



Hydrogen Methane Breath Tests

The Complete Guide

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Understanding Hydrogen Methane Breath Tests

Introduction

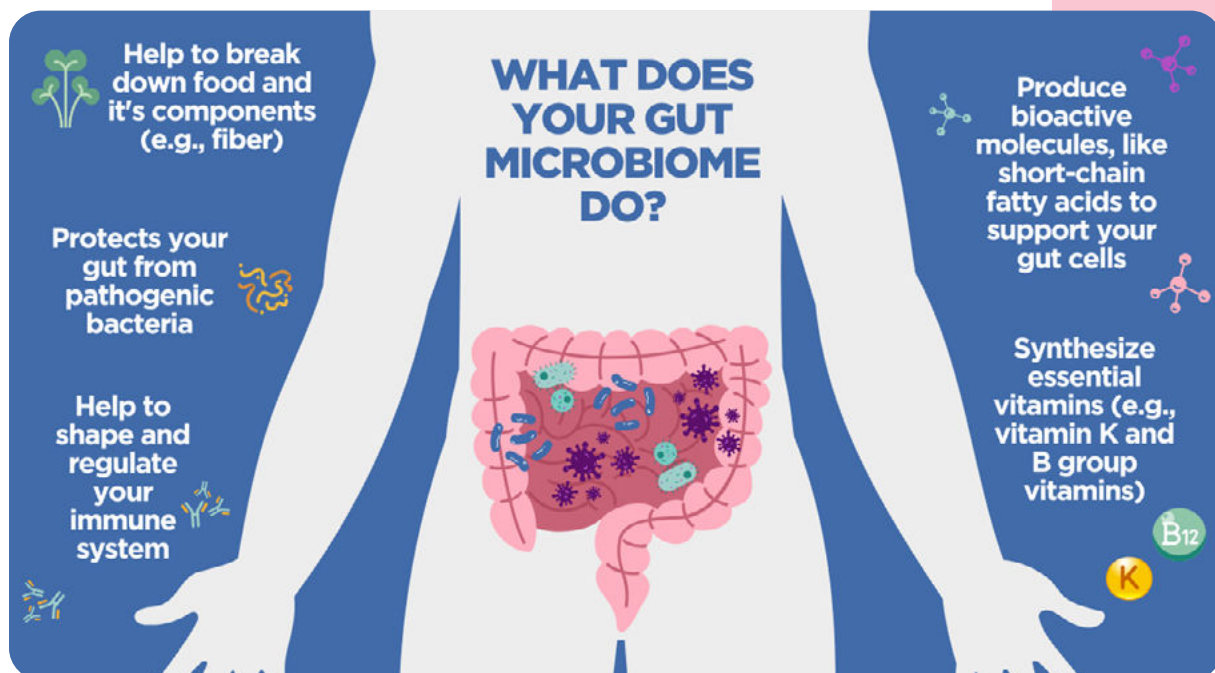
It has been estimated that we take an average of 22,000 breaths per day (1), which equals about 11,000 litres of air leaving our bodies into the atmosphere. This large volume of breath is left to dilute into the atmosphere, and the unique pattern, or “breath print”, of this vast array of chemicals is usually lost to the environment. Abnormal levels of breath chemicals can indicate the presence of certain diseases and those studying breath analysis believe it is an underutilized resource, that could be used to improve diagnostic tests and monitoring technology for a range of contexts.

Modern breath research dates back to 1971, beginning with the groundbreaking work of Nobel Prize winner Linus Pauling. He showed that approximately 250 compounds could be quantified in the breath of an individual who had been placed on a diet that starved the intestinal microbiota of any nutrients for several days (2). Breath analysis techniques

have improved significantly since this seminal work, with over 1,000 compounds now being readily detectable in each breath sample. Many of these compounds have important links with health and disease status and are produced by the gut microbiome. In the last 10 or 20 years, the conversation around gut health has greatly changed, and in turn, so has the introduction and use of breath tests within digestive disease.

The Origins of Gut Health Research

The recognition that the gut microbiome, the trillions of bacteria and other microorganisms in your gut, is a key influencer of health and disease in the body has revolutionized the way we think about our digestive health. There is now an increased incentive to strive to maintain ‘good gut health’, which involves having a diverse, balanced gut microbiome and limited digestive symptoms (3).



Living in urban environments has been associated with a reduction in gut microbiome diversity, yet the exact reason for this is still unclear (4). Potential causes for loss of gut microbial diversity include changes to modern diets, lifestyle factors, increased cleanliness in homes, and increased antibiotic usage.

Microbiome composition is important in many gastrointestinal diseases, such as inflammatory bowel disease (IBD) (5,6), and more people than ever now suffer from gastrointestinal issues; approximately 40% of the world's population (7).

In the 17th century, the observation of feces under a microscope led to the identification of moving cells that were termed 'animalcules', but we now know as bacteria (8). This was the first time that the link between bacteria and the gut was recognized. However, it wasn't

until almost two centuries later that these findings were pursued in the 1853 book 'A Flora and Fauna within Living Animals', which is widely considered to be the origin of microbiome research (9). This work inspired further research by Louis Pasteur, who developed the germ theory of disease and proposed that non-pathogenic microbes had a key role in human health.

Microbes beneficial to our gut health have been used in many different treatments over the centuries. For instance, fecal microbiota transplants (FMTs), which involve transferring fecal bacteria from one patient to another to treat gastrointestinal disease, were first described over 1700 years ago as part of traditional Chinese medicine (10). It wasn't until 1958 that FMTs were used in modern clinics to successfully treat *Clostridium*

Difficile infections (9). Other bacterial treatments were also used in the early 20th century, such as the discovery of an *E. Coli* strain during World War I that could be encapsulated inside gelatine pills to treat dysentery (an intestinal infection that causes diarrhea with blood or mucus).

Throughout the 20th century, the topic of gastrointestinal health was considered quite taboo, usually only to be discussed with doctors and dieticians. Even now, elements of this stigma remain, with research by Guts UK revealing that 58% of people are embarrassed to talk about their digestive symptoms, and 51% of people delay seeking advice for these symptoms for more than six months (12).

However, the conversation is widening around these topics with the advancing understanding of the importance of gut health. In fact, this importance has been recognized after advancements in technology towards the end of the 20th century allowed improved analysis and identification of the microbes making up the microbiome.

The Re-discovery of the Microbiome Research

In 1998, it was determined that each individual has a unique microbiome (13). These and other related research developments were seen as a 'rediscovery' of the microbiome, as they offered huge

Until recently, gastro-intestinal health was considered **taboo topic**, not to be discussed in public



58% of people are embarrassed to talk about their digestive issues



More than 1 in 2 delay seeking digestive health advice for more than



6 months

new insights into understanding the microbiome after years of little progress.

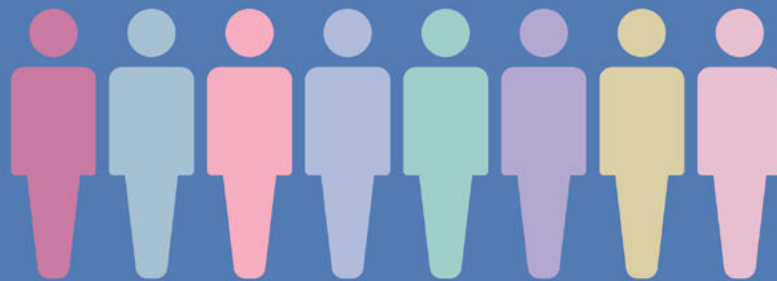
In 2007, The Human Microbiome Project was launched. After the first phase focused on identifying and characterizing the human microbiome was completed, a second phase attempted to reveal the impact of the human microbiome on various diseases. There has been an exponential increase in our understanding of the functions of the microbiome since its rediscovery, with some key discoveries opening vast new areas of research. For instance, connections between the gut

microbiome and the brain are currently being particularly highlighted, with new studies revealing that mental health conditions such as anxiety and depression are strongly associated with dysregulation of the gut microbiome (14).

Understanding The Microbiome

The newfound understanding of the importance of the microbiome has revealed insights into lifestyle changes, dietary changes, and treatments that can help to improve our overall

Each individual's gut microbiome is unique



Location



Genetics



Exposure



Culture and lifestyle



Medications



Diet



Birth and breastfeeding

and it's shaped by many factors.

health through our gut. However, given that everyone has a unique gut microbiome, none of this understanding is of any use if we can't understand and monitor our personal gut health. This is where breath testing comes in.

Hydrogen and Methane

Hydrogen perhaps remains the most well-established breath biomarker of gastrointestinal disease (15). Hydrogen gas is normally produced by certain bacteria in the large intestine, and some gut microbes can also produce methane. These gases are then absorbed into the blood where it can travel to the lungs to be excreted in breath, allowing for their detection.

