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PRINCIPLES OF FUNCTIONAL MEDICINE

What is Functional Medicine?

"Functional Medicine" is a term originally coined by Jeffrey Bland PhD, a biochemist and nutritionist in 1991. He is referred to as the "father of functional medicine. Dr. Bland founded the Institute for Functional Medicine in 1991 to provide a science-based, personalized framework for addressing the root causes of chronic disease, rather than simply managing symptoms. Functional medicine is a completely different way of viewing health, disease and aging. Currently, traditional medical practice looks at all of the diseases of aging - heart disease, cancer, dementia, autoimmune diseases, diabetes and more - as *different* diseases that each need *different* treatments or cures. However, the truth is that mostly, they are just manifestations of the same underlying changes in biology that occur with aging, and they are highly influenced and *modifiable* by our lifestyle and environment as it interacts with our genetics. The traditional medical paradigm focuses *downstream* on symptoms and diagnoses; functional medicine looks *upstream* to find root causes and mechanisms that lead to disease and dysfunction. Traditional medicine looks at diseases as separate entities that are unrelated to other diseases, or to the rest of the body. Functional medicine understands that the body is an ecosystem with a web of interconnected networks and systems that regulate our biological functioning; systems that, when out of balance drive dysfunction and disease.

Many people see chronic disease and a general decline of health as an inevitable part of aging; after all, the biggest risk factor for most diseases is age. However, much of what we consider to be aging is not the inevitable consequence of getting *chronologically* older, instead they are the signs of getting *biologically* older. Your chronological age and biological age are two different things. A major paradigm shift with a functional medicine approach to health and disease is to look at aging as a disease that is treatable.

In his recent book, “Young Forever” by Mark Hyman, he explains that scientists have identified ten hallmarks of aging - changes in our biology that go wrong as we age, and are upstream to the diseases they cause. They are:

1. Disrupted hormone and nutrient signaling - food and aging
2. DNA damage and mutations - problems with our genetic blueprint
3. Telomere shortening - becoming unraveled
4. Damaged proteins - malformed, misshapen, dysfunctional molecules
5. Epigenetic damage - dysfunctional regulation of genetic expression
6. Senescent cells - attack of the so called “zombie cells”
7. Depleted energy - the decline of our mitochondria
8. Of microbes and men - the link between gut health and longevity
9. Stem cell exhaustion - the decline of our body’s rejuvenation system
10. Inflammaging - the fire that drives chronic disease and shortens life.

I want to expand a little on number 10, “inflammaging”, because there is the inflammation that occurs with all chronic diseases, but I thought it was interesting to learn that just the process of aging actually causes inflammation. How does aging cause inflammation?

Inflammation increases with age - a phenomenon known as inflammaging - due to a chronic, low grade, and systemic increase in pro-inflammatory markers (like IL-6 and TNF-alpha) caused by accumulating cellular debris, immune system dysfunction, and reduced repair mechanisms. This process is driven by the accumulation of senescent “zombie” cells, oxidative stress, gut microbiota changes, and persistent activation of the immune system. This inflammation is driven by the inability of the body to resolve the cellular damage accumulated throughout life.

Key Reasons for Increased Inflammation with Age

Accumulation of Senescent Cells : As we age, cells stop dividing but refuse to die (senescence). These cells accumulate and secrete harmful inflammatory proteins (known as the senescence-associated secretory phenotype, or SASP), fueling chronic inflammation.

Reduced Cellular Cleanup (Autophagy): The body’s ability to remove damaged proteins, organelles, and debris decreases, leading to a buildup of “junk” that activates immune pathways.

Immune System Dysfunction (Immunosenescence): The immune system becomes less efficient at handling infections and repairs, resulting in a constant, low-level activation of immune responses that never fully resolve.

Mitochondrial Dysfunction and Oxidative Stress: Damaged mitochondria leak DNA and produce reactive oxygen species (ROS), which act as signals to trigger inflammatory responses.

Gut Microbiota Changes: Gut microbiota shifts (dysbiosis) and increased intestinal permeability ("leaky gut") allows bacterial toxins to enter the bloodstream, triggering immune activation.

LIfestyle Factors: Chronic stress, poor diet, lack of exercise, and obesity increase inflammation in the body over time, adding to the intrinsic inflammation from aging itself.

The good news is that by making some lifestyle and behavior changes, we can address the problems that occur with the hallmarks of aging, and have a healthy life as we grow chronologically older. This means out with the bad, in with the good. We remove and avoid the harmful things - including poor diet, excessive stress, sedentary lifestyle, toxins, allergens and microbes - and add in the good stuff - whole real food, nutrients, balancing hormones, sleep, movement, stress management, community and purpose. In this handout, I will try to help get you started on the pathway to a healthier and happier life moving forward.

The Big Picture of Health

It is important to understand your level of health comes from a combination of your genetics (genome) interacting with your environment - this is **everything** that you are exposed to over your lifetime; author and functional medicine guru Dr. Mark Hyman calls it your "exposome". Your exposome includes your diet, your thoughts and mindset including stress levels, exercise habits, oral hygiene, quality of sleep, toxin exposures including pesticides and herbicides, and low grade infections causing chronic inflammation. Think of your exposome as continuously washing over your genome, influencing your genetic expression.

One concept that is very important to understand is that your genetics are not your destiny. We now know that your genes can be turned on or turned off based on your exposures, your lifestyle and mindset. There is an emerging field called "nutrigenomics", which studies how

your nutrition has a dramatic impact on which genes will be expressed by your body. It is never too late to make a profound impact on your health by making dietary and lifestyle changes.

In this handout, I will be putting a lot of my emphasis on gut health, which means optimizing your diet, and choosing which supplements to take. Your diet and gut health have the single greatest impact on your level of health. I will also be addressing other key components of optimal health, including:

Exercise
Sleep
Stress reduction techniques
Importance of time outside
Toxin exposures
Importance of oral health
Treating sources of chronic low grade inflammation
Relationships/Having purpose in life
How to decide on the right dietary supplements to take

Lets get started on the specifics -

DIET AND GUT HEALTH

“Eat your food like it is medicine, or you will be eating medicine as your food”
- Steve Jobs

Functional medicine puts a major emphasis on the central role of gut health (stomach, small intestine and large intestine) in determining one’s overall level of health. That is because the lining of the gut contains **70 percent of the immune system!** The gut communicates closely with all parts of the body, and in particular with the brain - it is called the gut-brain axis. Many skin conditions are also thought to be linked in part to gut problems.

Inflammation of the gut leads to increased intestinal permeability in the intestinal tract, which is also known as **“leaky gut syndrome”**. The lining of the small and large intestines is only one cell layer thick. These cells are called enterocytes, and normally they are tightly bound together by a structure called “tight junctions”. However, when there is inflammation in the intestinal

tract, gaps occur between these cells. Food particles, bacteria, and toxins that are supposed to stay in the intestinal tract leak into the adjacent bloodstream, and trigger the immune system to react. This can lead to many different medical problems, including autoimmune diseases, cancer, dementia and several skin conditions.

How do we optimize our diet and prevent leaky gut syndrome?

Lets start with foods that should be **avoided or at least minimized**:

1. Sugar and Starch

It turns out that sugar and starch (which is metabolized by the body the same way sugar is) are the **most powerful drivers of aging!** They both shut off the longevity switches in our body and accelerate nearly all the hallmarks of aging. They shorten our telomeres, damage our DNA, our proteins, epigenome, mitochondria and microbiome. They also drive accelerated inflammation, create hormonal chaos, and age our stem cells. When there is too much sugar or starch in our bloodstream and tissues, it gloms onto proteins, causing irreversible damage called glycation, producing AGEs (advanced glycation end products). Once the sugars bind to the proteins, the proteins become dysfunctional and cause disease. This damages collagen throughout the body, causing aging and wrinkling of the skin, aging of the bones, and cataracts in the eyes (along with sun damage). Additionally, this effect on collagen causes blood vessels to stiffen, resulting in high blood pressure, heart failure, kidney disease and dementia.

High sugar and starch intake also eventually leads to insulin resistance, which affects about 90 percent of Americans to some degree and is the result of our highly processed high sugar and high starch diet along with a sedentary lifestyle. When you eat anything that breaks down into sugar - like bread, pastas, crackers, desserts, sugar sweetened beverages, and starches like rice and potatoes - your pancreas releases insulin, a hormone that takes sugar (glucose) from your bloodstream and delivers it to your cells for energy. The more starch and sugar you eat, the more insulin you produce in order to clear the sugar from your bloodstream. Insulin is the fat storage hormone. Over time, your cells become resistant to the effects of insulin, requiring more and more insulin production from the pancreas to keep your blood sugar normal. Higher insulin causes a whole cascade of harmful effects. This includes storage of belly fat (which is more dangerous and inflammatory than fat elsewhere in the body), loss of muscle, increased hunger and sugar cravings, high blood pressure, worsening cholesterol profile, fatty liver,

altered sex hormones, depression, increased blood clotting, and ultimately type 2 diabetes, heart attacks, strokes, dementia and cancer.

Also note that while eating whole fruit is generally good for you as fruit is full of healthy polyphenols, vitamins and fiber, drinking fruit juices can cause a spike in glucose (and insulin) because of the lack of fiber, and is like drinking sugar water for your body. Dried fruits are also relatively high in sugar content and can also spike insulin production, so they should be minimized in your diet.

2. Ultra-processed Foods

Ultra-processed foods are industrially manufactured foods that are significantly altered from their natural state, often containing added substances like sugar, salt, fat, preservatives, artificial colors and flavors, and stabilizers. Some of the worst additives are thickeners and emulsifiers found in most processed food, including carrageenan and gums. They cause leaky gut and autoimmune diseases. They also tend to contain high amounts of refined seed oils which are very high in pro-inflammatory omega 6 fatty acids. Typically they are packaged foods that are ready to eat or ready to heat. Examples include soft drinks, packaged snacks and candy, frozen meals, energy drinks, fast food, processed meats (including cured deli meats and sausage), sweetened breakfast cereals, margarine, packaged soups, chicken nuggets, hot dogs, fries, flavored yogurts, and mass-produced breads. Today, for the average American, 60 of their diet is ultra-processed food. For every 10 percent of your diet that is ultra-processed food, your risk of death goes up by 14 percent.

Ultra-processed foods are purposefully designed to be hyper-palatable, making them addictive to eat, which leads to overeating. They cause inflammation in the intestinal tract, fertilizing bad toxin releasing, inflammation causing bacteria which help lead to obesity. They also damage and break down the cells that line the intestinal tract, leading to leaky gut syndrome. They cause mitochondrial injury (mitochondria are the energy supply for all of our cells) and damage proteins, damage our DNA, and lead to the production of free radicals. Our bodies are not evolved to handle all of the artificial ingredients contained in these foods, and they should be eliminated from your diet, or at least minimized. Try to eat whole, natural foods that your great grandparents would recognize if they saw them.

