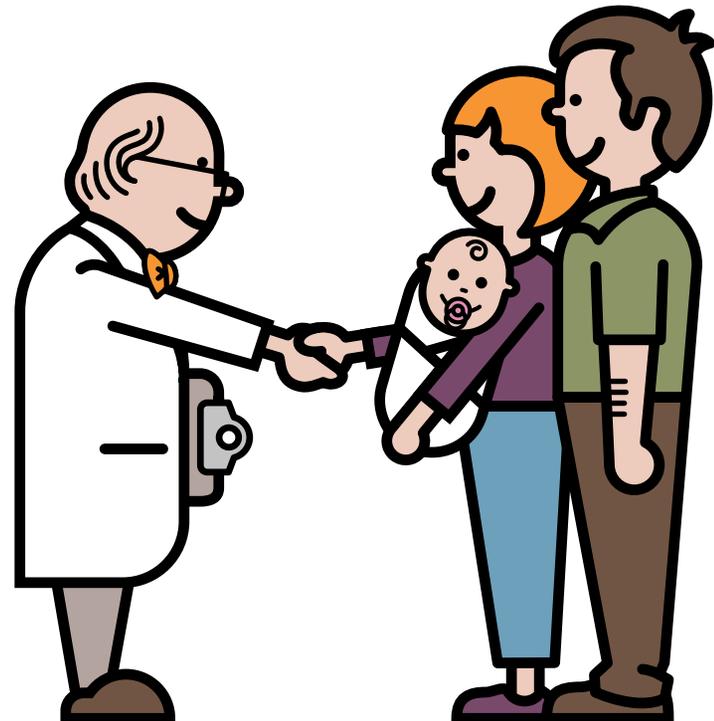


Methylmalonic Acidemia & Propionic Acidemia

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 This version no longer represents clinical or dietetic practice in the UK or Ireland.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

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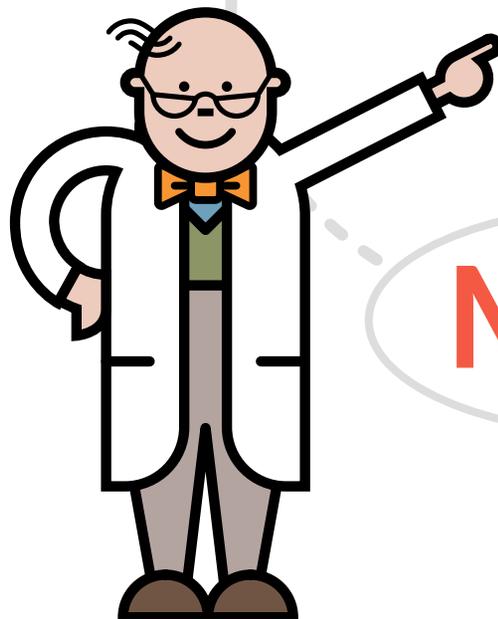
What is MMA?

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.

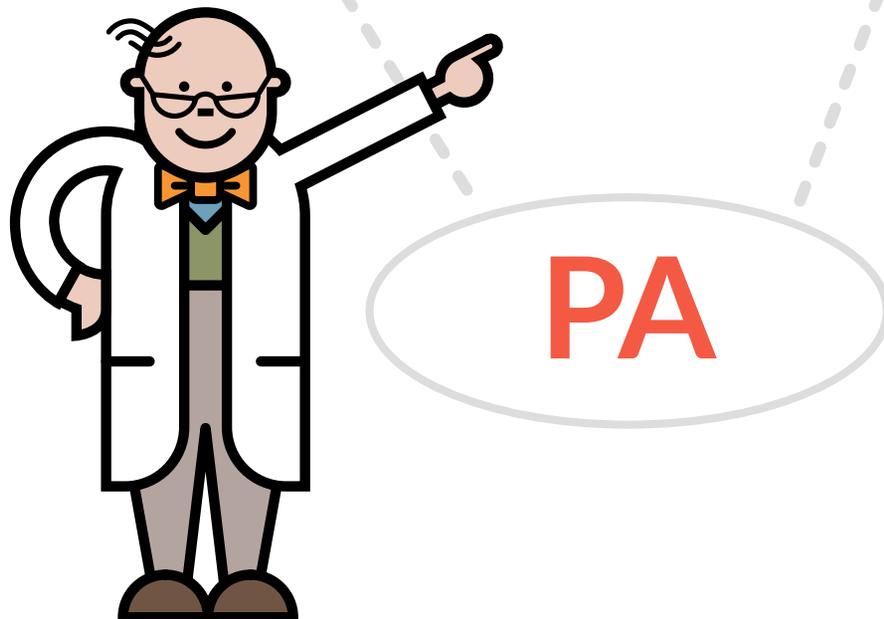
What is PA?

PA stands for propionic acidemia.

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

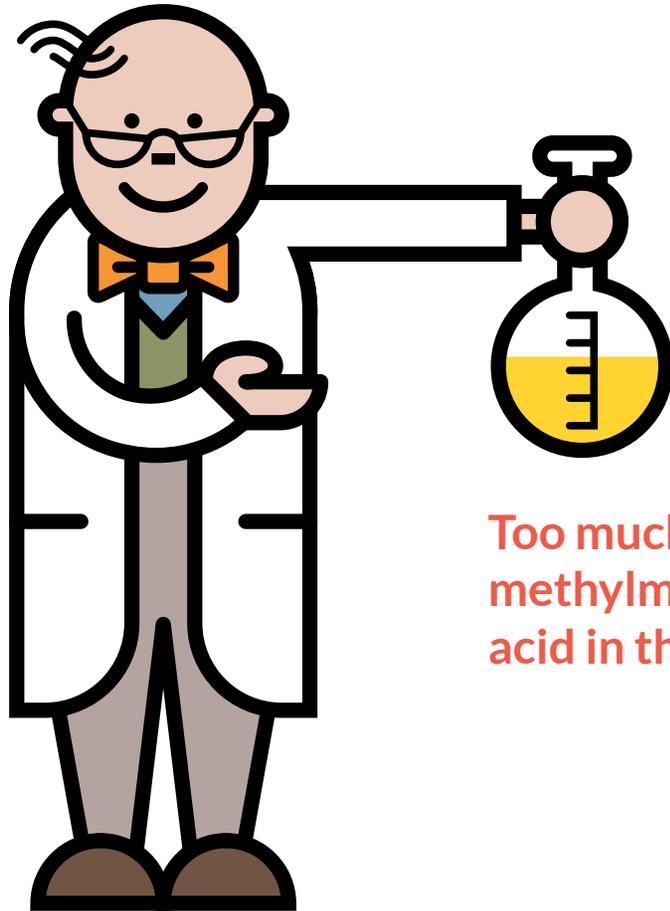
It is an inherited metabolic condition.

Propionic Acidemia

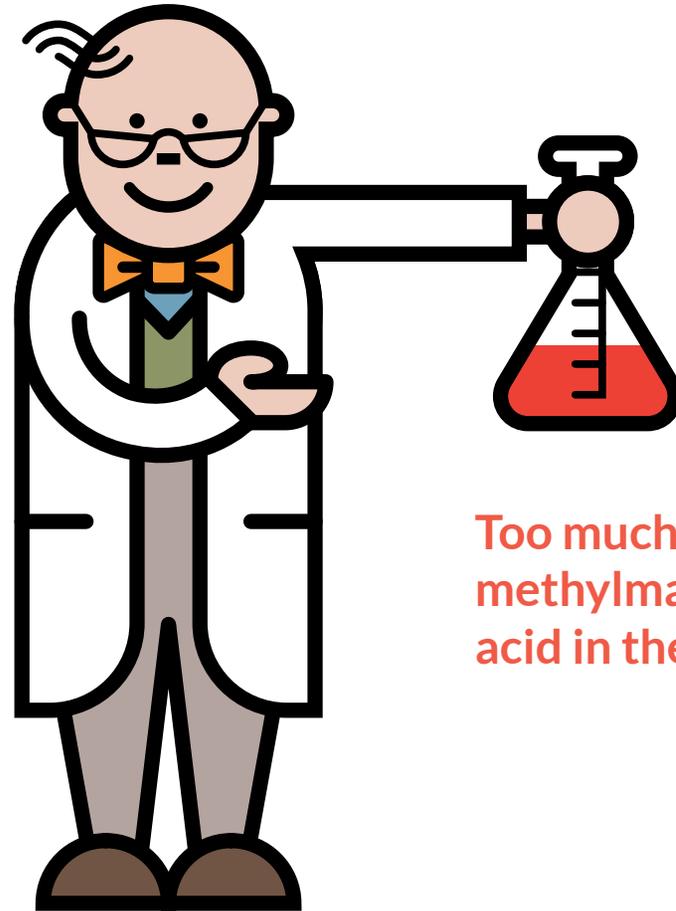


MMA and PA are separate, but similar conditions, so they are often discussed together as MMA/PA.

