ALL YOU NEED TO KNOW ABOUT

GUT MICROBIOME (POO) TESTING

FUNDING RESEARCH INTO DISEASES OF THE GUT, LIVER AND PANCREAS

THIS FACT SHEET IS ABOUT THE COMMERCIAL ANALYSIS OF POO (STOOL) SAMPLES OR MICROBIOME TESTING

Research into the gut and the microbes living in your gut (sometimes called the gut microbiome or gut microbiota) has now become big news. Scientists all over the world are analysing what kinds of microbes make the human gut their home and investigating how they affect our health – both in the long term and short term. Scientists are also interested in how these microbes might influence a person's response to drugs prescribed by doctors, for example, drugs for the heart or to treat different cancers as well as antibiotics.

Some of the findings have moved from scientific publications to articles/books for the general public. As a result of this attention, several companies now offer to analyse a sample of your faeces (a.k.a. stool or poo), with the aim of telling you about the microbes in your gut, and how they might affect your health, either positively or negatively.

But what is really known about this approach? How useful are these tests? What can we learn from the test results? This leaflet will explain about the gut microbes, their links to health, disease and therapy, and what the test reports mean.

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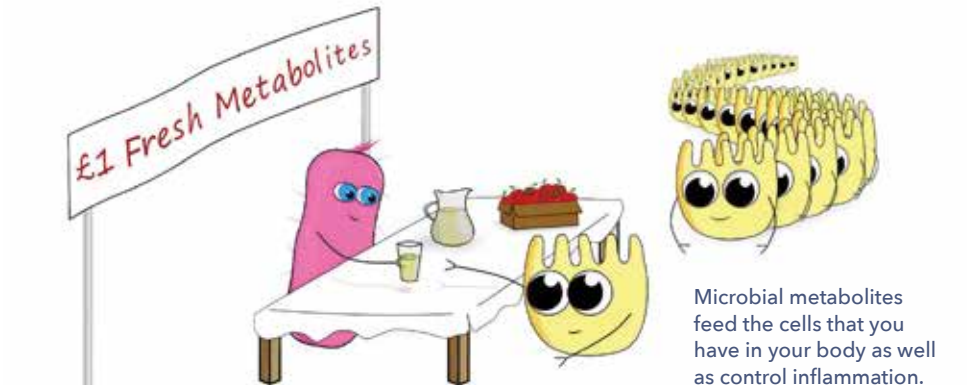
This leaflet was published by Guts UK charity in 2019 and will be reviewed in 2021. The leaflet was written by the Gut Microbiota for Health Expert Panel (a section of the British Society of Gastroenterology) and has been subject to both lay and professional review.

WHAT IS CURRENTLY KNOWN ABOUT THE GUT MICROBIOME AND WHY WE ARE INTERESTED IN IT.

An introduction to the gut microbiome

Currently our best guess (based on testing poo samples) is that, if we looked at everyone's large bowel, we would find about 1000 different types of bacteria living there. Each person has around 160 different types of bacteria, so you will probably have different bacteria compared to the person sitting next to you. And that is just the bacteria – many other microbes such as archaea, viruses and yeasts are there too! (See the glossary at the back for an explanation of the different microbes.) The small bowel also contains microbes; these are different to those found in the large bowel. For now, we know more about the microbes that live in the large bowel, because it is easier to get samples (i.e. poo).

Most companies and scientists are, for now, mainly interested in just the bacteria in our guts. We now know that gut bacteria perform a wide range of jobs, many of which are vital for good health. They make chemicals (a.k.a. microbial metabolites) that we need to live, for example, to feed the cells that you have in your body as well as to control inflammation. We now think of the gut bacteria as we do our immune system – a complex system doing important jobs that help maintain our health. In rare cases, your immune system and the gut bacteria can cause disease. That is why we need to analyse poo samples - to find out what microbes are there and understand what they are doing.



Microbial metabolites feed the cells that you have in your body as well as control inflammation.

Illustration by Dr Nick Ilott (www.closecompany.co.uk)

The bacteria that live in the large intestine can be broadly classified into two large groups called the Bacteroidetes and Firmicutes. These bacterial groups are huge and contain thousands of different bacteria. We should think of them in a similar way that we think of cats and dogs: both are large groups of different types but

with shared features. So, when we look at poo from thousands of people, we find that the proportions of these two groups of bacteria varies: some people have 90% Bacteroidetes whilst other people have 90% Firmicutes. The make-up of your bacteria is so variable that we cannot say that "one size fits all", or what can be called a "healthy gut microbiome". However, there are some features of your gut bacteria that can could indicate that your gut microbiota needs improving.