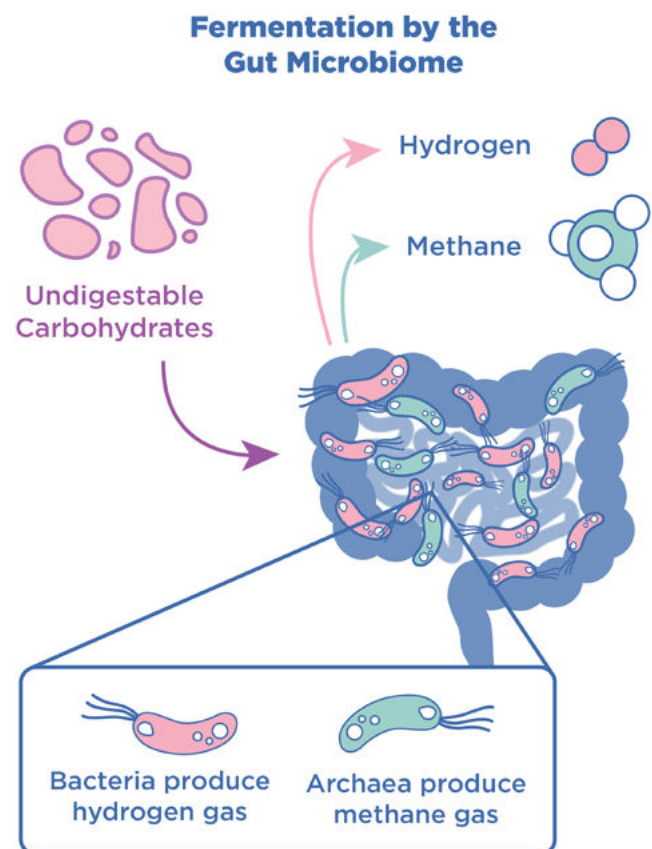
Hydrogen is produced by bacteria that live in the gut as they ferment the indigestible fiber from our diet. This is a normal process and helps us to extract nutrients from our food, and fermentation by gut bacteria creates many helpful compounds that can support our health and well-being. However, an excessive amount of hydrogen can cause uncomfortable symptoms such as abdominal pain and bloating, especially if this process of fermentation is happening too soon in digestion.

Breath methane is found in 30-50% of the healthy adult population and high levels can be accompanied by symptoms such as constipation and bloating, as well as obesity and reduced weight-loss following

bariatric surgery.

Both hydrogen and methane can be produced by a healthy gut microbiome, yet when the gut microbiome becomes dysregulated, the levels of these gases can be increased leading to unpleasant symptoms such as bloating and abdominal discomfort, as in small bacterial intestinal overgrowth (SIBO). The increase in these gases can be detected using a Hydrogen Methane Breath Test (HMBT).

Nearly 80% of those who suffer with irritable bowel syndrome and digestive health symptoms have SIBO or intestinal methanogen overgrowth (IMO). Both conditions are often tricky to diagnose, however, the 'gold standard'



diagnostic for SIBO is the HMBT, which analyses the amount of hydrogen and methane in your breath. HMBTs tests are highly sensitive, measuring the concentration of gases in the parts per million (ppm) range in the breath. An excessive amount of methane in the gut and therefore in the breath can be characteristic of IMO (intestinal methanogen overgrowth), or sometimes just methane SIBO. Elevated methane is usually measured in a single time point test, or it can be assessed longitudinally through at-home portable devices.

To measure the gases produced by gut bacteria, we first need to give them something to ferment, usually referred to as a 'substrate'. Substrates are simple carbohydrates that gut bacteria can break down easily, producing methane and hydrogen gases in the process. The substrate used in breath testing differs based on the disorder under investigation – for SIBO, lactulose and glucose are common substrates, whilst fructose and lactose are more often used for carbohydrate malabsorption tests (16).

An initial breath sample is taken to begin the test. The substrate is then usually dissolved in a glass of water and consumed. Further breath measurements are then taken at specific intervals over the course of two to four hours. You may also record digestive symptoms throughout the breath test to help your clinician to interpret your results.

How the Hydrogen Methane Breath Test Works

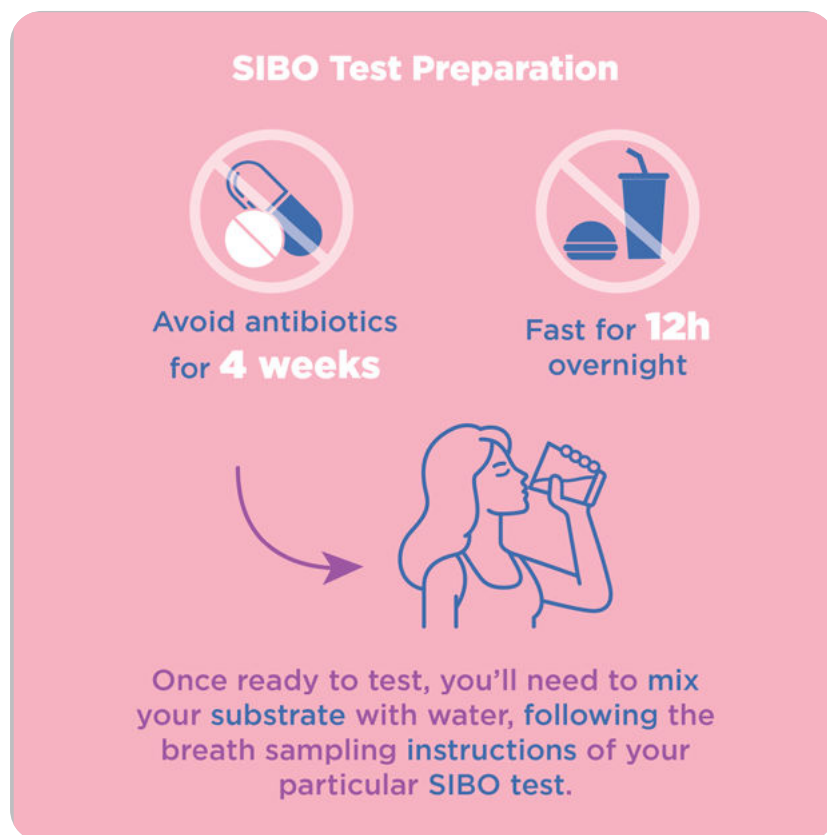
The breath contains many different compounds that can either originate from environmental factors or from metabolic processes within the body. However, in order to diagnose digestive disorders, a more accurate measurement of the gases is required, as opposed to a simple 'yes' or 'no' answer as to whether hydrogen and methane are detected.

To order to provide this level of diagnostic accuracy, we need to be able to measure the precise concentrations of hydrogen and methane in exhaled breath, which are low enough in concentration that they are measured in parts per million (ppm). This is the same as looking for a single water droplet in a swimming pool or if you had a million bubbles in one bottle, a single bubble.

It is important your breath test analyses both hydrogen and methane levels. There are some tests on the market that only analyse hydrogen but some of the microbes in your gut that can cause problems are archaea, which produce methane rather than hydrogen. If only hydrogen is measured, it is more likely that a false negative result occurs, which can affect your treatment plan.

A false negative result is when a diagnostic test incorrectly returns that you do not have a condition,

when in fact you do. A false negative can lead to misdiagnosis, meaning your undetected SIBO, or other digestive condition could go untreated.



Breath testing has also been shown to be useful in the diagnosis of carbohydrate maldigestion, methane-associated constipation, and evaluation of bloating/gas, but not in the assessment of oro-cecal transit.

What to Expect: Preparation, Test Process, Timing

Normally, you should not have taken any antibiotics for around four weeks before your test. This ensures that the bacteria that might be causing your digestive symptoms are present and able

to produce the gases that the test measures. Before your breath test, you may be asked to restrict your intake of certain foods and medications, and you will usually be asked to fast for around 12 hours overnight before you take the test.

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Glucose or Lactulose?

Lactulose is a synthetic sugar that cannot be absorbed by the body. This means that it will travel through all regions of the small intestine without being absorbed. If there is bacterial overgrowth present, the sugar will be fermented by organisms in the gut into hydrogen gas. Readings over a certain threshold in a specific timeframe indicate SIBO. However, if it passes through the gut too quickly, you may receive a false positive result. This is because lactulose may reach the large intestine faster, where it can be fermented by the bacteria typically found there. The resulting hydrogen gas readings could therefore appear soon after ingestion, mimicking SIBO even if there isn't a bacterial overgrowth in the small intestine.

Glucose, on the other hand, is a sugar that can be absorbed by the small intestine. This means that it could be absorbed before reaching a bacterial overgrowth present in the latter half of the small intestine. This increases the likelihood of a false negative result. The glucose test can be used for people with altered gut anatomy – for example, people who have had weight loss surgery, as it reduces the risk of false positive results that could result from these surgeries, when using lactulose.

It is best to consult with your doctor on which substrate to use as some people may have a strong reaction to the lactulose substrate.

At-Home vs in-Clinic Testing

Breath tests for digestive health problems can be performed in a clinic or healthcare facility using point-of-care devices which give instant results readouts. Tests will normally be carried out by a nurse, medical assistant, or other qualified healthcare professional. There may be some additional time before the breath test to discuss your symptoms or medical history with the supporting health care practitioner.

Although in-clinic breath testing has the benefit of in-person healthcare practitioner support, there are some disadvantages, mostly affecting you, the patient.



At-Home Breath Testing

Breath testing can also be carried out at home, allowing you to collect samples in the comfort of your own home at a time that works for you. Once you've finished collecting samples, you can send them back to the provider's laboratory for analysis, normally in a pre-paid package. Your results can then be interpreted by your clinician or an approved medical practitioner in partnership with the provider.

At-home testing is convenient and avoids most of the disadvantages of in-clinic testing. You won't have to take time off work to travel anywhere or worry about wait times for diagnosis and treatment.

Disadvantages of in-clinic breath tests



To attend a clinic or healthcare facility, you will need to take time away from work, life, or school – the breath testing can take up to four hours, a substantial time commitment.

Traveling to and from the clinic adds extra disruption to your day, as well as the additional cost of public or private transport (including parking).



Breath testing equipment used in clinics needs to be disinfected between patient visits – these safety measures, coupled with potential space limitations and evolving safety guidelines, can lead to longer wait times for both diagnosis and treatment.

Advantages of at-home testing



Collect samples at your own convenience, without needing to go to a clinic.

If using a test kit, drop off your parcel in a local mail box and wait for the laboratory to come back with results.



If using an at-home breath testing device. Get immediate results, often via a mobile app.

Always check consumer gadgets to make sure they are registered as medical-grade diagnostic devices for accurate results!