3. Dairy

Dairy is an interesting topic to discuss as it relates to functional medicine. Many people can consume dairy products - either all or some - with no problems, while for others dairy

products can cause a lot of problems. There are three primary components of dairy products that can cause problems for people. One is **lactose**, which is the primary sugar in dairy products. 75% of the worlds population is lactose intolerant. Common symptoms of lactose intolerance include bloating, gas, abdominal pain, cramps and diarrhea. The second is the many **hormones** that can be found cows milk, especially since many of the milk producing cows are pregnant. The hormones contained in milk have been shown to worsen acne for many people. Milk can also contain residual amounts of **pesticides, herbicides and antibiotics**. The third component of dairy that can cause problems for people is **casein - in particular A1 type casein** which is the primary protein found in most cows milk. The casein that is found in most mass produced milks is derived from Holstein cows, which produce milk that contains A1 casein. Some people are allergic or have sensitivity to A1 casein, which can cause GI symptoms such as diarrhea, or skin symptoms such as hives. Consuming milk or cheese from sheep or goats is usually less problematic for most people as it has A2 casein, which is much less allergenic. You can also find A2 casein milk from cows at some specialty grocery stores. Butter and cheese both contain casein and lactose, but in much smaller amounts, making them much less of a problem for most people. Hard cheeses have less lactose than soft cheeses in general. I recommend that people try to eat grass fed butter and cheeses when possible, as they are higher in beneficial omega-3 fatty acids, vitamins A, E and K2, as well as being more nutrient rich overall. People who are sensitive to A1 casein can also find A2 casein cheeses, as well as goat and sheep cheeses at specialty stores such as Sprouts, Whole Foods, and Central Market. If you suspect that you are lactose intolerant or sensitive to A1 casein, you can now do blood tests to find out if you are indeed allergic or sensitive to these dairy components.

4. Gluten

Gluten is another food source that, like dairy, causes more problems for some people than others. Gluten is a protein found primarily in wheat, barley and rye. Common foods containing gluten include breads, pasta, cereal, baked goods and beer (from barley). Many other grains do not contain gluten, such as rice, quinoa, corn and flaxseed. You can go to websites such as celiac.org, gluten.org, and nationalceliac.org to get guidance on ways to eliminate or reduce the amount of gluten intake in your diet.

About 1% of the population is allergic to gluten, and has **celiac disease**. these people cannot tolerate any gluten in their diet. Then there are people who are not allergic to gluten but have sensitivity to it. Somewhere between 6 to 15% of the U.S. population has some level of sensitivity to gluten. This is known as **non-celiac gluten sensitivity (NCGS)**. People who have

NCGS will often have symptoms similar to those with celiac disease, but often milder or more subtle, making it harder to detect. People with NCGS can often tolerate small amounts of gluten in their diet. Even for people who do not have a gluten allergy or sensitivity, it is recommended to not eat large amounts of gluten, since the primary source of wheat in the U.S. is a hybridized dwarf wheat which is much more inflammatory to the gut than ancient wheats and can cause gut inflammation and leaky gut syndrome. Also a lot of modern U.S. wheat is sprayed at harvest with the weed killer glyphosate, which is a known carcinogen and destroys the gut microbiome. A large study done by the CDC found glyphosate in the urine of over 80% of Americans.

I recommend that everyone consider getting blood testing for both gluten sensitivity and celiac disease, as well as blood testing for lactose and casein allergy and sensitivity. The reason is that dairy products and gluten containing foods are often a very large part of many people's diets, and if you are sensitive to a food source, but not allergic to it, your symptoms may be milder and more subtle, making them harder to detect, and meanwhile intake of these foods can be causing chronic low grade inflammation in your intestinal tract.

Bread: How to eat it and still stay healthy!

Let's talk about bread, because that is a major source of starch and gluten for most people, especially if you like sandwiches (like me). Bread is a big part of most Americans' diets, but most store bought breads are very unhealthy. They are ultra-processed foods made with refined flour, added sugars (including high fructose corn syrup), unhealthy fats (partially hydrogenated oils - trans fats, or seed oils), preservatives and emulsifiers, also artificial colors and flavors which spike blood sugar, cause inflammation, and damage the gut lining.

If you are shopping for bread, and want to keep it as healthy as possible, here are your top choices:

- Sprouted whole grain bread - made from grains that have germinated before baking, they typically have plenty of protein, fiber and antioxidants, and are often lower in gluten and sodium.
- 100% whole grain/whole wheat bread - contains all 3 parts of the grain (bran, germ, endosperm) for maximum fiber, B vitamins and minerals.
- Sourdough bread - fermented making it easier to digest, and usually has no added sugar. Look for bread made only with flour, water and salt.

In general, when shopping for bread, look for breads with short ingredient lists and little to no added sugar (2 gm or less per slice), and no oils or chemical names. The first ingredient for any bread (other than sourdough) should be “whole wheat”, “whole grain”, or “sprouted whole grain”.

Some Recommended Breads:

- Food for Life Ezekiel 4:9 - made from sprouted grains and legumes; no added sugar or oil, good protein, fiber and minerals, but very dense texture.

- Dave’s Killer Bread - hearty textures and good nutrient density with numerous seeds and grains. Some varieties do have added sugar, though.

- Silver Hills - another brand offering sprouted grain options rich in fiber and nutrients.

- Nature’s Own 100% whole wheat bread - widely available, affordable option with no artificial preservatives and low added sugar.

- 365 (Whole Foods) Organic Ancient Grains - a good organic choice with significant whole grains per slice.

- Izzio’s Sourdough Bread - sold at Sprout’s Grocery Stores, traditionally made with only 3 ingredients; no sugar added - this one is my personal favorite!

I think a lot of “healthy breads” taste better if you toast them first; just my opinion. Also a “pro tip” when consuming any bread or any starchy food, such as potatoes or rice. Typically any starches that are consumed are treated like simple sugars by the body, and are immediately broken down, causing a spike of glucose in the bloodstream. However, if you either freeze or completely cool down a starchy food in the refrigerator, much of the starch is converted to something called “resistant starch: which is digested much more slowly (avoiding a spike of insulin from your pancreas), and is used as food by healthy bacteria in the colon to produce short chain fatty acids, which are very good for your colon and health in general. You can reheat the starch after cooling it, and it will still maintain its resistant starch status from then on.

5. Seed Oils

Seed oils first emerged as an alternative to partially hydrogenated oils. They're plant based based cooking oils made from the seeds of various plants.

The eight seed oils that are most commonly used and discussed are:

- Canola oil (aka rapeseed oil)
- Corn oil
- Cottonseed oil
- Grapeseed oil
- Soybean oil
- Rice bran oil
- Peanut oil

Seed oils have become extremely common for both home use, and they are frequently used in restaurants and fast food locations, where canola oil is the oil of choice for deep frying. They are also found in most packaged, processed and ultra processed foods, including frozen foods, dressings and sauces.

In the functional medicine space, seed oils are a somewhat controversial topic, with some people saying see oils should be avoided, and others saying that seed oils are getting a bad rap. Those who are opposed to seed oils list two main problems with them. The first problem is the way they are manufactured. They go through a process where they are bleached, deodorized and treated with chemical solvents such as hexane, then heated to very high temperatures in order to be usable. This processing can strip the oils of many of the beneficial nutrients and antioxidants. There are also concerns about potential hexane residue in the final product. The second problem with seed oils is that they are very high in omega-6 fatty acids, especially linoleic acid. While intake of some omega-6 fatty acids is essential, and omega-6 fatty acids can be found in many healthy foods, consuming too high of a level of linoleic acid, especially in relation to omega-3 fatty acids, is harmful. The ideal omega-6 to omega -3 ratio is 2:1 or 1:1, but for most people in the U.S., the ratio is 10:1 or even 20:1. Having a high ratio of omega-6 to omega-3 fatty acids causes conversion of the omega-6 fatty acids into inflammatory compounds (oxidized linoleic acid metabolites - OXLAMs) and increases the production of free radicals in the body. Chronic inflammation caused by high linoleic acid intake has been linked to numerous health problems, including cardiovascular disease, some cancers, Alzheimers and other types of brain dysfunction, and obesity.

Those who argue that seed oils are OK point out that intake of some omega-6 fatty acids is essential, and that in fact, polyunsaturated oils are heart healthy. They also state that there is

no evidence that the processing required to create seed oils leaves any residue of chemical solvents in the final product. Everyone does agree that the seed oils found in ultra-processed foods are bad for you, and that you don't want your ratio of omega-6 to omega-3 fatty acids to be too high. Personally, I mostly cook with Olive oil or Avocado oil. I will use peanut oil and sesame oil when preparing asian foods; I also think that having seed oils as part of salad dressings is fine, especially when they are cold expeller pressed, which means that no chemical solvents or high heat are used in the processing, which preserves nutrients, antioxidants, and flavor. Generally I think it is best to get most of your omega - 6 fatty acids from sources other than seed oils, such nuts and seeds, soybeans, nut butters like almond or peanut butter; avocado oil also does have some omega 6 fatty acids, just in lower amounts.

Alternatives to seed oils:

- Extra virgin olive oil (EVOO) for low heat cooking
- Avocado oil for high heat cooking, because of a higher smoke point

These oils are not seed based, and don't go through the same type of processing, so they are unrefined and nutritional and health benefits. Both are primarily composed of monounsaturated fats, particularly oleic acid, which are beneficial for heart health. Both contain antioxidants, and EVOO in particular has a high concentration of polyphenols, which are potent antioxidants with anti-inflammatory properties.

6. Other foods (for some people)

While gluten and dairy are the most common foods that people can be sensitive to, triggering inflammation, other common foods can also cause sensitivity and negative reactions. This list includes beans, soy, eggs, nuts and seeds, and nightshades. Common nightshade plants include tomatoes, potatoes (not sweet potatoes), eggplants and various types of peppers; this also includes spices made from peppers, like cayenne pepper, paprika and chili peppers. The compounds in nightshades that can cause problems for some people are called alkaloids, including one called solanine. Alkaloids are poisonous when ingested in high levels. Most of the alkaloid compounds are present in the leaves, stems, flowers, skin and seeds. Also raw nightshades and unripe nightshades contain higher levels of alkaloids. Tips to minimize alkaloid exposure when eating nightshades include peeling potatoes and removing any green areas or sprouts; removing seeds from bell peppers and tomatoes, choosing ripe produce, and cooking nightshades instead of eating them raw.

Note that nightshades are flavorful, nutrient rich plants that are packed with vitamins, antioxidants and fiber. So unless you notice symptoms after eating nightshades, there's no

reason to stay away from these foods. Some people who have inflammatory or autoimmune conditions like arthritis, psoriasis or inflammatory bowel disease may be more likely to be sensitive to nightshades, and may need to avoid them. Sensitivity to nightshades or the other foods listed above can be determined either by avoiding the foods in question (either individually or as part of an elimination diet) for a period of time, then re-introducing them to see if symptoms occur. Blood testing is also now available to screen for not just food allergies, but food sensitivities (often with milder or delayed symptoms that can be harder to detect), and is recommended for those who feel that they may have some and don't want to do elimination diets.

7. Processed meats

Processed meats are fresh or preserved meat products that have undergone treatments like salting, curing, smoking or fermentation to enhance flavor or extend shelf life. Examples of processed meats include bacon, prosciutto, pastrami, hot dogs, sausages and prepackaged sliced meats including turkey and chicken breast. Studies have linked processed meat consumption to an increased risk of certain cancers, particularly colorectal cancer. The increased cancer risk is at least in part from the nitrates and nitrites added to processed meats to prevent bacterial contamination and extend shelf life. Added forms of nitrates can be broken down into nitrosamines, which are carcinogenic. A lot of meats that are labeled as "nitrate and nitrite free" will often have a naturally occurring form of nitrate such as celery powder added to it. This can be confusing because nitrates are naturally found in numerous fruits and vegetables, and no evidence suggests that naturally occurring nitrates are harmful; in fact they may have health benefits such as lowering blood pressure. However, **added nitrates** are a different story. This is because nitrates **added** to processed meats are more easily converted into nitrosamines in the stomach. Studies show that eating 50gm of processed meat daily (85 gm is about the size of your palm) increases our risk of colon cancer by 18%.

