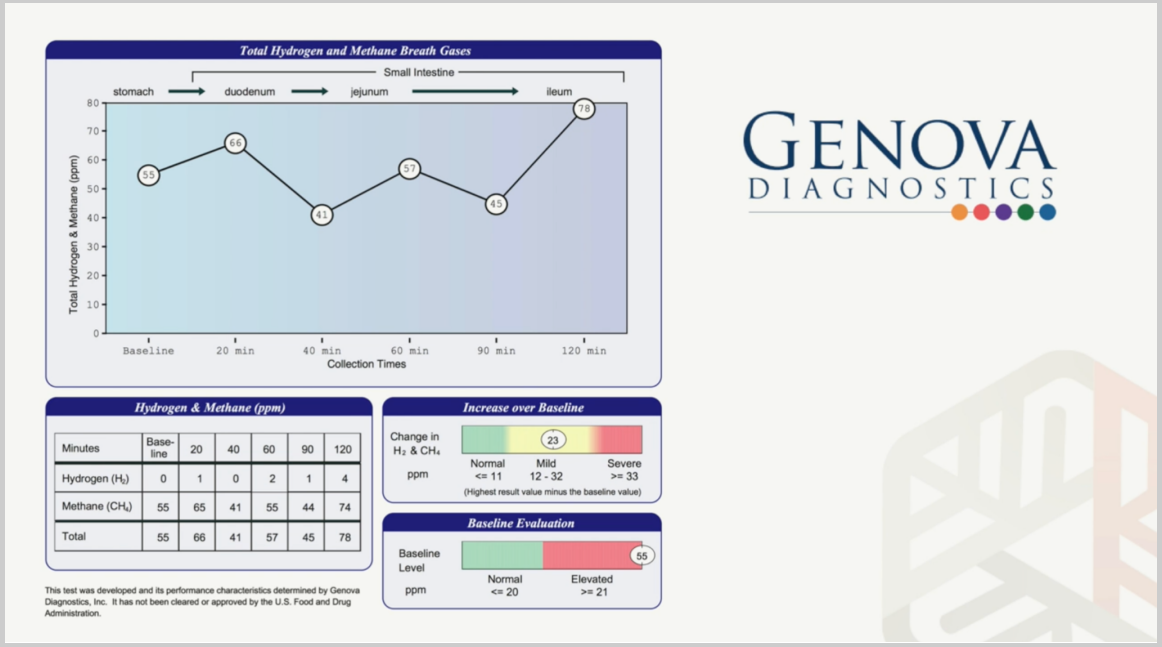
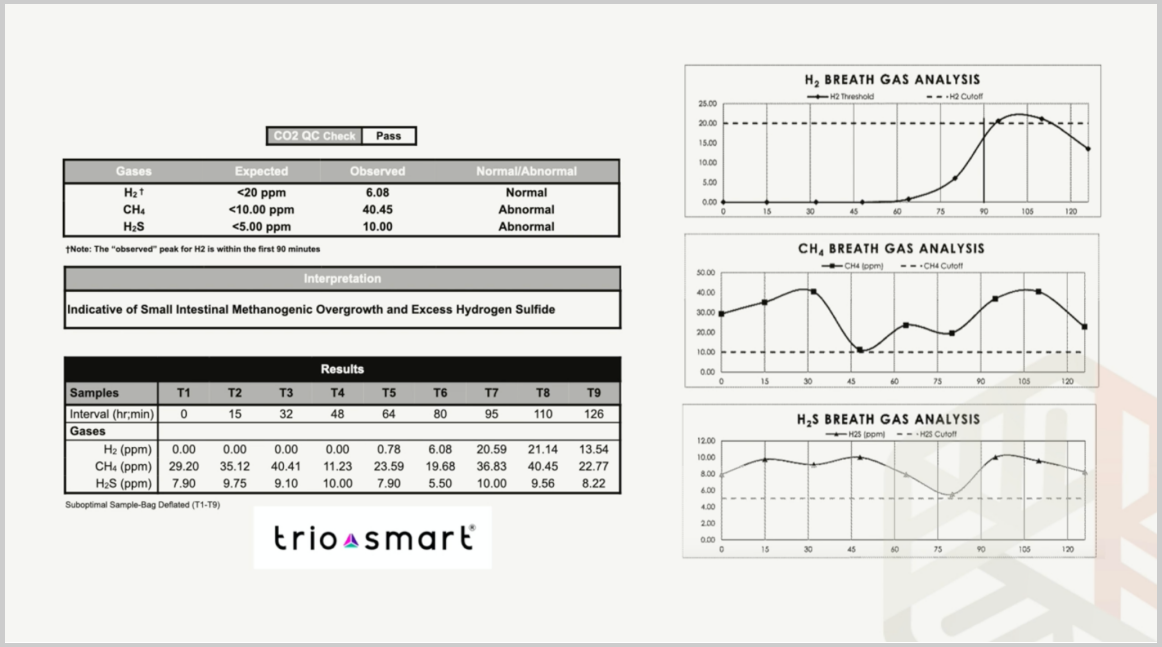
Identifying Gut Pathologies: Small Intestinal Bacterial Overgrowth Breath Test (Part 7)