Novel Digital Devices



At-home digital devices, have the potential to revolutionize hydrogen and methane breath testing. Given the widespread use of breath tests to inform and direct diagnosis and treatment pathways for a variety of gastroenterological conditions, these devices should be accurate and reliable, consistent with established in-clinic methods. Sensor precision, calibration consistency, and a standardised breath collection technique are fundamental in ensuring reliable results, as misleading readings could directly impact patient treatment and care.

While consumer-grade devices are increasingly promoted and available for the consumer/healthcare professional to purchase and use, they lack the structured validation for clinical use, as they do not meet the same

rigorous regulatory standards as medical-grade devices. This critical distinction must restrict the use of consumer-grade devices in healthcare. Healthcare professionals should base their decision-making only from medical-grade devices proven to be reliable, reproducible and comparable to in-clinic methods. Likewise, patients should place their trust only in medical-grade devices, as the accuracy of the results directly impacts diagnosis and treatment decisions, as well as any personal insights they may draw from the data.

The North American Consensus Guidelines

With the popularity of breath tests for digestive diseases and other gut problems growing, the North American Consensus (NAC) was developed. Informed by experimental work and expert opinion, a consortium of specialists published the NAC consisting of 26 guidelines, with the aim to provide a standardized process for the optimal interpretation of HMBTs (18).

The NAC in turn proposed several changes to the tests, with the goal of improving the accuracy of results and providing greater consistency across test providers. As part of an HMBT, patients are required to drink a substrate

diluted in water. The NAC changed the criteria for some of the tests, including lowering or raising the dosage of the substrate, the benchmarks for the parts per million on breath, as well as the duration of sampling. These changes have proven to have improved accuracy and reliability of HMBTs (19).

It is crucial that the tests and analysis provided are aligned with the recommendations given by the NAC to help patients receive the correct treatment and, ultimately, alleviate symptoms.

Are at home breath tests accurate?

The short answer is yes! All test providers should be following the NAC Guidelines (as described in the previous paragraphs).

As long as you follow the at home breath test preparation and the instructions for the test, then your result should be just as accurate as a standardized in-clinic test (17).

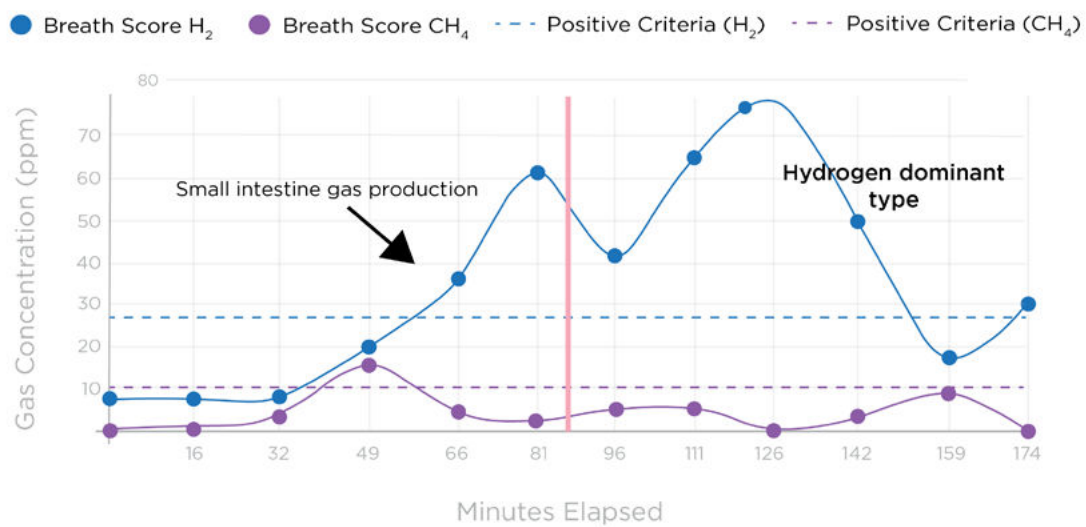
Breath Test Comparison

Method	Purpose	Pros	Cons
Clinic-Based HMBT	One-time diagnosis	Supervised test with immediate result	Inconvenient, costly to attend appointment and not ideal for multiple tests
At-Home Mail-Kit	One-time diagnosis	Convenient, affordable	Slow results, risk of error, single snapshot of levels
At-Home Digital Device	Multiple diagnostic tests as needed and longitudinal monitoring	Real-time, repeatable, lifestyle tracking	Upfront cost

What a positive SIBO test looks like

Positive Hydrogen Dominant SIBO Test

Lactulose Challenge Result (03/16/2025)



Breath no.	Base	1	2	3	4	5	6	7	8	9	10	11
Time, mins	0	17	32	50	66	81	96	111	127	143	159	175
H_2 , ppm	7	7	8	20	36	62	42	65	79	50	17	30
CH_4 , ppm	0	0	3	15	4	2	5	5	0	3	9	0
Abdominal Pain	0	0	0	0	0	0	0	0	0	0	3	0

Results

Hydrogen

Baseline: 7 ppm (LOW) **Rise in 90 min:** 55 (HIGH) **Peak in 90 min:** 62 ppm after 81 min

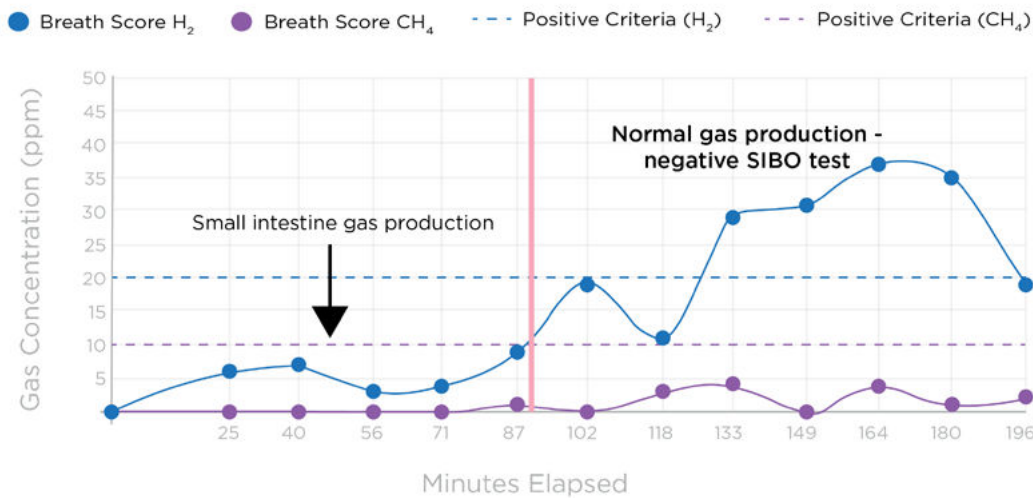
Methane

Baseline: 0 ppm (LOW) **Rise:** 15 (HIGH) **Peak:** 15 ppm after 50 min

What a negative SIBO test looks like

Negative SIBO Test - Normal Gas Production

Lactulose Challenge Result (01/18/2025)



Breath no.	Base	1	2	3	4	5	6	7	8	9	10	11	12
Time, mins	0	21	41	56	72	87	103	118	134	149	165	180	196
H ₂ , ppm	0	6	7	3	4	9	19	11	29	31	37	35	19
CH ₄ , ppm	0	0	0	0	0	1	2	3	4	0	4	1	2

Results

Hydrogen

Baseline: 0 ppm (LOW) **Rise in 90 min:** 9 (LOW) **Peak in 90 min:** 9 ppm after 87 min

Methane

Baseline: 0 ppm (LOW) **Rise:** 4 (LOW) **Peak:** 4 ppm after 134 min

Diagnosis and Treatment of SIBO (small intestinal bacterial overgrowth)

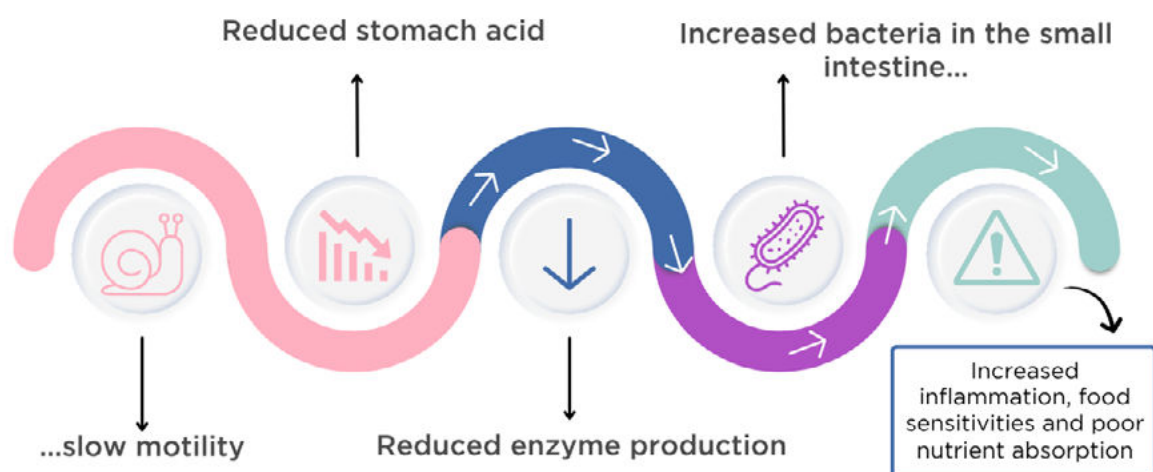
SIBO is characterized by an over-colonisation of bacteria in the small intestine, which arises when a person's balance is compromised. As hydrogen gas is exclusively produced by microorganisms in the gut, not by human cells, an elevated hydrogen level in the hydrogen/methane breath testing (HMBT) is indicative of increased bacterial growth.