So can you get deli meat that is healthy? Your best bet is to buy from the deli counter where the meat can be freshly sliced. These meats are likely to have fewer ingredients, be less processed, and be naturally nitrate free. In general, poultry options, including turkey and chicken, are healthier than red meats. They tend to be lower in sodium and fat, and are less processed. There are also some brands of packaged deli meats, such as Applegate Naturals, that have no added nitrates, although they are relatively high in sodium. Also, fresh sausage is often uncured (meaning no added nitrates), although sausage is typically high in sodium and saturated fat. So, including some processed meats in your diet is OK, but moderation is key; once or twice a week is much better than eating them daily.

8. Alcohol

I know this one is a bummer if you like to drink, but yes, alcohol is bad for you. Not only is it a toxin that affects all of the organs in your body in a negative way, it also kills good bacteria in the gut and damages the lining of the gut, causing leaky gut. Also, some alcoholic beverages contain sugar, which we have discussed already as a negative for your health. Of course, many people enjoy having alcohol as part of social activities and meals, and I am not telling people who enjoy alcohol that they can never drink. The key is moderation, and there are actions you can take to reduce some of the negative effects of drinking. Try to limit the number of days in a week the you drink and when you do drink, try not to binge drink (more than 2-3 drinks). I also recommend if you are drinking, increase your water intake as it will help your body metabolize the alcohol more effectively and minimize the dehydrating effect of alcohol. Drinking along with eating food also slows the absorption of alcohol and may help reduce some of the gut damage. Depending on how much you drink on a given evening, you may want to consider taking an extra dose of glutathione, or glutathione precursors (like NAC and glycine), and sulfurophane to help with detoxification of alcohol by the liver. Other supplements that may be helpful to take after drinking include an extra dose of probiotics to help restore your gut microbiome more quickly, B-complex vitamins as they are destroyed by alcohol, and extra vitamin C (2-5 grams) to help neutralize free radicals produced by drinking.

9. Medications that can cause problems with digestion and the intestinal tract

Acid blocking medications used for heartburn and reflux such as Prilosec, Prevacid, and Nexium are probably the worst for the gut. Blocking acid production prevents the absorption of vitamin B12, zinc, magnesium and other nutrients. It also prevents the proper digestion of food which leads to overgrowth of bad bacteria in your small intestine, and irritable bowel syndrome.

Other drugs including antibiotics, steroids and anti-inflammatory meds like Advil, Aleve and aspirin change the environment of the gut by causing damage to the lining of the intestinal tract, and changing the balance of bacteria in the gut, leading to the overgrowth of bad bacteria (dysbiosis) and yeast, leading to leaky gut.

Now let's talk about what you SHOULD be eating to optimize your diet and gut health

Let food be thy medicine and medicine be thy food

-Hippocrates

When diet is wrong, medicine is of no use. When diet is correct, medicine is of no need

-Ayurvedic Proverb

The most powerful medicine is at the end of your fork, not at the bottom of your pill bottle. Food is more powerful than anything you will find in your medicine cabinet.

-Mark Hyman, MD

This list is adapted from Mark Hyman's book *Young Forever*

1. Eat only or mostly real foods

This is one of the most important concepts of functional medicine. Our bodies evolved over tens of thousands of years to thrive on real food; they do not deal very well with overly processed foods with artificial colors, flavors, emulsifiers, gums and preservatives. Try to minimize your intake of processed packaged foods (unless it is something like frozen fruits or vegetables). You want to eat food that is as close to its original state in nature as possible. Eat foods that you great grandparents would recognize if they saw them. The key to a healthy gut is a whole foods diet high in prebiotic (fiber) and probiotic foods and abundant in phytochemicals from colorful plant foods.

2. Eat lots of plants

About three-quarters of the food you eat should be veggies. Aim for deep colors (more phytonutrients). Stick with mostly non-starchy veggies; winter squashes and sweet potatoes are fine in moderation. The only thing that all nutrition scientists agree on is that health and longevity are directly tied to the number of fruits and vegetables in your diet! The reason that it is important to eat lots of plants is that plants are full of **phytochemicals**. Phytochemicals are plant molecules that are powerful medicines and have the potential to prevent and reverse disease and extend life. Plants produce these chemicals as part of their own defense to deter predators and crease stress resistance against harsh environments and other dangers such as ultraviolet radiation. These compounds - like alkaloids, polyphenols, and terpenes - can be toxic in high doses, but when consumed in small amounts they produce a beneficial stress to our system called **hormesis**, a phenomenon that also occurs during fasting, saunas, cold plunges, exercise and more. What doesn't kill us makes us stronger; hormesis is essential to activating our innate healing systems. These compounds are highest in wild plants, then regeneratively raised foods, and then organic foods. Even organic produce (which has less phytochemical than wild plants) has 10 to 50 percent more phytochemical than conventional

produce. It is important to know that if we eat stressed plants, our bodies respond by optimizing pathways for health and longevity. A tiny wild strawberry bursts with flavor and the age reversing phytochemical fisetin. The large, starchy, crushproof industrial strawberry may look good but tastes bland. The true flavor in foods (not flavoring added by the industrial food system) always follows the phytochemical richness of the plant or animal. Phytochemicals are found in very small amounts in industrially grown vegetables, grains, and beans that have been bred for yield, starch content, and resistance to drought, pesticides, and herbicides. These foods have much less flavor, higher sugar content, lower protein, and far fewer vitamins and minerals.

3. Fruits

Always eat the whole fruit and avoid fruit juices. Think of dried fruit as candy and keep it to a minimum. Whole fruits are full of healthy phytonutrients and fiber, but try not to go too overboard on high glycemic index fruits (meaning more effect on blood sugar levels). Low glycemic index fruits include apples, cherries, strawberries, most berries, oranges and kiwi. High glycemic index fruits include mangoes, ripe bananas, raisins and watermelon.

4. Load up on foods with healthy fats

Whole Foods such as nuts, seeds, olive oil, avocados, pasture raised eggs, and small wild fatty fish such as sardines, mackerel, herring, anchovies, and wild salmon contain good fats. For oils, use extra virgin olive oil (at low or no heat), avocado oil (for higher heat cooking), and organic virgin coconut oil.

5. Add nuts and seeds

They help with weight loss, diabetes and heart disease and provide minerals, protein, good fats, fiber and more. Almonds, walnuts, pecans, hazelnuts, macadamia nuts and pumpkin, hemp, chia and sesame seeds are all great.

6. Eat adequate protein in your diet

As people age, they lose muscle and bone and their immune systems decline in function; all of these systems are dependent on high quality protein. With aging, you must work to compensate for something called *anabolic resistance*, which means that more protein intake is needed to build muscle. Also with aging the body is in a state of breakdown, and needs far more protein to maintain itself. The RDA for protein, at 0.8mg/kg per day is a minimum level to prevent protein malnutrition, and is not the amount for optimal health, or for the aging population, or for the very active. A person over 60 years old who exercises should consume

1.6 to 2 gm or more of protein per kilogram bodyweight. So the per meal *anabolic threshold* (the amount of protein needed to trigger muscle building) is 25 to 40 grams of high quality protein and about 2.5 to 3.0 gm of the amino acid leucine - found primarily in animal protein - per meal, depending on age, activity level and illness. That is a lot more than most people get. Getting enough leucine with your protein is critical because leucine is required to start protein synthesis.

This is one reason why *the best way to build muscle is to eat muscle (animal meat*). Plant proteins alone are inadequate, so if you are vegetarian you must supplement with branched chain amino acids high in leucine, and creatine, to activate muscle synthesis. A good rule of thumb is to eat at least a palm sized piece of animal protein (or the equivalent in grams of whey protein or plant proteins) at every meal. Also realize that ingesting collagen as a form of protein has benefits for hair, skin, nails and connective tissue, but it is not a complete protein, meaning it does not have all of the essential amino acids. It is lacking tryptophan, which must be added to make a complete protein - or you can take it along with a complete protein source to make sure you are getting all of the essential amino acids (the ones your body cannot make itself) with it.

If you are making protein shakes, whey protein is a very good source of easily absorbable high quality protein that is high in leucine and other key amino acids for muscle building. Regeneratively raised or organic goat whey is better tolerated than traditional cows mild whey protein for many people (because of the less inflammatory A2 casein it has). Another good source of protein for protein shakes is egg white protein powder. If you are using plant protein powders, it is important to supplement with leucine, branched chain amino acids and creatine. A protein shake within 1-2 hours after a workout is a very good muscle building strategy.

7. Buy animal (chicken, beef and pork) and dairy products (butter and cheese) that have been regeneratively raised, grass fed, or organic when possible

Grass fed products are nutritionally better for you and regeneratively raised products are better for the planet. They are also rich in phytonutrients from all the wild and diverse plants the animals consume. Grass fed animals also produce less stress hormones than traditional industrially raised corn fed animals. Eating organic means less exposure to environmental toxins.

8. Choose pasture raised eggs

They are a great source of protein and vitamins - including B12, which you can't get from a vegan diet - minerals, antioxidants, and more. Chickens raised on pastures produce eggs with much more nutritional value, and have less stress hormones than from chickens raised in cages or very crowded environments.

9. Eat fish that is low in mercury and toxins, high in good fats, and wild caught or sustainably raised.

Sardines, herring, anchovies, mackerel and salmon all have high omega-3 and low mercury levels. Check out Seatopia (seatopia.fish) or the Environmental Working Group's Consumer Guide to Seafood (ewg.org) for those that are sustainably harvested/raised and low in toxins. For canned tuna, try the brand "Safe Catch" as it is very low in mercury levels.

10. Eat only whole grains (not whole grain flours) and reduce or avoid intake of gluten, especially from American dwarf wheat.

All grains increase blood sugar, so only eat 1/2 cup to 1 cup per day, and choose low glycemic, gluten free grains like black rice, quinoa, teff, buckwheat or amaranth. Try heirloom grains like Himalayan Tartary buckwheat or ancient forms of wheat like einkorn, emmer or farro.

11. Eat beans

Lentils are best. Stay away from big starchy beans as your main source. Beans contain fiber, protein, and minerals, but some people don't digest them well, and the lectins and phytates in beans can inhibit mineral and protein absorption. If you digest beans without a problem, then up to one cup a day is OK.

12. Include herbs and spices with your food preparation

Herbs and spices are full of anti-inflammatory compounds and micronutrients that help promote optimal health.

13. Include foods that are rich in polyphenols in your diet

Polyphenols are a specific type of phytochemical found in many plant-based foods that act as antioxidants, and are known for their potential to protect against chronic diseases like heart disease and cancer. There are over 8,000 different types of polyphenols, categorized into groups like flavonoids, phenolic acids, lignans, and stilbenes. Polyphenols support the gut microbiome, and can be found in any colorful plant food, but some foods are especially high in polyphenols. There is one particular good bacteria - *Akkermansia muciniphila*, that loves the

high polyphenol content found in cranberry, pomegranate, and green tea. When this bug is in abundance, it creates a protective mucous layer in the gut, preventing a leaky gut, autoimmune disease, and even heart disease and diabetes. Turns out this bug is also necessary for certain cancer treatments, such as immunotherapy, to work.

14. Consider taking digestive enzymes

Many people have a reduction in their production of digestive enzymes from their pancreas as they get older. Taking digestive enzymes is helpful for many people when consuming difficult to digest foods, or to take when they are in an initial phase of treatment to help heal gut inflammation. Many people take digestive enzymes long term to help them more fully digest their food.

