

Foods that contain a mixture of macronutrients do need taking into consideration, as any carbohydrate must be included as part of total daily intake. Examples include high-fat foods such as double (heavy) cream, full fat Greek yogurt, cream cheese and avocados, and plant sources of protein, such as nuts, beans and lentils.

Ideally, for accuracy, foods should be weighed out on gram digital electronic scales, especially when the MKD is first started. However, household measures may be preferable for patients and caregivers that find weighing foods difficult.

Examples of food choices:

Fat 10g choice: 12g (or 3 level teaspoons) butter; 10g (or one dessert spoon) olive oil.

Carbohydrate 1g choice: 22g (or 4 medium size) raspberries.
5g choice: 83g (or two medium size) carrots, raw.

Fat and carbohydrate 10g choice and 1g choice: 50g (1/2 small size) avocado.

Patients are provided with an individualised meal plan that details how many and which food choices to include at each meal and snack (Table 3, page 7).

Food choices can be calculated from country-specific nutritional data, for example, in the UK, from information published by the government¹³.

Matthew's Friends (www.matthewsfriends.org) have produced UK-specific Ketogenic Diet Food Lists for fat, carbohydrate and protein choices. To access these, click on this link [HERE](#) or register and log onto www.vitaflo-via.com/



Fat inherent in protein foods: The decision to include, or not include, the fat naturally present in some protein foods (such as red meat, cheese, fish) as part of daily fat intake can be made on an individual patient basis, or by how the keto-team implement the MKD:

- If daily energy intake and/or overall macronutrient composition needs regulating precisely, fat from protein foods can be counted.
- Alternatively, if fat inherent in protein foods is ignored, and only fat from foods such as butter, oils, mayonnaise and double (heavy) cream counted, actual fat (and energy) intake will be higher than calculated. This approach can simplify the MKD for patients and/or caregivers and may prevent excess consumption of protein foods to achieve fat intake.

Beverages, flavourings and 'free' foods in the MKD

Suitable **beverages** are water and sugar-free fluids (for example, carbonated ('fizzy') drinks and cordials not containing fruit juice); herbal, fruit, black and green teas, and coffee.

Flavourings that can be used are:

- Carbohydrate-free sweeteners - liquids, powders or tablets.
- Salt, pepper, carbohydrate-free flavourings, stocks and essences. Note: Fresh and dried herbs and spices may contain carbohydrate, which must be counted.

Foods with a very low carbohydrate content may be included as '**free**' foods instead of being counted as part of daily carbohydrate intake or as a food choice if the amount of food providing 1g of carbohydrate is much larger than would usually be consumed at a meal. Examples include unsweetened plant milks (soya, coconut, almond), salad and leafy green vegetables (such as kale, celery and radishes), and mushrooms.

Check local product availability, product ingredients and keto-team policy when advising on beverages, flavourings and free foods.



1.0 Overview of the practical dietary implementation of the MKD for epilepsy and neurometabolic disease, continued

The process of planning and implementing the MKD can be divided into three phases, outlined in Figure 1.