Microbiome overgrowth can result from changes in gut motility (e.g.:

irritable bowel syndrome (IBS), narcotic use and diabetes mellitus), anatomical disorders (e.g.: small intestinal diverticulosis and blind intestinal loops), decreased stomach acid production (due to the use of proton pump inhibitors) and immune disorders (e.g.: HIV) (20, 21).

In fact, before the characterization of SIBO, many cases were misdiagnosed as IBS, due to the overlap in their symptoms.

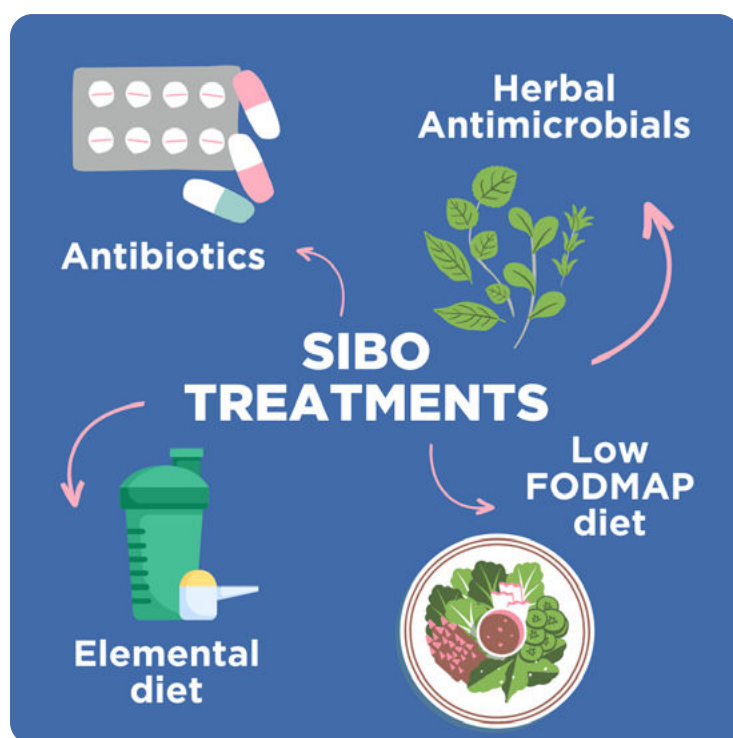
THE FLOW OF SIBO



SIBO Treatment

The good news is that the symptoms of SIBO can be effectively addressed. Currently, there are three main treatment pathways:

- » **Low FODMAP Diet + Antimicrobials**
- » **Low FODMAP Diet + Antibiotics**
- » **Elemental diet**



Maintaining a nutritious, well-balanced diet is paramount to retaining gut health. Whilst it might be tempting to try all the methods mentioned above, they must be done in moderation, and under the guidance of a healthcare professional. An imbalanced diet can lead to malnutrition, adversely affect your health, and even

exacerbate your GI symptoms. Foods high in FODMAPs include fruits and vegetables that are important for your diet, hence, it is crucial to remove and reintroduce them to your diet one by one, to effectively identify the cause of your symptoms, but also identify alternatives and levels of tolerance that allow you to maintain a varied diet. Although antibiotics can rapidly eradicate bacterial overgrowth, their use is limited by contraindications and the risk of developing antibiotic resistance. For this reason, antimicrobials such as herbal therapies should be used first when possible.

SIBO can recur after treatment. Adherence to your treatment regime and follow-up appointments with healthcare professionals are key to preventing relapse and ensuring long-term management of the condition can help. Longitudinal monitoring of your symptoms and hydrogen and methane breath levels can also help to identify a flare up or the build up to one, both helping you to identify when to consider additional support from a healthcare professional or treatment plan.

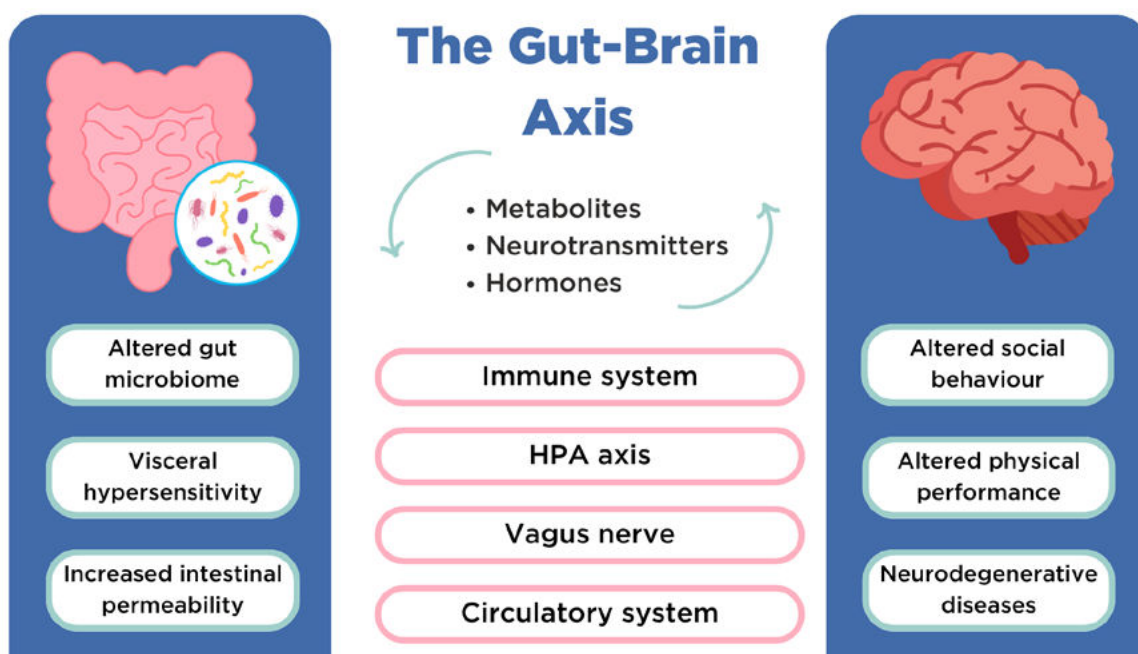
Getting a negative SIBO test result

It can be frustrating when you test negative for small intestinal bacterial overgrowth (SIBO)

but still suffer from persistent gastrointestinal (GI) symptoms. However, the silver lining is that a negative SIBO test rules out one potential cause, bringing us closer to identifying the underlying issue. Before undergoing the SIBO test, you should have completed the test for intestinal methanogen overgrowth (IMO). With SIBO and IMO ruled out, it's time to explore other potential diagnoses and option to improve symptoms.

known as the gut-brain axis (GBA), which links the brain's thoughts and feelings to intestinal function (22). The GBA operates through complex signalling mechanisms that involve neural, immune, and hormone factors. Feeling emotional when you have an upset tummy, knowing the degree of fullness of the stomach, and recognizing the need to open your bowels are examples of the GBA system at work (23). Insights into the GBA axis have also led to the use of antidepressants for relieving GI symptoms, based on the idea that improving mood and reducing psychological distress can relieve gut discomfort (24).

Gut-Brain Disorders



It is now established that there is bidirectional communication between the central nervous system and the extensive network of nerves lining the gut (the enteric nervous system). This is

Recent advances have confirmed the role of gut microbiota in influencing these gut-brain interactions and how excessive microbiome colonization can lead to disorders of the GBA (25).

There is emerging evidence to suggest that another potential cause of non-specific GI symptoms could be disorders of the GBA, which is estimated to affecting more than 40% of the population. The five most common disorders are irritable bowel syndrome (IBS), functional dyspepsia (chronic indigestion), functional constipation, functional diarrhea,

and functional bloating/distention (26). The term 'functional' indicates although patients have ongoing symptoms, standard tests do not find any physical problems. It was once believed that such gastrointestinal symptoms have no clear cause, but new understanding of the GBA has changed this perspective (27).

Food group	Low-FODMAP examples	High-FODMAP examples
Vegetables	 Lettuce, carrot, cucumber	 Garlic, beans, onion
Fruits	 Strawberries, pineapple, grapes	 Blackberries, watermelon, peaches
Protein	 Chicken, eggs, tofu	 Sausages, battered fish, breaded meats
Fat	 Oils, butter, peanuts	 Almonds, avocado, pistachios
Starch, cereal, and grain	 Potatoes, tortilla chips, popcorn	 Beans, gluten-based bread, muffins

It is challenging to outline a treatment plan without a clear diagnosis. However we have grouped disorders into diarrhoea-predominant, constipation-predominant, and mixed symptoms and potential options to help relieve symptoms.

Diarrhea-predominant symptoms

For those experiencing diarrhea-predominant symptoms, implementing a low-FODMAP diet can promptly and significantly improve diarrhea (28,29). FODMAPs poorly-digested sugars that draw excess liquid into the intestines and promote bacterial fermentation, leading to pressure build-up and diarrhea (30, 31).

A low-FODMAP diet is also suggested to improve abdominal pain, bloating, and quality of life (32). Following a low-FODMAP diet involves three steps (33):

» Restriction Phase

- Adhere to the low-FODMAP diet as closely as possible for six weeks to assess its impact on GI symptoms.

» Reintroduction Phase

- Gradually reintroduce avoided foods one at a time, in increasing portions, to identify specific carbohydrates that cause symptoms.

» Personalisation phase:

- Establish a personalized diet plan that includes both low-FODMAP foods and high-FODMAP foods that do not trigger symptoms.

Constipation-predominant symptoms

For those experiencing constipation-predominant symptoms, a fiber-rich diet can be effective in alleviating symptoms. Constipation is medically defined as difficult and infrequent bowel movements, typically characterized by having fewer than three bowel movements per week (34). You've probably heard that dietary fiber aids in bowel regularity, a fact supported by years of research, but do you know why (35)?