15. Consider taking a fiber supplement

Fiber is a primary food source for good gut bacteria (prebiotics). Most people do not get nearly enough fiber from their daily diet, and daily intake of a fiber supplement will help to support a healthy microbiome. Acacia fiber is a dietary fiber supplement that is often recommended - 5 to 10 gm daily.

16. Consider using bovine immunoglobulins (like colostrum) to support gut healing

There are dairy-free versions as well.

17. Consider drinking filtered water

Even though tap water may meet basic safety standards, it may contain trace amounts of chemicals including PFAS, metals or microplastics. These low level exposures, while not causing immediate harm, can accumulate over time and potentially impact health. Reverse osmosis is a powerful way to filter your water, but it will also remove minerals that should be replaced using drops or other methods. Dr. Mark Hyman recommends the **AquaTru Classic Water Purification System** as a countertop filtration system for about $400. It is a reverse osmosis system that also adds back healthy minerals. Also try to minimize drinking water out of plastic bottles to reduce microplastic exposure.

18. Take appropriate dietary supplements

Because our modern environment is so different than what our ancestors lived in, supplementation is important. Modern living means exposure to a lot of toxins (pesticides, herbicides, heavy metals), a lot of stress, and modern farming practices have stripped the soil of a lot of nutrients that it used to have a few decades ago. There are also a lot of new cutting

edge supplements that have multiple anti-aging, pro-longevity benefits. I have a specific section of this handout devoted to recommended supplements.

19. Eat organic fruits and vegetables when possible

In general, it is better to eat vegetables and fruits that are organic for two main reasons. One is that they are free of exposure to chemicals like pesticides and herbicides. The other reason is that organic produce has been shown to have a higher polyphenol content than non organic produce. That being said, eating all organic produce can be expensive and inconvenient at time. You also cannot always find organic versions of all fruits and vegetables. My recommendation is to follow the guidelines produced the Environmental Working Group (EWG.org). Every year they produce a list of the "dirty dozen" fruits and vegetables that tend to have the most pesticide contamination, and the "clean fifteen" fruits and vegetables that have the lowest amounts of pesticide residues, according to EWG's analysis of the most recent USDA data. So, try to buy and consume organic produce whenever possible for the "dirty dozen". For the "clean fifteen" it is not as important to go organic, although organic will have more polyphenol content. Also remember to always rinse off your fruits and vegetables prior to eating them, organic or not. The EWG website has instructions on how to wash your produce. Here are the 2025 EWG lists:

"Dirty Dozen"

- Spinach - has more pesticide residues by weight than any other type of produce
- Strawberries - the fruit most likely to be contaminated with pesticide residues
- Kale, Collard, and Mustard Greens - more than half of kale samples tainted by possibly cancer causing pesticide
- Grapes
- Peaches - high levels of pesticide contamination
- Cherries
- Nectarines
- Pears - among the most pesticide contaminated
- Apples - doused with chemicals after harvest
- Blackberries - new to the list after the USDA tested the fruit for the first time in 2023
- Blueberries - back on the list with traces of several toxic pesticides
- Potatoes - the most consumed vegetable in the U.S.

“The Clean Fifteen”

- Pineapples
- Sweet Corn, fresh and frozen
- Avocados
- Papaya
- Onion
- Sweet peas (frozen)
- Asparagus
- Cabbage
- Watermelon
- Cauliflower
- Bananas
- Mangoes
- Carrots
- Mushrooms
- Kiwi

For more specific dietary advice, I recommend Dr. Mark Hyman’s books “The Pegan Diet” and “Food - What The Heck Should I Eat?” Also, included in your Functional Medicine Workup notebook is a comprehensive dietary guide called the “Core Food Plan” designed by the Institute of Functional Medicine - I highly recommend that you review it!

Optimizing Gut Health (Big Picture Look)

In this section I am going to discuss the recommended supplementation along with a good diet to optimize your gut health and prevent leaky gut syndrome. All of these supplements have substantial supporting published medical literature, and I recommend that **everyone** do the first five; herbal antimicrobials can be used when needed for specific gut problems, which I will discuss in the next section. I will list them here then give a more detailed summary of benefits.

1. Optimizing Diet
2. Probiotics (3 categories)
3. L-glutamine
4. Butyrate/resistant starches
5. Fiber supplementation

6. Herbal antimicrobials (if needed)

1. Optimize your diet

Eat a healthy real food diet following the recommendations listed in the handout for what you should and should not be eating. This will be guided by blood testing and genetic testing to determine foods that you may be allergic or sensitive to, as well as testing to determine if you have any vitamin or mineral deficiencies. It is also, of course, guided by your personal dietary preferences and your lifestyle.

2. Probiotics

Probiotics are an essential part of optimizing gut health, and everyone should be taking them. There is now a large body of published studies showing the multiple benefits of taking probiotics, which have now been shown to be effective for multiple intestinal disorders. Published studies show that probiotics have very good antimicrobial properties, being helpful for killing excessive yeast growth in the gut (and at the same time clearing vaginal yeast infections in women as well as clearing yeast "thrush"in the mouth), as well as killing harmful bacteria in the gut. One very interesting feature about probiotics is that they are very good at restoring a normal balance of yeast and bacteria in the gut. You do not have to worry about taking too high of a dose of probiotics, and "overdoing it" in terms of killing yeast and bacteria. It is normal to have some yeast in your gut; probiotics don't kill all of the yeast, they just bring them back into balance. Probiotics are also very specific in reducing the number of harmful bacteria, while supporting the growth of good bacteria, again bringing the organisms into balance. This is how probiotics improve something called **dysbiosis** in the gut, which is when your bacteria are out of balance, meaning you have too many harmful bacteria in your gut, and not enough good ones. That is one of the problems with taking oral antibiotics or oral anti fungal prescription medications to treat gut organisms; they can often kill too many organisms in the gut, leading to imbalances in the population of organisms in your gut (your microbiome) and causing other problems.

The reason you want to have a proper balance of bacteria and yeast in the gut **(eubiosis)** is that it greatly reduces leaky gut. There are now many published studies showing improvement of both leaky gut and abdominal symptoms - pain, gas bloating - from irritable bowel syndrome (IBS) with probiotic supplementation. One recent study from 2023 used radio nucleotide tracers to confirm that supplementation with a probiotic led to an improvement of leaky gut in 82% of participants with irritable bowel syndrome along with significant improvement of abdominal pain and diarrhea. People who have IBS may have either constipation or diarrhea

along with their abdominal symptoms; probiotics have been shown in multiple studies to help with **both constipation and diarrhea** types of IBS. Probiotics can help treat depression by increasing serotonin production in the gut. A 2023 meta analysis summarizing 81 randomized control trials involving over 9,000 patients showing that the cat . So when people tell you there is not good research of probiotics, it tells you that they are not looking at the published evidence.

So which probiotics should you take, and how much?

Published studies suggest that different types of probiotics may help with different types of problems. One study from 2023 compared two groups of patients on different probiotics. One group took a bifidobacterium probiotic, the other group took a soil based probiotic. The group taking the bifidobacterium probiotic had improvement in frequency and intensity of abdominal pain, while the group taking the soil based probiotic had more improvement in bowel movement satisfaction. So taking a blend of different probiotic species is likely to produce a broader level of benefit. A 2023 meta analysis summarizing 81 randomized control trials involving over 9,000 patients reviewed the most effective probiotics for IBS. They found that lactobacillus and bifidobacterium probiotics, “healthy yeast” saccharomyces species probiotics, and soil based (bacillus) probiotics were all among the most effective. This was a huge review, so when people tell you there is not good research of probiotics, it tells you that they are not looking at the published evidence. Someone I follow on YouTube is Michael Ruscio, DC, DNM. If you are interested in doing a deep dive into probiotics and management of common bowel disorders, I recommend you subscribe to him. All of his videos are about reviewing the published medical literature on these topics. Based on the 2023 meta analysis, as well as additional extensive review of the published data on probiotics, he has organized the available probiotics into **three general categories**, along with the dosing ranges that have been used in published studies. This is his **Evidence-Based Meta-Protocol:**

- Lactobacillus/Bifidobacteria Blend
  Dose: 1-10 billion CFU (colony forming units) - higher is OK

- Saccharomyces boulardii (or cerevisiae) - “healthy yeast”
  Dose: 10-15 billion CFU (500-750 mg)

- Soil based probiotics

Dose: 2-6 billion CFU

I recommend that you take either two, or all three categories of probiotics daily. I have found a combination of two probiotics that I recommend. Taking both of these gives you probiotics from all three categories, and they are both shelf stable, meaning they do not have to be refrigerated (you do want to keep them in a cool environment though). They are also both highly rated on the SuppCo app. I have listed both of these in the supplement section of this handout. They are 1) NOW Probiotic 1-25 Billion CFU Lactobacillus/Bifidobacteria blend, 1 capsule daily, and 2) Codeage SBO Probiotic+ 50 Billion CFU. This one is a blend of soil based probiotics, saccharomyces boulardii and some prebiotics, 1 capsule daily.

Please note that while most people will see some benefit within a month of starting probiotics, it usually takes 2-3 months of consistent use to see the full benefits for symptoms. Also, if you want to work into it gradually, you get established on one for 2-4 weeks, then add another one.

3. L-Glutamine (support for the small intestine lining)

L-glutamine is an amino acid that plays a vital role in maintaining and improving gut health. It acts as a primary fuel source for the cells lining the small intestinal tract (enterocytes), promoting their growth and repair, and thus help maintain the integrity of the gut lining by strengthening the tight junction proteins. This then reduces gut permeability (leaky gut), preventing harmful substances such as harmful bacteria, toxins, and undigested food particles from leaking into the bloodstream. L-glutamine may also promote the growth of beneficial gut bacteria, contributing to a healthy and balanced gut microbiome. Research also indicates L-glutamine supplementation may help alleviate symptoms from IBS and other gut disorders.

L-glutamine typically works the best when taken on an empty stomach. I recommend taking a glutamine powder supplement, 5 to 15 grams, mixed with water first thing in the morning. The one I take is Nutricost L-Glutamine powder, one heaping scoop (about 8 gm) in water every morning. You can also take L-glutamine at a higher dose: 5-10 grams three times a day prior to meals as many published protocols recommend a range of 15-30 grams of L-glutamine daily.

4. Butyrate (support for the colon lining)

Butyrate is a short chain fatty acid that is produced by bacteria that feed on soluble fiber in the colon. Just as L-glutamine is the primary fuel source for the cells lining the small intestine, butyrate is the primary fuel source for the colonocytes, the cells that line the large intestine (the colon). Butyrate helps the colonocytes maintain the tight junction proteins, again to reduce gut

permeability (“leaky gut syndrome”). Butyrate also strengthens the colon barrier by promoting the production of mucin, a component of mucus that lines the gut. It also reduces inflammation by reducing inflammatory cytokines and increases mucosal immunity. Research suggests butyrate may have a protective effect against colorectal cancer by promoting the growth of healthy colonocytes and inhibiting the proliferation of cancerous cells. Butyrate has also shown in studies to help manage IBS, diverticulitis and Crohn’s disease. Butyrate has numerous significant systemic benefits as well - it supports your immune system, increases insulin sensitivity, reduces inflammation throughout the body, improves sleep and helps to optimize brain health - reducing brain inflammation, promoting mood stability and reducing “brain fog”.