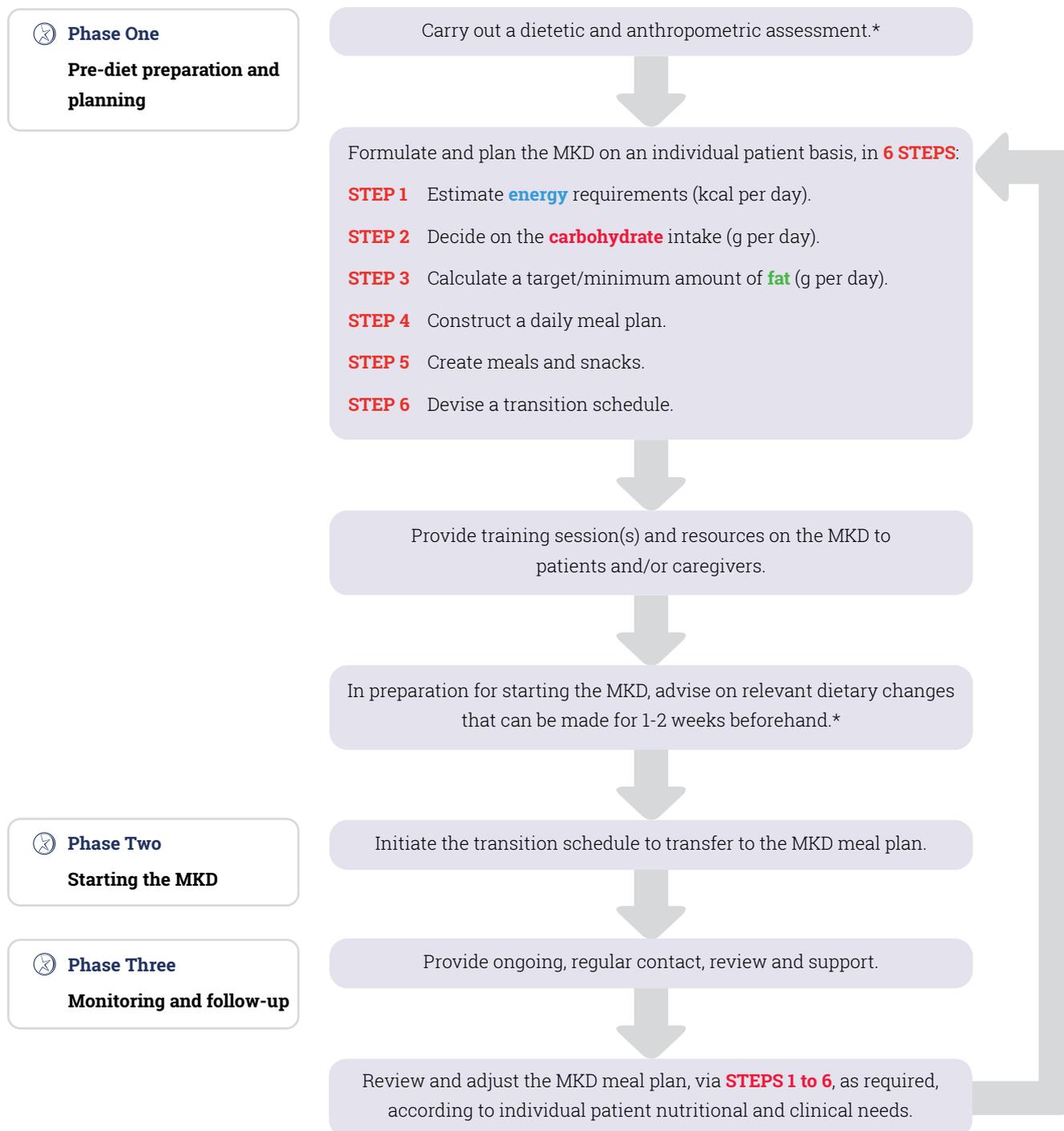


Figure 1: Phases One, Two and Three of planning and implementing the MKD.

* Described in the Vitaflo resource 'An introductory guide for the practical implementation of the ketogenic diet (KD) for the dietary management of epilepsy and neurometabolic disease' (available from www.vitaflo-via.com/).

2.0 Phase One - Pre-diet preparation and planning

A period of time prior to implementing the MKD is essential, both for the patient and/or caregivers and the keto-team. The MKD is typically planned on an individual patient basis, to meet unique dietary requirements. Tailoring advice for implementing and following the diet on a personal level is also important.

Dietetic and anthropometric assessments* (see footnote, page 4) will aid planning of the MKD. This information can be used to estimate daily energy requirements (which may differ from that recommended for age), in consideration with anthropometry, growth and/or nutritional status. An example of the calculation of the MKD, **STEPS 1 to 3**, (from Figure 1, page 4), using the food choices system for fat and carbohydrate, is shown below, and in **Table 1**:

STEP 1 Estimate energy requirements (kcal per day), considering anthropometry/growth/nutritional status.

STEP 2 Decide on the carbohydrate intake (g per day).

Convert the amount in grams into a maximum number of 1g and 5g carbohydrate choices.

STEP 3 Calculate the minimum amount of fat (g per day).

This example calculation of a MKD generates a minimum fat intake (grams per day) based on a chosen percentage (%) of estimated daily energy requirements. The range of daily energy provided by fat on the MKD is typically 65-80%⁶.