What is MMA?



Too much
methylmalonic
acid in the urine

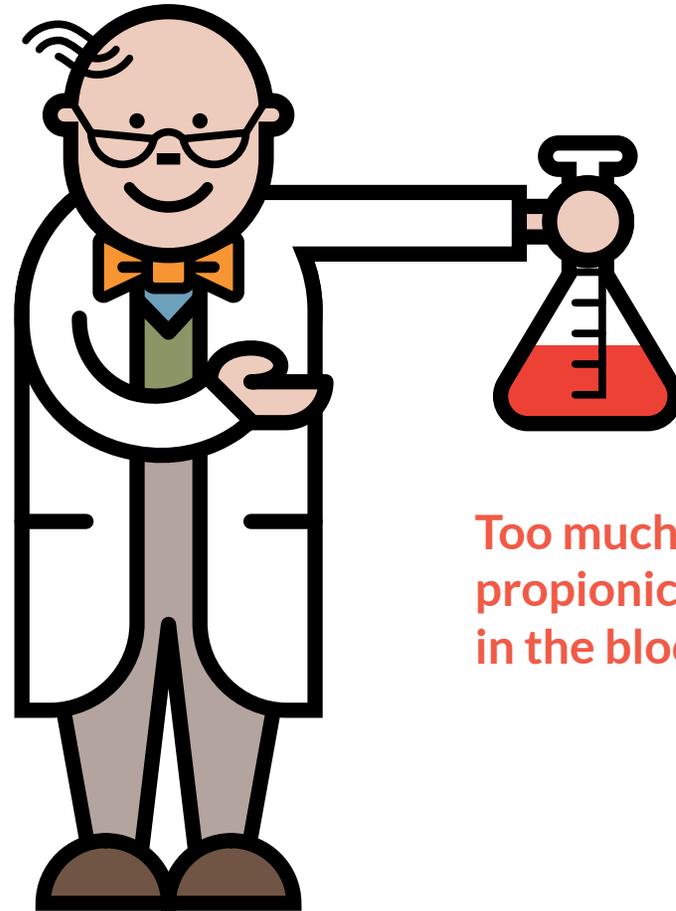


Too much
methylmalonic
acid in the blood

What is PA?



Too much
propionic acid
in the urine



Too much
propionic acid
in the blood

How does MMA/PA affect the body?

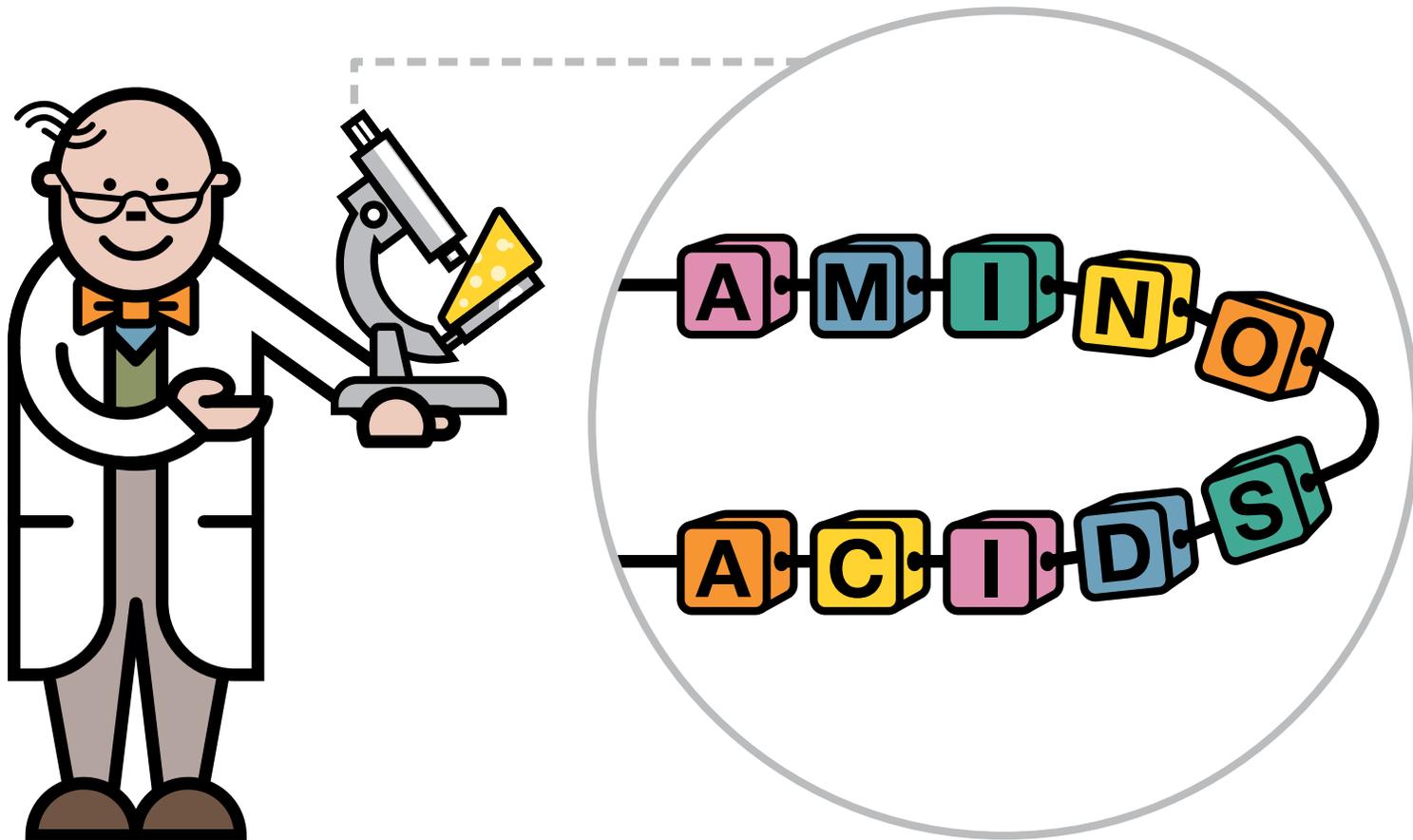
MMA/PA affects the way the body breaks down protein.