I recommend taking the Tributryrin form of butyrate supplementation because it is fat soluble and reliably delivers butyrate to the intestinal tract; it is also able to cross the blood brain barrier to exert its beneficial brain benefits. The recommended brand of Tributyrin is The Perfect Stool Tributyrin-Max 750mg. You can take the less expensive supplement form of butyrate, sodium butyrate, but you need to take a micro encapsulated form so it can make it to the intestinal tract and not get broken down by gastric acid in the stomach (you can find more info in the supplement handout). This form of butyrate does not cross the blood brain barrier in significant amounts. You can also increase colon production of butyrate by increasing your intake of soluble fermentable fiber. The best sources of fiber for increasing the production of butyrate are resistant starches, such as cooked, then cooled potatoes, rice or green bananas (can also be taken as green banana flour added to food or a protein shake) and fructans (onions, garlic, oats) which feeds the butyrate-producing bacteria.

5. Fiber supplementation

Having adequate fiber in your diet is important for many reasons. Fiber is a crucial food source for beneficial gut bacteria, it can help stabilize blood glucose levels by slowing down the absorption of sugar into the bloodstream, it also helps add bulk to the stool, making it easier to pass and preventing constipation. If you are consuming a high fiber diet, then you may not need a fiber supplement. However, most people don’t consume enough fiber in their diet (the recommended dose of fiber is 30 grams a day), and for those people a fiber supplement can be helpful. I typically recommend acacia fiber as a good supplement. Acacia fiber, also known as gum arabic, is a type of soluble dietary fiber derived from the sap of acacia trees. Being a soluble fiber means that it dissolves in water and forms a gel like substance in the digestive tract. It acts as a prebiotic, meaning that it supports the growth of beneficial gut bacteria, promoting a healthy gut microbiome. If starting a fiber supplement, start with a small amount and work up gradually. Also take it with plenty of water to avoid issues with constipation.

If you are in the process of changing over to a more healthy diet with increased fiber intake, you may want to get established on that diet first before adding a fiber supplement. Increasing fiber intake too quickly can cause problems with bloating or gas in some people. I like the Nutricost brand Organic Acacia Fiber, one to two scoops mixed in water at night, again work up the dose gradually. Acacia fiber can be a little difficult to mix; I recommend you add the powder to water, and use a small whisk to mix it in.

6. Herbal antimicrobials

These are sometimes used for people who have ongoing digestive issues, and are still having problems in spite of dietary changes and adding supplements like probiotics. They can be used to help with problems such as yeast or bacterial overgrowth in the small intestine when it is a persistent or recurrent problem. Some commonly used herbal antimicrobials are oregano oil and berberine, and these are used on a case by case basis.

Common Intestinal Problems Seen In Functional Medicine

In this section I am going to discuss the most common intestinal disorders seen by functional medicine practitioners, and the usual approaches. All of them are associated with leaky gut. The disorders are as follows:

1. Irritable Bowel Syndrome (IBS)
2. Gut Dysbiosis
3. Small Intestinal Bacterial Overgrowth (SIBO)
4. Small Intestinal Fungal Overgrowth (SIFO)
5. Histamine Intolerance

1. Irritable Bowel Syndrome (IBS)

The primary criteria for diagnosing Irritable Bowel Syndrome involve recurrent abdominal pain and changes in bowel habits, with the pain being present for at least 1 day per week for the past 3 months and associated with at least two of the following: changes in stool frequency, changes in stool form, and pain related to defecation. Additionally, other symptoms like bloating, gas, and feeling of incomplete evacuation can be present.

Irritable Bowel Syndrome is defined by symptoms, and does NOT indicate what the cause of the problem is. Numerous disorders may lead to the symptoms of IBS. In functional medicine the treatment approach is to address the root causes of the condition, rather than just managing symptoms. This means taking a detailed history and optimizing diet, looking for food sensitivities or allergies, infections, supporting gut function with appropriate supplementation including digestive enzymes and probiotics, as well as incorporating lifestyle changes to reduce stress, improve sleep, and encourage regular exercise to promote overall well-being.

2. Gut Dysbiosis

Gut dysbiosis refers to an imbalance in the composition and function of the microbial community (microbiome) living in the digestive tract, which is composed of trillions of microorganisms, including bacteria, fungi, and viruses, that play crucial roles in digestion, immunity, and overall health. Dysbiosis occurs when this delicate balance is disrupted, leading to a shift in the types and amounts of microbes present. It usually means in increase in the number of “bad” bacteria, and sometimes means an overgrowth of yeast. Numerous factors can cause dysbiosis, including diet (high in processed foods, low in fiber), infections, medications (especially antibiotics), stress and other lifestyle factors. Symptoms of dysbiosis can include digestive problems, fatigue, brain fog, skin issues and autoimmune problems. The treatment approach is very similar to that used for IBS symptoms.

3. Small Intestinal Bacterial Overgrowth (SIBO)

SIBO is a disorder where too much bacteria grows in the small intestine. It is a type of gut dysbiosis. The small intestine normally has lower concentration of bacteria, unlike the colon which is very rich in bacteria. In SIBO bacteria normally found in the colon start to “back up” into the small intestinal tract. These excess bacteria then feed on and ferment carbohydrates. This fermentation process produces gas in the small intestine; the gas can be hydrogen and/or methane gas. The gas stretches the small intestine, causing abdominal pain and bloating. People with SIBO will often notice a flare of their symptoms after eating high FODMAP foods. Other symptoms include diarrhea, constipation, nausea, fatigue and the potential for nutrient deficiencies (especially vitamins B12, A, D, E, K, and iron) due to malabsorption. SIBO can be caused by numerous factors including impaired motility of the small intestine (sometimes from prior food poisoning), structural abnormalities such as strictures, adhesions or diverticulosis that create pockets for bacterial overgrowth. Dysbiosis of the gut and medical conditions including diabetes can also contribute to the condition.

Treatment of SIBO typically involves correcting dysbiosis, oral antibiotics - usually rifaximin which is not absorbed by the gut and is indicated specifically for SIBO. Some studies suggest that probiotics may work as well as rifaximin in many cases. Herbal antimicrobials such as berberine and oregano oil are often used. Sometimes patients are treated with pro motility agents, either Rx or herbal in nature. Patients are also usually started on a low FODMAP diet. FODMAP is an acronym for fermentable oligosaccharides, disaccharides, monosaccharides and polyols, which are short chain carbohydrates that the small intestine absorbs poorly. Some examples of high FODMAP foods include apples, mangoes, dried fruits, onions, Brussels sprouts, cabbage, wheat, milk, yogurt, beans and some nuts. You can find multiple online websites with comprehensive lists of high and low FODMAP foods. Usually a person with SIBO will need to stay on a low FODMAP diet for several weeks to let their gut heal. Then they can reintroduce foods one at a time to see which ones cause the most problems. Usually once your gut is healed you can get off of the FODMAP diet and you may be able to tolerate most problem foods in small amounts.

4. Small Intestinal Fungal Overgrowth (SIFO)

SIFO is a disorder where there is an excessive amount of fungi, primarily Candida, in the small intestine. Like SIBO, SIFO is a type of gut dysbiosis. It is normal to have some fungus in your gut, but with SIBO you have too much. Common symptoms include bloating, gas, abdominal pain, constipation, diarrhea and indigestion. SIFO can also cause headaches, brain fog, fatigue and depression. Causes of SIFO include antibiotic use, compromised immune system, high sugar and carbohydrate diets - these are fuel for fungal growth. Poor gut motility can cause or contribute to SIFO. Proton pump inhibitors (PPIs) can also contribute to the problem as changing the pH of the gut by suppressing acid production can lead to overgrowth of fungus.

Treatment of SIFO usually involves a course of prescription anti fungal medication, although many people may respond well to probiotics and herbal antimicrobials and can avoid prescription medications. It is recommended to eat a diet that is low in sugar and carbohydrates to help restrict fungal growth. It is important to identify and address the underlying factors contributing to SIFO for successful long term management.

5. Histamine Intolerance

Histamine intolerance is a disorder where the body has difficulty properly breaking down histamine. It is distinct from a food allergy. While symptoms can be similar, allergies involve an immune system reaction, whereas histamine intolerance is related to the body’s metabolic pathways for breaking down histamine. Histamine intolerance often stems from poor gut

health, specifically dysbiosis, SIBO and leaky gut. Some gut bacteria can produce excess histamine, contributing to the overall histamine load in the body. It is also thought that poor gut health reduces the activity of DAO (diamine oxidase), which is the intestinal enzyme that breaks down histamine and is located in the lining of the gut. Some foods contain large amounts of histamine. Other foods do not contain high levels of histamine themselves, but cause your mast cells to release histamine (histamine liberators). Both of these types of foods can cause excess amounts of histamine in your body. Foods that are high in histamines include chocolate, tomatoes, avocados, strawberries and spinach. Foods that are processed, such as processed meats, and foods that involve fermentation such as alcohol (especially beer and red wine), aged cheeses and sauerkraut all have high histamine levels. Foods that are histamine liberators include most fish products, especially canned fish, most citrus fruits, legumes, tomatoes and nuts. Symptoms of histamine intolerance are many and variable. They include bloating, abdominal pain, diarrhea, sneezing, runny nose, shortness of breath, flushing, hives, eczema, swelling of the lips, tongue or throat, racing heart and headaches.

Treatment of histamine intolerance has many different facets. Blood testing can help differentiate between foods that you are allergic to vs foods that are causing problems because of high histamine levels or triggering histamine release. In functional medicine it is thought that problems with the small intestinal lining reduces DAO activity, thus leading to a buildup of histamine, so it is important to treat the underlying intestinal disorder and restore normal DAO levels. Patients are often advised to go on a low histamine diet, usually for about 3 weeks, while the gut heals. The low FODMAP diet can also be beneficial in reducing histamine levels and associated symptoms. In some cases, a combination of a low FODMAP *and* low histamine diet might be necessary for individuals with more severe symptoms. Problem foods can be re-introduced gradually to identify individual tolerance thresholds; keeping a food diary can be very helpful for this. Histamine intolerance can be treated with oral antihistamines as well as supplements that help stabilize mast cells which release histamine. Quercetin, a flavonoid with antihistamine properties, and vitamin C, known to reduce serum histamine levels, can be helpful. Optimizing vitamin B6 levels helps by supporting DAO enzyme activity. DAO enzyme supplements are also sometimes used, and as with most digestive issues, probiotics are helpful. Nettle Extract is an herb than help moderate the body's histamine response. NAC (N-Acetyl L-Cysteine) is an antioxidant that can help support histamine metabolism and reduce inflammation. Note that histamine intolerance is considered somewhat controversial in traditional medicine, and at this time it is still not recognized as a disorder by the Academy of Allergy and Immunology.

Optimizing Metabolic Health: Insulin Resistance, Visceral Fat, Muscle Mass, and NEAT (Sugar is bad!)

The information in this section of the handout is **extremely important! Why? Because insulin resistance is the key driver of most chronic diseases and poor metabolic health.** Insulin resistance is a **major driver** of type 2 diabetes, heart disease, hypertension, stroke, fatty liver disease and dementia. So what is insulin resistance? Insulin resistance occurs when blood levels of sugar (glucose) are chronically elevated. One of the primary functions of the pancreas is to release insulin to push excess glucose into the muscle, fat and liver via insulin receptors on all of these tissues. During the early stages of insulin resistance the pancreas can simply produce more insulin to activate the insulin receptors and successfully push the glucose into tissues throughout the body, lowering blood glucose levels. However, over time the insulin receptors throughout the body become so resistant that they stop responding to insulin and no longer take up glucose, even with high levels of insulin in the blood. So now your blood vessels throughout your body have high levels of both glucose and insulin - this is very bad, because both do very harmful things to your body.