Convert the amount in grams into a minimum number of 10g fat choices.

Note: Depending on protein sources chosen, some fat will be consumed from these foods. Actual daily fat and energy intakes will therefore be higher than the total calculated in **Table 1** (see page 3 for more detail).

Table 1: Example calculation of the MKD, and conversion to food choices.

STEP 1	Estimated energy requirement	2000kcal per day	
STEP 2	Chosen carbohydrate intake	25g per day (maximum)	15 x 1g and 2 x 5g carbohydrate choices per day
STEP 3	Chosen % of daily energy requirements from fat	70% Calculation: Estimated energy requirement per day x (% fat ÷ 100) 2000kcal x 0.7 = 1400kcal 1400 ÷ 9* = 155.6g per day (round UP to 160g) *9kcal per gram of fat	16 x 10g fat choices per day

STEP 4 Construct a daily meal plan.

A daily meal plan provides structure for the patient and/or caregivers to follow. It can be based on information gathered from the dietary assessment, such as usual pattern of meals and snacks, with regard to number, frequency and relative energy content. To promote ketosis on the MKD, meals and snacks, each containing fat, are best consumed at regular intervals throughout the day, and this routine is generally to be encouraged⁶.

For a MKD meal plan:

- Allocate carbohydrate, as grams or choices, evenly in meals and snacks over the day, and always in combination with fat.
- Include fat, as grams or choices, at each meal and snack.
- Provide guidance on appropriate serving sizes for protein foods.

An example MKD daily meal plan using the results from **Table 1** is shown in **Table 2** on the following page. Access the Matthew's Friends UK-specific Ketogenic Diet Food Lists for fat, carbohydrate and protein choices **HERE**.

2.0 Phase One - Pre-diet preparation and planning, continued

STEP 4 (continued) **Table 2:** Example daily meal plan for the MKD from grams of macronutrients calculated in **Table 1**.

Meal or snack	Number of 10g fat choices	Carbohydrate, total g (selected as 1g or 5g food choices)	Protein foods - moderate-sized portion
Breakfast	4	7 (1 x 5g and 2 x 1g)	✓
Mid morning	2	2 (2 x 1g)	Optional
Lunch	4	7 (7 x 1g)	✓
Evening meal	4	7 (7 x 1g)	✓
Supper	2	2 (2 x 1g)	Optional
Total:	16	25 (1 x 5g and 20 x 1g)	

STEP 5 Create meals, snacks and recipes.

To help patients/caregivers get established on the MKD, use the quantities of fat and carbohydrate calculated for the daily meal plan (**STEP 4**) in conjunction with protein foods to create meals, snacks and recipes from suitable ingredients. Include, where possible, favourite and/or familiar foods and flavours, as even small amounts may aid acceptability of the diet. Too many suggestions or choices may be overwhelming at first. A small selection of 5-6 meals and 2-3 snacks, will be sufficient. This will also save dietetic time until the MKD has been fully implemented and its efficacy determined.

Reliable advice, ideas and suggestions for meals, snacks and recipes can be obtained from www.myketogenicdiet.co.uk (Vitaflor International Ltd), www.matthewsfriends.org, www.charliefoundation.org and www.ketocook.com. Adaptation may be needed to meet individual nutritional requirements and daily meal plan. Encourage the preparation and trying out of meals, snacks and recipes before the MKD officially starts.

There are three options for creating MKD meals, snacks and recipes on an individual patient basis:

1. Manually, using country-specific information on the nutritional composition of foods, such as the UK database¹¹.
2. Manually, using a food choices system (For example, the Matthew's Friends UK-specific Ketogenic Diet Food Lists for fat, carbohydrate and protein choices, page 3, access [HERE](#)).
3. Using a KD meal planner program, such as the The Electronic Ketogenic Manager (EKM)¹⁴. This accesses a UK food composition database¹¹ but nutritional data for other countries can be entered. Alternatively, country-specific versions of the EKM are available.

Table 3 shows **STEP 5**, that is, examples of meals and snacks created from the daily meal plan (from **Table 2**) using the food choices system.

STEP 6 Devise a transition schedule.