Here's another one with high baseline methane. As we discussed, it's not uncommon to see low hydrogen levels as the methanogens consume hydrogen in the production of methane. So it's typical to see those high levels, though, stay high throughout the test. They may bounce around a bit like this particular situation. This first one was a 56-year-old female with depression and severe acid reflux and fatigue. They did have slow transit time and constipation, as you might expect from seeing this result. And if you've read our information about gastric reflux and believe that it's often caused by [small intestinal bacterial overgrowth] (SIBO) or dysfunctional lower esophageal sphincter, and we treated the SIBO and the reflux for this particular patient improved and resolved.



CO_2 QC Check	Pass

Gases	Expected	Observed	Normal/Abnormal
H_2†	<20 ppm	6.08	Normal
CH_4	<10.00 ppm	40.45	Abnormal
H_2S	<5.00 ppm	10.00	Abnormal

†Note: The "observed" peak for H2 is within the first 90 minutes

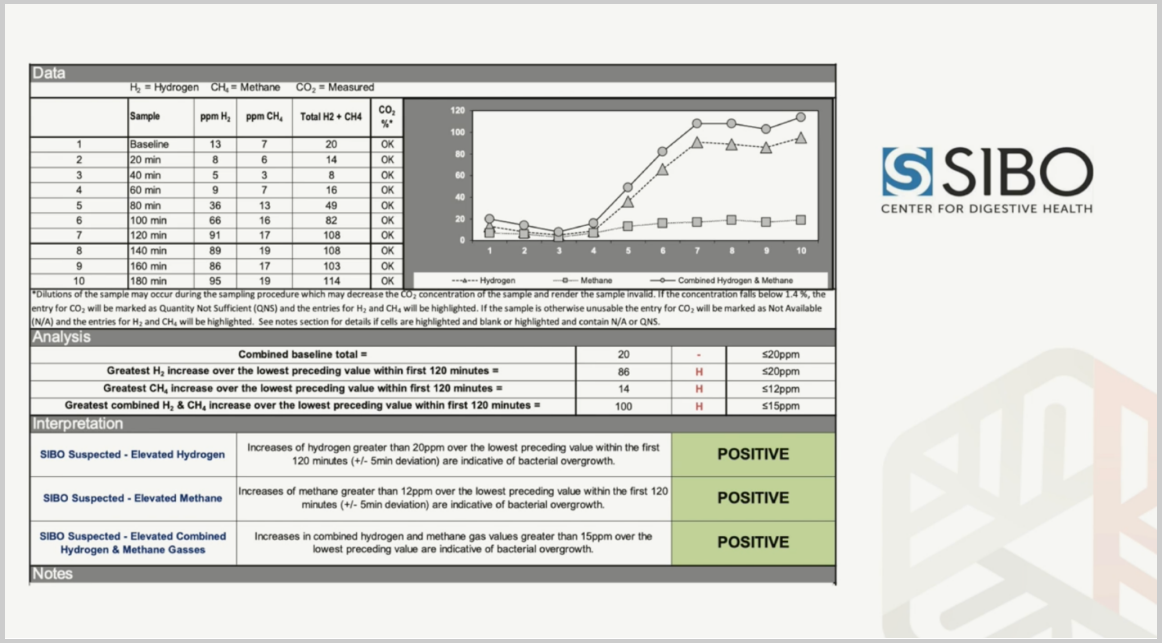
Interpretation
Indicative of Small Intestinal Methanogenic Overgrowth and Excess Hydrogen Sulfide