First, let's look into the different types of fiber. There are two main categories: soluble fiber (found in the inner flesh of fruits, most root vegetables, and legumes) and insoluble fibers (found in the outer skin of plants) (36). Insoluble fiber increases fecal mass and promotes food passage by stimulating the gut wall and peristalsis (the muscle contractions that propel food through the digestive tract). On the other hand, soluble fiber maintains the water content in stools, making them easier to pass. A combination of both fiber types is encouraged to improve constipation symptoms (37). If the first-line dietary advice and

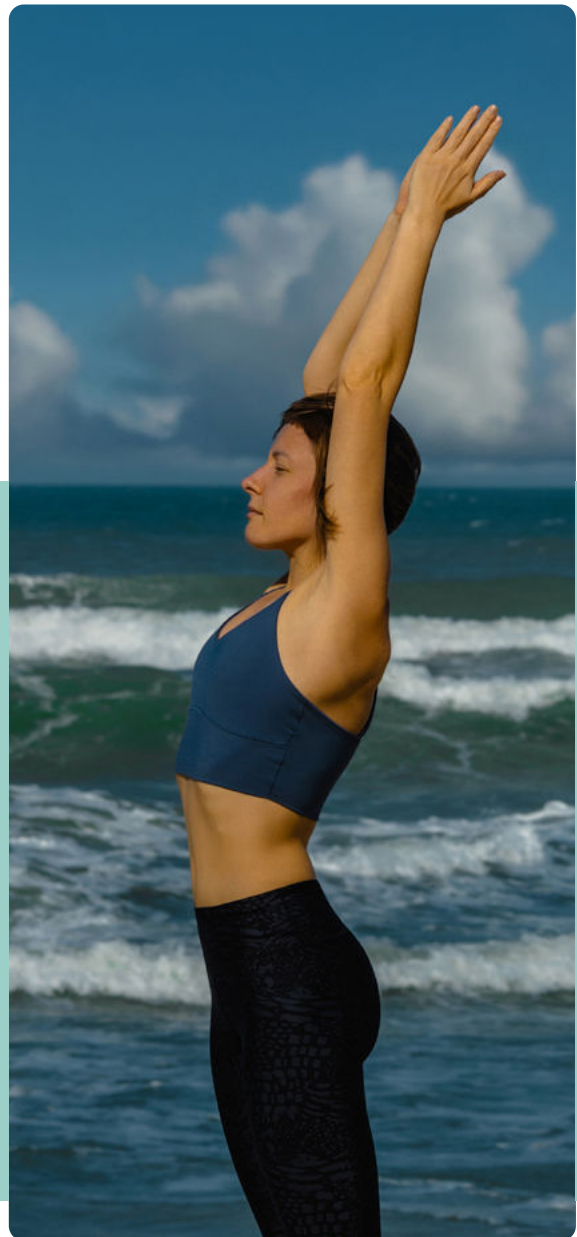
lifestyle changes are ineffective, patients can consider referral to a clinician for further evaluation. In some cases, patients can be prescribed antimotility drug for persisting diarrhoea, laxatives for constipation or antispasmodic drug for ongoing abdominal pain and spasms (39). Subsequent treatments are also likely to involve multidisciplinary groups with primary physicians, gastroenterologists, and specialist nutritionists.

Inconsistent bowel habits

For those who do not have consistent bowel habits and struggle with both diarrhea and constipation along with other GI symptoms, treatment can be challenging. Mixed symptoms are multifactorial and there is yet to understand what conditions cause the symptoms to change. Ongoing research aims to uncover the various mechanisms behind changes in gut sensitivity, motility, and microbiome dysbiosis (38).

Maintaining general well-being to limit microbiome overgrowth and dysbiosis is key. Patients are advised to:

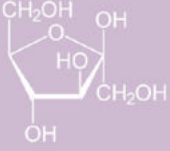
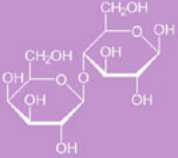
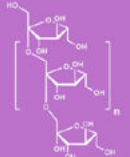
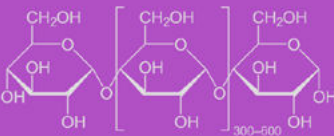
- » **Eat regular meals with a healthy, balanced diet and adjust their fiber intake according to their symptoms.**
- » **Maintain adequate fluid intake.**
- » **Engage in 30 minutes of moderate-intensity physical activity at least five days a week.**
- » **Identify and manage any stress, depression, or anxiety**



Carbohydrate Malabsorption

Despite being a core part of human diets, some people cannot break down and absorb carbohydrates correctly - a condition called carbohydrate malabsorption. Carbohydrates provide a vital

source of energy as one of the macronutrients in your diet, alongside protein and fat (1). Carbohydrates (or saccharides) are molecules made up of carbon, hydrogen, and oxygen, and can be divided into four structural groups: monosaccharides, disaccharides,

	Monosaccharides	1 sugar
	A single sugar unit, like glucose, fructose, or galactose. Monosaccharides are absorbed in the gut.	
	Disaccharides	2 sugars
	Two sugars together, such as lactose and sucrose. Disaccharides can be split by human or bacterial enzymes.	
	Oligosaccharides	3-10 sugars
	Chains of monosaccharides, such as fructooligosaccharides (FOS) and galactooligosaccharides (GOS).	
	Polysaccharides	>10 sugars
	A long chain of monosaccharides, like amylose and dietary fibers.	

Simple Carbohydrates

One or two sugars combined in a simple structure that are used as an energy source, e.g., fructose, lactose, maltose, glucose.



Complex Carbohydrates

Three or more sugars bonded in a complex structure which take longer to digest, e.g., dextrin, amylose, cellulose, rutinulose.



Starches

Complex carbohydrates that have a large number of glucose molecules. Starch polysaccharides are produced by plants.



Fiber

Non-digestible complex carbohydrates that help to add bulk to your stool and that your gut bacteria feed on. Fiber can be soluble or insoluble.



oligosaccharides, and polysaccharides. It is also possible to classify carbohydrates by type, of which there are also four: simple and complex carbohydrates, starches, and fiber. These molecules are found in many different foods and are broken down either by your digestive enzymes or gut bacteria. Normally, on the journey from your mouth to your small intestine, carbohydrates are broken down by enzymes to monosaccharides, which are then absorbed by your gut cells (2). Following absorption, carbohydrates primarily act as an energy source, and have secondary roles in blood glucose control and insulin, cholesterol, and triglyceride metabolism (1).

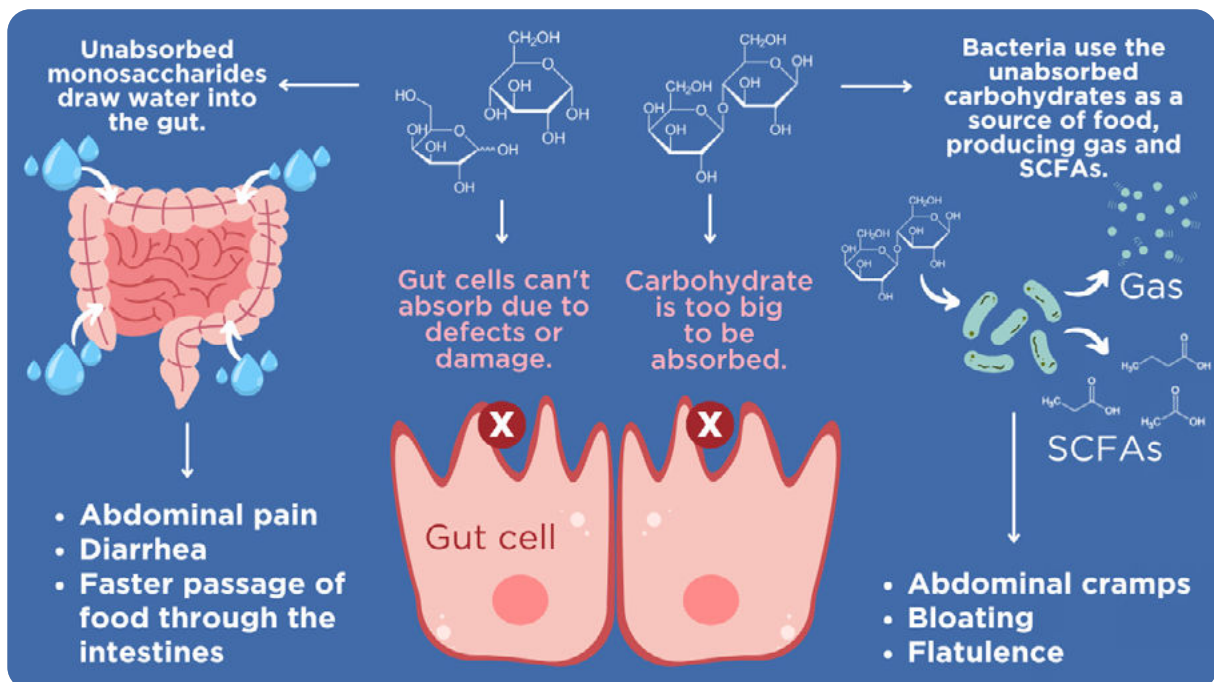
Some people do not produce the right enzymes to help break down carbohydrates (congenital malabsorption), have defective enzymes or absorption systems (primary malabsorption), or are

unable to absorb carbohydrates normally due to impairments in gastrointestinal function, often as a result of digestive conditions like Celiac Disease and Crohn's Disease (secondary malabsorption) (2).