Transition to the MKD will be dependent on the individual patient, their caregivers and the keto-team over a period of time. This will allow for the sequential exchange of usual foods, meals and snacks for MKD alternatives.

This is covered in more detail in **Phase Two - Starting the MKD** (page 9).

2.0 Phase One - Pre-diet preparation and planning, continued

Table 3 Sample meal plan for the MKD based on the example calculation shown in **Tables 1** and **2 (STEPS 1 to 4)**.

Suggested meal or snack	Food and quantity, g	Fat (using 10g fat choices *)	Carbohydrate (using 1g and 5g carbohydrate choices*)
Breakfast Scrambled eggs with baked beans, fried tomatoes and mushrooms Totals	Eggs, two large <i>Scramble with:</i> Butter, 24g <i>Serve with:</i> Baked beans (Heinz reduced sugar) 50g Mushrooms (free food) Tomatoes, 64g <i>Cooked with</i> Olive oil, 20g	2 x 10g Choices - - - 2 x 10g Choices 40g	- 1 x 5g Choice - 2 x 1g Choices - 7g
Mid-morning snack Creamy coffee with fruit Totals	Black coffee Double cream 42g Raspberries, fresh, 22g	2 x 10g Choices 20g	1 x 1g Choice 1 x 1g Choice 2g
Lunch Cheese and ham salad Totals	Cheddar cheese, grated, 2-3 tablespoons, Ham, two - three slices, Mayonnaise, 39g Tomato, 64g Lettuce, 71g Cucumber, 67g Avocado, 50g Carrot, raw, grated, 34g	3 x 10g Choices - - - 1 x 10g Choice - 40g	- 2 x 1g Choices 1 x 1g Choice 1 x 1g Choice 1 x 1g Choice 2 x 1g Choice 7g
Evening meal Creamy chicken, fried cauliflower rice and buttered spinach Totals	<i>Fry, mix/blend:</i> Chicken breast, diced, medium sized portion, Cream cheese, full fat**, 46g Cauliflower, 92g Olive oil, 20g Spinach, 63g Butter, 12g Add dried spices / herbs and seasoning to taste	1 x 10g Choice - 2 x 10g Choices - 1 x 10g Choice 40g	2 x 1g Choices 4 x 1g Choices - 1 x 1g Choice - - 7g
Supper Strawberry almond frozen 'fat bomb' [^] Totals	<i>Combine together and freeze:</i> Butter, 12g Almonds, ground, 18g Strawberries, fresh, mashed, 16g	1x 10g Choice 1x 10g Choice 20g	- 1 x 1g Choice 1 x 1g Choice 2g
Totals		160g Fat	25g Carbohydrate

* Access by clicking on this link [HERE](#) or by registering and logging onto www.vitaflor-via.com/

[^] Add sweetener and/or sugar free flavouring (optional).

** Philadelphia™, UK

Note: Fat from protein foods, e.g. meat, cheese, has NOT been counted as part of daily fat intake in this meal plan. The carbohydrate in the high fat foods (double (heavy) cream, ground almonds, avocado and cream cheese) HAS been counted as part of daily carbohydrate intake.

2.0 Phase One - Pre-diet preparation and planning, continued

2.2 Teaching session

The MKD can be daunting and challenging for patients and/or caregivers, and a period of pre-MKD preparation and training is essential, to aid understanding of the diet and what is involved.

Figure 2 gives suggestions for the areas to cover when training on the MKD. Education may need to be extended beyond immediate caregivers to include anyone involved with the care of the patient, for example, other relatives, friends, staff at school, college or a respite facility. Some will require more input, support and guidance than others, as each will have their own unique learning style and ability.



Figure 2: Main dietary principles and advice to provide to patients/caregivers during Phase One - Pre-diet preparation and planning for the MKD.

3.0 Phase Two - Starting the MKD

⊗ Pre-MKD preparation

- Making specific changes to the usual diet before starting the MKD (for example, eating less carbohydrate and more fat and establishing a regular meal and snack pattern) can help with dietary acceptance. For more details, see the Vitaflo resource 'An introductory guide for the practical implementation of the ketogenic diet (KD) for the dietary management of epilepsy and neurometabolic disease' (available from www.vitaflo-via.com/).
- Allow time for patients and/or caregivers to learn about the MKD, and to practice preparing and to try out their new meals and recipes before the diet is started. Changing over from their usual diet to the MKD can be challenging as meals and snacks will look and taste quite different.