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



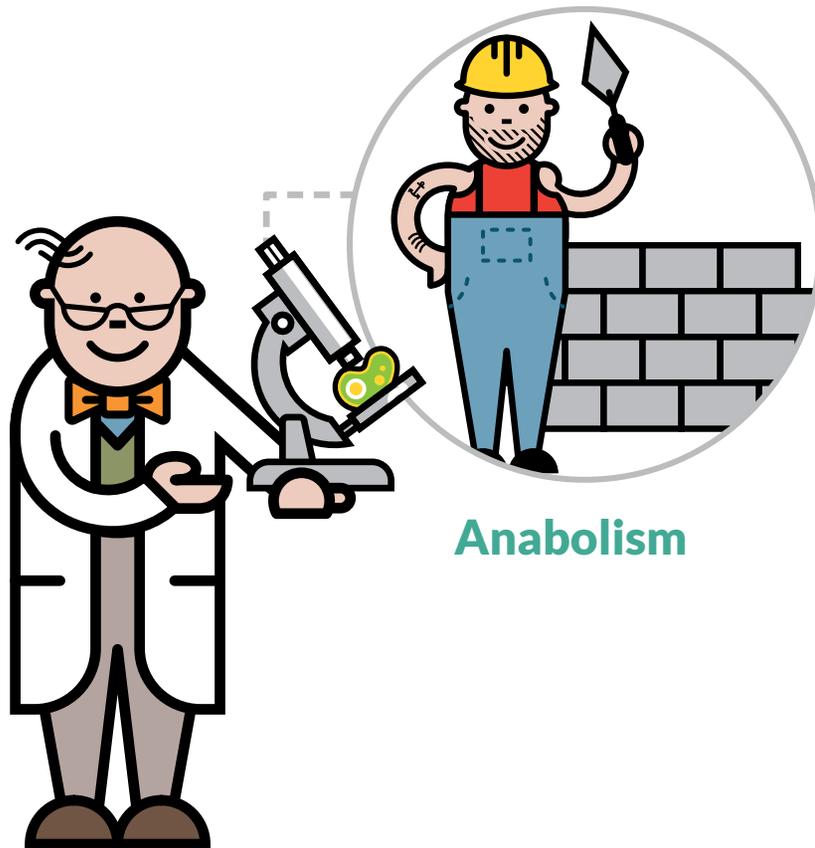
What is protein?

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

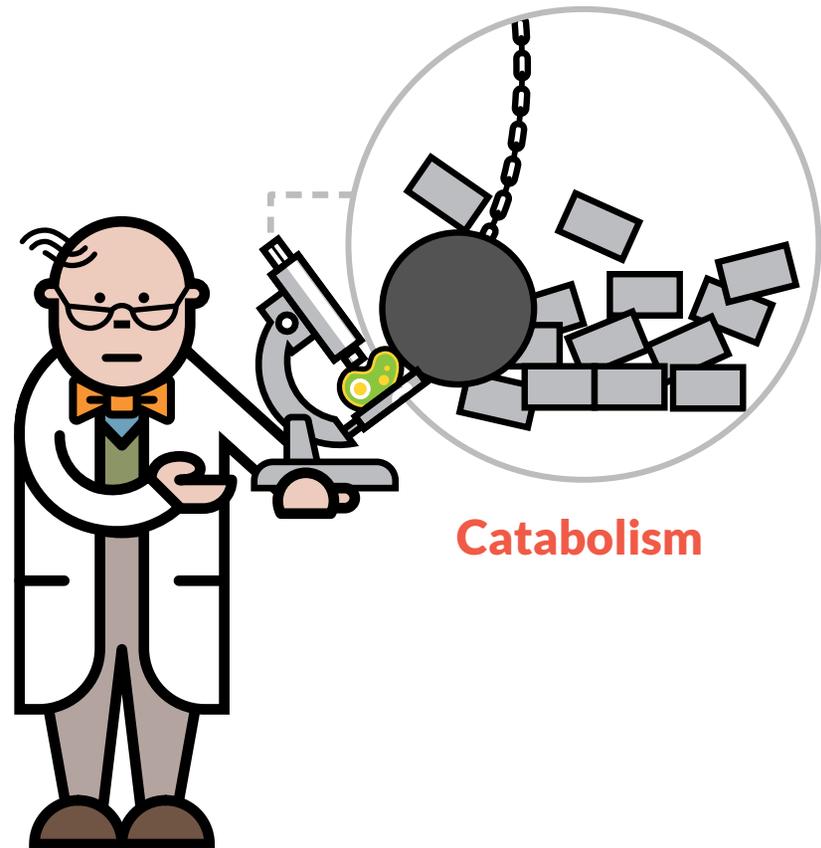


Protein metabolism

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



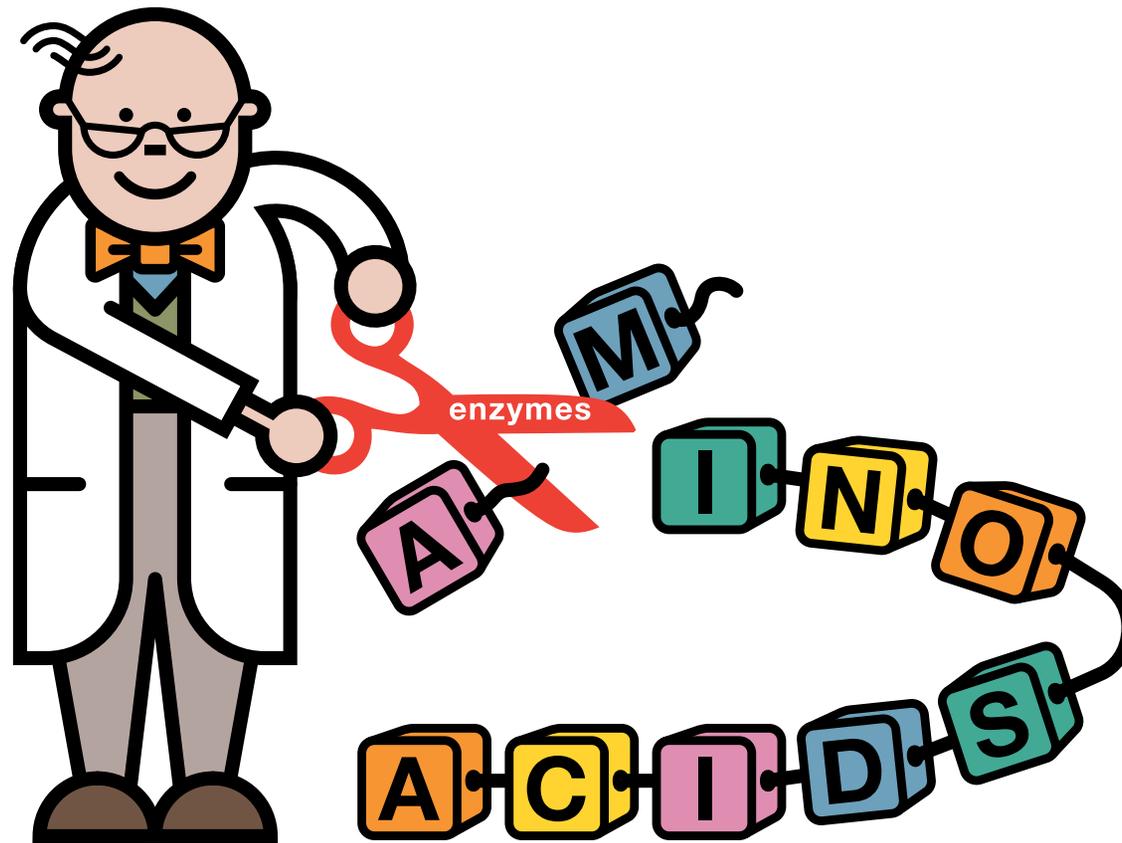
Anabolism



Catabolism

What do enzymes do?

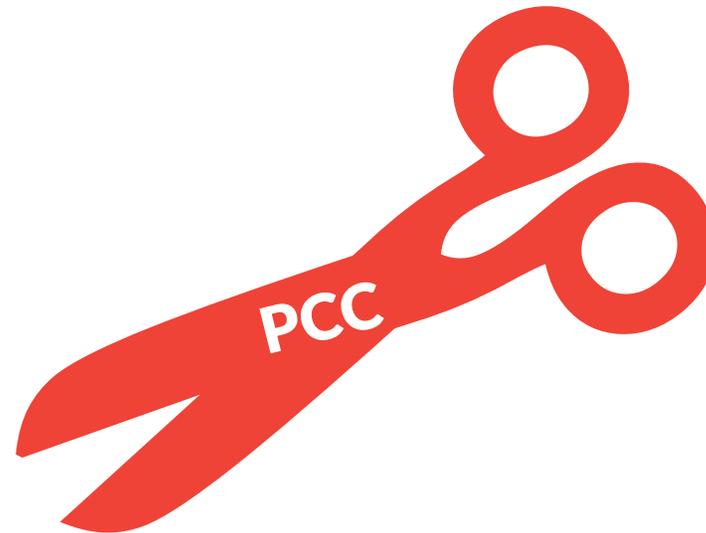
Enzymes help with metabolism by functioning like scissors. They break down proteins into smaller parts, including amino acids.