Results									
Samples	T1	T2	T3	T4	T5	T6	T7	T8	T9
Interval (hr:min)	0	15	32	48	64	80	95	110	126
Gases									
H_2 (ppm)	0.00	0.00	0.00	0.00	0.78	6.08	20.59	21.14	13.54
CH_4 (ppm)	29.20	35.12	40.41	11.23	23.59	19.68	36.83	40.45	22.77
H_2S (ppm)	7.90	9.75	9.10	10.00	7.90	5.50	10.00	9.56	8.22

Suboptimal Sample-Bag Deflated (T1-T9)

While we're on the topic of [the] competitive hydrogen gas model, I think it's important to show you a representation that I do see from time to time. This is the trio-smart test showing methanogen overgrowth and hydrogen sulfide excess. Now, based [on] the competitive hydrogen gas model, the idea is that these two organisms are competing for hydrogen and that generally, there is one dominant group that's represented on the breath test. So seeing low hydrogen in this case makes sense because the hydrogen is being used by methanogens and hydrogen sulfide producers.

According to [Dr.] Pimentel, you generally will see a dominant group represented on the breath test, but from time to time, I do see both methane and hydrogen sulfide represented. So, in instances like this, it's really important to correlate your results with symptoms. In this case, the 68-year-old female patient was dealing with mostly constipation, food sensitivities, anxiety, and joint pain, so I mostly focused on intestinal methanogen overgrowth but did make sure to review and rule out other typical symptoms for hydrogen sulfide excess, look at her diet, nutrient imbalances, and other things that might contribute to the excess production of hydrogen sulfide, which we'll cover more later on in this section.



Data

H_2 = Hydrogen CH_4 = Methane CO_2 = Measured

	Sample	ppm H_2	ppm CH_4	Total H2 + CH4	CO_2 %*
1	Baseline	13	7	20	OK
2	20 min	8	6	14	OK
3	40 min	5	3	8	OK
4	60 min	9	7	16	OK
5	80 min	36	13	49	OK
6	100 min	66	16	82	OK
7	120 min	91	17	108	OK
8	140 min	89	19	108	OK
9	160 min	86	17	103	OK
10	180 min	95	19	114	OK

*Dilutions of the sample may occur during the sampling procedure which may decrease the CO_2 concentration of the sample and render the sample invalid. If the concentration falls below 1.4 %, the entry for CO_2 will be marked as Quantity Not Sufficient (QNS) and the entries for H_2 and CH_4 will be highlighted. If the sample is otherwise unusable the entry for CO_2 will be marked as Not Available (N/A) and the entries for H_2 and CH_4 will be highlighted. See notes section for details if cells are highlighted and blank or highlighted and contain N/A or QNS.