⊗ Transitioning to the MKD

Note: Biochemical evaluation (and especially regular ketone and glucose monitoring) is an important part of initiation onto a MKD^{5,6}, and should be carried out as per keto-team policy.

- The MKD can be initiated at home.
- There is no set or recommended timescale for transitioning to the MKD; some patients may prefer to swap over to the MKD over a few days, whilst others may choose to do so over a more extended period, such as over a week or fortnight. **Table 4** gives an example of the sequential exchange from usual to MKD meals and snacks on a daily (or weekly) basis. Introducing the MKD slowly rather than making the change all at once may help facilitate acceptance of the alteration in macronutrient content of meals and snacks, and help with dietary adherence. However, the time period for transition from usual diet to the MKD may need to be flexible, and be guided by factors such as tolerance of the new way of eating, patient and/or caregiver preference, or if any side effects are experienced.
- Maintaining an adequate energy intake during this period is crucial as hunger may reduce acceptance of the MKD. To help counteract this, provide a quick and easy recipe for making a 'keto-drink' (or tasty 'keto-snack') that matches the macronutrient content of the patients MKD meals (or snacks) for use during this period. This approach can also be applied during times of illness when appetite and eating is poor.

Table 4 - Example of a daily (or weekly) meal and snack exchange schedule for establishing the MKD.

Key: MKD meal or snack Usual meal or snack

Day or week number	Breakfast	Lunch	Dinner	Snacks
1				
2				
3				
4				

4.0 Phase Three - Monitoring and follow-up of the MKD

Regular contact and support is essential for patients and/or caregivers, particularly at the start of the MKD. Those with feeding difficulties, and/or poor nutritional status may need more frequent review to ensure individual dietary requirements are being adequately met.

NOTE: Biochemical evaluation (especially of ketones and glucose) is an important part of monitoring and follow-up of the MKD and should be carried out as per keto-team policy.

During the first three months

- **Monitor dietary intake and adherence to the calculated daily meal plan.** Re-calculation may be required to ensure an appropriate energy intake, especially if body weight changes. Follow **STEPS 1 to 6** to update the meal plan and create new meals and snacks as necessary.
- **Check fluid intake** is adequate for hydration, and a **micronutrient supplement** is being taken every day.
- **Check protein food portion sizes.** If these are excessive, and to the detriment of daily fat intake and ketosis, advise on the importance of moderation of intake. Provide guidance on appropriate amounts of these foods, as required.
- **Check accuracy of weighing and measuring of food portion sizes by patient and/or caregivers:**
 - If the food choices system is used, check they understand how it works and are including and counting the correct number of choices at each meal and snack, and in total per day.
 - If they are finding it difficult to weigh foods out accurately, change over to household measures, and provide training and/or information.
- **Check how the patient and/or caregivers are managing the 'day-to-day' practicalities of following the MKD - how are they getting on?** Do they need some encouragement to continue with the diet if they are finding it difficult, and/or further advice on what to eat, for example, on foods providing fibre, eating away from home, or more recipes and suggestions for meals and snacks? Provide support and/or additional information as indicated.

Further individual fine-tuning of the MKD

- **Consider carbohydrate allowance** in relation to the efficacy of the dietary management of symptoms of epilepsy - does it need to be adjusted down, or be increased slightly? If so, follow **STEPS 1 to 6** to reflect this in the daily meal plan.
- **MCT can be incorporated into the MKD**, for example, to enhance ketosis, allow more carbohydrate to be consumed or to help alleviate constipation^{6,12}. For further details, refer to the Vitaflo resources for the use of MCT and betaquik® (MCT emulsion) in the KD (available from www.vitaflo-via.com/).

After three months

The decision to continue or stop the MKD is typically made at this time point, depending on clinical efficacy achieved and/or dietary adherence, in consultation with the keto-team and patient and/or caregivers.

