

## Hyperglycemia II - Part Three

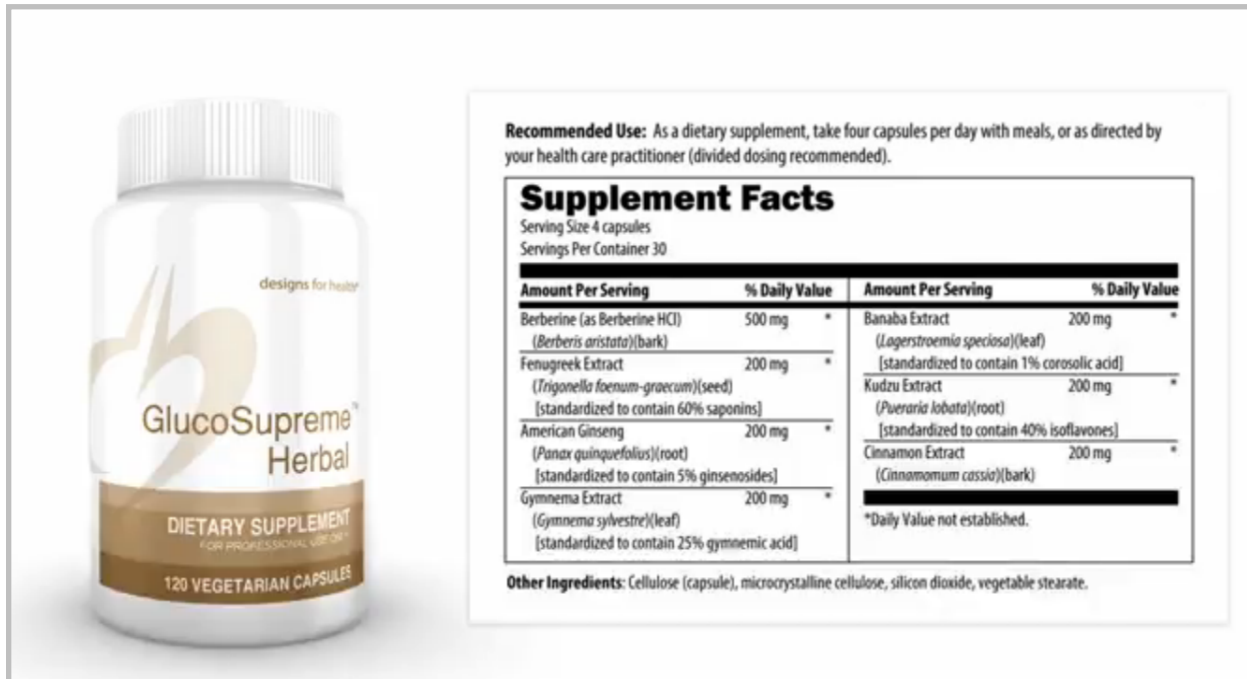
<b>Botanicals for blood sugar regulation</b>	
<b>Botanical</b>	<b>Dose</b>
<b>Berberine</b>	400-600 mg/d
<b>Gymnema</b>	200-400 mg/d
<b>Banaba</b>	40-60 mg/d
<b>Fenugreek</b>	200-300 mg/d

In addition to supplemental nutrients, botanicals can also be helpful. Berberine targets a very basic and ancient regulator of metabolism that is present in all animals and plants called AMP-activated protein kinase, or AMPK. AMPK activation stimulates the uptake of glucose into cells, improves insulin sensitivity, and reduces glucose production in the liver. In a clinical trial published in the journal *Metabolism*, people with newly diagnosed type 2 diabetes were randomly divided into groups and assigned to take metformin or berberine. Improvements were noted the very first week, and at the study's conclusion, the average blood sugar and A1c levels were significantly decreased in both groups. Remarkably, berberine helped fight diabetes every bit as effectively as metformin. The researchers concluded that the two had identical effects in the regulation of glucose metabolism.

Gymnema is an herb with a long history of use in India. It reduces insulin requirements, decreases fasting blood sugar, enhances the action of insulin, and may even promote regeneration of the beta cells of the pancreas, which produce insulin. It is also very helpful for reducing sugar cravings. The recommended dose is 200 to 400 mg per day.

Banaba is rich in compounds that have been shown to lower blood sugar, reduce inflammation, and protect against oxidative damage. It's used in traditional medicine, some Asian and Indian traditions to treat diabetes, and the recommended dose is 40 to 60 mg per day.

Finally, fenugreek slows enzymatic digestion of carbohydrates, reduces gastrointestinal absorption of glucose, and thus reduces postprandial glucose levels. It also stimulates glucose uptake in peripheral tissues and improves insulin production. The recommended dose there is 200 to 300 mg per day.



