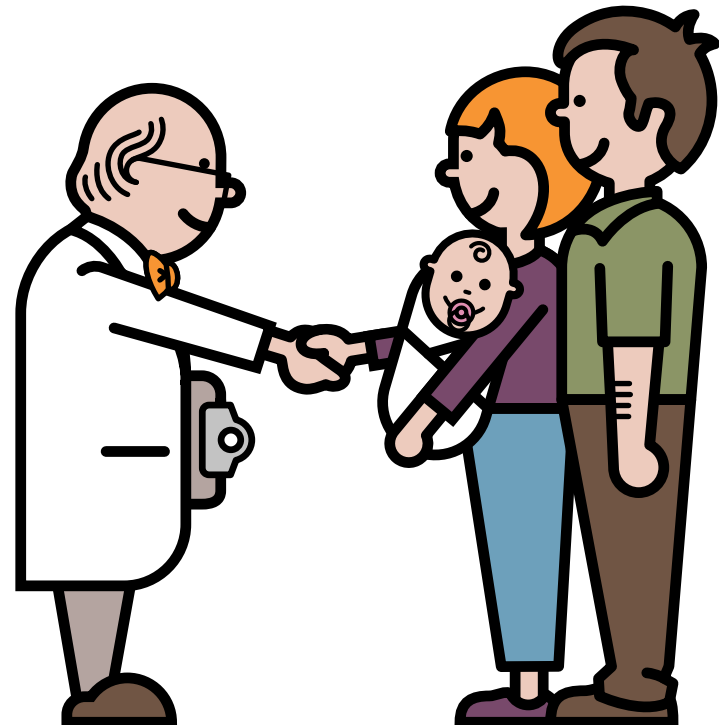


# Methylmalonic Acidemia & Propionic Acidemia

# MMA/PA

Information for families following  
a positive newborn screening



Adapted by the Dietitians Group BIMDG

**BIMDG**

British Inherited Metabolic Diseases Group



BASED ON THE ORIGINAL TEMPLE WRITTEN BY  
BURGARD AND WENDEL

This version of the TEMPLE tool, originally adapted by the Dietitians group of the BIMDG for use within the UK and Ireland, has been further adapted by Nutricia North America for use within United States and Canada. This version no longer represents clinical or dietetic practice in the UK or Ireland.

**TEMPLE**

Tools Enabling Metabolic Parents LEarning



Supported by **NUTRICIA**  
as a service to metabolic medicine

©2020 Nutricia North America, Inc. All Rights Reserved.

For more educational tools, visit [MedicalFood.com](https://www.MedicalFood.com)

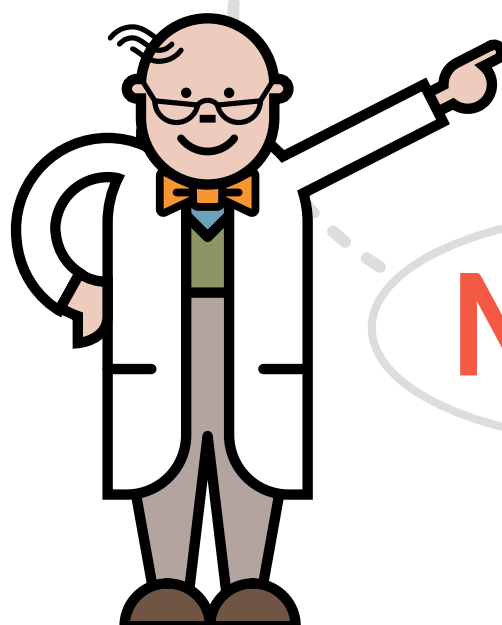
# What is MMA?

**MMA** stands for methylmalonic acidemia.

It is pronounced meth-ill-mah-lon-ic acid-ee-me-a.

It is an inherited metabolic condition.

Methyl Malonic Acidemia



MMA

MMA and PA are separate, but similar conditions, so they are often discussed together as MMA/PA.

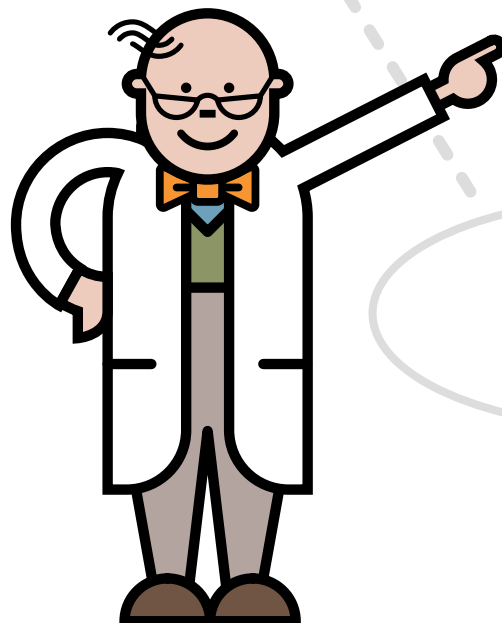
# What is PA?

**PA** stands for propionic acidemia.

It is pro-pee-on-ic acid-ee-me-a.

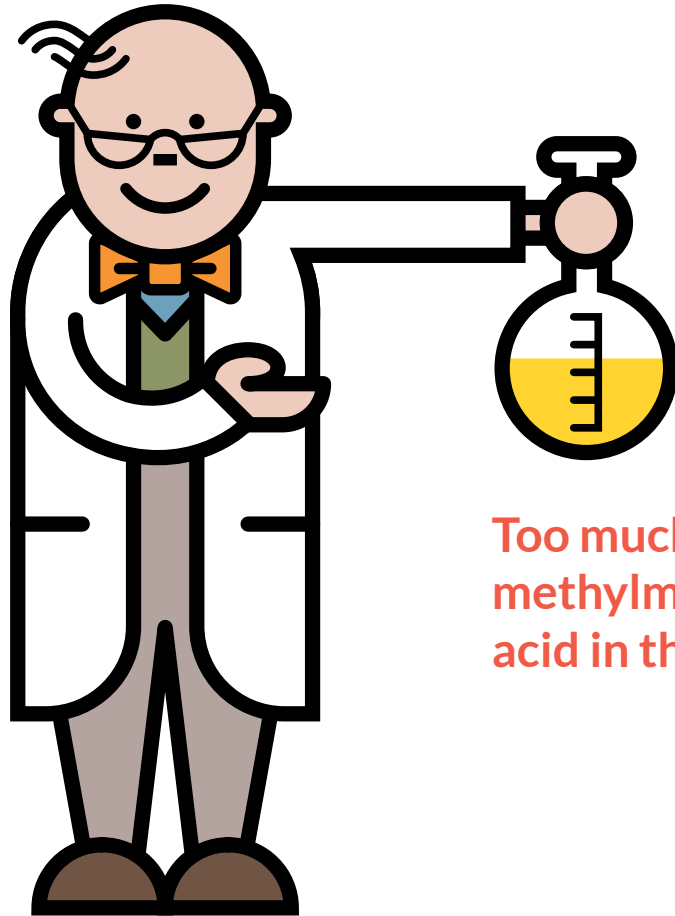
It is an inherited metabolic condition.

**Propionic Acidemia**



MMA and PA are separate, but similar conditions, so they are often discussed together as MMA/PA.