If continuing with the MKD:

- Repeat the review processes outlined above on a regular basis for example, monthly.
- Regularly assess growth in children and adolescents; update their MKD daily meal plan as required.
- Review body weight and use as a guide for tailoring advice on an appropriate energy intake. If this needs amending, adjust the amount of fat and/or protein to help achieve this. Recalculate the MKD via **STEPS 1 to 6** and provide an updated daily meal plan.

5.0 Discontinuing the MKD

If the MKD is found efficacious after the initial three-month period, it is typically followed for around 2 years by those with epilepsy⁵. Discontinuation of the MKD and return to a usual diet can be made over a few days, or more slowly, for example, over a few weeks, on an individual basis, and under the supervision and guidance of the keto-team, to allow monitoring of any increase or alteration in seizure activity⁵.

The process of discontinuing the MKD essentially involves reducing the amount of fat consumed and increasing carbohydrate intake. Portion sizes of protein foods can remain moderate.

Once the process of returning to a usual diet starts, the varieties and quantities of certain foods eaten at meals and snacks will change. This can be disconcerting for patients and/or caregivers after a period of precise portion control and restricted food selection, especially if the MKD was followed for a long time.

As well as reassurance, providing an individual meal plan as an example of a healthy, balanced diet may be useful, to help guide macronutrient and energy intakes once the transition back to the patients usual diet is completed.

Two suggested options for discontinuation of the MKD are outlined below:

Option 1. Gradually increase the daily carbohydrate allowance stepwise, daily or weekly, either as grams of carbohydrate or the equivalent in 1g or 5g carbohydrate choices. Distribute the extra carbohydrate evenly throughout all the days meals and Snacks. For MCT (if used), gradually and incrementally reduce the amount down to zero, for example, by 5g (or the equivalent in ml of oil or emulsion), on a per meal, day or weekly basis.

An example is shown in **Table 5** of an intake of carbohydrate starting at 30g per day and increasing over 4 days (or 4 weeks) by 12-15g per day up to 90g per day, and then continuing beyond this, on a daily or weekly basis, until a more usual dietary intake of carbohydrate is achieved.

Table 5: Example of daily or weekly increase in daily carbohydrate allowance (Option 1).

Key: MKD meal or snack Usual meal or snack

Day or week	Breakfast carbohydrate, g	Lunch carbohydrate, g	Dinner carbohydrate, g	Snacks carbohydrate, g	Total daily carbohydrate, g
MKD meal plan	8	8	8	3	30
1	12	12	12	3	42
2	15	15	15	7 - 8	60
3	20	20	20	7 - 8	75
4	25	25	25	7 - 8	90
Continuing...	Increase by chosen amount of carbohydrate until that in usual meals and snacks is reached				

Option 2. Alternatively, instead of the gradual, calculated increase in carbohydrate outlined above, MKD meals and snacks can be exchanged for non-MKD ones (**Table 6**). If MCT is being used, discontinue as per Option 1.

Table 6: Example of daily or weekly transition from the MKD to usual meals and snacks (Option 2).