As with the supplemental nutrients, I prefer formulas that combine several of these botanicals. My current choice is GlucoSupreme from Designs for Health. The recommended dose is two capsules twice a day with meals. I've found that this has an even more potent effect than Metabolic Synergy on cravings, so if your patient is having a hard time switching to a Paleo-type diet because she craves sugar, this can be really useful. It does contain American ginseng, which as I explained in the HPA axis unit, is pretty stimulating for some patients, but the dose is not significantly high, and I haven't seen that effect in most patients. If the patient does experience sleep disruption, just have her take it at breakfast and lunch and see if that improves things.

The next category of nutraceuticals to talk about is fiber. High-fiber diets have been consistently shown to reduce the risk of diabetes, but fiber can also be used as a treatment for high blood sugar. Fiber may benefit diabetes by altering hormonal signals, slowing down nutrient absorption, or altering fermentation in the large intestine along with promoting feelings of satiety. Eating a high-fiber diet is also associated with weight loss, which in turn improves glucose control. Finally, fiber may decrease insulin peaks after meals because it slows absorption of carbs and increases insulin sensitivity. As a starting place, you should instruct patients to follow a diet high in microbiota-accessible carbohydrates, or MACs. We covered this in detail, fiber and prebiotics in the gut section, so you can refer to that for more information.



That said, I do like supplementation with fiber, especially certain kinds of fiber, in cases where the patient has recalcitrantly high blood sugar. Glucomannan is an especially useful type of soluble fiber. It's been marketed under the brand name PGX, but you can get just plain glucomannan in many other brands. It's a highly viscous, soluble fiber derived from konjac tuber, and studies have shown that it reduces hyperglycemia and improves insulin sensitivity. It's thought to work by reducing both post-meal and fasting levels of ghrelin, a hormone associated with appetite. Glucomannan also reduces and improves blood lipid profiles and reduces the risk of coronary heart disease. The suggested dose for glucomannan for blood sugar control is quite high, 0.5 g per 100 calories consumed per day, which works out to about 8 to 13 g a day for most patients. They really need to take a glucomannan powder to achieve those doses. NOW has a glucomannan powder—the capsules are pictured here on this slide—where a half teaspoon is 2 g, so a typical dose would be two to four teaspoons per day depending on the patient's calorie intake.

Resistant starch has also been shown to be helpful in regulating blood sugar. One randomized control trial showed that supplementation with resistant starch improved glycemic status, endotoxemia, and markers of oxidative stress in patients with type 2 diabetes. Another study showed positive effects on inflammation and other metabolic parameters, including A1c, triglycerides, and HDL. Yet another study found that resistant starch reduced postprandial

hyperglycemia without inducing hypoglycemia in type 2 diabetes patients. You can refer to the gut section for a detailed discussion of resistant starch. Recall that it can be obtained in the diet from cooked and cooled potatoes, white rice, and lentils. As a supplement, you can use green banana, green plantain flour, or Bob’s Red Mill potato starch, which is gluten free.

Potato starch is probably the easiest. The maximum therapeutic dose is four tablespoons a day, but I’d strongly suggest starting at a much lower dose such as a half a teaspoon because some patients have a pretty violent reaction to resistant starch. It can cause a lot of gas, bloating, and discomfort. I’ve even had a patient who saw another practitioner prior to me who recommended four tablespoons off the bat go take himself to the hospital because he thought he was having appendicitis, so it can be really, really serious. In some cases, it might be better to get it from cooked and cooled potatoes, cooked and cooled white rice, or cooked and cooled lentils. Those are good sources. Keep in mind that different fibers have different impacts on different people, and this has actually been shown in the scientific literature, so if glucomannan doesn’t do anything, then try resistant starch. If resistant starch doesn’t do anything, try glucomannan. You have to experiment sometimes to find what works best.

<b>Hyperglycemia treatment</b>	
<b>Intervention</b>	<b>Comments</b>
<b>Diet</b>	Basic Paleo, Low-carb/ketogenic Paleo, IF, PSMF
<b>Lifestyle</b>	Physical activity, sleep, stress management
<b>Address pathologies</b>	Primarily gut and HPA axis
<b>Rebalance nutrients</b>	Vitamin D, iron, magnesium
<b>Therapeutic supplementation</b>	Metabolic Synergy, GlucoSupreme
<b>Fiber</b>	Glucomannan, resistant starch

When all these interventions are combined into a focused treatment, I’ve seen results that are comparable to or better than metformin and other medications with far fewer side effects. However, in some cases, dietary and lifestyle changes, supplements, and botanicals may not be enough, or the patient may not be able to afford all of them, and he wants to use his insurance to cover treatment. That’s when medication might be helpful.