# What is MMA?



Too much  
methylmalonic  
acid in the urine

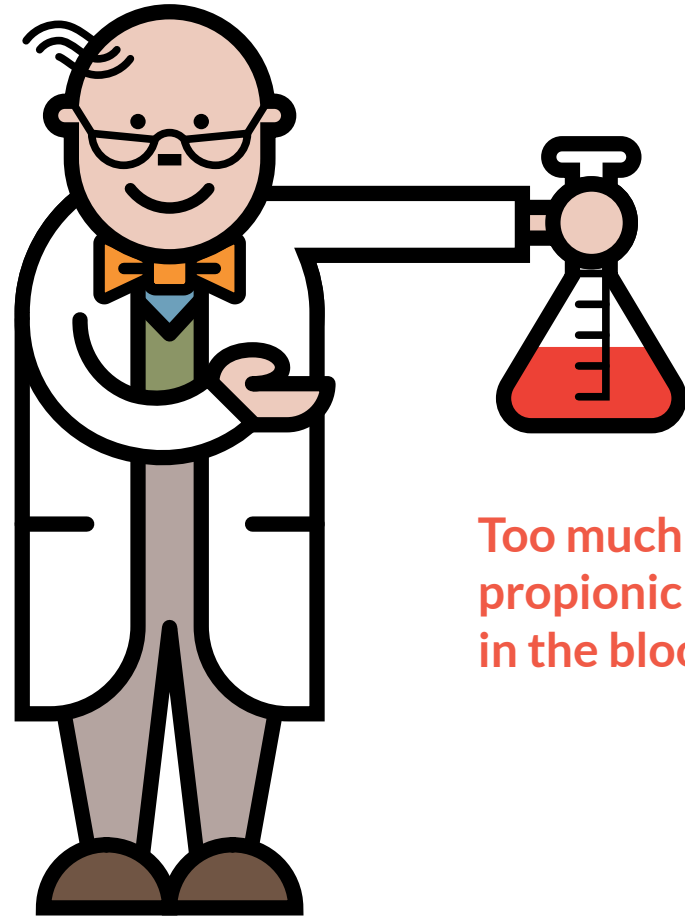


Too much  
methylmalonic  
acid in the blood

# What is PA?



Too much  
propionic acid  
in the urine



Too much  
propionic acid  
in the blood

# How does MMA/PA affect the body?

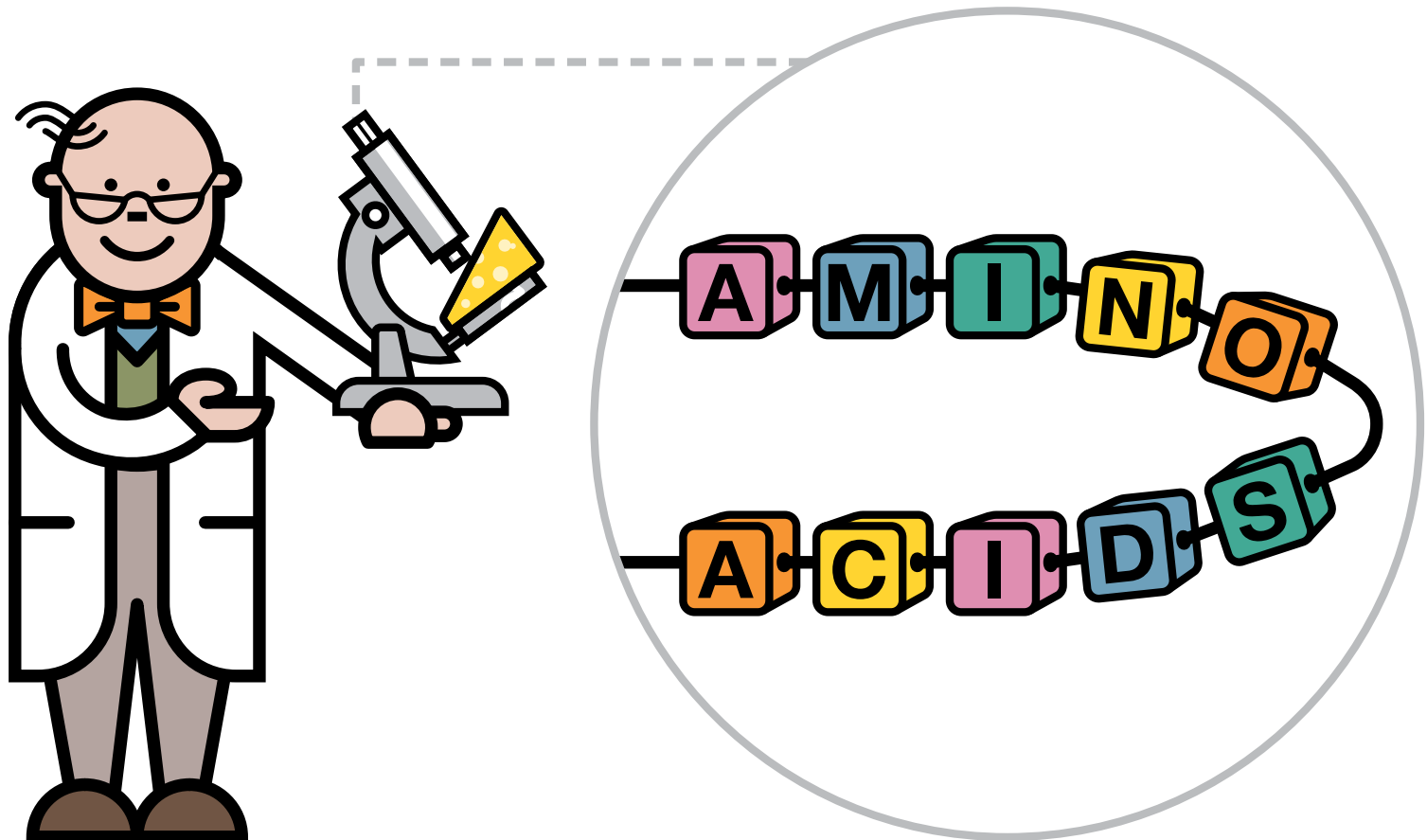
MMA/PA affects the way the body breaks down protein.

Protein is found in our bodies and in many foods. The body needs protein for growth and repair.



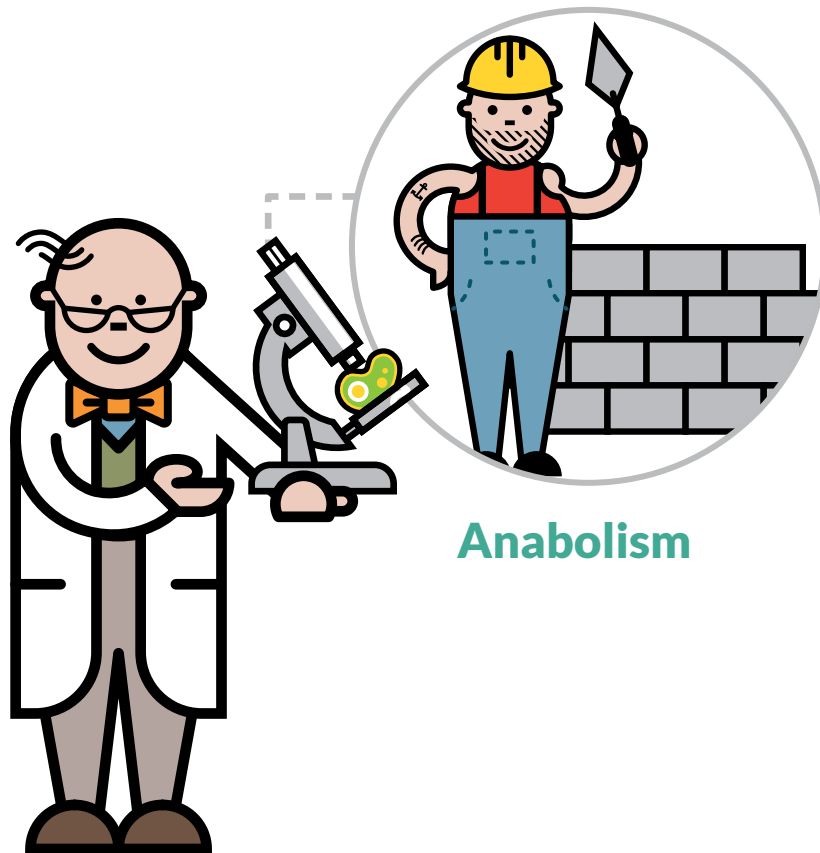
# What is protein?

Protein consists of chains of many smaller units called amino acids.