Analysis

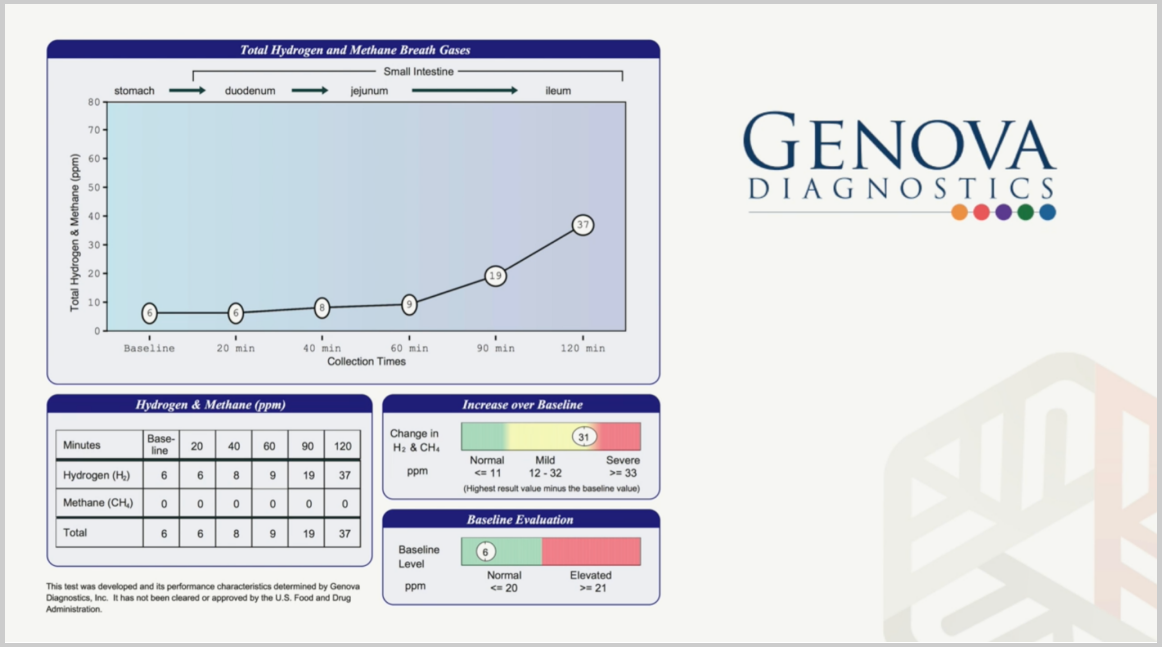
Combined baseline total =	20	-	≤20ppm
Greatest H_2 increase over the lowest preceding value within first 120 minutes =	86	H	≤20ppm
Greatest CH_4 increase over the lowest preceding value within first 120 minutes =	14	H	≤12ppm
Greatest combined H_2 & CH_4 increase over the lowest preceding value within first 120 minutes =	100	H	≤15ppm

Interpretation

SIBO Suspected - Elevated Hydrogen	Increases of hydrogen greater than 20ppm over the lowest preceding value within the first 120 minutes (+/- 5min deviation) are indicative of bacterial overgrowth.	**POSITIVE**
SIBO Suspected - Elevated Methane	Increases of methane greater than 12ppm over the lowest preceding value within the first 120 minutes (+/- 5min deviation) are indicative of bacterial overgrowth.	**POSITIVE**
SIBO Suspected - Elevated Combined Hydrogen & Methane Gasses	Increases in combined hydrogen and methane gas values greater than 15ppm over the lowest preceding value are indicative of bacterial overgrowth.	**POSITIVE**