High glucose levels in the blood (hyperglycemia) act as a “silent toxin” in the body. Sugar is very “sticky” in the body, and “gums everything up”. Sugar infiltrates into tissues throughout your body, stiffening and narrowing the blood vessels. This leads to high blood pressure, increased risk of stroke and heart disease. The tiny filtering units in your kidneys become scarred and clogged from excess sugar (and from hypertension), leading to kidney failure. Damage to the delicate blood vessels in the retina can cause blurry vision, cataracts, and permanent blindness. Sugar damaged nerves often cause tingling, numbness, or burning pain in the feet and hands. High sugar levels weaken white blood cells, making the body more prone to infections. Chronic high blood sugar is linked to faster memory loss, cognitive decline, and a higher risk of dementia. Nerve and blood vessel damage can lead to erectile dysfunction in men and sexual performance issues in women.

Elevated insulin blood levels (hyperinsulinemia) that occur because of insulin resistance tell your body to store fat, and blocks the body’s ability to burn stored fat for fuel. This often leads to stubborn abdominal weight gain (visceral fat). High insulin levels can cause “reactive hypoglycemia”, where blood sugar levels drop too quickly after eating. This triggers intense cravings for sugar and refined carbohydrates as your brain looks for a quick energy fix. Fatigue after meals, as well as brain fog and irritability are common. High insulin levels contribute to

high blood pressure by causing the kidneys to retain more sodium and water. It also promotes atherosclerosis (hardening of the arteries) by increasing systemic inflammation and stimulating plaque buildup. Excess insulin drives fatty liver disease by increasing fat production ion in the liver. It can cause skin changes like skin tags, ore dark velvety patches in skin folds (acanthosis nigricans). In women high insulin levels are a primary driver of PCOS (polycystic ovary syndrome), often leading to irregular periods and fertility issues. High insulin levels also accelerate the aging process by inhibiting **autophagy,** which is the body's natural cellular cleaning process of getting rid of old and dysfunctional cells. High insulin levels are also associated with a higher risk of cognitive decline.
One of the most destructive features of insulin resistance is its role in causing and perpetuating the deposition of **visceral fat.** Your body has two main types of fat - subcutaneous fat and visceral fat, and they behave very differently. Subcutaneous fat is fat under the skin that you can pinch. You may not like the way it looks, but it doesn't do anything metabolically. Visceral fat, however, is very different. Visceral fat wraps around your internal organs and is metabolically active. It is often called "angry fat", and it secretes inflammatory molecules and hormones that drive insulin resistance, high blood pressure and cardiovascular disease. Visceral fat also releases large amounts of free fatty acids directly into the liver via the portal vein. This overload of fat overwhelms the liver's capacity to process fat, leading to fatty liver. Insulin resistance and visceral fat feed off of each other to produce a vicious inflammatory cycle. The inflammatory compounds released by visceral fat impair insulin signaling of the muscles and the liver, worsening insulin resistance. That increases levels of insulin in the blood further which then leads to more visceral fat storage.

How do you know if you have excessive visceral fat? A good rough measure of visceral fat is your waistline - it should be less than half of your height in inches or centimeters. However, there is the "skinny fat" phenomenon. That is where an individual can have a normal weight and appear to be slim, but actually carry significant levels of visceral fat. The most precise way to measure your visceral fat levels is with a DEXA scan, or you can buy a home device such as the Hume Body Pod (around $200), which has been shown to be almost as accurate as a DEXA scan. Ideally you should have less than one pound of visceral fat.

Another major damaging feature of insulin resistance is the damage it does to your brain. Insulin resistance acts as a key driver of cognitive decline by starving brain cells of glucose and accelerating Alzheimer's-related pathology, leading to increased dementia risk. Alzheimer's is now often referred to as "type 3 diabetes". This condition involves impaired insulin signaling in the brain which leads to decreased energy for brain cells, promoting amyloid plaques, tau

tangles, and neuroinflammation. Insulin resistance in the brain lowers insulin-degrading enzyme (IDE) levels, preventing the brain from clearing amyloid beta plaques, a hallmark of Alzheimer's. Studies suggest that people with insulin resistance are two to four times more likely to develop Alzheimer's disease. To be clear, Alzheimer's disease and other forms of dementia appear to have numerous possible causes and contributing factors, but insulin resistance is a major one.

What are the primary causes of Insulin Resistance?

1. **Poor diet (excessive sugar, starch and ultra-processed food intake)**
2. **Low muscle mass**
3. **Sedentary lifestyle/low activity level**
4. **Chronic stress**

Lets review each of these factors in more detail:

1. Poor diet

The average American today eats way more simple sugars than what our bodies are evolved to handle. For most of the 200,000 years that humans have roamed the earth, sugar was scarce and refined grains nonexistent. Other than an occasional late summer wild berry patch or beehive, humans have not been exposed to much sugar - maybe 22 teaspoons something sweet a year. Today Americans eat 22 teaspoons a day, with kids eating more than 34 teaspoons a day. Sugar consumption has increased from 10 pounds per person a year in 1800 to 152 pounds per person each year. The invention of the flour mill in the 1800s flooded our diet with refined starches. Now the average American consumes 133 pounds of flour a year. Below the neck your body doesn't know the difference between a soda and a bagel. The consistently high levels of sugar intake leads to the over secretion of insulin by the pancreas, and over time leads to insulin resistance. Lets define what you body sees as "sugar". It is not just table sugar that causes issues; it is a family of molecules that includes glucose, fructose, sucrose and lactose. There are many other forms of carbohydrates that your body processes the same way as table sugar. It includes refined carbohydrates, which are basically sugar in disguise. Refined carbohydrates include white bread, starchy foods such as white rice and

potatoes, most breakfast cereals, pastries, pasta, crackers, chips and processed snacks. These are foods where the fiber, the matrix of the food, has been stripped away, which means they digest extremely fast, and they dump glucose into your bloodstream almost as quickly as table sugar. Companies that manufacture processed foods now realize that consumers are trying to read labels and cut back on sugar, so they will label their products as “no added sugar”, but then add other hidden ingredients which act like sugar in the body, such as maltodextrin (very common; a highly processed starch), or other modified food starches. Dextrose, which is basically another name for glucose, is also frequently used as a sweetener and a filler, as is corn syrup. Look for these hidden ingredients in all kinds of products such as protein bars and powders, instant soups, low fat products, and meal replacement bars. Food manufacturers know that sugar activates the brain’s dopamine reward pathways similarly to addictive substances, and often design their foods to hit a “bliss point”, using high-glycemic ingredients to bypass satiety signals and keep consumers eating. Also remember that many foods labeled as “low fat” have added sugar instead to make up for the lower fat content to maintain palatability.

When trying to avoid or reverse insulin resistance, it is not just about your average level of blood sugar. It is also very important to try to reduce blood sugar spikes that often occur after eating. High, repeated spikes of glucose cause glycation of tissues and oxidative stress, which damage blood vessels and collagen over time. Also, glucose spikes can trigger an overactive insulin response that causes blood sugar to drop, leading to energy crashes, brain fog, and intense cravings for more sugar; it is a vicious cycle.

So, from a dietary perspective, how do you eat to control your average blood sugar levels, and avoid insulin spikes?

- Try to eat a mostly whole foods diet, as whole foods provide fiber content that slows down digestion and reduces glucose and insulin spikes.
- Avoid or minimize ultra-processed foods, as they are engineered for overconsumption and have a lack of structural integrity (no fiber) for digestion.
- Avoid liquid calories in the form of sweetened drinks or sodas, and this includes fruit juices. Because of the lack of fiber in these drinks, you get a very rapid glucose surge.
- Food sequencing - this is a very important concept to understand. When eating a meal, try to eat fiber first (such as a salad or veggies), then protein and fat, and then later eat the carbohydrates. Eating in this order will greatly blunt your glucose and insulin spikes because

the fiber, fat and protein will all slow down digestion. The carbs you eat afterwards will be added to this mixture and slow down their rate of absorption.

- Stop constant grazing; allow periods of time where insulin levels can fall to baseline by creating clear gaps of time between meals.
- Eat earlier in the day and finish meals 2-3 hours before bed. Your body can more easily digest carbohydrates earlier in the day, and eating right before bedtime will disrupt your sleep and circadian rhythm.
- Moderate alcohol; alcohol disrupts glucose digestion and regulation, and promotes visceral fat accumulation.
- Light activity after eating greatly reduces the spike of glucose and insulin with meals; I will discuss this further under the low activity section.

2. Low muscle mass

I cannot overemphasize how important muscle mass is for optimizing not only your metabolic health, also for you general health, longevity and quality of life as you age. The more muscle mass you have, the better your metabolic health will be. I will first discuss the benefits of muscle for your metabolic health, then I will touch on some of the other benefits of having adequate muscle mass.

Muscle benefits for metabolic health:

- Muscle acts as your body's primary "glucose sink" by absorbing, using and storing large amounts of glucose from the blood to manage blood sugar levels. Skeletal muscle is responsible for about 80% of post meal glucose uptake. It functions by converting glucose into glycogen for energy storage via insulin-dependent mechanisms, or by utilizing it directly for energy contraction, especially during exercise.
- Exercise-Induced Uptake: Muscle contraction allows glucose uptake *without insulin*, a critical pathway if insulin sensitivity is low, allowing active muscle to pull glucose directly from the blood. After exerciser, muscles actively consume blood glucose to restock their glycogen stores, lowering blood sugar.
- Improved insulin sensitivity: Regular exercise increases muscle mass and glycogen synthase activity, improving overall insulin sensitivity and preventing sustained high blood sugar.
- Metabolic flexibility: Having adequate muscle mass improves metabolic flexibility, which is the ability of your body to switch back and forth from using carbohydrates to using fat for energy.

Muscle benefits for general health:

Sarcopenia is age related muscle loss; it usually starts after your mid thirties, and you lose 1-3% of your muscle mass every year if you do nothing to maintain it. By your seventies, you may have lost 40-50% of your muscle mass. Low muscle mass makes you vulnerable to many health problems - infection, falls, metabolic disease, and cardiovascular events. When you have low muscle mass your body is less resilient and less able to recover from illnesses or injuries.

- Having adequate leg and core strength is critical for fall protection, and to be able to get up from the floor if you fall. If you do not continue to work to strengthen your legs, you will eventually lose your use of them. A fall in older age can be life altering, with hip fractures having high mortality rates. If you cannot get up from the floor easily with your legs, then you will live in fear of falling, and you will not be able to live independently.
- The resistance training that is critical to building and maintaining muscle is also very important to maintain adequate bone density and prevent osteoporosis, which will also help you prevent having a hip fracture as mentioned above. The same resistance that builds muscle also strengthens your bones.
- Grip strength is a reliable "vital sign" for overall mortality and functional health with aging. Having a good grip is very important for many daily activities and maintaining independence. This can be improved by incorporating movements like farmer carries or dead hangs.
- Cognitive Protection - Resistance training boosts BDNF (brain derived neurotrophic factor). BDNF is a protein that acts as a "fertilizer" for the brain, promoting the survival, growth, and maintenance of neurons. It is crucial for neuroplasticity - the brain's ability to adapt and form new connections - and plans a key role in long-term memory, learning, and higher thinking.
- Myokines - When muscle tissue contracts, it releases myokines which are anti-inflammatory compounds. Their primary role is to keep systemic, low grade inflammation in check throughout the body, including the brain.