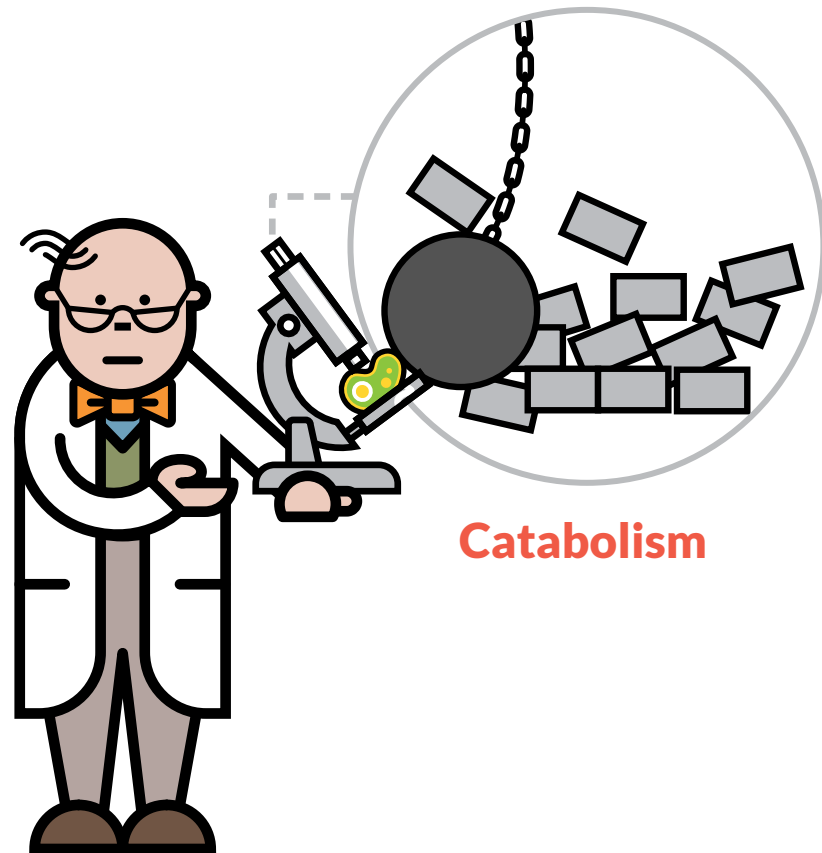


# Protein metabolism

**Metabolism** refers to the processes that occur inside the cells of the body.



Anabolism

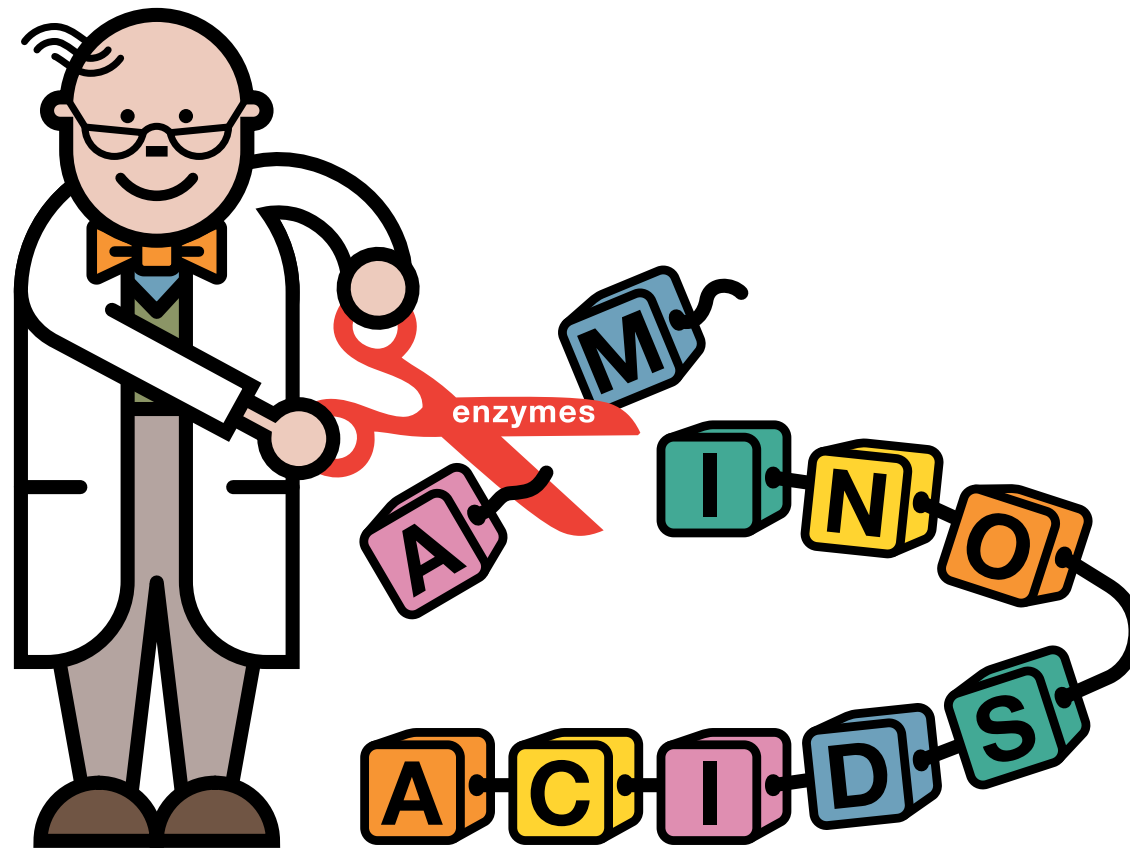


Catabolism



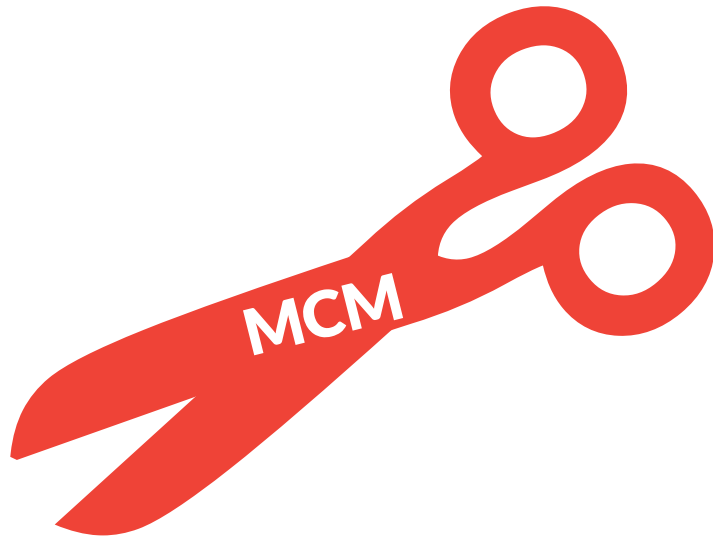
# What do enzymes do?

Enzymes help with metabolism by functioning like scissors. They break down proteins into smaller parts, including amino acids.

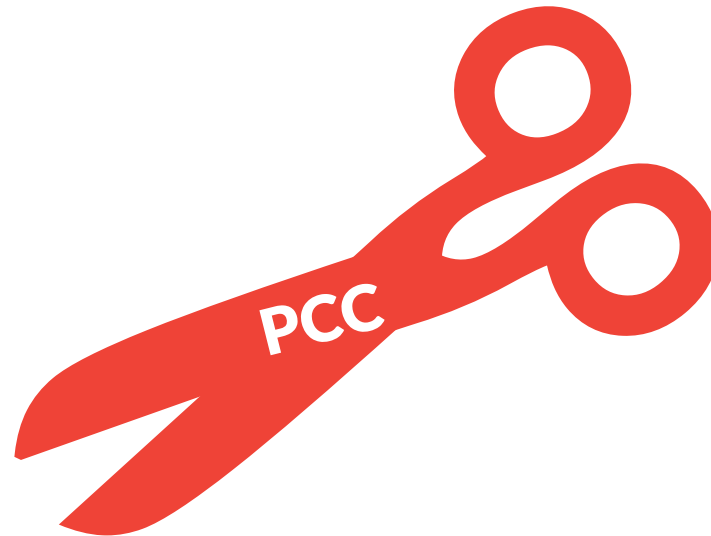


# What enzymes are affected in MMA/PA?

MMA is due to a deficiency of an enzyme called **methylnalonyl-CoA mutase (MCM)**.



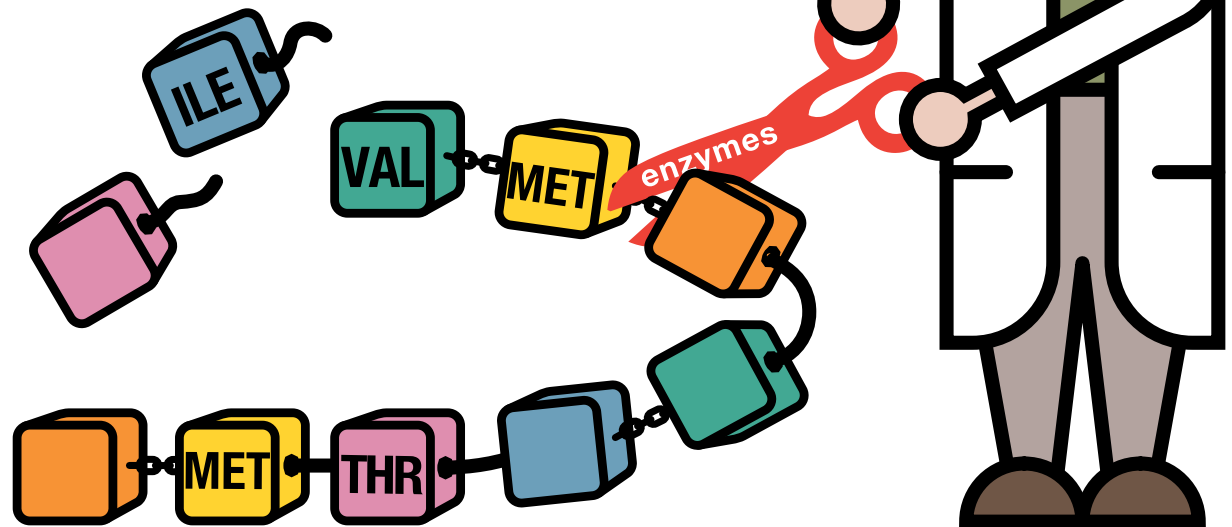
PA is due to a deficiency of an enzyme called **propionyl-CoA carboxylase (PCC)**.



# What happens in MMA/PA?

The enzymes MCM and PCC are both used by the body to break down valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR). These four amino acids are called **propiogenic amino acids**.

The deficiency of MCM or PCC means the body cannot break down the propiogenic amino acids. This causes a buildup of methylmalonic acid (in MMA) or propionic acid (in both MMA and PA) and other harmful substances.

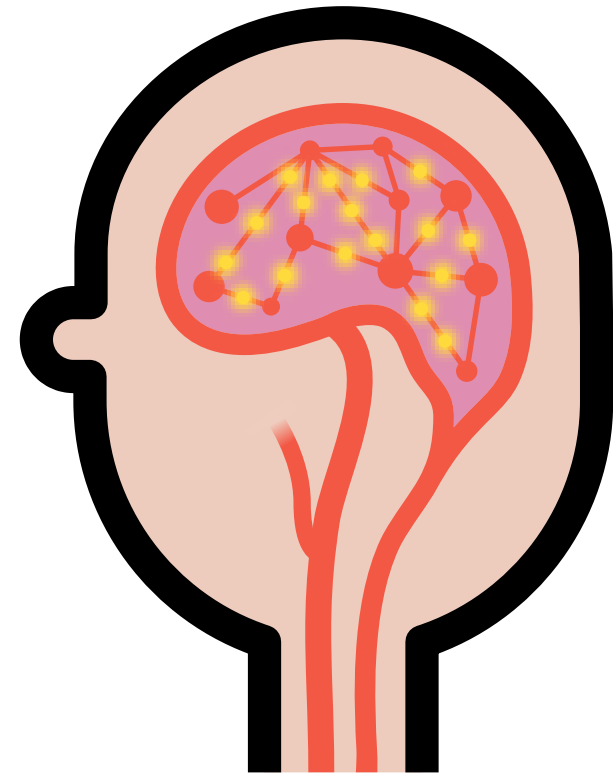


# What can go wrong in MMA/PA?

Methylmalonic acid, propionic acid, and other substances build up to high toxic levels. This can damage the brain and possibly other organs, like the kidneys, liver, and heart. It may affect babies and children in different ways.

Before management, early symptoms can include poor feeding, vomiting, sleepiness, and rapid breathing. If left unmanaged, some babies may have a metabolic crisis and go into a coma which can lead to brain damage.

Early management can prevent brain damage and learning difficulties.



# How is MMA/PA diagnosed?

As part of newborn screening, a few drops of blood are collected.

The blood sample is then analyzed for certain markers.

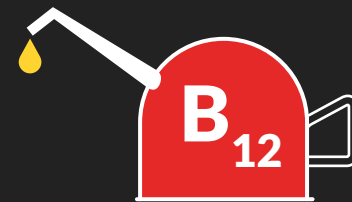
Abnormal results could mean your child has MMA/PA, which will prompt your clinician to do further testing to confirm the diagnosis.