What enzymes are affected in MMA/PA?

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

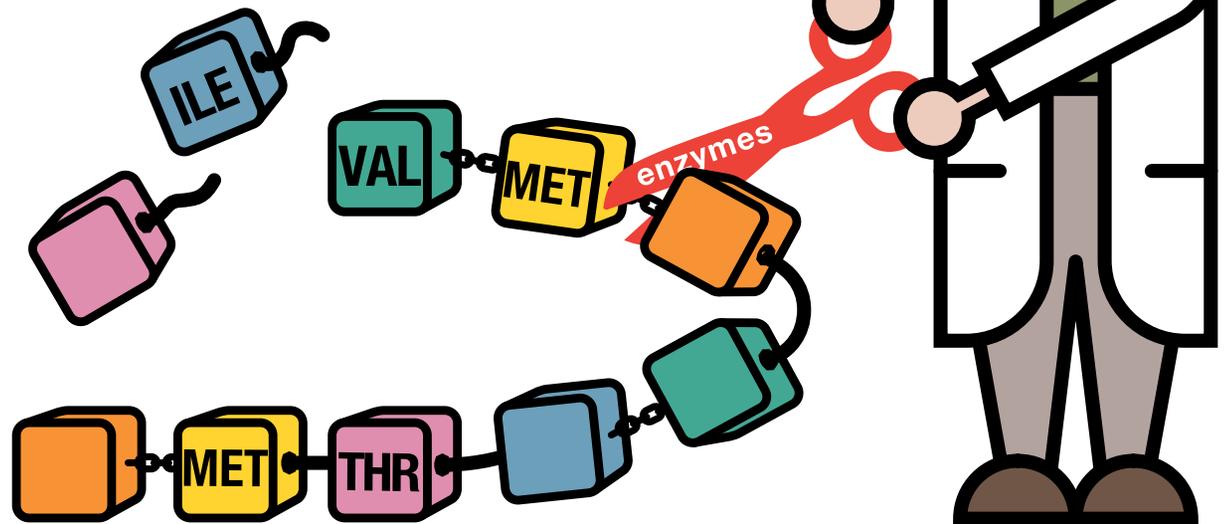
PA is due to a deficiency of an enzyme called **propionyl-CoA carboxylase (PCC)**.



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.

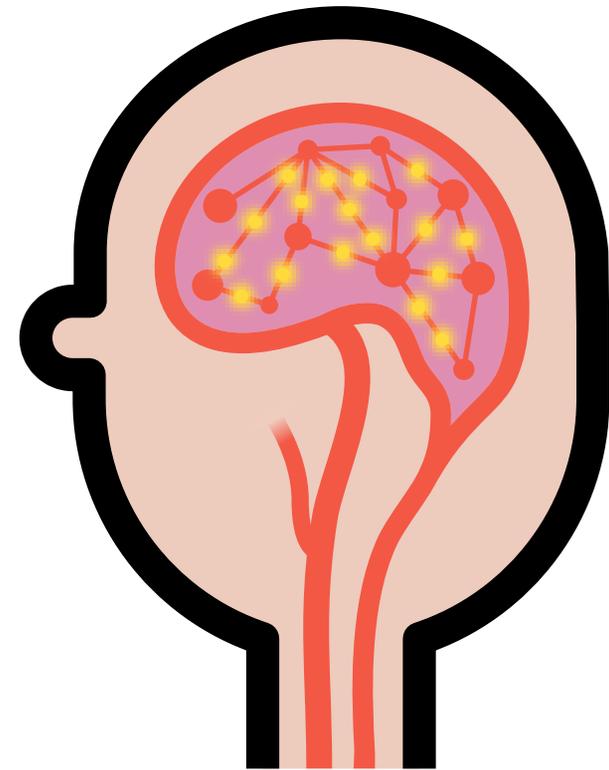


What can go wrong in MMA/PA?

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.



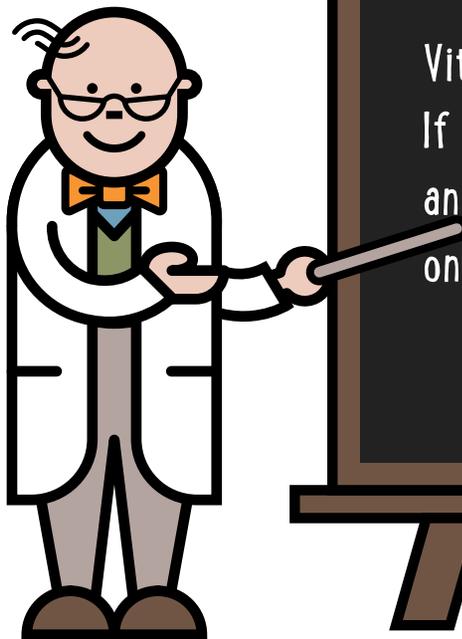
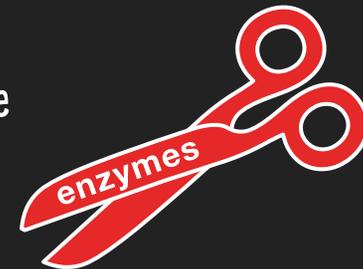
How is MMA managed day-to-day?

For
MMA
only

For some individuals with MMA, the enzyme needs the help of a vitamin called vitamin B₁₂, or hydroxocobalamin, to work properly.



Vitamin B₁₂ does not work for all children with MMA. If vitamin B₁₂ is helpful, it is given in high doses as an injection. For these children, vitamin B₁₂ 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 B₁₂ and for PA patients, the condition is managed with the following:

For
MMA
and
PA

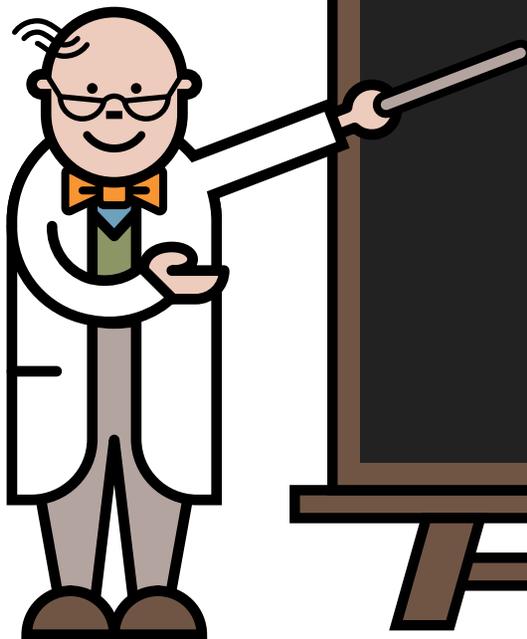
1. A whole protein-restricted diet
 - ✓ Avoid high protein foods
 - ✓ Include foods low in protein



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

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Dietary management of the condition should only be done under medical supervision.