3. Sedentary Lifestyle/Low Activity Levels (Concept of NEAT)

Having a regularly scheduled exercise regimen is very important, but your activity level the rest of the day also matters. If you do a one hour workout in the morning, then drive to work, sit at a desk job all day, then drive home and relax that evening, then you still have a sedentary lifestyle, because you are only moving during a short time period each day. There is a somewhat new concept in metabolic health called NEAT - non exercise activity thermogenesis. This is all of the energy you burn outside of formal exercise - walking, standing, fidgeting, gardening, cleaning, moving between tasks. This is important because NEAT can burn up to

2,000 calories a day, and keeps your metabolic rate at a consistently higher level. Also visceral fat corresponds very strongly with the amount of sedentary time a person has on a daily basis. The practical target is to aim for about 8,000-12,000 steps daily, and to walk after everything you eat. Movement after eating has been shown to significantly blunt the blood sugar spike that often occurs after eating - 15 to 20 minutes of walking is ideal, but even just a few minutes of walking makes a difference. You also want to try to break up long periods of sitting. That can be doing something every 30 to 60 minutes, whether it is just walking for a few minutes, or doing some bodyweight squats in your office. I should also mention here that doing 2-3 sessions a week of zone 2 cardio (aerobic work at a conversational pace) will boost mitochondrial function and help your body become more efficient at burning fat for energy, shrinking visceral fat.

4. Chronic Stress

When you have an elevated level of ongoing psychological stress for a prolonged period of time, whether it be from work pressure, stress at home, or watching the news or social media, which has a lot of negativity, your body responds by producing an elevated level of cortisol in your body. Not only does cortisol cause an elevated level of glucose in the bloodstream, but visceral fat has a very large number of cortisol receptors. Because of that, elevated levels of cortisol in the body will increase the deposition of visceral fat; yes, stress makes you grow more visceral fat. So how do you deal with this? Obviously stress is not going to just go away. You need to build time for relaxation into your schedule. Things like daily walking, meditation and breath work can actually flip your central nervous system from a sympathetic mode (fight or flight) to a parasympathetic mode (rest and digest). It is also very important to prioritize 7-8 hours of quality sleep nightly to regulate cortisol, ghrelin, and leptin, which directly influence fat storage.

Other Key Non Dietary Factors For Optimizing Overall Health Exercise

1. Exercise
2. Sleep
3. Toxin Exposures (Dietary and Environmental)
4. Optimizing hormones
5. Treatment of chronic infections (Including dental, viral, tick borne)

6. Stress management and mental health
7. Hormesis: Activating Healing and Repair Mechanisms

1. Exercise

Those who think they have not time for bodily exercise will sooner or later have to find time for illness. -Edward Stanley, Earl of Derby

The science is now clear on how exercise has so many health and longevity benefits. Combined with the right diet, exercise is the most powerful tool you have for staying healthy and extending your life. It optimizes all of your biological systems. It improves sugar control and insulin sensitivity. It reduces the risk of heart disease, high blood pressure and high cholesterol. It improves mood and motivation and cognitive function. It prevents dementia by increasing brain derived neurotrophic factor (BDNF), which increases neuroplasticity and builds new brain cells. It reduces the risk of many cancers, such as colon, breast, uterine and lung cancer. It improves sleep. It boosts libido and sexual function by boosting testosterone. It enhances immune function, mitochondrial function, and detoxification pathways. It also increases telomere length and reverses epigenetic changes that occur with aging.

A complete exercise regimen has three components:

1. Resistance training to build muscle mass
2. Aerobic activity - high intensity interval cardio training, and type two aerobic training
3. Mobility and balance training/functional strength.

It doesn't take much exercise to get health benefits. Even something as simple as walking 10 minutes a day can add years to your life, but more vigorous activity for about 75 to 150 minutes a week is better. Add in 3 to 4 days a week of strength training with bands, weights or even body weight exercises, including squats, pushups, shoulder presses, chest presses and planks. **Two of the three components of exercise are highly correlated with longevity: 1) Muscle mass and function, and 2) Good aerobic capacity as measured by VO2 max.** Resistance training is critical to counteract the age-related loss of muscle mass and muscle function (sarcopenia). Focus on compound movements such as squatting for the legs, and pushing and pulling movements for the upper body. This must be combined with eating

adequate amounts of high quality protein as discussed earlier in the handout. If we don't build more muscle, we will waste away. Use it or lose it.

For the cardio component, intense bouts of aerobic activity (HIIT - high intensity interval training) lead to the highest levels of VO2 max, but you don't have to be an extreme athlete to get the aerobic benefits of exercise; just get moving. The biggest jump in longevity benefits is seen in going from being sedentary to moderate fitness. Right now the general recommendation for aerobic activity is two or three 45 minute sessions of type 2 cardio weekly. Type 2 cardio is where you are a little winded from your activity, but can still carry on a conversation - think brisk walking or mild to moderate intensity cycling. High intensity training is where you can say a few words to someone, but are too out of breath to carry on a conversation - think high intensity cycling, swimming or sprinting. The benefit of doing high intensity cardio activity is that you only need a fraction of the time that you do with type 2 cardio to achieve a similar level of some health benefits; however there is some difference in health benefits between zone 2 cardio and high intensity cardio. Zone 2 exercise improves your metabolism and increases mitochondrial efficiency, but high recent evidence shows that high intensity exercise, even in short bursts, dramatically reduces all cause mortality, cardiovascular disease mortality, and cancer-related mortality. For every 1 minute of vigorous exercise, you need to perform significantly more moderate (up to 10 minutes) or light (up to 200+ minutes) exercise to achieve the same protective health benefits. Just 9 minutes a day of cumulative vigorous activity can lead up to a 40% reduction in cancer-related mortality and 50% reduction in cardiovascular -related mortality.

Zone 2: The Foundation

- Increases mitochondrial efficiency and fat-burning capacity
- Drives eccentric remodeling of the heart (stretching the heart to hold and pump more blood per beat)
- Usually requires 45-90 minute sessions to be effective

High-Intensity: The Peak

- Increases mitochondrial density (making more "power plants" and VO2 max.
- Drives concentric remodeling of the heart (thickening the heart walls to pump with more force)
- Can be completed in 15-20 minutes, including warmups

Ideally, you want to try to do both HIIT *and* Zone 2 cardio training, but if you have to pick one, high intensity (HIIT) appears to offer the most benefits for health and longevity.

The final component to optimize the benefits of exercise for health and longevity is mobility and balance, plus functional strength. Muscles and connective tissues tend to lose elasticity with age, which leads to stiffness and reduced range of motion in joints. Regular stretching helps combat this decline, keeping muscles pliable and joints mobile. This leads to many benefits for quality of life as one ages. Stretching can improve flexibility and balance, reducing the risk of falls as well as strains, sprains, and fractures. It can help alleviate back pain and joint stiffness by reducing muscular tension and improving circulation. Regular stretching promotes synovial fluid circulation within the joints, nourishing cartilage and maintaining joint health. This can be very helpful in managing conditions like osteoarthritis. One easy way to include stretching into your routine is to do some simple yoga regimens which can be readily found online. You may want to check out "Movesmethod" on YouTube, which has a lot of great videos to improve flexibility, balance and strength. Also on YouTube I like Will Harlow, who has a lot of great videos to maintain balance and functional strength with aging. Maintaining good balance as you age is also very important to minimize your risk of falling; try standing and balancing on one leg every day (2-3 minutes for each leg) to help maintain good balance.

2. Sleep

Getting good quality sleep, is of course, important throughout your life, but it becomes especially important as you get older. Getting adequate high quality sleep as you age helps strengthen the immune system, lowers the risk of developing high blood pressure, heart disease and diabetes. It also reduces the risk of falling in the elderly. Good sleep is especially critical for the brain, as getting enough sleep during middle age may reduce the risk of developing dementia later in life. The brain's glymphatic system, which clears away harmful toxins and debris, is more active during sleep and is critical to maintaining optimal cognitive function and memory, as well as reducing dementia risk. Older people often have more problems getting good sleep as they may have shifts in their circadian rhythms, hormonal changes, medications, chronic pain and illnesses that lead to less deep sleep and more awakenings at night.

Fortunately, there are a lot of measures you can take to improve your "sleep hygiene". I will list a few of them here:

- Try to go to bed and wake up at about the same time every day as your body and brain like to have a consistent sleep schedule.
- Try to keep the room you are sleeping in very dark and relatively cold; sleep quality is better in a cold room.
- Try to eliminate blue light exposure for 2 to 3 hours before bed; this includes computers, smartphones, tablets and television. One hack is to wear blue light blocker glasses after sunset. Also start to darken lights inside the house 1 to 2 hours prior to bedtime.
- Avoid caffeine after noon, and avoid alcohol in the evening.
- Try to get regular exposure to daylight at least 20 minutes daily. This helps reset your circadian rhythm and triggers your brain to release specific hormones like melatonin that are important for healthy sleep, mood, and aging.
- Eat no later than 3 hours before bed. Eating a heavy meal prior to bed will lead to a bad night's sleep.
- Don't exercise vigorously after dinner; it excites the body and makes it more difficult to get to sleep.
- Take a magnesium supplement (magnesium glycinate is best for relaxation, 200-400mg) before bed. Magnesium is a powerful relaxation mineral for the nervous system and muscles.
- Use earplugs if necessary to create a quiet environment, or consider a fan or a white noise machine to create a relaxing consistent background sound if you prefer that.
- You can find guided relaxation and meditation online or on phone apps to listen to and help you fall asleep. You can also try binaural beats sound apps, which synchronizes brain waves for deep sleep. They can be found on apps and on YouTube.
- One interesting recent study showed that going to bed while wearing socks helps your body's core temperature drop more easily, leading to better quality sleep - give it a try!
- Dr. Mark Hyman has a free Sleep Master Class available at *drhyman.com/sleep*

3. Toxin Exposures (Dietary and Environmental)

More than 84,000 new chemicals have been introduced into commercial products since 1900, and fewer than 1% have been tested for safety. They are in our food, water, air, household cleaning products and personal care products. They include pesticides, herbicides, plastics, flame retardants, phthalates, PFAS (per and poly fluoroalkyl substances - "forever chemicals"), bisphenols, and heavy metals including arsenic, lead and mercury - just to name a few. Biopsies of human fat show that all of us are full of various toxins. The average newborn has 287 known toxins in their umbilical cord blood.

Toxins can damage us in many different ways. Some are called **obesogens** because they can contribute to obesity, insulin resistance, diabetes and heart disease. Some are considered **autogens** for their impact on autoimmune diseases. Some toxins interfere with the body's hormone systems and are called **endocrine disrupting chemicals (EDCs)**. They do this by mimicking natural hormones, blocking hormone receptors, or disrupting hormone production and metabolism. Many toxins, of course, are also carcinogens.

So how to deal with this problem? By reducing exposures and optimizing your detoxification systems. To optimize detoxification:

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- Drink 8-10 glasses of filtered water daily.
- Have daily bowel movements.
- Sweat regularly, whether it is from exercise, or with saunas, steam or hot baths
- Consume detoxifying foods, which include cruciferous vegetables, garlic, onion, avocados, green tea, lemons and turmeric.
- Take supplements that support detoxification. These include B vitamins, selenium, zinc, magnesium, alpha-lipoic acid, curcumin and milk thistle.
- Support glutathione, which is the most important detoxifying molecule made by your body from the amino acids glycine, cysteine and glutamine. A very effective way to boost your glutathione levels is to supplement with a combination of glycine (1 gm a day) and NAC (N-acetyl cysteine) - usually 600 mg a day. This combo is often called glynac when combined in one supplement. One can also take glutathione as a stand alone supplement (liposomal is best), but taking glutathione precursors supports more natural continuous intracellular replenishment by the body.
- Some people with a high risk of heavy metal exposure from fish intake, amalgam dental fillings, or living in a polluted environment may need a heavy metal chelation challenge to assess total body burden.