WHAT IS POO?

This may seem like an odd question, but many people think that poo is just undigested food. Poo is a waste product, but only a small part is unused food. Poo is a waste matter passed out from the bowels after food has been digested and processed. Poo consists mainly of water (75%); the rest is undigested fibre from fruit and vegetables (i.e. the food you can't digest), protein (mainly from you), fat, salts, cells from the bowel wall, mucus made by the cells of the gut, and a lot of bacteria (hundreds of trillions of them), which help digest parts of the food that you have not used, and which are responsible for producing gas as well as chemicals we need.

The colour of healthy poo is various shades of brown due to the effects of a chemical called stercobilin, which comes from when red blood cells renew themselves. Some foods, medications or diseases can change the colour of poo. For instance, iron tablets can make it black and a problem with the liver can make it chalk-coloured. The smell of poo is pretty awful; it comes from a mixture of chemicals mainly made by the gut bacteria. For example, hydrogen sulphide causes the rotten egg smell that, in fact, is perfectly normal.

WHAT IS GUT MICROBIOME TESTING?

Gut microbiome testing requires either some or all of a poo sample to be collected in a container and sent to a lab for analysis. The lab analysis can include test tube experiments looking for bacteria that can cause infections, in the same way that we check a urine sample for a urinary tract infection. However, many of the new companies offer to analyse the composition of the microbiome in the gut. This analysis shows how many different bacteria are present by analysing their DNA (sequencing) and estimates how many types are in the poo sample. Some tests will also measure other markers of gut health, e.g. calprotectin, which can tell if there is inflammation in the gut.

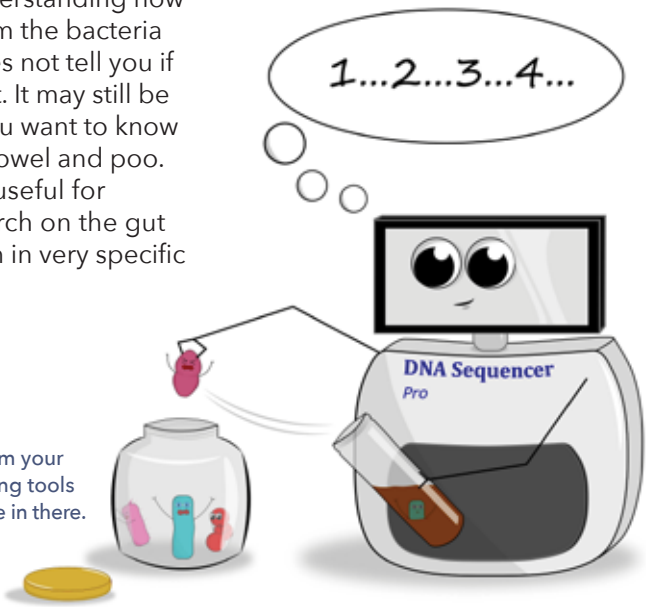
After an initial analysis, some companies offer you a 'solution' to help manage the levels of some bacteria in your gut. The 'solution' could be a probiotic or a

product (a prebiotic) that stimulates the growth of certain microorganisms considered to be beneficial. There is evidence for some products to support this suggestion. The companies may offer to retest your poo to find whether their recommendation has improved the composition of your gut microbiome and, in particular, any species highlighted as being too low or too high in number.

FAECAL ANALYSIS AND THE GUT MICROBIOTA

When you send off a poo sample and get it analysed, profiled or fingerprinted, what does this mean? The answer depends on what tests are being done.

If the company running the test tries to grow the bacteria in your poo, they will try and look for bacteria that are known to cause disease. However, many of these cause obvious symptoms, like diarrhoea, and the test helps the doctor prescribe the right medicine or to rule out a bacterial infection if nothing is found. It is what many hospitals do when they analyse poo if doctors think you have a gut infection. Other companies extract DNA (think CSI on the television) from your poo and by using DNA sequencing tools, they will be able to tell you what bacteria are in your poo, giving you a list of which types and how many bacteria that you have. This analysis is sometimes referred to as a profile or fingerprint. Currently this has very little value to you, your GP or nurse. This is for many reasons. Firstly, it is only one sample and the bacteria usually vary from sample to sample taken from the same person. Secondly, understanding how healthy your gut is from the bacteria found in your poo does not tell you if you have a healthy gut. It may still be interesting to you if you want to know what is in your large bowel and poo. These tests are more useful for scientists doing research on the gut and its microbes, often in very specific circumstances.