Key: MKD meal or snack Usual meal or snack

Day or week	Breakfast	Lunch	Dinner	Snacks
1				
2				
3				
4				

6.0 References

1. Martin-McGill, K.J., Jenkinson, M.D., Smith, C.T., Marson, A.G. 2017. The modified ketogenic diet for adults with refractory epilepsy: An evaluation of a set up service. *Seizure*, 52, pp.1-6.
2. Wood, S. 2015. Ketogenic therapy for adults with drug resistant epilepsy: time it was on the menu for adults. *NHDMag.com*, 106, pp. 28-33.
3. Fitzsimmons, G., Sewell, M. 2015. Ketogenic diets. *Clinical Paediatric Dietetics*. Chapter 16, p354. 4th Edition. Editor: Vanessa Shaw. John Wiley and Sons Ltd, Chichester UK. ISBN: 978-0-470-65998-4.
4. Magrath, G., Leung, M.A., Randall, T. 2012. The modified Atkins diet. *The dietary treatment of epilepsy – practical implementation of ketogenic therapy*. Chapter 10, pp. 89-99. Editor Elizabeth Neal. Wiley-Blackwell. Oxford, UK. ISBN 978-0-470-67041-5.
5. Kossoff, E.H., Zupec-Kania, B.A., Auvin S., Ballaban-Gil, K.R., Christina Bergqvist, A.G., Blackford, R., Buchhalter, J.R., Caraballo, R.H., Cross, J.H., Dahlin, M.G., Donner, E.J. 2018. Optimal clinical management of children receiving dietary therapies for epilepsy: Updated recommendations of the International Ketogenic Diet Study Group. *Epilepsia open*, 3(2), pp. 175-92.
6. Martin McGill, K.J., Lambert, B., Whiteley, V.J., Wood, S., Neal, E.G., Simpson, Z.R., Schoeler, N.E. and Ketogenic Dietitians Research Network (KDRN), 2019. Understanding the core principles of a 'modified ketogenic diet': a UK and Ireland perspective. *Journal of Human Nutrition and Dietetics*, 32(3), pp.385-390.
7. Kossoff, E.H., Turner, Z., Cervenka, M., Henry, B., Doerrer, S. 2016. *The Ketogenic and Modified Atkins diets. Treatments for epilepsy and other disorders*. 6th Edition. Demos Medical Publishing, New York, USA. ISBN: 978-1-936303-94-6.
8. Muzykewicz, D.A., Lyczkowski, D.A., Menon, N., Conant, K.D., Pfeifer, H.H., Thiele, E.A. 2009. Efficacy, safety and tolerability of the low glycaemic index treatment in paediatric epilepsy. *Epilepsia*, 50, pp. 1118-1126.
9. Roehl, K., Sewark, S.L. 2017. Practice paper of the Academy of Nutrition and Dietetics: Classic and Modified Ketogenic Diets for treatment of epilepsy. *Journal of the Academy of Nutrition and Dietetics*, 117, pp. 1279-1292.
10. Neal, E.G. 2017. 'Alternative' Ketogenic Diets. In: *Ketogenic Diet and Metabolic Therapies: Expanding Roles in Health and Disease*. Ed: Masino. Oxford University Press, New York.
11. McCance and Widdowson's 'Composition of foods integrated dataset' on the nutrient content of the UK food supply (CoFID). 2019. Available at: <https://www.gov.uk/government/publications/compositionoffoodsintegrateddatasetcofid>
12. Magrath, G. 2012. Fine tuning. *The dietary treatment of epilepsy – practical implementation of ketogenic therapy*. Chapter 17, pp. 142-148. Editor Elizabeth Neal. Wiley-Blackwell. Oxford, UK. ISBN 978-0-470-67041-5.
13. EKM (Electronic Ketogenic Manager). Available at: <http://www.matthewsfriends.org/keto-kitchen/ketorecipes/ketogenic-mealplanner-electronic-ketogenic-manager-ekm/>
14. Regulation, E.U., 2011. No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers. *Official Journal of the European Union*.

Appendix 1**Energy values, calculation symbols and measurement units****Energy values used in calculations¹⁴.**

per gram	kcal
Fat	
LCT	9
MCT	9
Protein	4
Carbohydrate	4

Fat	
LCT	9
MCT	9
Protein	4
Carbohydrate	4

Calculation	Symbol
Plus (or addition)	+
Minus	-
Divide	÷
Multiply	×
Percentage	%
Equals (or result)	=

Plus (or addition)	+
Minus	-
Divide	÷
Multiply	×
Percentage	%
Equals (or result)	=

Measurement	Unit
Energy (kilocalorie)	kcal
Gram	g
Kilogram	kg
Millilitre	ml
Metre	m
Centimetre	cm

Energy (kilocalorie)	kcal
Gram	g
Kilogram	kg
Millilitre	ml
Metre	m
Centimetre	cm



Innovation in Nutrition

A Nestlé Health Science Company

VitaFlo International Ltd,
Suite 1.11, South Harrington Building,
182 Sefton Street, Brunswick Business Park,
Liverpool L3 4BQ, UK

+44 (0)151 709 9020

www.vitaFlo-VIA.com

 **Follow VitaFlo Dietitians on Twitter: @VitaFloRDs**

® Reg. Trademarks of Société des Produits Nestlé S.A.

© Société des Produits Nestlé S.A.