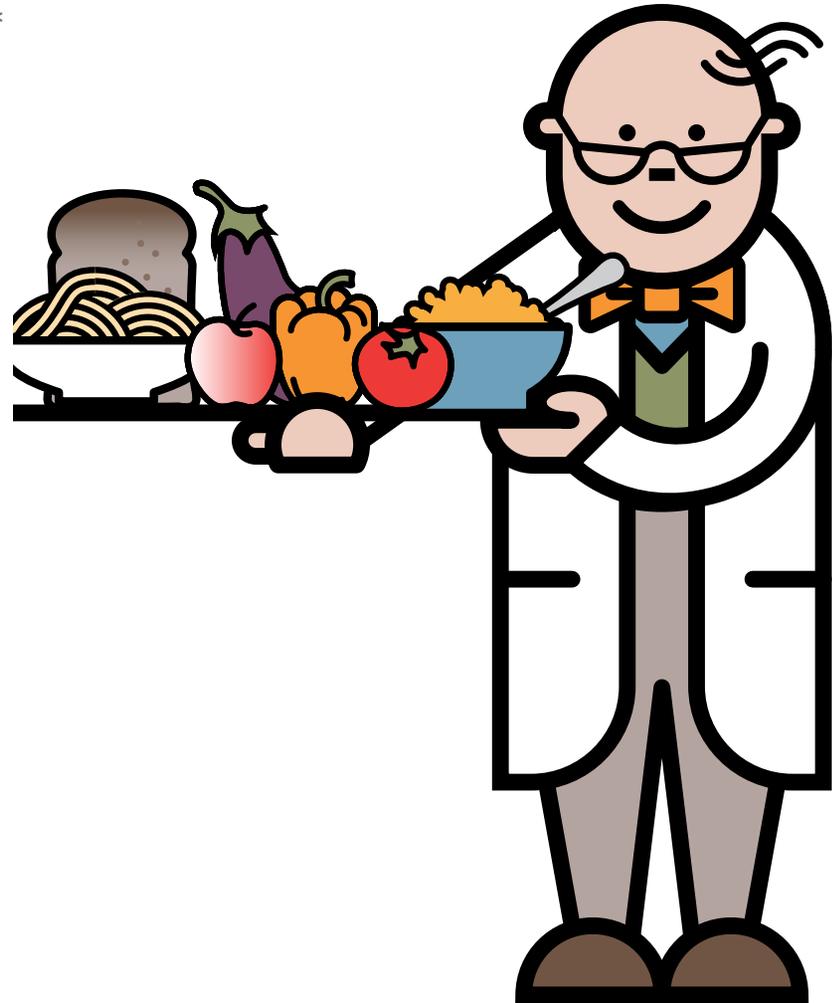
Include foods low in protein

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

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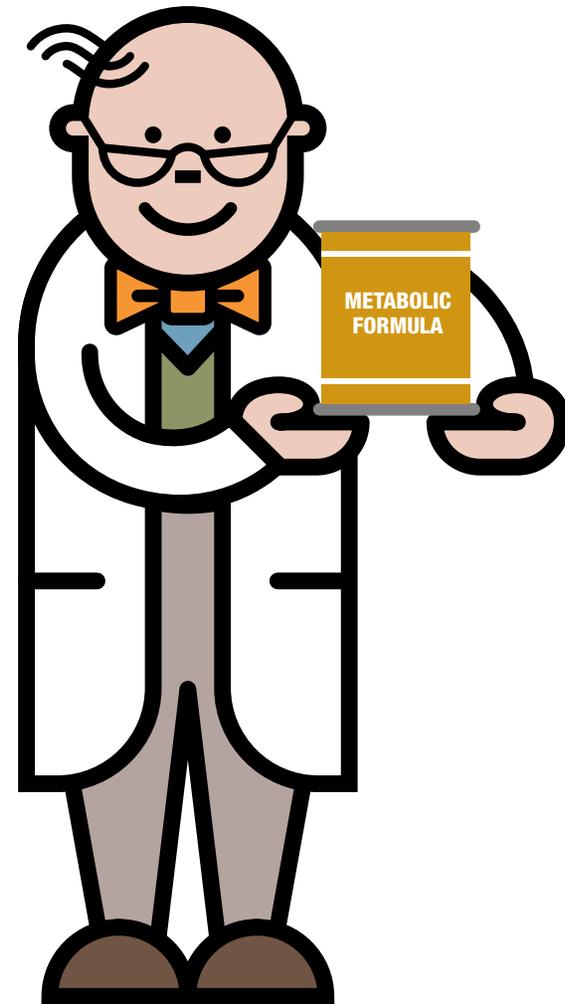
Dietary management of the condition should only be done under medical supervision.

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

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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).

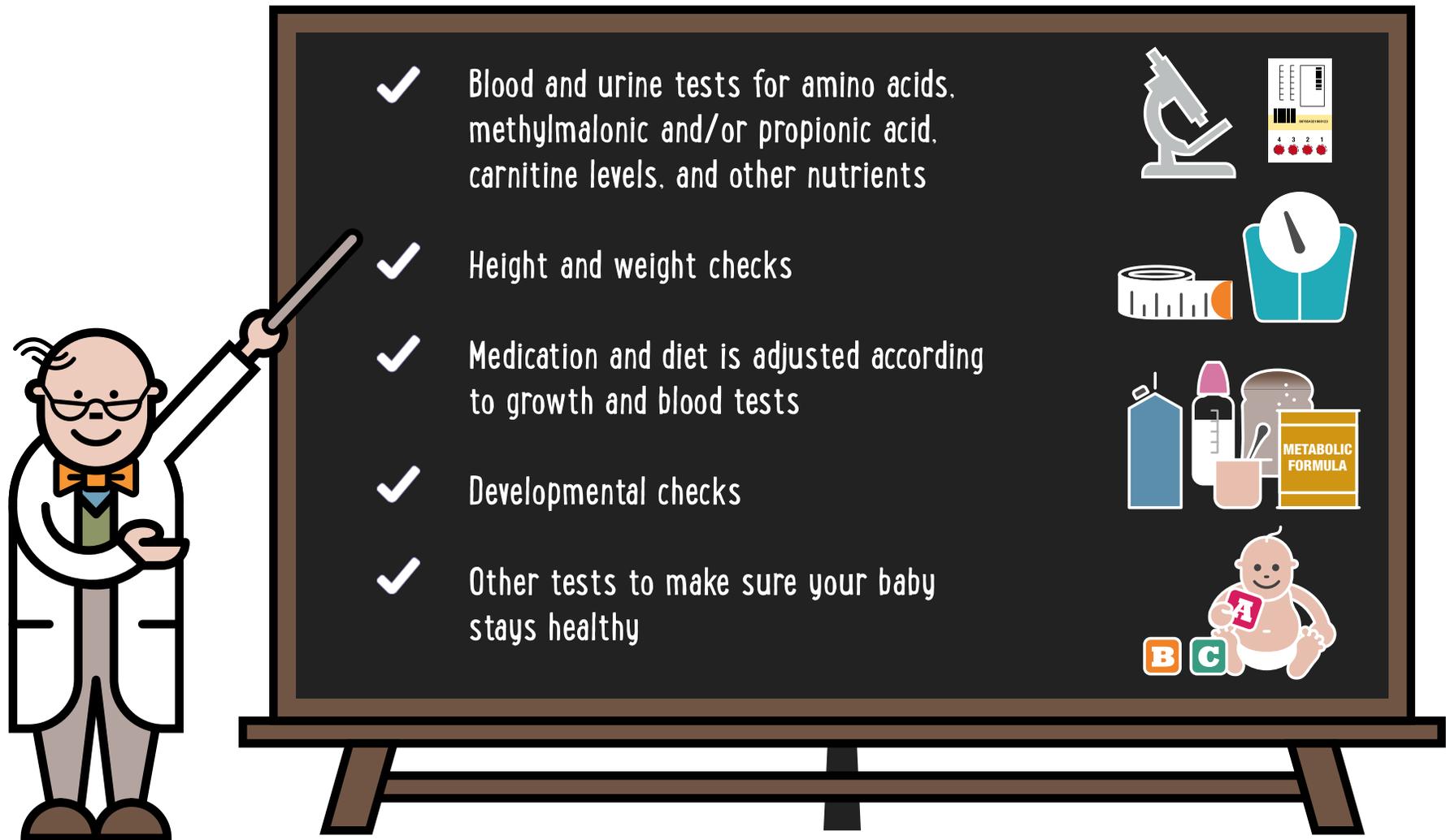
21

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Dietary management of the condition should only be done under medical supervision.

How is MMA/PA monitored?