Companies extract DNA from your poo and use DNA sequencing tools to find out what microbes are in there.

Illustration by Dr Nick Ilott (www.closecompany.co.uk)

Furthermore, DNA testing does not tell you if a microbe is dead or alive - just that it is or was there. Also many gut bacteria may not be detected in faecal samples because they stay stuck onto the gut wall.

If the types of bacteria shown in your test are similar to what is commonly seen in thousands of other people's poo, then congratulations: your poo is just like other people's poo. Some companies will send you a report showing how your poo compares to thousands of other people's poo, and also showing the levels of different types of bacteria associated with some diseases. These results are interesting, but do not indicate a particular risk of developing that disease. We have not yet made strong links between the presence or absence of any types of bacteria with many of the "big" diseases such as cancer, heart disease or dementia. So, DON'T PANIC, for instance, if your report says you have low levels of a bacterium associated with preventing Type 2 diabetes. We are not at a stage where we can confidently say that we need to increase levels of that bacterium to reduce your risk of getting Type 2 diabetes. At the moment, we just do not have enough knowledge to safely and accurately recommend any specific interventions (such as particular changes in diet, and/or particular probiotics) to cause beneficial long-term changes to the composition of the bacteria in the gut.

There is also the question of how much value there is in doing a single test taken at a single time point. Many doctors measure markers of disease more than once, just in case the one reading they took was an odd one. Some of these poo tests only become useful when you look at the profile or fingerprint of the bacteria at different times.

Additionally, we do not really know what a 'healthy' level of some of these bacteria and chemicals should be in poo, and are only beginning to understand to what degree levels of microbes naturally fluctuate in the gut in a healthy person over time. Until we have done more research, the information given by these tests can be confusing, and often does not help doctors or nurses in guiding their advice to make you healthier or in treating any conditions that you may have. We do know that if you have a well-balanced diet with a good variety of different foods, this usually leads to a wide variety of different bacteria in your large bowel and poo. Many experts feel that this is probably a good thing.

WHAT RESULTS DO YOU GET?

Different companies offer different reports and there is no single standard of reporting what is in your poo. A common feature is to report levels of bacteria in your poo sample and compare this to the wider population.
As an example, a company may report this:

"Your test results indicate that your microbial diversity score is normal. This result shows that your gut microbiome is like that of individuals with healthy guts.

Your sample tested negative for some pathogens in particular *Clostridium difficile, Escherichia/Shigella, and Vibrio cholerae."*

However, if you had some of these germs, you probably don't need a DNA test to know it - you would be unwell, and doctors would probably have already made a diagnosis. Moreover, some of these bacteria are found in poo from healthy people and do not cause disease, e.g. many types of *Escherichia coli*.

Some test providers may make a statement such as:

"The test does not suggest a diagnosis or lack of diagnosis.
Please consult your doctor to interpret the results provided in this report"

What this means is that the science and evidence are not yet strong enough to support any associations with disease. In some reports there may be indications that you have low or high levels of specific bacteria compared to a "healthy" population, and the report may say "Condition more likely", but this is speculation.

CONCLUSION

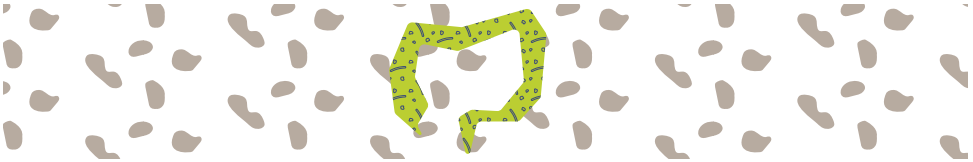
We are entering a very exciting period of research into the role of different bacteria in the body, and how they might be connected to diseases and affect how we respond to drugs prescribed by doctors. But we are a long way from being able to say that one poo sample can tell us if we are at risk of colon cancer, or that we have protection against getting heart disease or Type 2 diabetes.
So, at the moment getting your poo tested by commercial companies may be interesting if you are curious to know what bacteria are in there, but not as a direct way to find out why you're not feeling well or how to improve your health.
Eating a healthy diet, including lots of different fruit and vegetables and reducing intake of unhealthy foods (e.g. processed foods or foods high in fat) is one way to improve your gut microbiota and maintain good health.