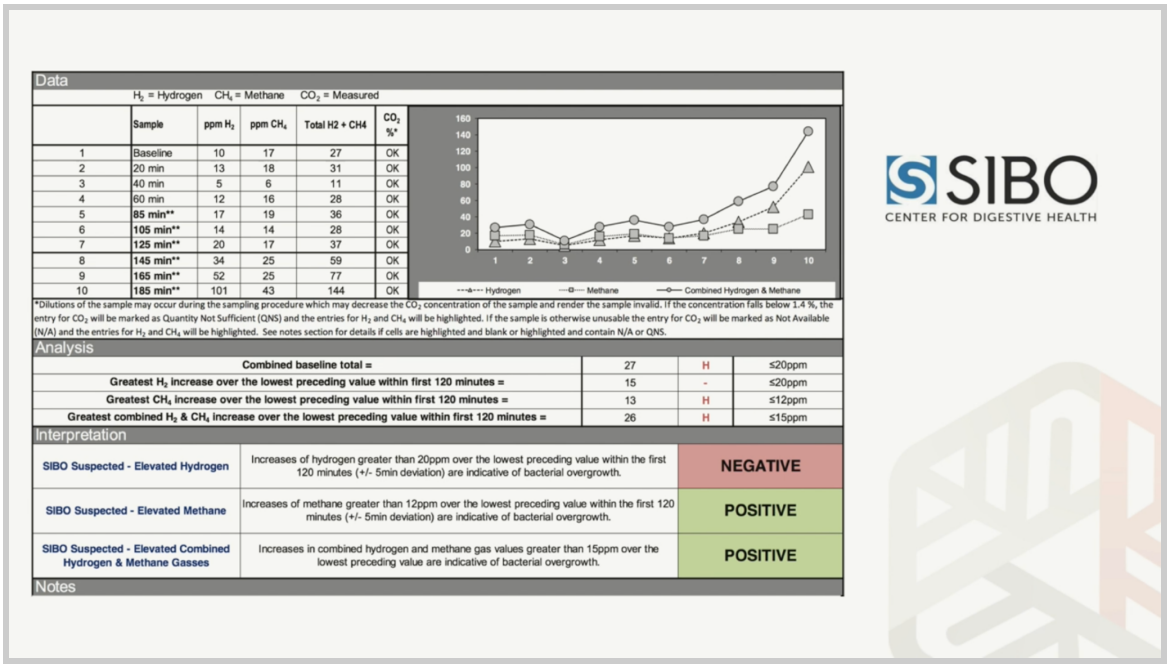
Notes

Here's a positive NUNM breath test so that you can see how NUNM is interpreting their positive criteria. This test is marked "positive" for both hydrogen and methane, with a rise in hydrogen from 13 to 91 at the 120-minute mark. [It's] a positive result based [on] NUNM criteria, but this would also be a positive result according to the North American Consensus, with a rise from 13 to 43, so about a difference of 30. You'll see that NUNM is collecting every 20 minutes, so you will have to use the graph to get an estimate of that 90-minute value if you're trying to use the North American Consensus Interpretive Guidelines with the NUNM test. The methane [is] also positive here for both criteria, with a 14 parts per million difference between [the] 120-minute mark and the lowest preceding value, or a [maximum] value of 19 at any time on the test for the North American Consensus. In this case, this was a 17-year-old male with [irritable bowel syndrome] mixed, upper [gastrointestinal] discomfort, burping and reflux after meals, intermittent skin rashes, and seasonal allergies. He also had a stool test that showed dysbiosis, high secretory [immunoglobulin A], and low pancreatic elastase and was also tested for [*Helicobacter*] *pylori* that was negative.



Here's an example of where having the additional hour might be helpful. We talked about the option of having a two-hour or three-hour test. And this is an old result from Genova, so that's why it may look a little different to you. But I think it's a good example of why a 120-minute test could be problematic in some cases. You can see a late rise in hydrogen happening at 120 minutes, with a baseline value of 6, and then it goes up to 19 at 90 minutes. That's only an increase of 13 in the first 90 minutes, so that would be negative for hydrogen based [on] the North American Consensus. There are zeros for methane throughout, so we don't know what is happening for that last hour. Maybe methane goes up in that patient above 10, and maybe they would be positive from that perspective. Maybe if the patient isn't really constipated and only has a bowel movement every two to three days, that would suggest their transit time is reduced. In that case, seeing what happens in the last hour might be helpful, as well, because if we see a pretty significant increase, that might be bacterial overgrowth in the terminal ileum in that patient that's not showing up in the first 90 minutes.

This patient is a 52-year-old female with chief complaints of weight gain, fatigue, insomnia, poor exercise recovery, and hair loss. She didn't have a significant tendency toward constipation and hard, dry stool, often only having a bowel movement every two to three days without intervention. This makes it even more likely that she could be positive for SIBO, and we might want to consider that three-hour test.



Data

H_2 = Hydrogen CH_4 = Methane CO_2 = Measured

	Sample	ppm H_2	ppm CH_4	Total H2 + CH4	CO_2 %*
1	Baseline	10	17	27	OK
2	20 min	13	18	31	OK
3	40 min	5	6	11	OK
4	60 min	12	16	28	OK
5	**85 min****	17	19	36	OK
6	**105 min****	14	14	28	OK
7	**125 min****	20	17	37	OK
8	**145 min****	34	25	59	OK
9	**165 min****	52	25	77	OK
10	**185 min****	101	43	144	OK

*Dilutions of the sample may occur during the sampling procedure which may decrease the CO_2 concentration of the sample and render the sample invalid. If the concentration falls below 1.4 %, the entry for CO_2 will be marked as Quantity Not Sufficient (QNS) and the entries for H_2 and CH_4 will be highlighted. If the sample is otherwise unusable the entry for CO_2 will be marked as Not Available (N/A) and the entries for H_2 and CH_4 will be highlighted. See notes section for details if cells are highlighted and blank or highlighted and contain N/A or QNS.