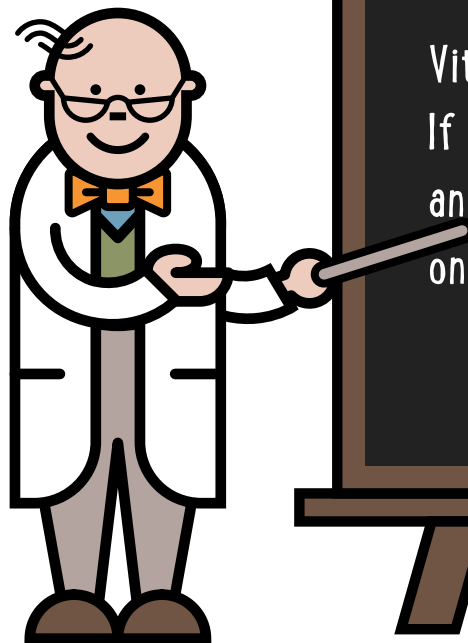
# How is MMA managed day-to-day?

For  
MMA  
only

For some individuals with MMA, the enzyme needs the help of a vitamin called vitamin B<sub>12</sub>, or hydroxocobalamin, to work properly.



Vitamin B<sub>12</sub> does not work for all children with MMA. If vitamin B<sub>12</sub> is helpful, it is given in high doses as an injection. For these children, vitamin B<sub>12</sub> may be the only necessary treatment.

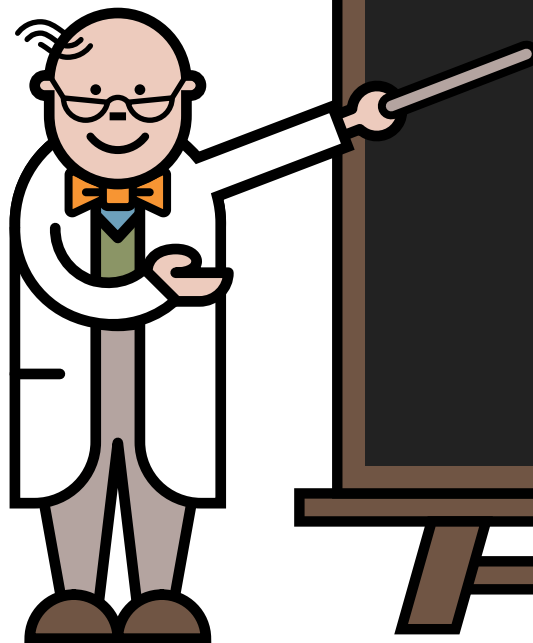


# How is MMA/PA managed day-to-day?

For many MMA patients who do not respond sufficiently to vitamin B<sub>12</sub> and for PA patients, the condition is managed with the following:

For  
MMA  
and  
PA

1. A whole protein-restricted diet
  - ✓ Avoid high protein foods
  - ✓ Include foods low in protein
2. A metabolic formula, as prescribed by your clinic
3. Carnitine supplementation



# Avoid high protein foods

Foods high in protein are also high in propiogenic amino acids\* and therefore, should be avoided.

This may include **meat, fish, eggs, cheese, milk, bread, pasta, nuts, soy, and tofu.**

\*Remember, the propiogenic amino acids are valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR).

16

©2020 Nutricia North America, Inc. All Rights Reserved.



Supported by  **UTRICIA** as a service to metabolic medicine.  
Dietary management of the condition should only be done under medical supervision.



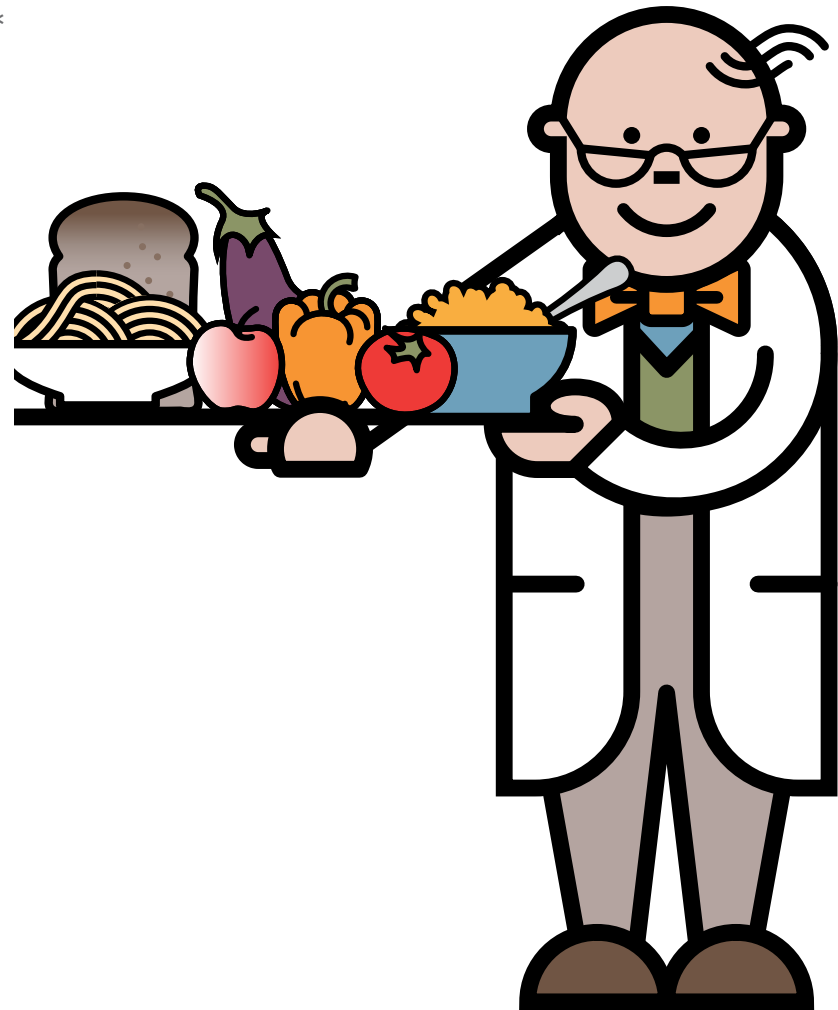
# Include foods low in protein

Foods naturally low in protein contain small amounts of propiogenic amino acids\* which can be used in typical quantities.

They include many fruits and vegetables, and special low protein foods.

They provide:

- An important source of energy
- Variety in the diet



\*Remember, the propiogenic amino acids are valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR).

# Low protein cooking

Cooking low protein meals for your child can still be visually appealing and taste good.

There are many low protein cookbooks to choose from. Your dietitian may be able to recommend a few favorites.



# Feeding your baby with metabolic formula

Propiogenic amino acids\* are essential for normal development, and therefore a limited and controlled amount must be consumed daily.

Breast milk or standard infant formula will provide the propiogenic amino acids needed by your baby prior to the introduction of solid foods, generally around 4-6 months of age.

Your baby may also need a special metabolic formula to provide protein without propiogenic amino acids.

Your dietitian will determine how much breast milk or standard infant formula and metabolic formula to offer.

\*Remember, the propiogenic amino acids are valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR).

19

©2020 Nutricia North America, Inc. All Rights Reserved.



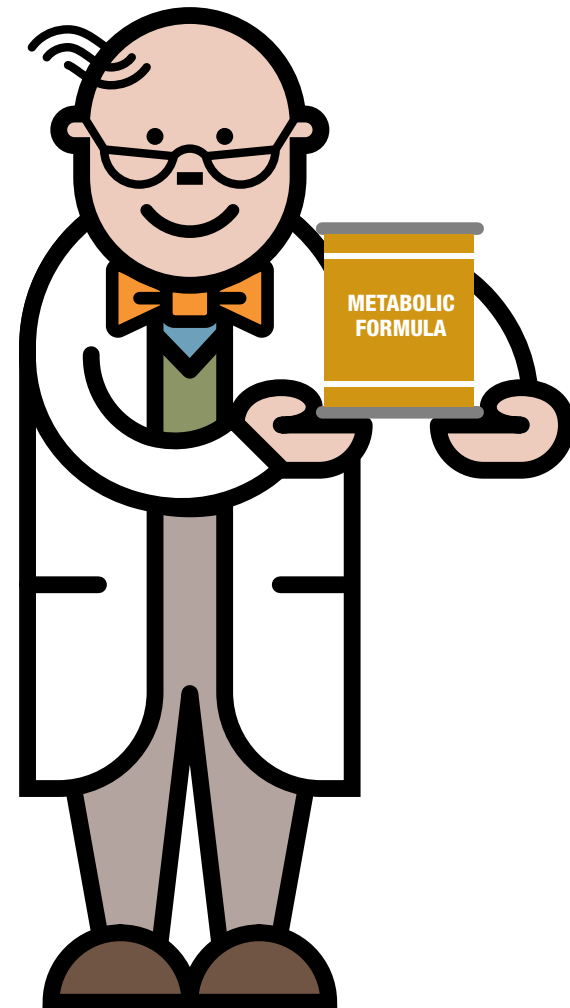
Supported by  **UTRICIA** as a service to metabolic medicine.  
Dietary management of the condition should only be done under medical supervision.

# Propiogenic amino acid-free metabolic formula

Metabolic formula is an essential part of meeting the nutritional needs of many babies with MMA/PA.

Like breast milk or standard infant formula, metabolic formula has carbohydrate, fat, vitamins, minerals, and protein in the form of amino acids without the propiogenic amino acids.\*

Metabolic formula, plus the prescribed amounts of whole protein allow your baby to get all the nutrients he or she needs to grow.