GLOSSARY

Test reports often list a bewildering list of microorganisms but in most cases, it s not unusual to find these microbial species in the gut. Most of them are probably harmless and some may be beneficial, as we have explained above.

Examples of bacteria used in probiotics and food: *Bifidobacterium, Lactobacillus, Streptococcus salivarius* subsp. *thermophilus*

Further explanation of terms used in this leaflet and/or used in test reports are shown below:



ARCHAEA	Microscopic single-celled organisms that do not contain a nucleus – very similar to bacteria, but with some key scientific differences.
BACTERIA	Microscopic single-celled organisms that do not contain a nucleus.
BETAGLUCURONIDASE	Tests for this enzyme are used to detect certain bacteria.
CALPROTECTIN	The test for this protein is used to help diagnose inflammatory bowel disease.
DNA	Deoxyribonucleic acid (DNA) is a molecule found in all living organisms (apart from some viruses), which contains their genetic information.
FLORA OR MICROFLORA (GUT)	Outdated terms to describe all the microorganisms that inhabit the gut – now called the gut microbiota or gut microbiome.
MICROBES OR MICRO-ORGANISMS	This is a term for any type of microscopic organism – bacteria, viruses, archaea and fungi (including yeasts) – all of which are naturally found in the gut (see below).

MICROBIOTA OR MICROBIOME (GUT)	All the different types of microorganisms found living in the gut: i.e. all the bacteria, archaea, viruses and fungi (including yeasts). Although the terms are interchangeable, sometimes microbiome is used to refer to all the genetic material of the microbiota, and their functions.
PREBIOTIC	Dietary substances that selectively promote the growth of beneficial bacteria in the gut. These compounds are not digested by human enzymes, so they reach the colon where they feed, for instance, bifidobacteria. Prebiotics can be found in many vegetables (e.g. chicory, Jerusalem artichoke, onions, leeks, asparagus, etc.) as well as commercial products. Examples include certain types of dietary fibre, fructooligosaccharides, galactooligosaccharides and inulin.
PROBIOTIC	Live microorganisms that confer a health benefit on the host. They are often sold in the form of yoghurt, fermented milk and other drinks, powders, capsules and tablets. The probiotic strain(s) should be fully labelled on products and there should be clinical trial evidence demonstrating health benefit.
SPECIES	A classification group used in science to identify different types of microorganisms. A species name consists of two words: e.g. *Escherichia coli, Bifidobacterium breve* and *Lactobacillus casei*.
VIRUSES	Microscopic infectious agents (smaller than bacteria) that can only replicate inside a living organism such as a bacterium, human, animal or plant cell. There is an abundance of viruses in the gut, mostly living in bacterial cells.
YEASTS	Types of single-celled fungi often found in the gut and usually considered harmless. If yeast growth in the gut becomes too high, this may cause gut symptoms. Yeasts in the gut present more of a health risk for certain people, such as those who are immunocompromised or with inflammatory bowel disease.

USEFUL INFORMATION SOURCES

British Dietetic Association

Has food fact sheets on several topics, including healthy eating, medical conditions including irritable bowel syndrome, and probiotics.
https://www.bda.uk.com/foodfacts/home

The Gut Microbiota for Health Expert panel (part of the British Society of Gastroenterology)

The website for this panel of medical and scientific experts features key research and information for the public.
https://www.bsg.org.uk/research/gut-microbiota-for-health-expert-panel.html

The International Scientific Association for Probiotics and Prebiotics

This group comprises academics, clinicians and industry researchers. The website features infographics for the public and links to posts on microbiome testing.