Symptoms of carbohydrate malabsorption are primarily gastrointestinal and can include (2):

- » **Abdominal cramps and pain**
- » **Diarrhea**
- » **Bloating and gas**
- » **Nausea**
- » **Headaches**

Gastrointestinal symptoms of carbohydrate malabsorption are thought to be driven by two factors. Firstly, a gut full of unabsorbed sugars attracts water

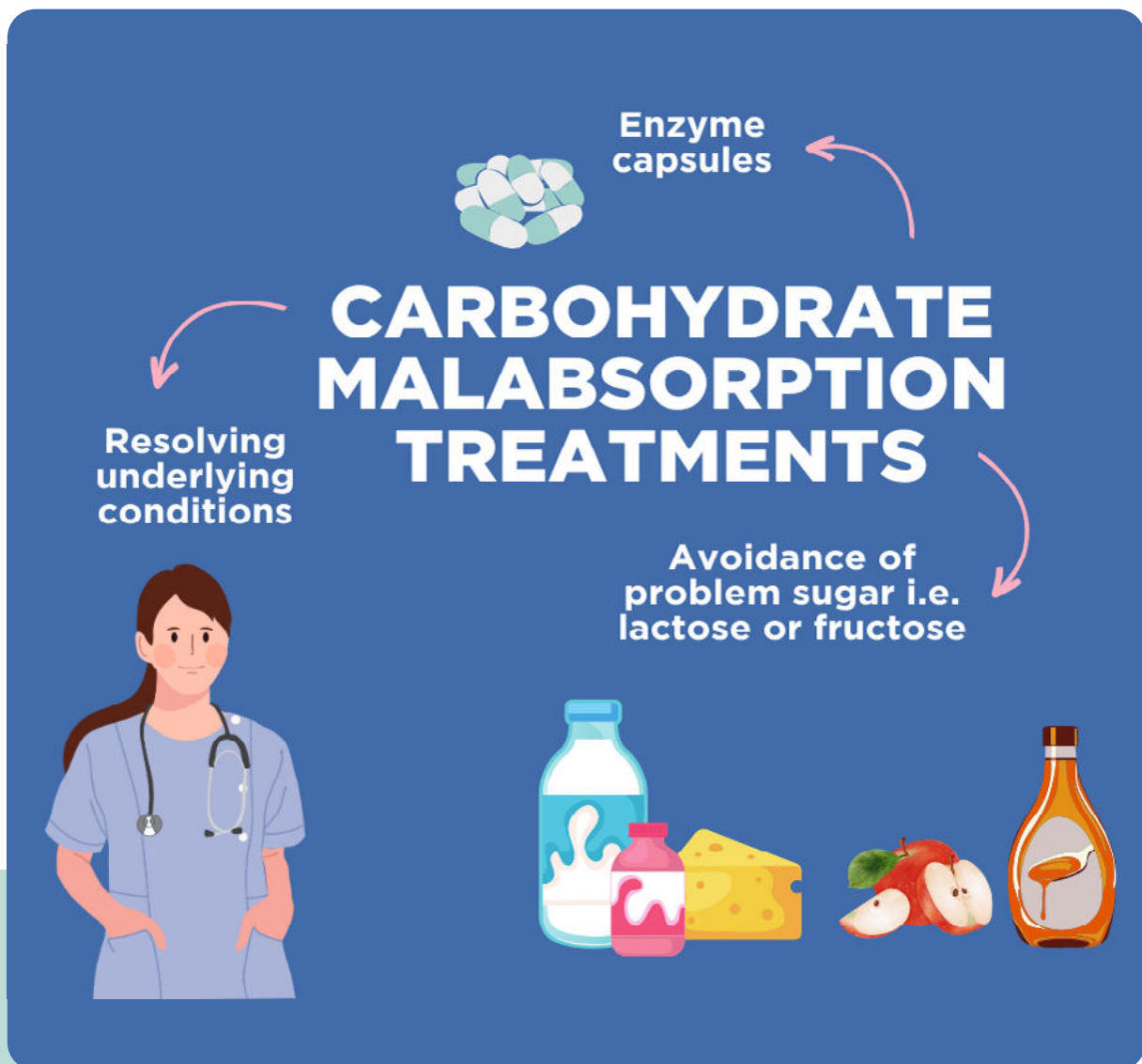


- this is known scientifically as 'increasing the osmotic load' (2). Large amounts of water in your gut can lead to pain, diarrhea, and accelerated passage of food through your digestive system (2). Secondly, when carbohydrates are not broken down and absorbed properly, they can act as a fuel for your gut bacteria which readily feed on them, producing hydrogen, methane, and carbon dioxide gases in the process. This can leave you feeling bloated and suffering from abdominal pain and

flatulence (3). Bacterial metabolism of carbohydrates also produces short-chain fatty acids (SCFAs) which although beneficial to your gut cells, can cause cramps and diarrhea at higher concentrations (3).

Diagnosis of Carbohydrate Malabsorption

Living with carbohydrate malabsorption symptoms can be incredibly uncomfortable and



have knock-on effects on your quality of life. Seeking diagnosis and treatment for carbohydrate malabsorption is not always easy, as the gastrointestinal symptoms can overlap with other gut health conditions. It's therefore likely that your doctor may want to rule out other more serious conditions first (e.g., colorectal cancer, inflammatory bowel disease) before testing for carbohydrate malabsorption.

Luckily, carbohydrate malabsorption is relatively easy to diagnose via a HMBT. The hydrogen gas that your gut bacteria produce as they break down carbohydrates enters your systemic circulation, travels to the lungs, and is exhaled on breath. By collecting breath samples after you've drunk a carbohydrate solution (e.g., lactose, fructose), we can see whether the hydrogen levels on breath rise over a set time frame, indicating that you have a carbohydrate malabsorption disorder.

Treatment of Carbohydrate Malabsorption

Carbohydrate malabsorption is often managed through dietary modifications, such as avoiding the malabsorbed sugar (e.g., lactose, fructose) (40). Some carbohydrate malabsorption conditions can also be managed by taking enzyme supplements (41). For patients suffering from secondary carbohydrate malabsorption as a result of a gastrointestinal disease,

treatment instead focuses on resolving the underlying condition (42).

Ultimately, management and treatment of carbohydrate malabsorption is unique to the type of malabsorption condition you have and your personal therapeutic preferences. Treatment pathways for carbohydrate malabsorption, particularly those involving dietary modification or restriction, should always be undertaken with the guidance of an appropriate medical professional.



Understanding Methane

Methane and its role in Breath Tests

Approximately a third of people are methane producers. Interestingly, the presence of methane in the gut seems to be something that runs in families, as the majority of people who can produce methane have parents or siblings who are the same (43).

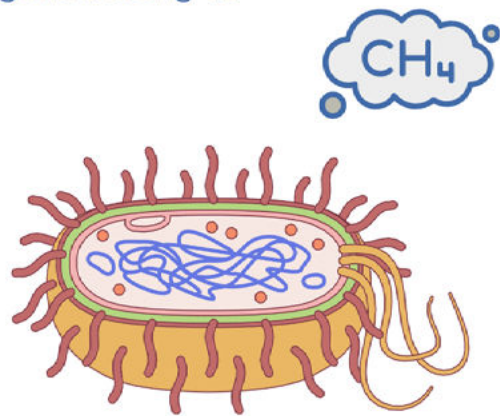
Methanogen Fact Sheet

Methanogens are **microscopic organisms** that can produce **methane**. In the human gut, methanogens belong to the domain of life called **archaea**.

Methanogens mostly **feed** on the products of **bacterial fermentation** including hydrogen.

There is an **association** between methanogen presence and **chronic constipation**.

Methanogens are the **oldest form of life**, lacking membranes to form nucleus around their RNA (genetic information).



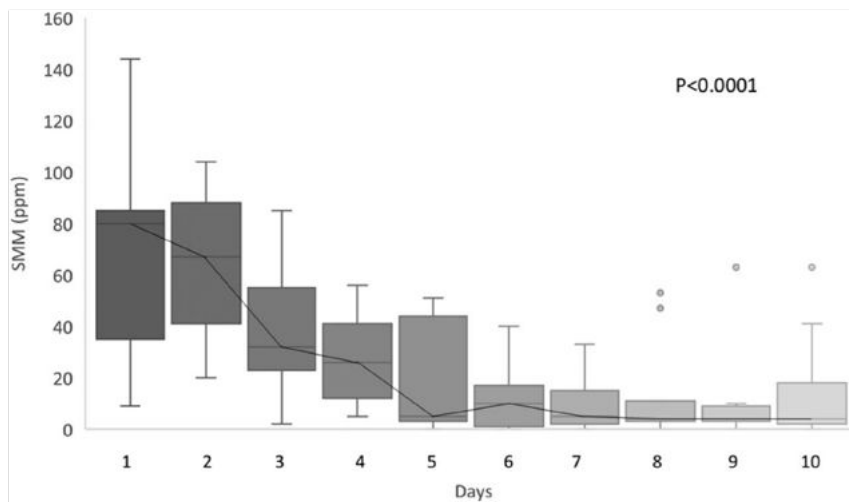
Microorganisms called archaea are almost exclusively responsible for producing methane in the gut (44). Although they are similar to bacteria in many ways, they have a few key differences in their biology. A type of archaea known as a methanogen can convert hydrogen into methane in the gut. Because this process can lower the levels of hydrogen in the breath, it is important to take the levels of

methane into consideration during the diagnosis of conditions such as SIBO – where a false negative result may be given.

We can accurately measure an excessive amount of methane in the gut through a breath test, as between 20 – 50% of the methane in the gut is excreted in the exhaled breath.

Case Study

In a 2022 study, researchers explored the feasibility of using a methane test as a diagnostic and monitoring tool for IMO (45). IMO patients exhibit relatively stable methane levels on breath, potentially making methane a simple and effective biomarker for the disease.



Daily SMM levels rapidly and significantly drop during antibiotic therapy.

Takakura and team leveraged extensive historical data, including over 12,000 lactulose breath tests and more than 700 glucose breath tests. The results were compelling — using a single methane measurement (SMM) from the standard HMBT test showed a high correlation with IMO diagnosis. The sensitivity ranged between 86.4% and 98.8%, with a specificity of 99.3% to 100%, depending on the cut-off points.