Analysis

Combined baseline total =	27	H	≤20ppm
Greatest H_2 increase over the lowest preceding value within first 120 minutes =	15	-	≤20ppm
Greatest CH_4 increase over the lowest preceding value within first 120 minutes =	13	H	≤12ppm
Greatest combined H_2 & CH_4 increase over the lowest preceding value within first 120 minutes =	26	H	≤15ppm

Interpretation

SIBO Suspected - Elevated Hydrogen	Increases of hydrogen greater than 20ppm over the lowest preceding value within the first 120 minutes (+/- 5min deviation) are indicative of bacterial overgrowth.	**NEGATIVE**
SIBO Suspected - Elevated Methane	Increases of methane greater than 12ppm over the lowest preceding value within the first 120 minutes (+/- 5min deviation) are indicative of bacterial overgrowth.	**POSITIVE**
SIBO Suspected - Elevated Combined Hydrogen & Methane Gasses	Increases in combined hydrogen and methane gas values greater than 15ppm over the lowest preceding value are indicative of bacterial overgrowth.	**POSITIVE**

Notes

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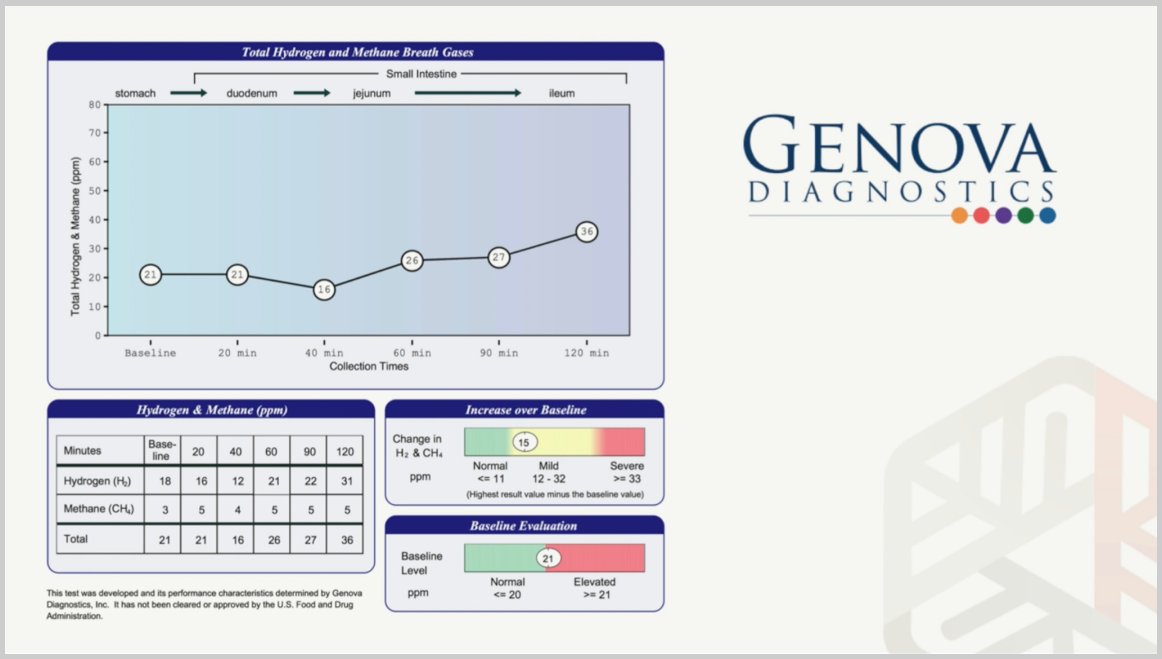
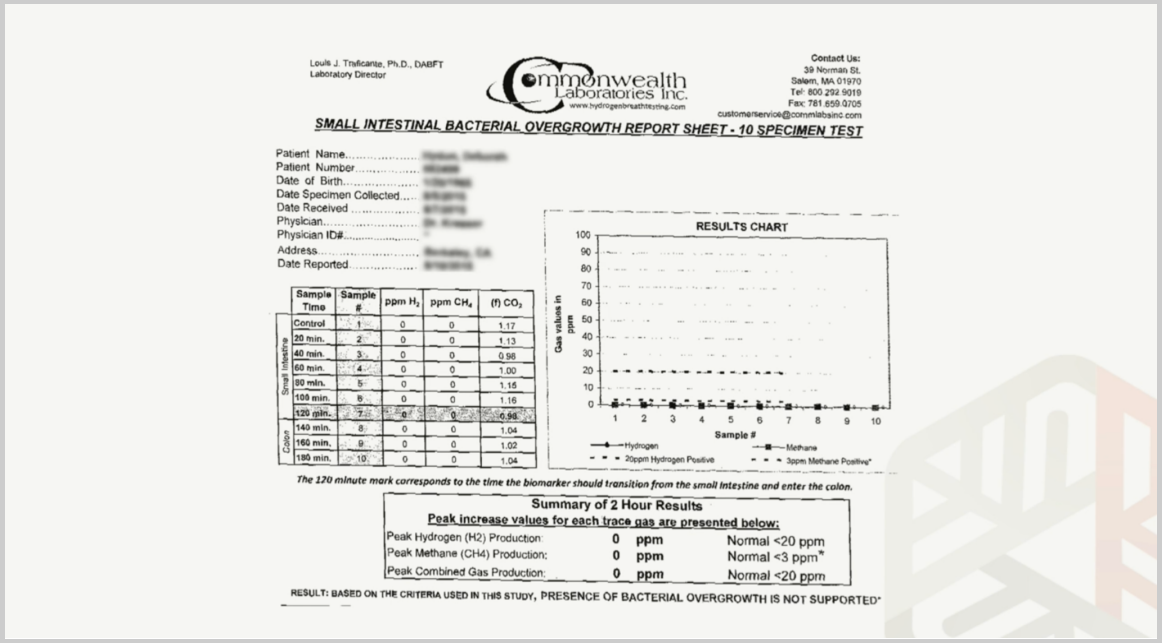
Here's an interesting pattern that you will likely see at some point when using these tests. We see that the baseline levels of hydrogen are higher than typical at 10, and baseline methane is 17, so that already means that it's positive for methane. Sometimes when you see high levels of hydrogen at baseline, that can be a result of improper test preparation. And this analysis is even more supported when gas levels decrease after the first few samples and never increase again, or they stay or remain steady and don't rise much later on in the test. Even in the North American Consensus statement, this is an unresolved question that they mention. What's the significance of higher hydrogen at baseline? We still don't really have a consensus on [the] answer to [that] question, but there are some suspicions.