\*Remember, the propiogenic amino acids are valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR).

20

©2020 Nutricia North America, Inc. All Rights Reserved.

Supported by  **UTRICIA** as a service to metabolic medicine.  
Dietary management of the condition should only be done under medical supervision.



# Tracking protein

As your baby starts to eat solid foods your clinic will work with you to track whole protein from foods to limit their intake of the propiogenic amino acids.\*

Foods are typically weighed or measured using household measures (1 cup, 1 tablespoon, etc.) to determine their protein content.

Your clinic can help you find the best tools to help determine the protein content of foods.

\*Remember, the propiogenic amino acids are valine (VAL), methionine (MET), isoleucine (ILE), and threonine (THR).

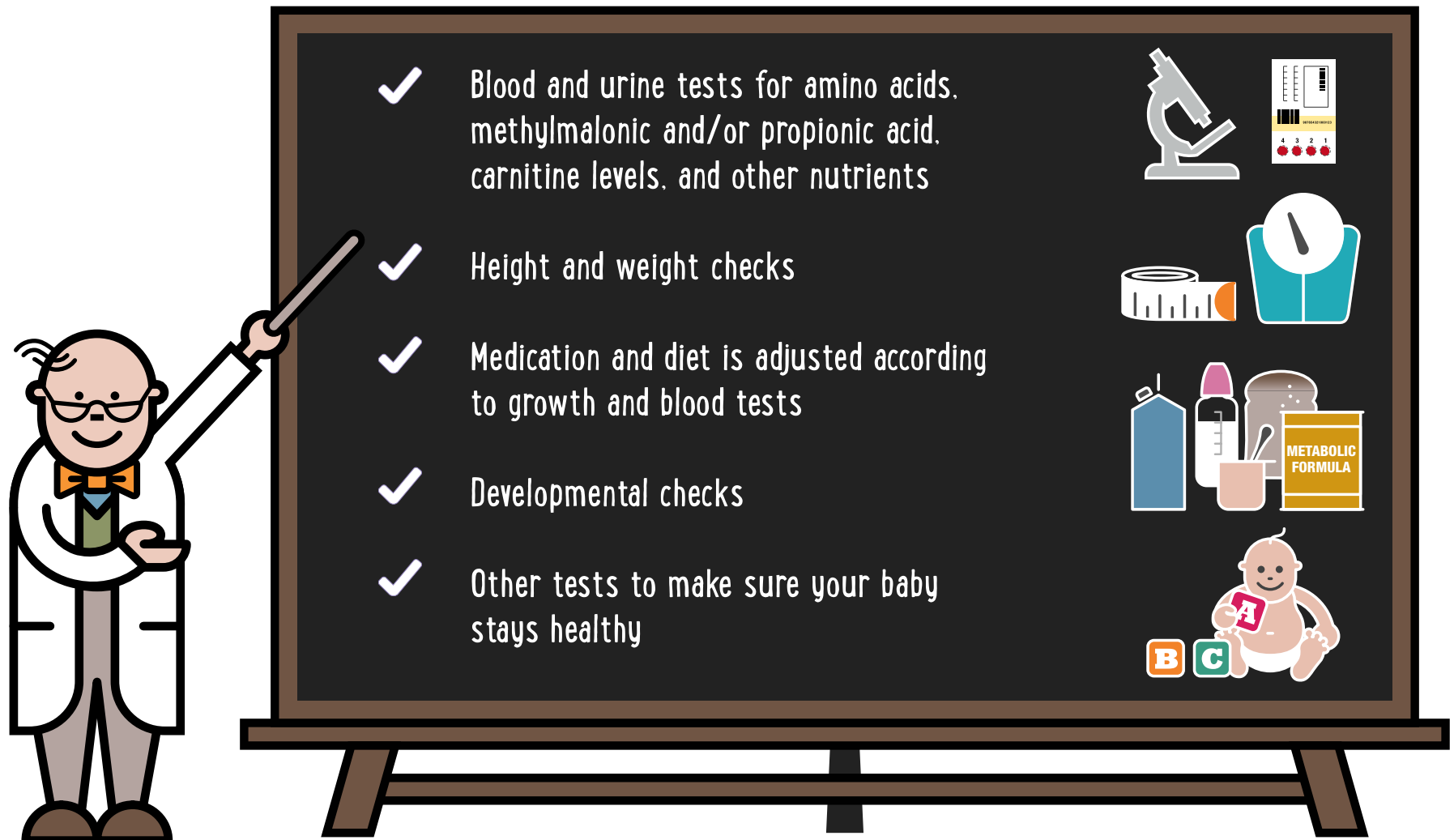
21

©2020 Nutricia North America, Inc. All Rights Reserved.



Supported by  **UTRICIA** as a service to metabolic medicine.  
Dietary management of the condition should only be done under medical supervision.

# How is MMA/PA monitored?

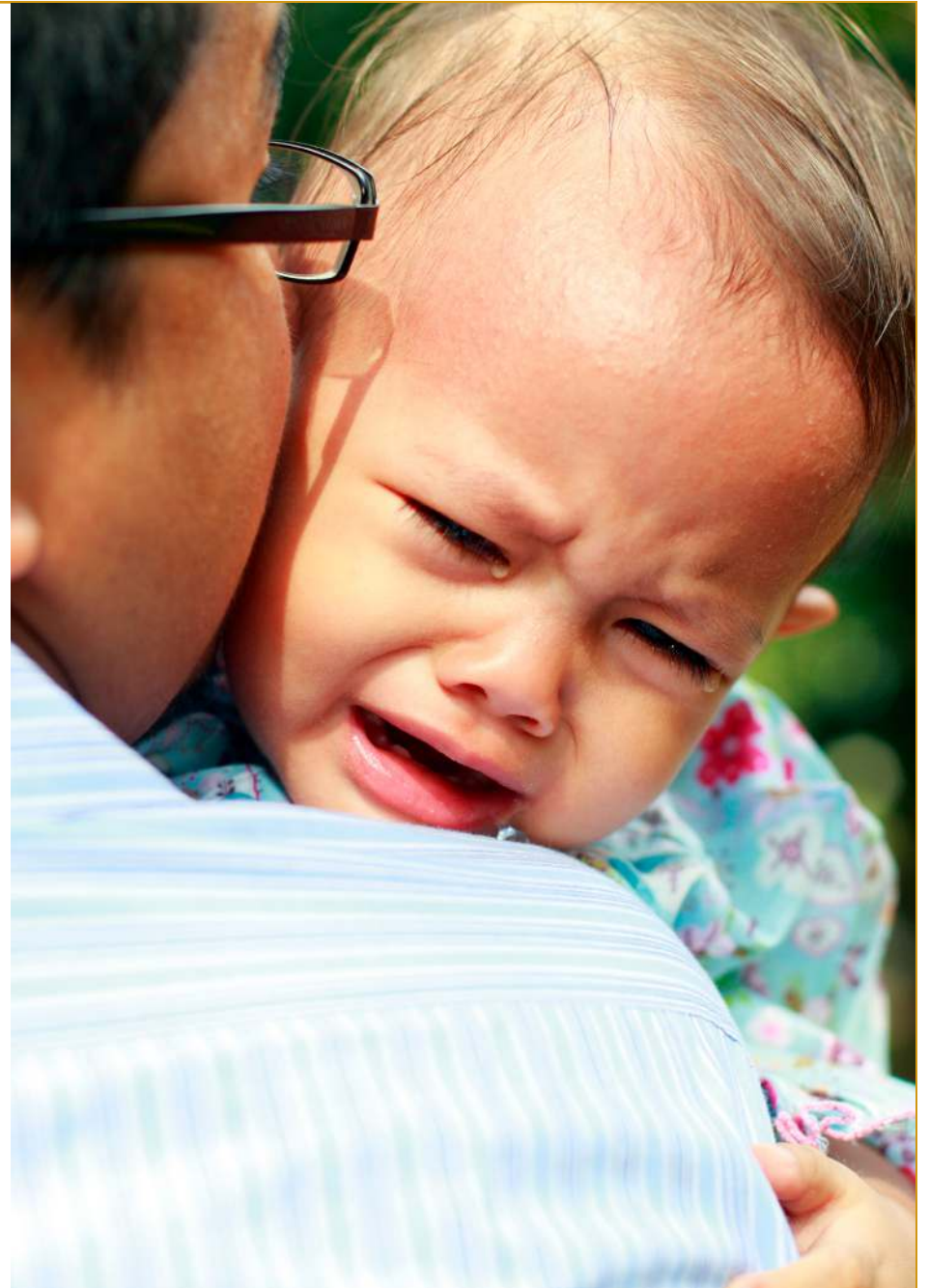


# Metabolic crisis

A '**metabolic crisis**' can occur when there is a buildup of methylmalonic and/or propionic acid and other toxic substances.

It is usually triggered by childhood infections or viruses causing high temperatures, vomiting, and diarrhea.