To assess the stability of a SMM, the researchers examined

breath methane measurements taken on the day of a two-hour test and compared them with measurements taken 14 days later. The results indicated minimal changes, suggesting that SMM remains consistent over time.

Further data from a placebo group (where subjects take pills made without any o active ingredients) supported this.

This group saw stable methane levels for at least 84 days.

In the group taking antibiotics, methane levels were shown to drop over several days as shown in the graph to the left.

The study also found a correlation between SMM

levels and gastrointestinal symptoms. Patients with an SMM greater than 10 ppm were more likely to report constipation, while those with levels under 10 ppm were more prone to diarrhea. This aligns with previous knowledge that methane can slow intestinal motility.

The robustness of the results led Takakura *et al.* to conclude that SMM can accurately and non-invasively diagnose IMO, offering a simpler alternative to the standard HMBT.

A positive methane result

If your results suggest elevated levels of methane, what are likely to be the next steps? Elevated methane is associated with a condition called Intestinal Methanogen Overgrowth (IMO).

What is IMO?

IMO is characterized by the presence of abnormal and excessive methanogenic archaea in the gastrointestinal (GI) tract, causing non-specific GI symptoms such as flatulence, abdominal discomfort, pain, and nausea. Contrary to its close relative SIBO, which often has diarrhoeal presentations, IMO is associated with constipation (46,47). It is estimated that at least 33% of patients with unexplained GI symptoms or those with irritable bowel syndrome (IBS) are affected by IMO.

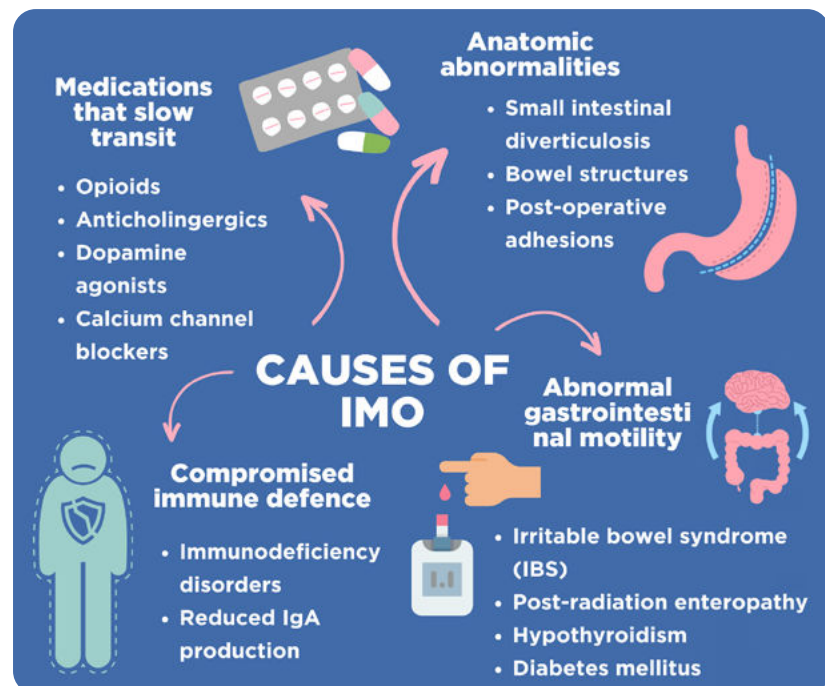
IMO Treatment Strategies

As the pathophysiology and development of IMO can be multifaceted and complex, treatment involves targeting the underlying causes and addressing the symptoms. Here, we have largely broken down the next three steps.

Step 1: Identifying the underlying cause

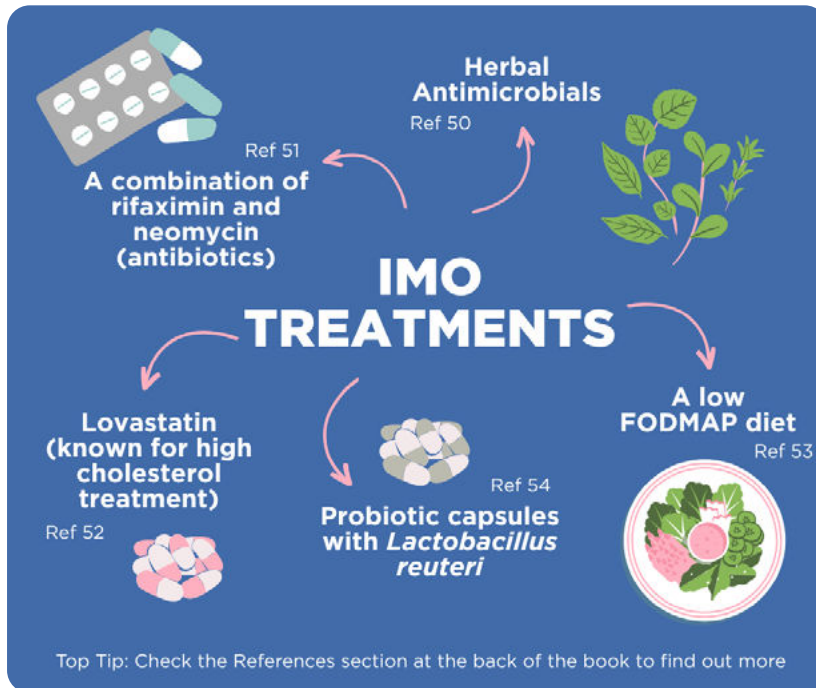
Excess microbiome growth is usually limited by gastric acid, bile, peristalsis, and proteolytic digestive enzymes. However, there are conditions that impair these host defense mechanisms, fostering the overgrowth of microorganisms (48,49).

These conditions promote the overgrowth of archaea and slow gut transit, providing more opportunity for bacterial or archaeal action. Unfortunately, these conditions are chronic and challenging to cure, with many treatments offering only modest improvements in IMO symptoms. In addition, a clear indication is necessary to determine if the patient requires any operative or invasive intervention due to the risks involved.



Step Two - Treatment

If there is too much methane in the gut, there are a number of treatments that have been proven to be effective. These include herbal antimicrobials (50), antibiotics (51), the statin lovastatin (52), FODMAP avoidance (53) and probiotics containing the strain *Lactobacillus reuteri* (54).



normalizing methane levels in lactulose breath tests. In a study evaluating the efficacy of the combination in patients with a positive methane breath test, 85% reported a clinical response. In comparison, 63% and 56% of patients reported improvement with neomycin and rifaximin monotherapy respectively.

In normalizing the breath tests, 87% of subjects in the

combination therapy group eradicated methane, whereas only 28-33% of patients achieved methane elimination with single-antibiotic treatments. Subsequently, when patients in the rifaximin group were switched to combination therapy, 66% of patients eliminated methane from their breath (55).

Although metronidazole, clindamycin, and ampicillin have been studied, clinical trials have shown that their effectiveness is limited. The superior efficacy of rifaximin and neomycin is

Antibiotics and Antimicrobials

Herbal antimicrobials can be used to treat SIBO to try and avoid the overuse of antibiotics, and to reduce the risk of antibiotic resistance. This includes probiotics and herbal remedies that include ginger and peppermint, which have been shown to be effective alternative SIBO treatments in some patients. Antibiotics, particularly the combination of rifaximin and neomycin, have been shown to be highly effective in alleviating GI symptoms and

likely attributed to their unique pharmacokinetics – both are minimally absorbed in the GI tract, allowing their therapeutic actions to extend to the distal parts of the gut (56). However, in some regions, orally administered neomycin is unavailable due to its risk of nephrotoxicity, and irreversible auditory and vestibular ototoxicity. Consequently, rifaximin is used with other antibiotics (57, 58). It is essential to follow your doctor's advice and adhere strictly to the prescribed treatment regimen to achieve optimal results and minimize the risk of complications.

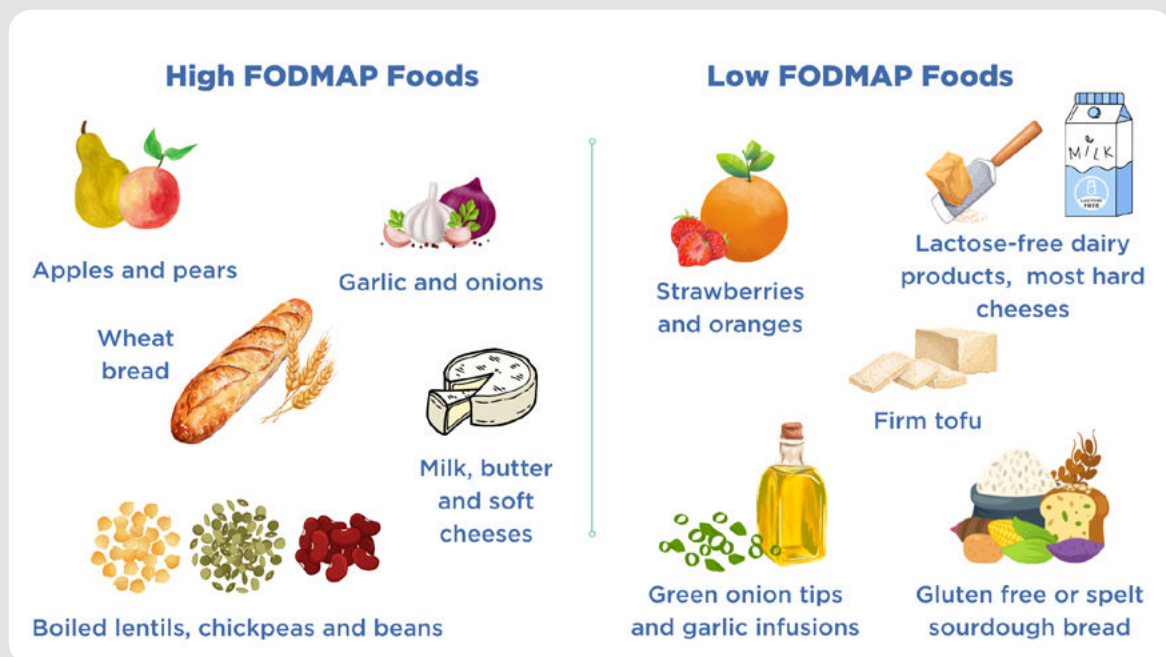
The low FODMAP diet

A favourable and viable strategy for reducing symptoms is the adoption of a low FODMAP (fermentable oligo-, di-, monosaccharides, and polyols) diet. FODMAPs are a group of

carbohydrates that are poorly absorbed in the small intestine and are prone to fermentation by the gut microbiome, leading to gas production and bloating. Limiting the intake of foods high in FODMAPs can limit the growth and proliferation of microorganisms (59).