Here we see that the gas levels dropped down just at the third sample. They start out high at baseline, drop down, both hydrogen and methane at 40 minutes, and then they start going back up again. At 90 minutes, hydrogen is only 17, which is an increase of only 7 from baseline, which again would be normal, according to the 2017 Consensus. But again, the methane at 17 is already positive at the baseline value. I would say this is a clear positive, particularly for methane, and this particular test result was from a 39-year-old with chronic inflammation, intestinal permeability, food sensitivities, and skin conditions.



Okay, so what about this one? It's an interesting result because you see the high baseline hydrogen, 18 parts per million at baseline, but it stays more or less at the level throughout the test, dip[s] down a bit at 40 minutes, and increases a little bit at 120 minutes. But it's more or less a similar level throughout, and this can be improper test preparation, residual fiber in the intestine causing elevated hydrogen, essentially. But this pattern could also be indicative of SIBO, so it could be a positive result. More typically, when you see improper test prep, you'll see a high baseline level of hydrogen and maybe high at 20 minutes, and then it drops down into the normal range. In some cases, though, you can see it high throughout the test. And in this case, actually, we did find out that the patient did not stay strictly to the test diet, which should only include meat and fish, jasmine rice, fat, [and] salt and pepper, as we've discussed. And he, for whatever reason, just decided to ignore that and just did his own thing, which included some blended smoothies with fruit and vegetables, which could have produced this result. So we did, in this case, have him redo the test, and it was actually completely negative when he did follow the proper test prep.



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SMALL INTESTINAL BACTERIAL OVERGROWTH REPORT SHEET - 10 SPECIMEN TEST

Patient Name.....
Patient Number.....
Date of Birth.....
Date Specimen Collected.....
Date Received.....
Physician.....
Physician ID#.....
Address.....
Date Reported.....