- ✓ Blood and urine tests for amino acids, methylmalonic and/or propionic acid, carnitine levels, and other nutrients
- ✓ Height and weight checks
- ✓ Medication and diet is adjusted according to growth and blood tests
- ✓ Developmental checks
- ✓ Other tests to make sure your baby stays healthy

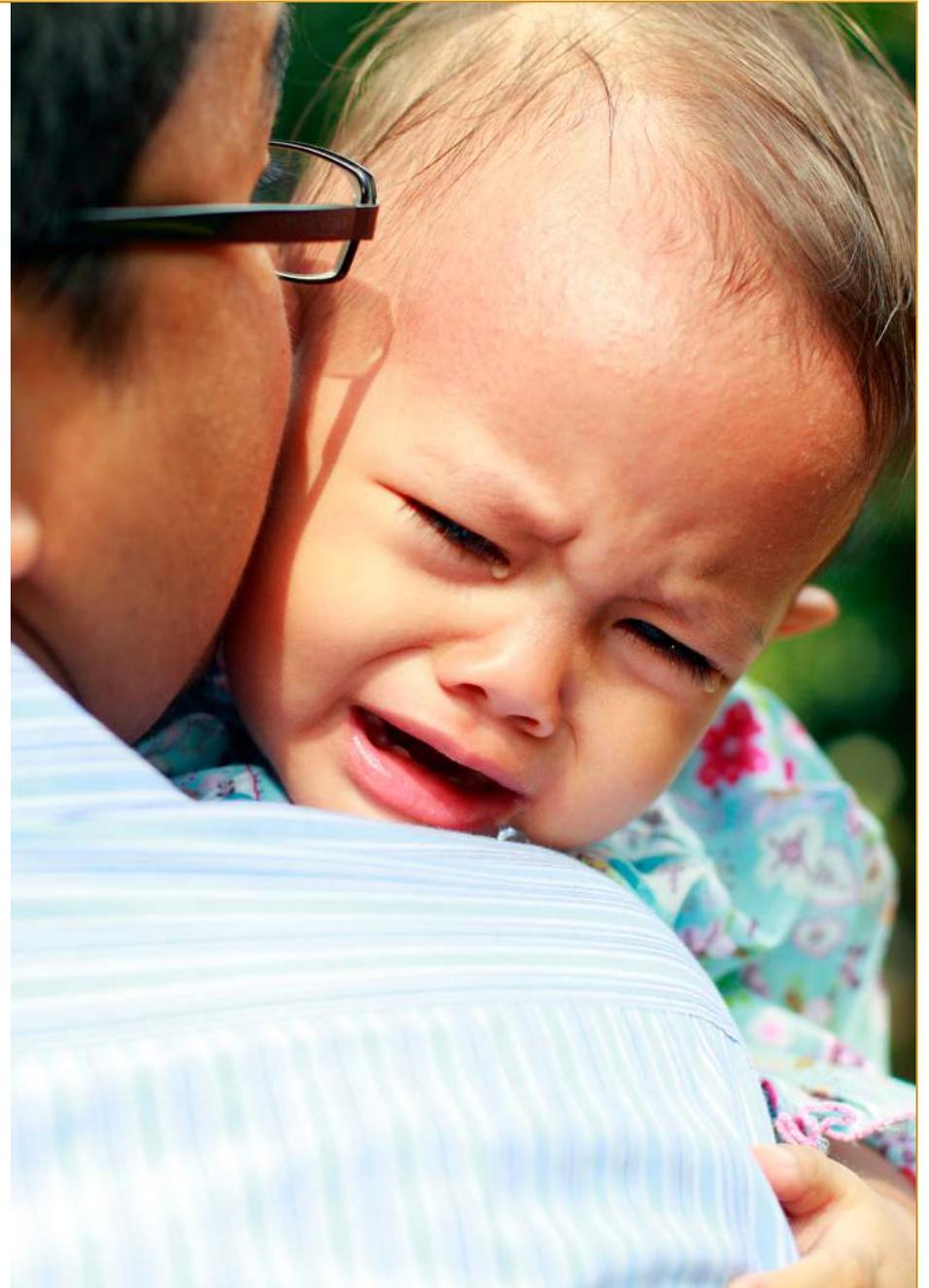
The chalkboard also features several icons: a microscope, a test strip, a measuring tape, a scale, a baby bottle, a metabolic formula container, and a baby playing with alphabet blocks.

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.

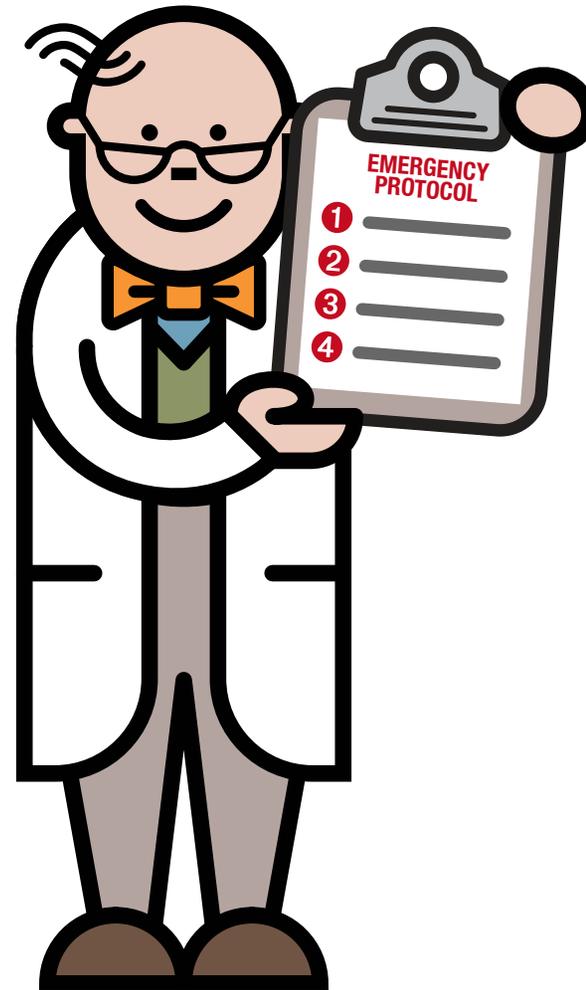
It is important to manage a metabolic crisis quickly and properly.



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.



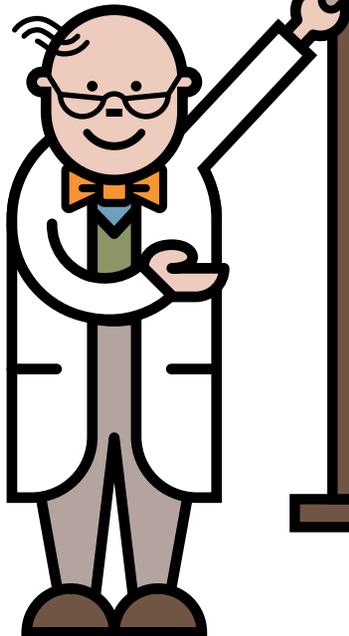
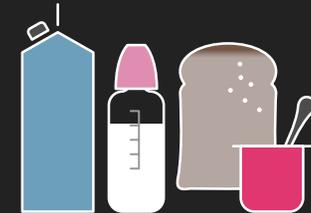
How is MMA/PA managed during illness?

Always follow your medical team's guidance.

Contact your medical team at the first signs of illness.