Foods high in FODMAPs include certain dairy products (eg: milk, yoghurt and ice cream), wheat-based products (cereal, bread and crackers) and specific vegetables (eg: beans, lentils, onions and garlic). Whilst foods low in FODMAP include eggs, meat, grains (eg: rice, quinoa and oats) and some vegetables (eg: eggplant, potatoes, tomatoes) (60).

The effects of a low-FODMAP diet exhibit considerable inter-patient variability, meaning that different individuals may experience varying responses to the same foods.



Furthermore, a complete elimination of FODMAP-containing foods from the diet could lead to nutrient deficiencies. The low FODMAP approach is not only the exclusion of FODMAP-rich foods, but also a diagnostic tool to assess a patient's tolerance to specific foods. The recommended approach is as follows (61):

- » **Patients should adhere to the low FODMAP diet as closely as possible for 4-6 weeks to determine if symptoms improve.**
- » **After this initial period, it is crucial to reintroduce one FODMAP at a time, observing any symptoms over three days.**
- » **With repeated testing, a balanced diet which incorporates certain high-FODMAP food is established.**

Any treatment options should be discussed with your doctor, as they can interpret your breath analysis results and symptoms in context to

give you tailored advice. The good thing about breath testing is that you can monitor the success of your treatment through repeated breath samples, ideally aiming to get the levels of methane in your breath below 10 ppm.

Step 3: Preventing Recurrence

As treatment primarily focuses on alleviating symptoms, IMO can recur, particularly in patients with chronic conditions that predispose them to excessive microorganism growth. Managing IMO requires precision and timely intervention when excessive methanogen colonisation reoccurs. Hence, it is important to constantly monitor hydrogen and methane levels through breath tests to detect flare-ups and adjust treatment accordingly.

A negative IMO result

Receiving a negative IMO result can be frustrating, especially when persistent gastrointestinal (GI)

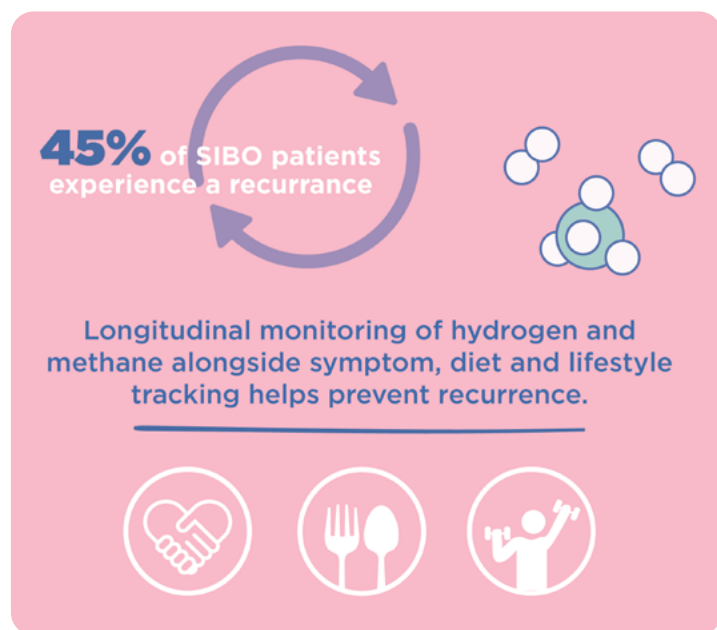


symptoms continue to affect your quality of life. However, this result is still valuable, as it effectively rules out the overgrowth of methanogens and helps guide further investigations to identify the underlying cause of your symptoms.

If you have received a negative IMO result from a single methane test, the next step is usually to undertake a HMBT to determine if your unexplained symptoms are being caused by SIBO. If you also test negative for SIBO, it is best to speak with your doctor about other mechanisms to try and alleviate your digestive health symptoms.

Longitudinal monitoring of hydrogen and methane

Approximately 45% of SIBO patients experience a recurrence (62). Longitudinal monitoring of hydrogen and methane levels through breath testing, in conjunction with tracking lifestyle factors and symptoms, provides a useful approach to help prevent recurrence of both SIBO and IMO. These conditions are not isolated events; rather, they often reflect an ongoing susceptibility influenced by motility, diet, stress, and other environmental or physiological triggers. By monitoring gas levels over time, even when symptoms are minimal or absent, individuals and clinicians can detect early shifts in microbial activity that may precede a full relapse. This allows



for proactive interventions before symptoms intensify or become chronic again.

Hydrogen and methane gases are byproducts of microbial fermentation in the gut, and abnormal levels can serve as biomarkers of overgrowth. In SIBO, elevated hydrogen typically signals excess bacteria in the small intestine, while in IMO, methane-producing archaea (like *Methanobrevibacter smithii*) lead to increased methane levels and often correlate with constipation. These gases fluctuate in response to diet, antibiotics, motility agents, and stress.

By capturing these patterns over weeks or months, not just during flare-ups, you can identify personal triggers or early signs of imbalance. For instance, a rise in methane levels after reintroducing certain foods might suggest the need for dietary modification or additional motility support.

Incorporating lifestyle tracking, such as sleep, exercise, stress levels, and bowel habits, adds another layer of insight. These factors can significantly impact gut motility and microbial balance, which are key in preventing recurrence. For example, disruptions in circadian rhythm or chronic stress can impair migrating motor complex function, a known contributor to bacterial overgrowth. When this information is tracked alongside gas levels and symptoms, it becomes easier to make informed, individualized adjustments that support long-term gut health and reduce the likelihood of relapse.

Ultimately, longitudinal tracking can empower decisions with data to bridge the gap between treatment and prevention. Rather than relying solely on episodic testing or symptom flare-ups to guide care, this approach can enable a more nuanced, real-time understanding of what sustains remission as well as what can threaten it.

How OMED Health Can Help

Drawing on years of expertise in breath research, we have produced the OMED Health Breath Analyzer, the only hand-held medical device for use as an aid in diagnosis of SIBO and IMO. This sensor-based medical-grade device precisely measures the levels of hydrogen and methane in your breath, providing detailed readings down to parts per million.

Our Breath Analyzer is a portable, handheld device, with the data instantly displayed in the companion app.

The OMED Health App guides you step by step through the process of taking breath samples. After the data are reviewed by an expert OMED Health doctor, the diagnosis is provided via the app.



Over **90%** of users have reported the clarity of the user guidance in the OMED Health App for breath sampling to be **good or excellent**



You can download the OMED Health App for free from the Apple or Google store. Please note, the App must be used alongside an OMED Health Breath Analyzer to access hydrogen and methane tracking.



The OMED Health SIBO Test is available through approved healthcare providers. If you think SIBO or IMO could be behind your gut symptoms, speak to your doctor, dietitian, or nutritionist about ordering a test for you.

Test for SIBO and IMO

Your healthcare provider arranges the SIBO test, and your kit is sent to your home with everything needed to complete the test.

The OMED Health App will guide you through the process step by step including preparation ahead of the test and how to use the OMED Health Breath Analyzer throughout the test.

SIBO and IMO Treatment

A confirmed SIBO or IMO diagnosis gives your healthcare provider what they need to recommend a treatment plan built around your symptoms and history.

Treatment options may include antibiotics, herbal antimicrobials, dietary interventions and probiotics. Your healthcare provider can guide you to the most effective treatment for you.



An OMED Health doctor reviews your results and confirms in the app whether you have SIBO or IMO.

If you test positive for SIBO or IMO, the good news is that treatments are available. Your healthcare provider can recommend a personalized treatment plan based on your diagnosis.

Your healthcare provider can also request repeated SIBO tests using the OMED Health Breath Analyzer, to help monitor treatment and follow-up, with a doctor-led diagnosis in the app each time.

This gives you and your healthcare provider a way to see how your gas levels change over a course of treatment, rather than relying on a single snapshot.

Could SIBO be behind your gut symptoms?

Up to half of people with IBS symptoms may have SIBO, and it can be treated.

An accurate diagnosis is where treatment starts.

Ask your healthcare provider about the OMED Health SIBO Test.

[Learn More](#)

Clinical-Grade SIBO Breath Testing for Your Patients

Partner with OMED Health to offer your patients clinical-grade SIBO breath testing through a seamless at-home experience, with results you can trust.

Join our growing network of independent practitioners, dietitians, nutritionists, and GI specialists who use OMED Health's SIBO Test to remove the guesswork from gut health management.

[Partner with OMED Health](#)



Hear Jayne's experience:

"OMED's personalized approach and comprehensive support helped me finally tackle my SIBO after years of suffering with bloating, nausea, and reflux. I'm now SIBO-free, my symptoms have improved, and I've even gained weight. I'm truly grateful for the support I received!"

[VIEW TESTIMONIAL](#)

Begin your gut health journey today.

Find an approved Healthcare Practitioner and get the clear diagnosis you need.

[Get Started](#)

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