	Sample Time	Sample #	ppm H_2	ppm CH_4	(f) CO_2
Small Intestine	Control	1	0	0	1.17
	20 min.	2	0	0	1.13
	40 min.	3	0	0	0.98
	60 min.	4	0	0	1.00
	80 min.	5	0	0	1.15
	100 min.	6	0	0	1.16
	120 min.	7	0	0	0.98
Colon	140 min.	8	0	0	1.04
	160 min.	9	0	0	1.02
	180 min.	10	0	0	1.04

RESULTS CHART

The 120 minute mark corresponds to the time the biomarker should transition from the small intestine and enter the colon.

Summary of 2 Hour Results
Peak increase values for each trace gas are presented below:

Peak Hydrogen (H2) Production:	0 ppm	Normal <20 ppm
Peak Methane (CH4) Production:	0 ppm	Normal <3 ppm*
Peak Combined Gas Production:	0 ppm	Normal <20 ppm

RESULT: BASED ON THE CRITERIA USED IN THIS STUDY, PRESENCE OF BACTERIAL OVERGROWTH IS NOT SUPPORTED*

This is also interesting; it's all zeros across the board. So hydrogen, a zero from the first sample, control sample before the lactulose, all the way to 180 minutes. And then methane was zero all the way from control to 180 minutes. So you might think that this person is fantastic. They have no bacterial overgrowth at all. Really great negative result. And you'll see this in about 5 percent of cases of these breath test results. An important note here is that this is an older Commonwealth [Laboratories] test result, so you'll see the older criteria mentioned here. This company is still in business or they may have gone out of business, and from my understanding, does not use the North American Consensus for interpreting results. And so, we haven't used this company in some time. But this is a really great example of what you might see if you are using Genova Diagnostics or another SIBO breath test company that does not test for hydrogen sulfide excess.

So, as you can imagine, and as I've alluded to, there's a little bit more than meets the eye here. And if you understand the physiology behind the lactulose breath test as we've been discussing it, you might be questioning this already because you should see a rise in hydrogen and methane or at least hydrogen when lactulose enters the colon. That would be normal bacterial fermentation of lactulose when it enters the colon.

If you see zeros across the board like this, there are a couple of different possibilities. One is the patient's severely constipated, and the lactulose has been in the small intestine this entire time. And they don't have SIBO, which is pretty unlikely if they really are that severely constipated. They can be constipated without having SIBO, of course, but this wouldn't be my number one interpretation of this test result because usually, you'd see some production of gases along the

way if the patient is that constipated. The second interpretation here is that there's production of other types of gases that aren't measured by this particular test, like hydrogen sulfide that we've been talking about.

Studies show that patients with lower methane production, like zeros in this instance, can have higher concentrations of sulfate-reducing bacteria, and the product of sulfate reduction as hydrogen sulfide. Hydrogen sulfide should be removed by first pass [through] detoxification in the liver. But if detox mechanisms are impaired, the hydrogen sulfide can accumulate in the small intestine and the colon, and that gas has been shown to damage the colonic epithelium. It's associated with ulcerative colitis, and it can also cause brain fog, post-exertional malaise, and immune problems. It's been identified as a possible carcinogen, and you may know it as the gas that produces the characteristic smell of rotten eggs. So if you go to a hot spring or have been around someone who has particularly foul smelling gas, like parasite infection, sometimes it can be produced—that's hydrogen sulfide.

As I described in the competitive hydrogen gas model, sulfate-reducing bacteria and methanogens compete for hydrogen in mutually exclusive ways. I mentioned before that methane-producing organisms consume hydrogen rather than carbohydrates themselves, which is what the hydrogen-producing bacteria do. So the hydrogen-sulfide-producing or sulfide-reducing organisms [are] the same as methanogens in that sense. They also use hydrogen as their substrate, but they compete with methanogens. So if you have a ton of sulfate-reducing bacteria in your gut, you could see methane levels of zero and hydrogen levels of zero because those sulfate-reducing bacteria are basically consuming all of the hydrogen that would normally have been produced by bacteria, and there's nothing left for methanogens to consume. So methanogens get starved out and aren't present, and then you get zeros on the test. So if you aren't using the trio-smart test or aren't able to order it because of the lactulose prescription it requires, this could be a clue that hydrogen sulfide excess is at play and can work to correlate symptoms to find a way to move forward with the hydrogen sulfide testing.