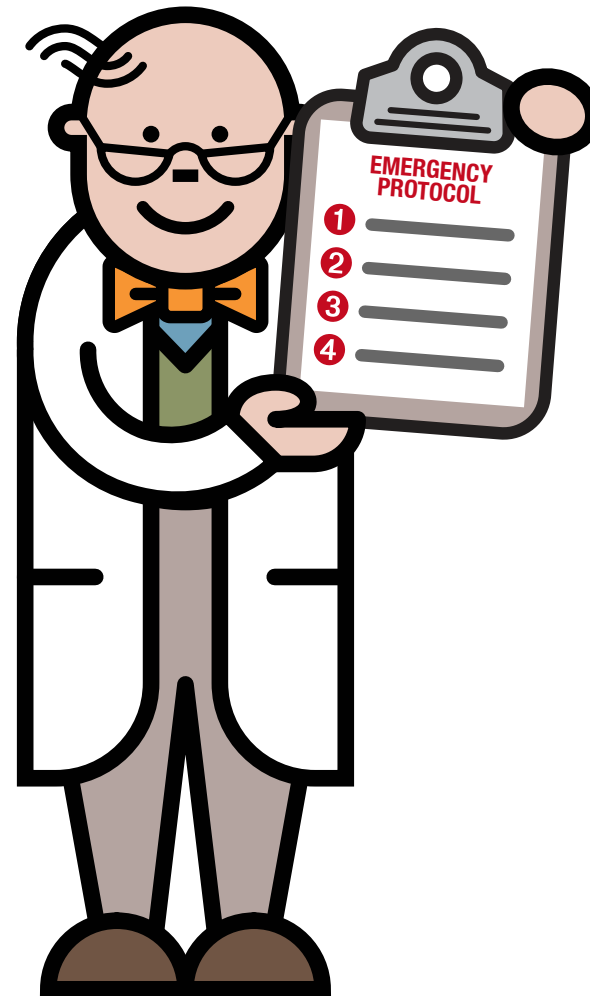
**It is important to manage a metabolic crisis quickly and properly.**



# How is MMA/PA managed during illness?

During any illness, our bodies need extra energy. The body will start breaking down cell protein, a process called catabolism. This will lead to a rapid buildup of methylmalonic and/or propionic acid and other harmful substances, causing a metabolic crisis.

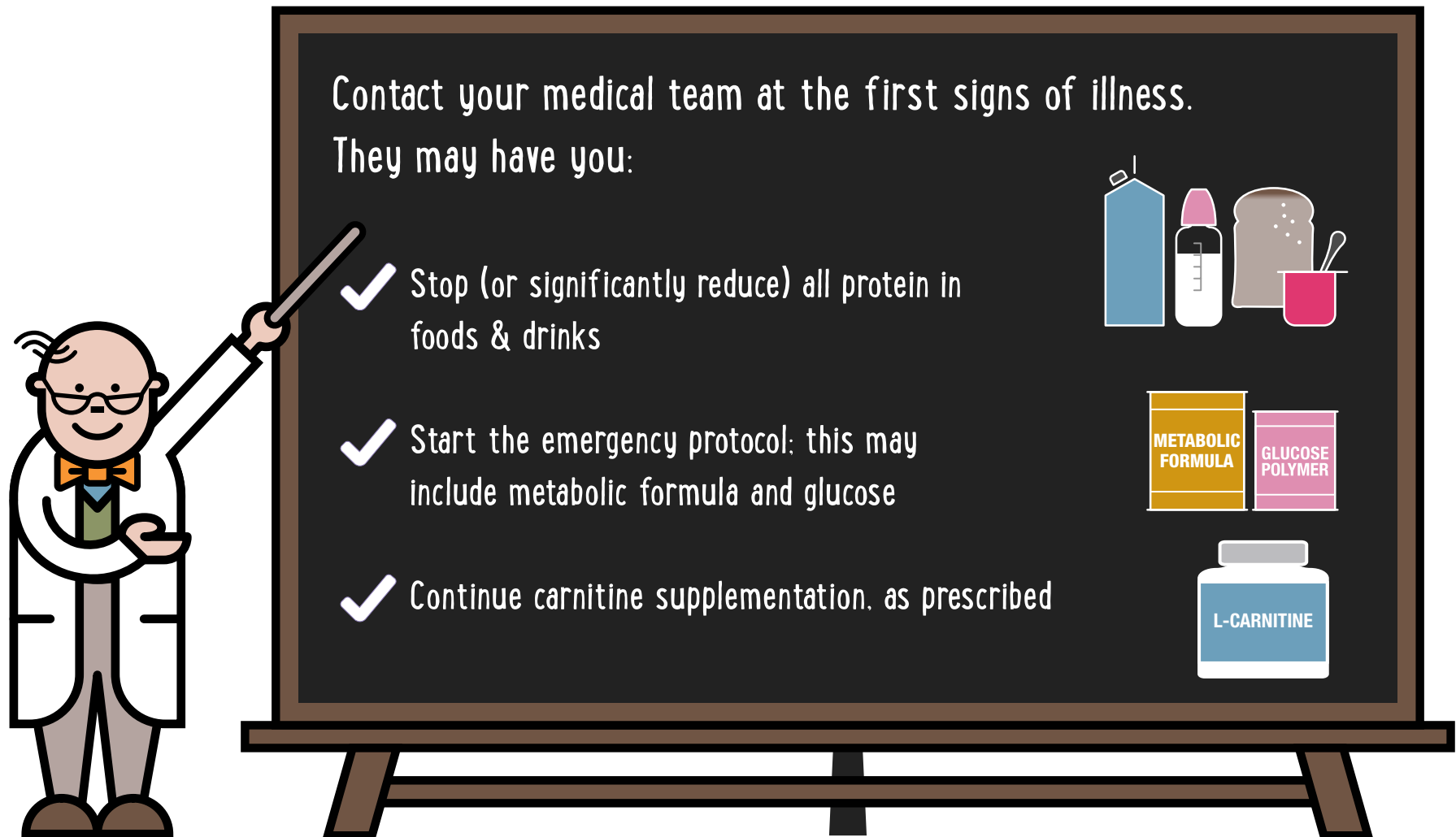
**It is extremely important to start the emergency protocol your metabolic team has developed for you and contact them right away.**






# How is MMA/PA managed during illness?

Always follow your medical team's guidance.



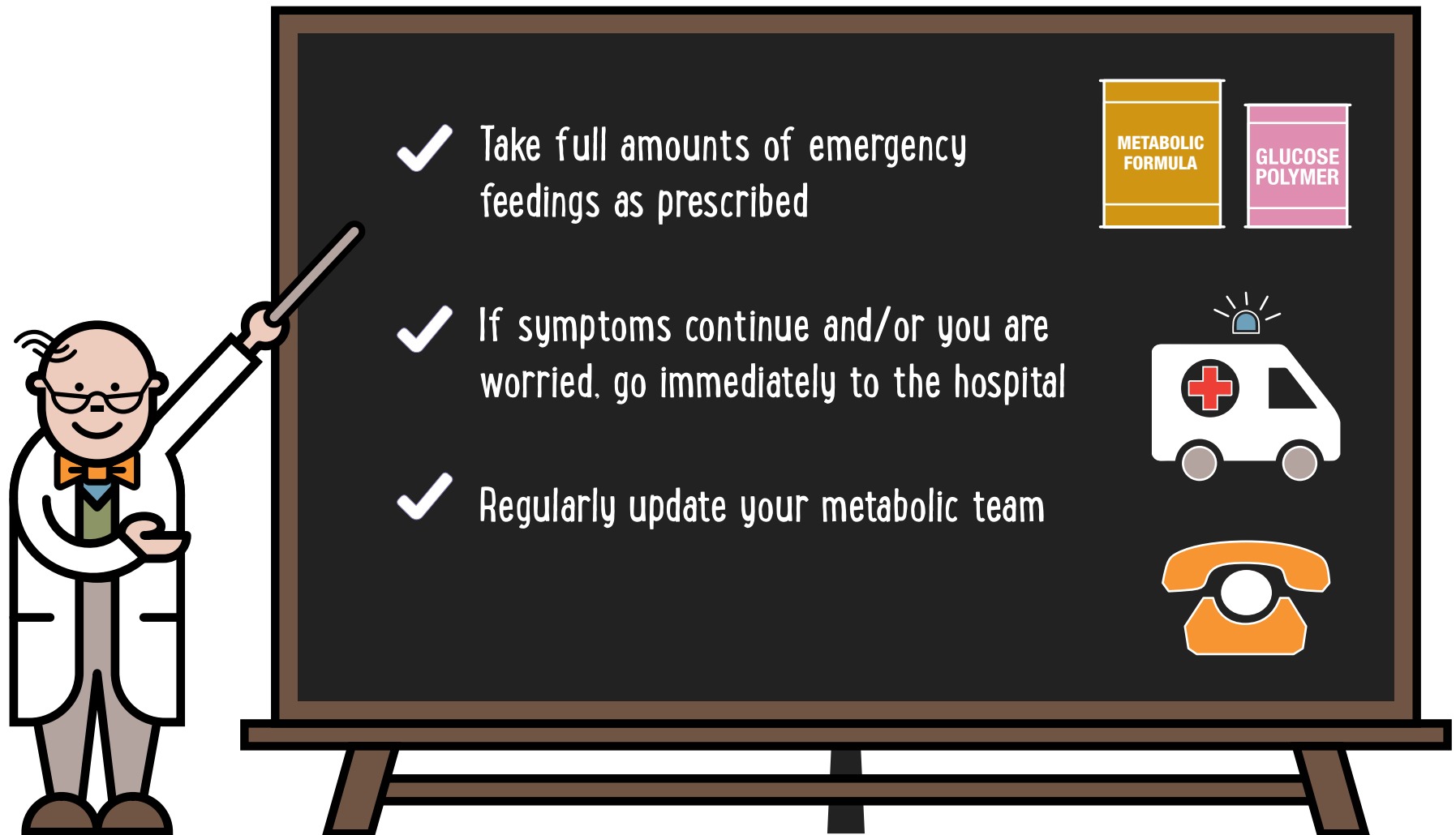
Contact your medical team at the first signs of illness.  
They may have you:

- ✓ Stop (or significantly reduce) all protein in foods & drinks
- ✓ Start the emergency protocol: this may include metabolic formula and glucose
- ✓ Continue carnitine supplementation, as prescribed



# How is MMA/PA managed during illness?

Always follow your medical team's guidance.