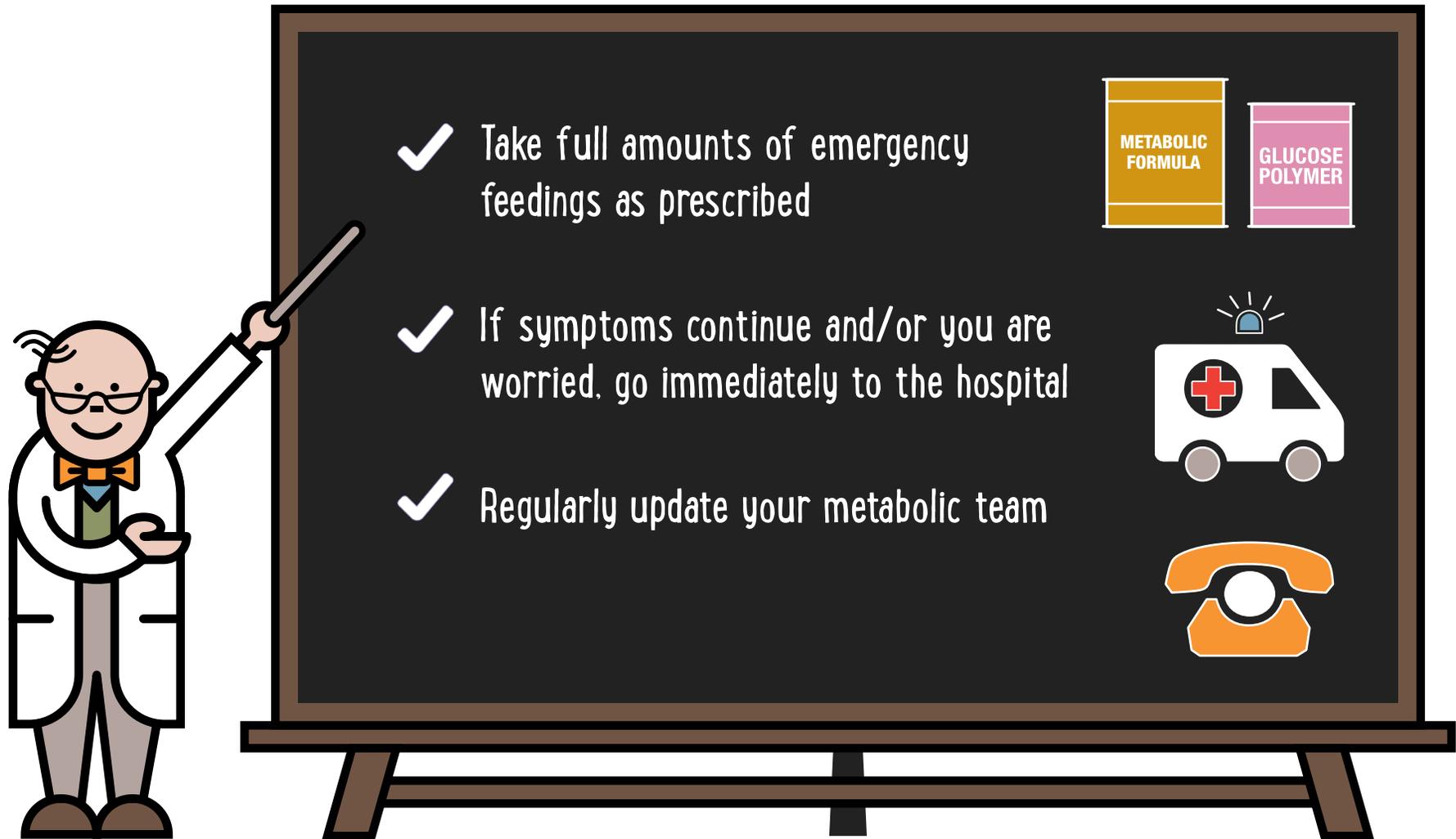
They may have you:

- ✓ 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.



- ✓ 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

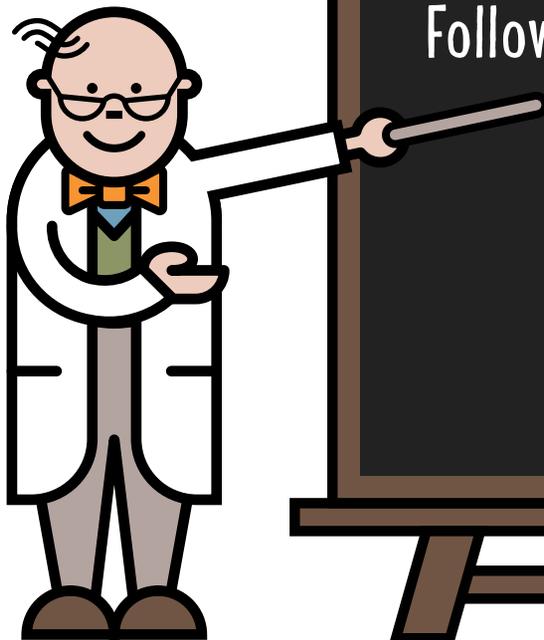
Icons on the blackboard:

- METABOLIC FORMULA (yellow container)
- GLUCOSE POLYMER (pink container)
- AMBULANCE (white van with red cross)
- PHONE (orange rotary phone)

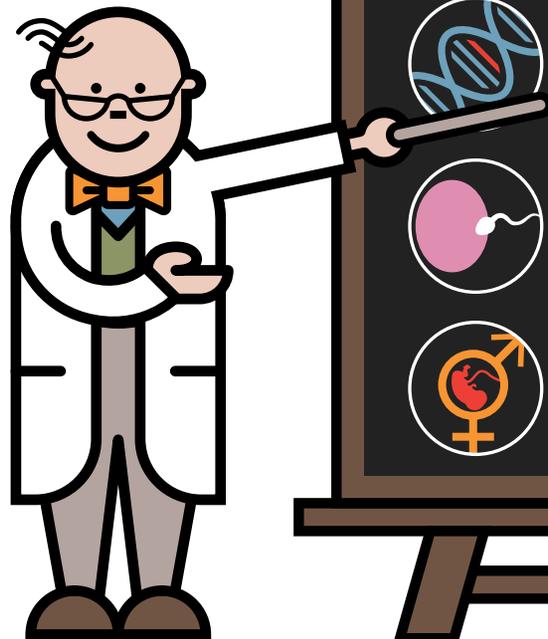
Most importantly

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?



Humans have chromosomes composed of DNA.



Genes are pieces of DNA that carry the genetic instruction.
Each chromosome may have several thousand genes.



The word mutation means a change or error in the genetic instruction.

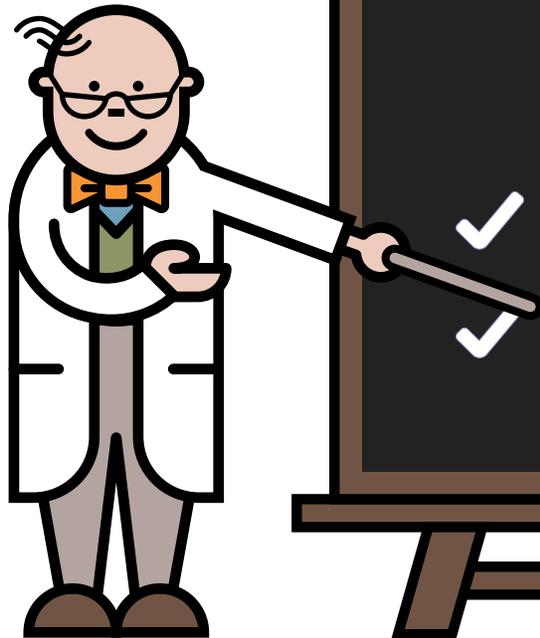


We inherit particular chromosomes from the egg of the mother and sperm of the father.