## Metformin (Glucophage)

Long track record of **safety**

Associated with **lower risk of death** from CVD and cancer in diabetics

Inhibits **gluconeogenesis**, stimulates glucose uptake in muscles, blocks triglyceride synthesis, promotes fat burning

Metformin, or Glucophage, is a drug that has been used to control diabetic blood sugar since the 1970s in Europe. It's a cheap generic drug. It's supposed to be the first medication doctors prescribe because of a long track record of safety. Unfortunately, this often doesn't happen. Pharmaceutical companies don't make much money on generics, and they aggressively market the newer, more expensive drugs, which can cost up to 15 times what metformin costs and, unfortunately, are relatively untested compared to metformin and can have much more serious side effects. Several studies have shown that metformin alone among diabetes drugs leads to a dramatically lower risk of death from heart disease and has a strong anticancer effect. Metformin inhibits the liver's production of glucose, stimulates glucose uptake in muscles via AMPK activation, blocks the liver's ability to synthesize triglycerides, and promotes fat burning. It may boost GLP-1 level. GLP-1 is an incretin hormone secreted in the gut, which appears to stimulate insulin release when blood sugars rise and limits glucagon production at the same time.

## Metformin tips

Takes 3 days to kick in and **3 weeks to achieve maximum effect**

Most common side effect is **GI disturbance**

Taking metformin ER at night results in **stronger effect on FBG**

Taking metformin in AM gives best coverage for lunch/dinner, but results in **highest FBG and most GI discomfort**

Metformin takes about three days to kick in and three weeks to achieve its maximum effect, so keep that in mind if you're using it. The most common side effect is GI disturbance, and this can be mitigated by starting at a lower dose or using the metformin extended release or ER form. Most people don't see an effect on their blood sugar until they are at 1,000 to 1,500 mg per day, and heavier people may need up to 2,250 or 2,500 mg per day, which is the full dose of metformin and metformin extended release, respectively. Taking metformin extended release at night will often result in a stronger effect on fasting blood sugar but less effect on blood sugar later in the day. Taking metformin in the morning may give the best coverage on lunch and decent coverage for dinner but result in the highest fasting blood sugars and the most GI discomfort, so you can have the patient experiment with the time that he takes metformin as long as he never takes more than the prescribed dose during a 24-hour period.

## Metformin side fx/contras

Most common side effect: **GI distress** (“Metfartin”)

Contraindications: **kidney/liver damage, CHF**

Stop Metformin for **48 hours after contrast agent** administered (with CT Scans)

Avoid **alcohol**

Watch **B12/folate** levels

Metformin has fewer side effects than other diabetes drugs, but that doesn't mean it's side effect-free. The most common side effect is G.I. distress, as mentioned before, nausea, diarrhea, heartburn, and gas, and this is why some people call it “met-fart-in.” These symptoms typically go away after a few weeks but not always. And the extended release form is much easier on the gut.

Contraindications from metformin include people with kidney and liver damage or congestive heart failure. Patients who are taking metformin should stop it for 48 hours after the contrast agent is administered if they're getting a CT scan because it can cause lactic acidosis in people with pre-existing kidney issues. Metformin does not need to be stopped prior to radiographs using contrasts which are most often oral or rectal barium, not IV-iodinated contrast.

Patients should avoid alcohol while taking metformin. It can also increase the risk of lactic acidosis. And they should watch their B12 and folate levels because metformin has been shown to deplete B12 and folate when taken chronically.

If there has already been significant beta cell destruction, and type 2 diabetes is advanced, or the patient has autoimmune diabetes, he will often need insulin. In most cases, these patients will already be under the care of an endocrinologist and already on insulin. If not, and you don't have experience with insulin, I suggest you refer them to an endocrinologist. There is some good information on **Jenny Ruhl's Diabetes 101** site about insulin treatment in diabetics, including most of the important things you'll need to be aware of as a clinician when you're treating with insulin. *One important note:* if you're treating a patient on insulin, and you implement some of the diet, lifestyle, and supplement botanical interventions we've talked about, you should warn them that their required dose of insulin may decrease, and ask them to coordinate with their endocrinologist. What you want to avoid is inducing a hypoglycemic episode. You know, the dose of insulin that they require to achieve normal blood sugar while they're on a crappy diet and not doing any of the

stuff that you're going to recommend is probably significantly higher than what they will require when they start implementing some of your changes, so it's very important to keep that in mind.

Okay, that's it for now. See you next time.