- Infographics on probiotics, prebiotics, etc.
  https://isappscience.org/infographics/

- 'I have IBS, should I have my microbiome tested?'
  https://isappscience.org/ibs-microbiome-testing/

- 'Microbiome analysis – hype or helpful'
  https://isappscience.org/microbiome-analysis/

Close Company

Close Company was created by Dr Nick Ilott, a scientist at the University of Oxford, who provided the illustrations for this booklet. For more illustrations, please visit **www.closecompany.co.uk**

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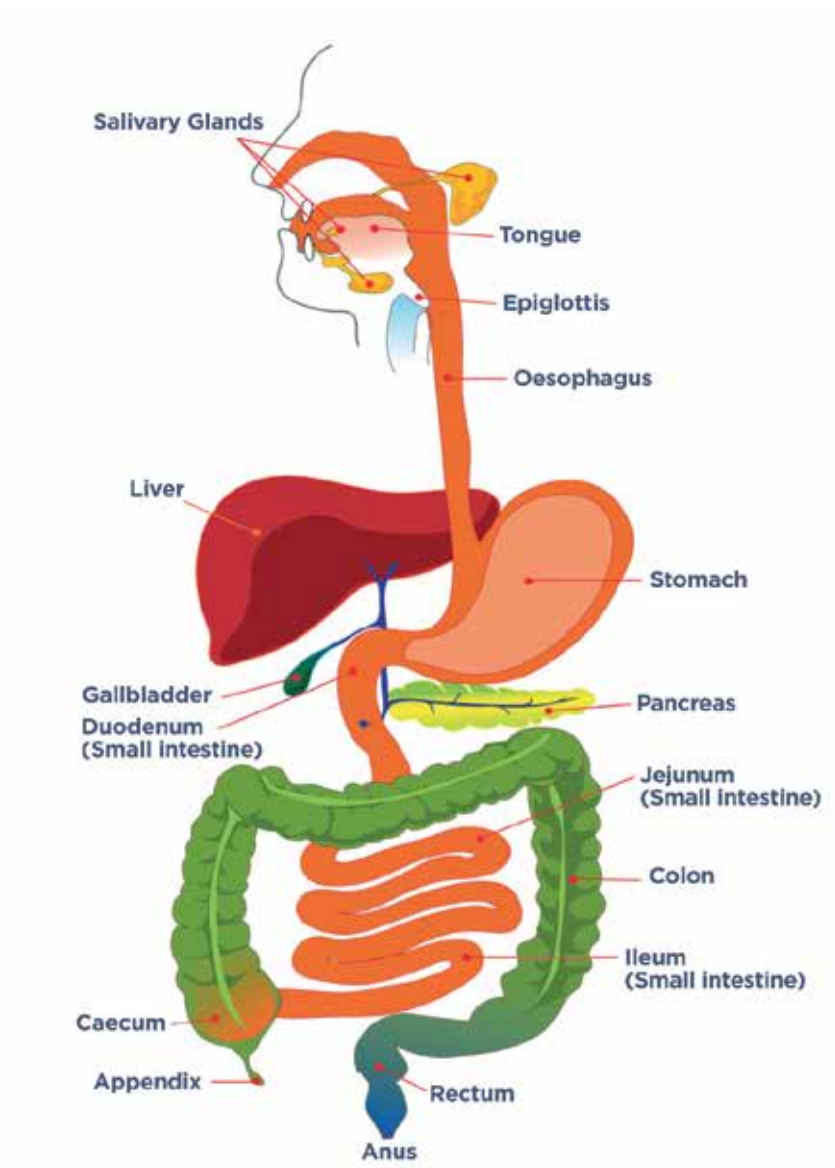
OUR DIGESTIVE SYSTEM



Can you support Guts UK Charity

Whatever you do already, do it for Guts UK charity. The more we all know about our digestive system, the better we can look after it.

Fancy making us a knitted guts set for educational purposes? Contact us for a pattern

IF YOU FIND THIS INFORMATION USEFUL, PLEASE SHARE IT WITH OTHERS

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ABOUT GUTS UK

Guts UK's vision is of a world where digestive disorders are better understood, better treated and everyone who lives with one gets the support they need.

Our mission as Guts UK is to provide expert information, raise public awareness of digestive health and transform the landscape for research into our digestive system to help people affected by deseases of the gut, liver and pancreas.

WE ARE PASSIONATE ABOUT OUR GUTS.
COME ON BOARD AND JOIN US.

This charity was set up to change something – to increase the levels of research into diseases of the gut, liver and pancreas so no one suffers in silence or alone. Since 1971 we have funded almost 300 projects and invested £15 million pounds into medical research that leads to better diagnoses and treatments for the millions of people who, like us, don't have the luxury of taking our guts for granted.

But we still have much more to do.
Will you support Guts UK?

Give a donation today and play your part in the next vital research that will change things for future generations of people affected by the frustration and misery of digestive disease.

Together we can make more important change happen. Vital answers, new treatments and hope.

FIND OUT MORE
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