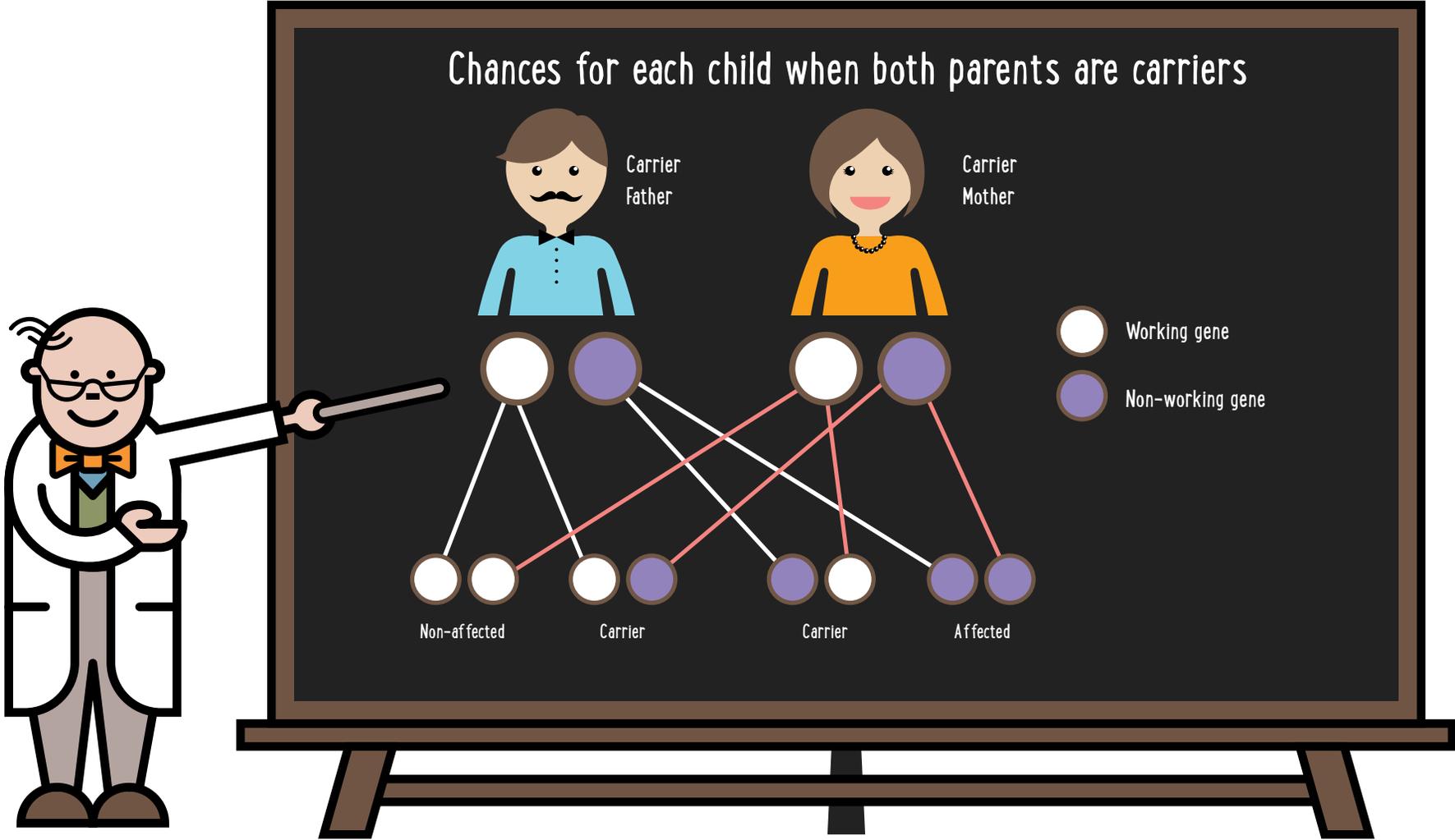
The genes on those chromosomes carry the instruction that determines characteristics, which are a combination of the parents.

How does one inherit MMA/PA?



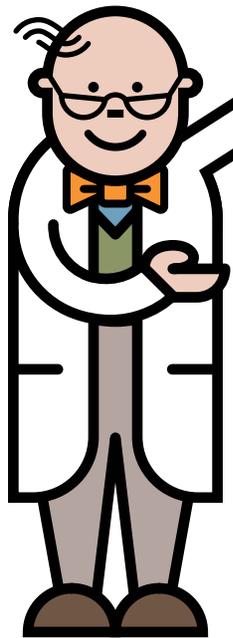
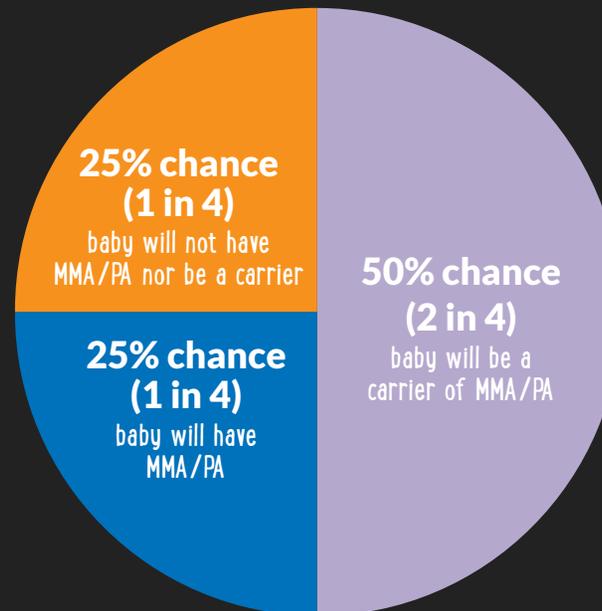
- ✓ MMA and PA are inherited conditions. There is nothing that could have been done to prevent your child from having MMA/PA.
- ✓ Everyone has a pair of genes that make the MCM enzyme (for MMA) and the PCC enzyme (for PA). In children with MMA or PA, those genes don't work correctly. These children inherit 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

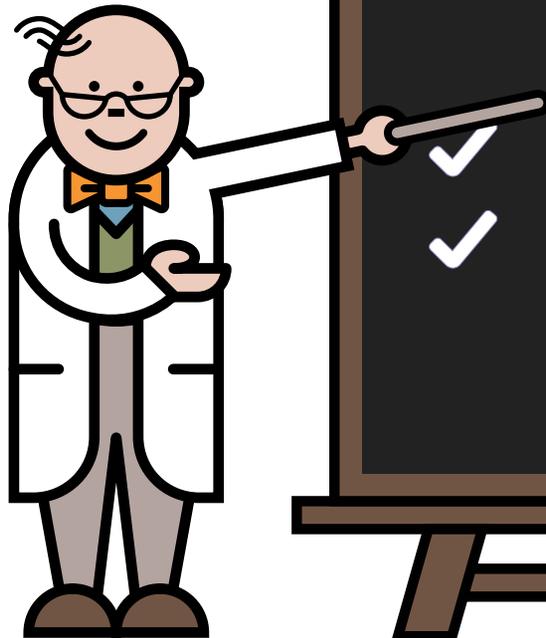


Future pregnancies

When both parents are carriers, *in each pregnancy* the risk to the baby is as follows:

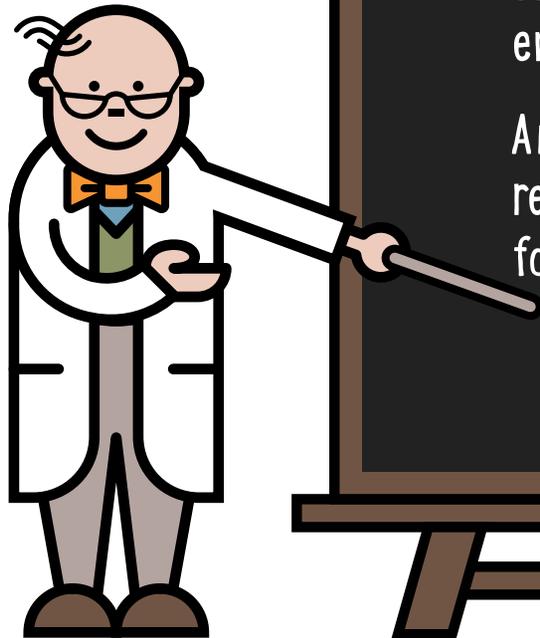


Take home messages



- ✓ MMA and PA are inherited metabolic disorders that can lead to serious medical problems.
- ✓ MMA/PA is managed under medical supervision with:
 - Vitamin B₁₂ 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

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

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