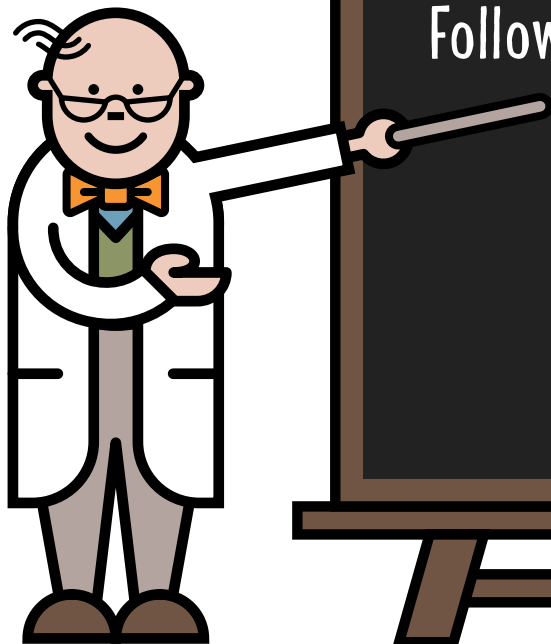
A cartoon doctor with glasses and a bow tie stands to the left of a large chalkboard, pointing at it with a stick. The chalkboard has a dark background and contains three bullet points, each preceded by a white checkmark. To the right of the text are four icons: a yellow container labeled 'METABOLIC FORMULA', a pink container labeled 'GLUCOSE POLYMER', a white ambulance with a red cross, and an orange rotary phone.

- ✓ Take full amounts of emergency feedings as prescribed
- ✓ If symptoms continue and/or you are worried, go immediately to the hospital
- ✓ Regularly update your metabolic team

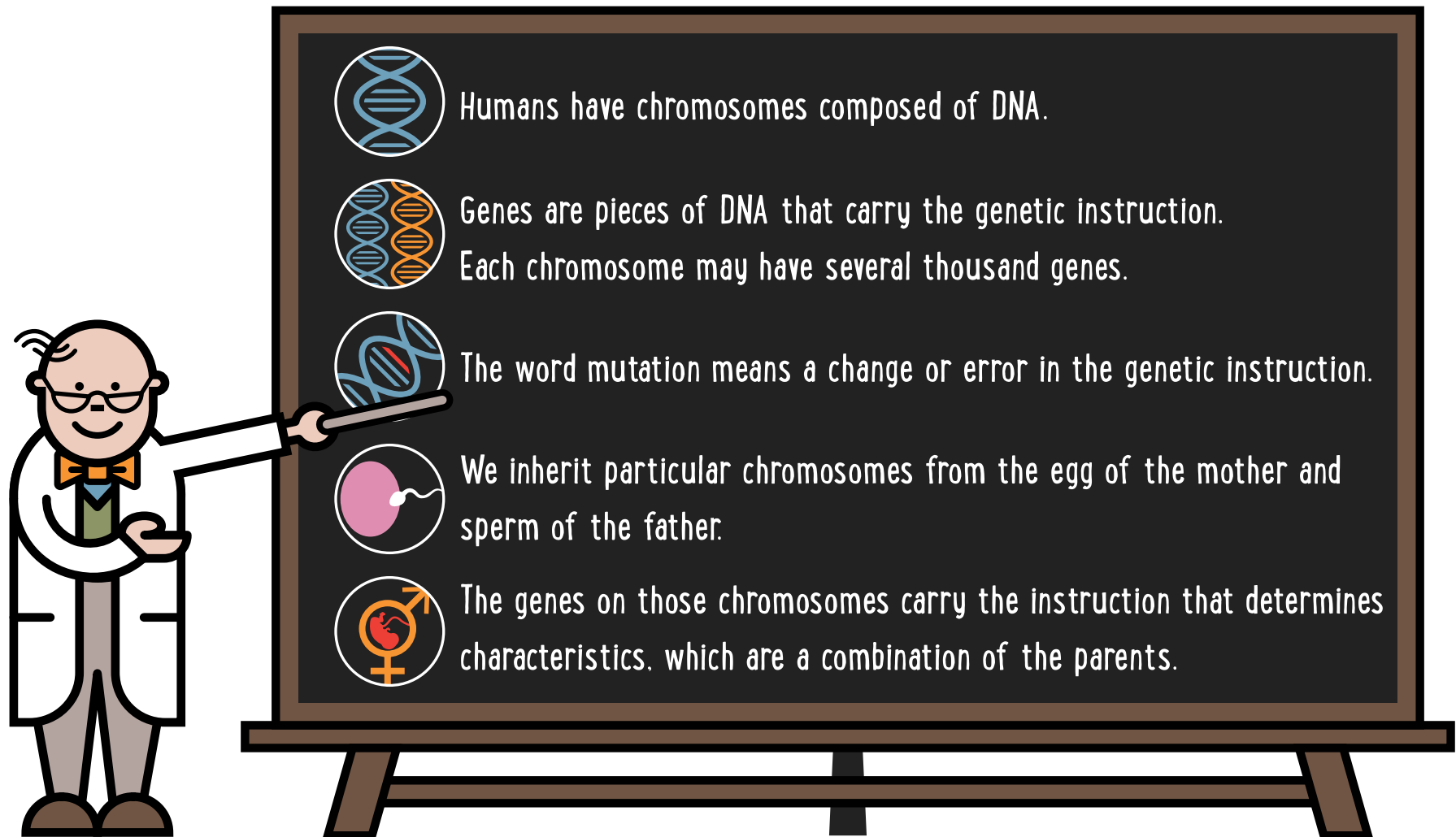
# Most importantly

It is essential that you contact your metabolic team immediately if your child is getting sick.

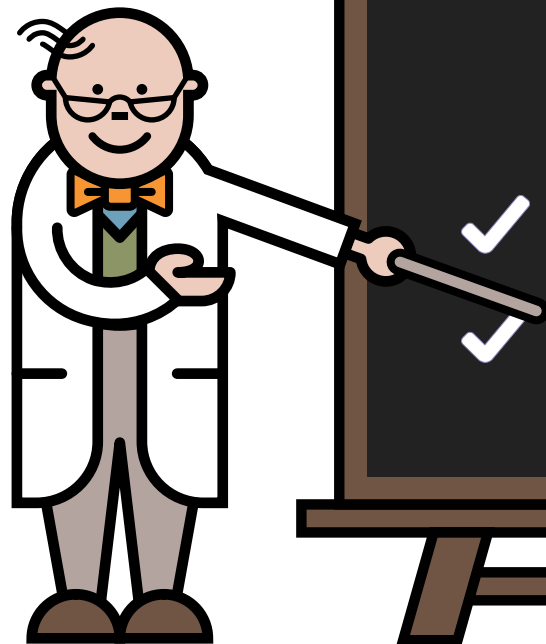
Follow their instructions promptly without delay.



# What happens in human genetics?

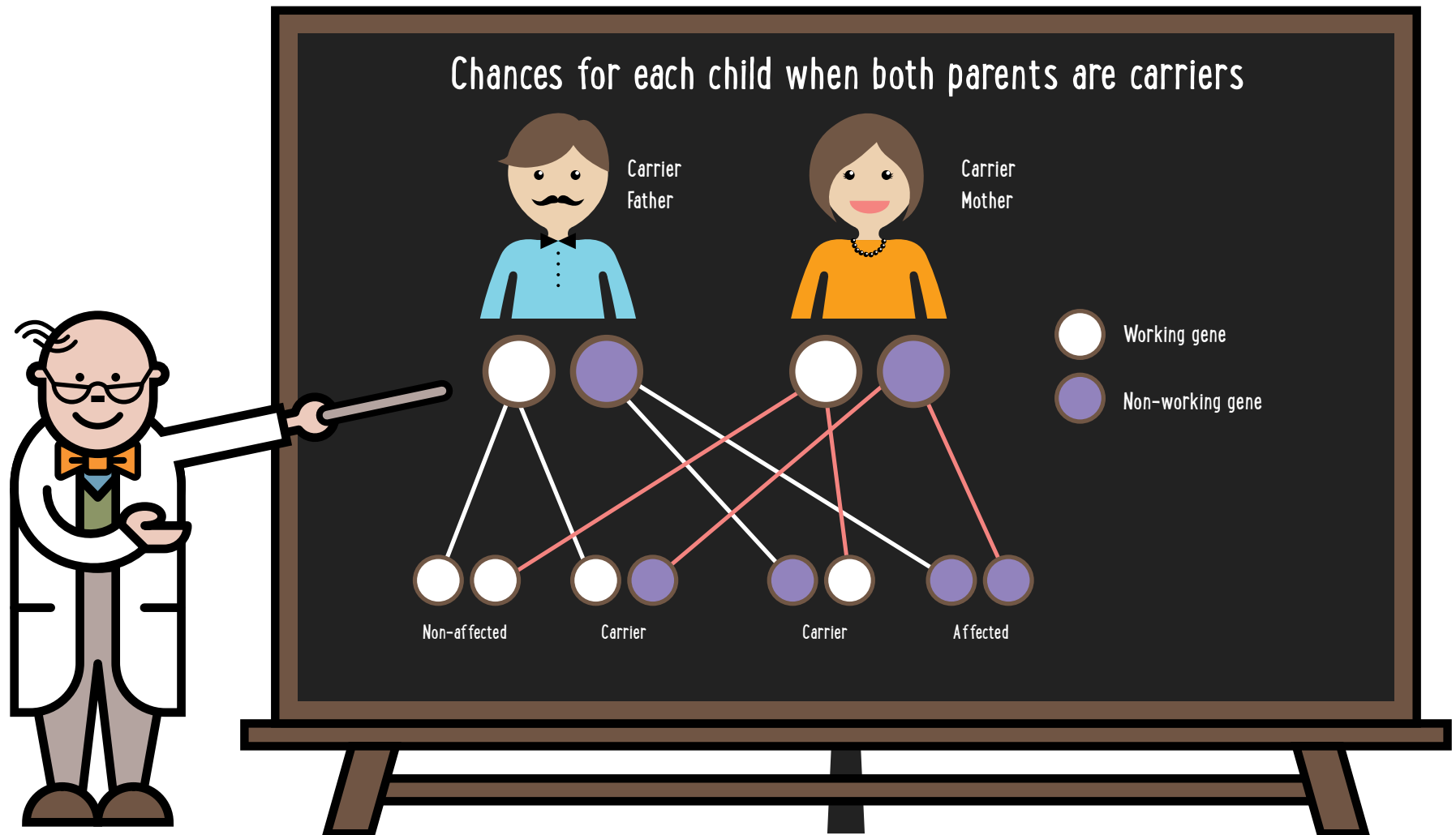


# How does one inherit MMA/PA?

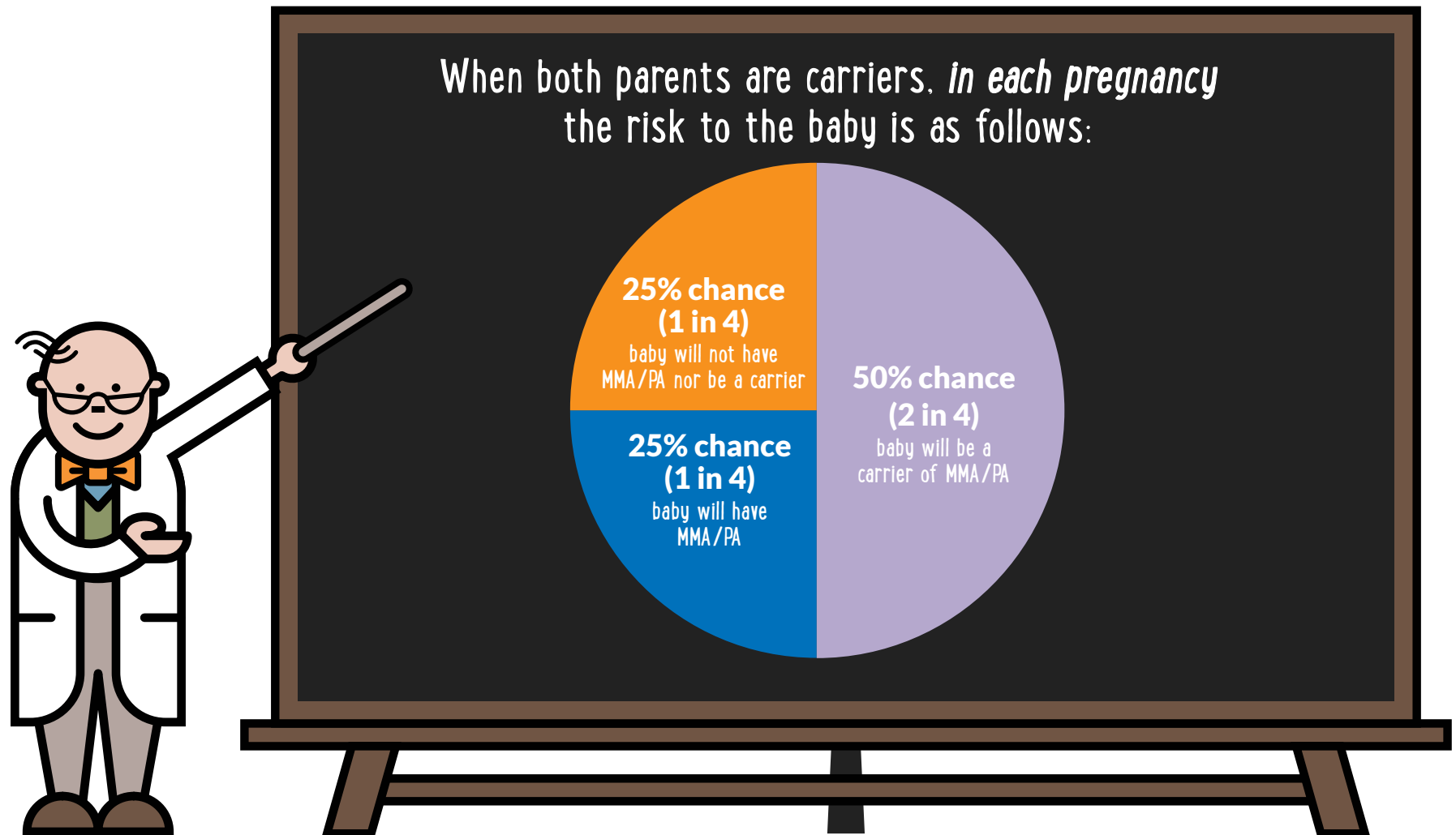


- ✓ MMA and PA are inherited conditions. There is nothing that could have been done to prevent your child from having MMA/PA.
- ✓ Everyone has a pair of genes that make the MCM enzyme (for MMA) and the PCC enzyme (for PA). In children with MMA or PA, those genes don't work correctly. These children inherit one non-working gene from each parent.
- ✓ Parents of children with MMA/PA are carriers of the condition.
- ✓ Carriers do not have MMA/PA because the other gene of this pair is working correctly.

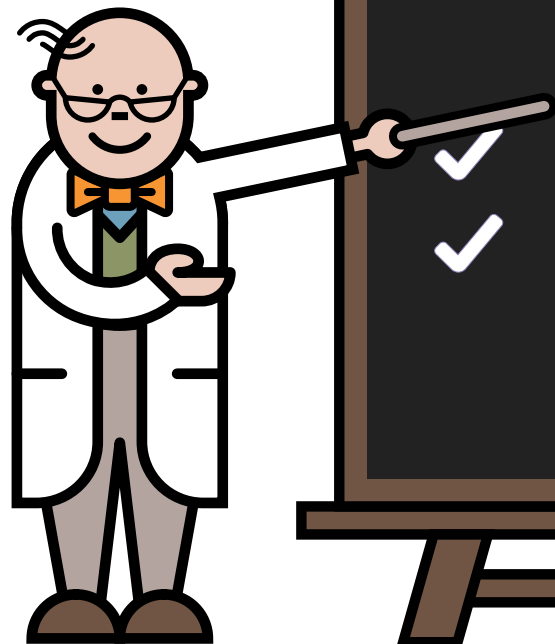
# Inheritance – Autosomal recessive – possible combinations



# Future pregnancies



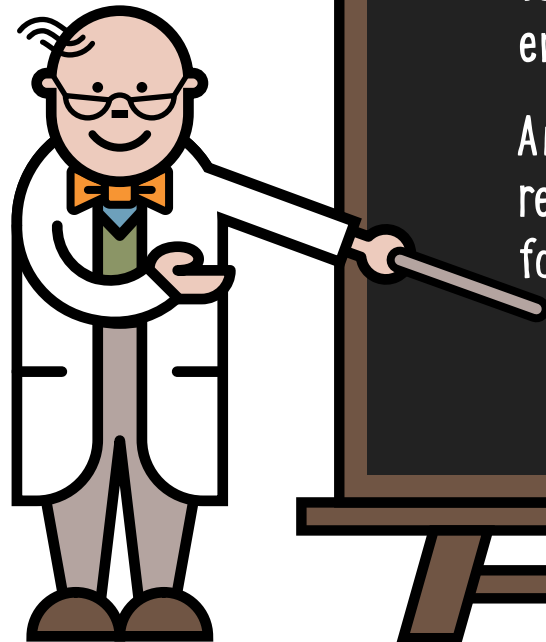
# Take home messages



- ✓ MMA and PA are inherited metabolic disorders that can lead to serious medical problems.
- ✓ MMA/PA is managed under medical supervision with:
  - Vitamin B<sub>12</sub> injections for some children with MMA
  - A protein-restricted diet, metabolic formula, carnitine, and appropriate illness management (for children with PA and many children with MMA)
- ✓ Regular lab tests are essential to assess a need for change in management.
- ✓ During illness, it is extremely important that emergency feedings are started quickly, followed strictly and there are no delays in management. It is important to communicate with your metabolic team regularly to prevent a metabolic crisis.



# Helpful hints



- ✓ Always ensure that you have an adequate, non-expired supply of your special dietary products and metabolic formula.
- ✓ Always ensure you give the correct amount of metabolic formula as prescribed by your metabolic clinic and have your emergency regimen products and written emergency protocol.

And remember to always follow your metabolic team's recommendations to offer your child the best opportunity for normal growth and development.

# Who's who (contact details)

## My dietitian

Name: .....

Phone #: .....

Email: .....

## My nurse

Name: .....

Phone #: .....

Email: .....

## My doctor

Name: .....

Phone #: .....

Email: .....

# Notes

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

# TEMPLE



Tools **E**nabling **M**etabolic **P**arents **L**earning

**BIMDG**

British Inherited Metabolic Diseases Group



BASED ON THE ORIGINAL TEMPLE WRITTEN BY  
BURGARD AND WENDEL

This version of the TEMPLE tool, originally adapted by the Dietitians group of the BIMDG for use within the UK and Ireland, has been further adapted by Nutricia North America for use within United States and Canada. This version no longer represents clinical or dietetic practice in the UK or Ireland.

To learn more, visit [MedicalFood.com](https://MedicalFood.com)

ZMMAPATBEN 3/20  
©2020 Nutricia North America

Supported by **NUTRICIA**  
as a service to metabolic medicine