To reduce toxin exposures:

- Do your best to eat organic food or regeneratively raised food.
- Use the Environmental Working Group's Dirty Dozen and Clean Fifteen as a guide to which fruits and vegetables are the most or least contaminated (*ewg.org*).
- Filter your water, ideally with a reverse osmosis filter, and get a good air filter for your home. Check brands at drhyman.com/filter

- Use *ewg.org* to find fish sources that are low in mercury.
- Use *ewg.org* to eliminate toxic household cleaning products and personal care products.
- Switch from non-stick cookware to (which has PTFE, a type of PFAS) to safer alternatives such as ceramic, cast iron and stainless steel.
- Try to reduce exposure to plastics by using glass to store food, and avoid drinking out of plastic water bottles.

4. Hormone Optimization (sex hormones, thyroid and adrenal/cortisol)

Both women and men experience hormonal changes with chronological age: menopause and andropause. Hormones can also be affected by diet, stress, lifestyle and environmental toxins. Typical symptoms for reduction of sex hormones in women include hot flashes, mood changes, sleep problems, low libido and vaginal dryness. Men with reduced testosterone levels may experience loss of muscle, fatigue, low motivation, low sex drive, and erectile dysfunction. Women are commonly treated typically with estrogen, sometimes low dose testosterone, and progesterone is often prescribed in an oral form. Subcutaneous pellets can be used for hormone therapy in women, and they have the advantage of convenience. The downside of pellets can be more variability in hormone blood levels, peaking soon after placement, then dropping lower over time. The other downside of pellets is that if someone gets too high of a dose of hormone for them, there is extra wait time before being able to change the dose. Usually it is best to determine your optimal dose of hormones through other forms of administration before considering the switch to pellets. Men are most commonly treated with testosterone as intramuscular weekly injections, but can also be treated topically.

One in five women and one in ten men suffer low thyroid function. This can result in increased risk of heart disease, memory loss, depression, fatigue, muscle loss, low libido, hair loss, constipation and dry skin and hair. Gluten (for those who are sensitive to it) and environmental toxins can cause thyroid dysfunction. Lab testing through *functionhealth.com* includes the necessary testing to accurately evaluate for thyroid dysfunction, which is best treated using a combination of levothyroxine (T4), the inactive hormone, and liothyronine (T3), the active hormone. Ideal treatment is with desiccated porcine thyroid, which contains all of the compounds in the appropriate balance (T2, T3 and T4) to support optimal thyroid function. Brands include Armour Thyroid and Nature-Throid.

Our adrenal glands (which sit on top of our kidneys) help us respond to stress by releasing cortisol and adrenaline. However, as we age, we become less stress resilient. Sugar, starch, alcohol, stress, lack of adequate sleep, excessive caffeine, undulate eating all produce extra burden on our adrenal glands, and over time your adrenals can't keep up and become "fatigued"; they can't produce cortisol in response to stress, resulting in adrenal burnout. The key to restoring adrenal function is to focus on living a healthy lifestyle. Nutritional and herbal supplements can be helpful as well. Key strategies to optimize your adrenal function include:

- Wake and sleep at the same time daily.
- Get exposure to morning sunlight 20 minutes a day if possible.
- Eliminate blue light exposure at night with blue-blocker glasses, and consider using red-light bulbs.
- Avoid sugar and starch which cause elevated cortisol and adrenaline.
- Practice a stress reduction strategy daily, such as breath work, yoga, meditation, massage or a hot bath or sauna.
- Take core supplements - vitamin C, B vitamins, and magnesium all help adrenal function.
- Consider herbal support if needed, such as adaptogenic mushrooms, and herbs like rhodiola, ginseng, and ashwagandha.
- Low doses of DHEA (an adrenal hormone) can improve energy, but can have some androgenic effects, including facial hair growth for women and hair loss in both sexes.

5. Treatment of chronic infections

Poor Dental Health

The biggest source of chronic infection for most people is poor dental health. Dental plaque is composed of harmful bacteria, and inflammation of the gums (periodontitis) is also caused by bacteria, the most common of which is *P. gingivalis.* Poor dental health has several mechanisms by which it can damage your health:

1) Constant infection in the mouth is a source of chronic, systemic inflammation. It keeps the immune system in a state of high alert, increasing pro-inflammatory markers like C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-a), and interleukin-6 (IL-6). Pathogenic bacteria in the mouth can mimic human tissues, causing the immune system to mistakenly attack other parts of the body, which is what auto-immune disease is.

2) The average person swallows 2,000 times a day. Harmful bacteria in the mouth is swallowed into the gut, disrupting the gut microbiome (dysbiosis) and contributing to gut issues like Inflammatory Bowel Disease (IBD), small intestinal bacterial overgrowth (SIBO), and increased gut permeability ("leaky gut"). This leads to systemic immune activation.

3) Inflamed, bleeding gums provide a direct route for oral bacteria to enter the bloodstream. These bacteria have been found in arterial plaques, directly contributing to atherosclerosis (plaque buildup), endothelial dysfunction and increased risk of heart attack and stroke.

4) Oral pathogens (specifically *P.gingivalis*) have been detected in the brain tissue of Alzheimer's patients. These bacteria produce enzymes called **gingipains** that destroy brain neurons, contributing to amyloid plaque formation and accelerating cognitive decline.

5) Chronic inflammation from periodontitis worsens insulin resistance, making blood sugar management more difficult. This becomes a self reinforcing cycle because insulin resistance increases the risk of gum disease, and the resulting gum disease makes blood sugar harder to control.

What all of this means is that it is important to practice good oral hygiene to minimize plaque formation and optimize gum health. Make sure any issues with sore or infected teeth are addressed with you dentist, and get regular teeth cleanings. I am also personally a fan of Ellie Phillips, DDS. You can find her on YouTube, and she also has a couple of books, including "Mouth Care Comes Clean". She is a dentist who focuses on natural treatments to optimize dental health. She has a four step protocol for cleaning your mouth when you brush your teeth, and she is a big proponent of using Xylitol containing gum or mints after every meal and snack. Xylitol is a natural sugar substitute that significantly improves oral health by starving, inhibiting, and reducing decay-causing bacteria. It prevents these bacteria from adhering to tooth enamel, reduces acid production, maintains a neutral mouth pH, and stimulates saliva to help with tooth remineralization. I encourage you to look up and read about the benefits of Xylitol for optimizing your dental health.

Chronic viral and tick diseases

Chronic viral or tick diseases can play a significant role in a number of chronic inflammatory and autoimmune diseases. They can often be the underlying, overlooked cause of chronic

diseases such as chronic fatigue syndrome, fibromyalgia, Hashimoto's thyroiditis, and rheumatoid arthritis. Common chronic viral infections include the Epstein-Barr virus, HHJV-6, Cytomegalovirus, and lingering Covid (Long Covid). Commonly implicated tick-borne diseases include Lyme disease, Bartonella and Babesia. These infections can be "stealth pathogens" that evade the immune system, leading to long-term immune dysfunction, chronic fatigue, and neurological issues. They can also trigger "molecular mimicry" where the immune system, in its attempt to attack the virus or bacteria, mistakenly attacks host tissue, resulting in autoimmune-like symptoms. Advanced testing is available for those who are suspected of having hidden infections. Treatments include agents to break down biofilms (protective barriers) often produced by chronic infections, detox support and various herbal protocols. This is in addition to working to maximizing support for the patient's immune system, gut health, and control of systemic inflammation.

6. Stress reduction and mental health optimization

Getting your mind and mindset right has profound health benefits. All of your thoughts, feelings, beliefs, grief, joy, sadness, love, and anger are all transmuted into biological signals that change your gene expression, impacting your immune function, hormones, microbiome, neurotransmitters, neuroplasticity, mitochondria and more. If your emotions are inflamed, so is your biology. Multiple studies have shown, for example, how repressed anger can predict who gets breast cancer and other cancers.

Practices that will help you to optimize your mental health include cultivating a positive mindset, developing self love and self worth, prioritizing self care, cultivating community, social connections, and meaningful relationships. Spending time outdoors has been shown to lower stress levels, and learning breathing techniques that activate the parasympathetic nervous system can significantly reduce stress. Practicing healthy stress management techniques like meditation and mindfulness can significantly lower cortisol levels, and having a sense of purpose is associated with overall well being, improved physical and cognitive health, reduced depressive symptoms, and slower aging.

On a related note, functional medicine views having a sense of purpose in life, and spirituality as essential pillars of "whole-person" health - directly impacting physical, mental and emotional well-being. Research suggests that purpose-driven lives are associated with better emotional regulation and stronger social connections. Many people have spirituality that is

linked to religious belief, but there are also non religious practices that cultivate inner peace, foster a sense of awe and connection with the universe and others. These include immersing oneself in nature through hiking, gardening, watching sunsets, or stargazing. Practices like meditation and yoga can promote inner peace and presence. Engaging in artistic and creative expressions such as music, painting, dance or poetry can foster a “flow state” that is deeply personal and transcendent. Community volunteering provides a sense of purpose and connection to humanity. Reading philosophical texts, studying science, or exploring existential questions offers meaning and wonder. Creating personal rituals can help mark meaningful moments in life.

7. Hormesis: Activating Healing and Repair Mechanisms

One of the keys to health and longevity is the simple principle that what doesn’t kill you makes you stronger. When your system is stressed a little but not too much, it responds by becoming stronger and more resilient. Think of hormesis as small doses of adversity or abundance that kick your body into high gear to protect itself. There are many types of hormesis, and I will touch on just a few of them here:

- Exercise - The most well understood example of hormesis. The mechanisms by which exercise improves health and longevity have been deeply studied. Using your cardiovascular system and your muscles to work harder stimulates a cascade of longevity benefits. The two aspects of exercise most associated with longevity are increased aerobic capacity, as measured by VO2 max, and increasing muscle mass and function. In comparing the highest to the lowest levels of fitness using the VO2 max, the highest fitness group reduced their risk of death by 70 percent, with the biggest benefits in going from being sedentary to moderate fitness. As for muscle mass, sarcopenia (age related muscle loss) is an invisible killer. You must fight age related loss of muscle function and mass with resistance or weight-training exercise while eating adequate amounts of high quality protein (at least 1.6-2.0 mg protein per kg of body weight!). If we don’t build more muscle, we will waste away. Use it or lose it. Intense exercise also stimulates autophagy by the body (see below).
- Caloric Restriction - This can be in the form of reduced overall calorie intake, or intermittent fasting, or time restricted eating. Any of these are a good way to activate autophagy (“self-eating”) which is a natural, essential cellular housekeeping process that breaks down and recycles damaged proteins and organelles, acing as a quality control mechanism. These benefits include cellular repair, immune defense (destroys pathogens inside of cells), anti-

aging effects by clearing out old damaged cells, and cancer prevention - helping to prevent healthy cells from turning into cancer cells. Ketogenic diets, which are high in fat (70-80% of calories), moderate protein (10-20% calories) and low carbs (5-10% calories), mimic starvation and force the body to switch from running on carbohydrates to running on fat for its fuel source. When doing a ketogenic diet it is probably best to cycle in and out of it to follow our evolutionary pattern of alternating between periods of starvation and abundance. Cycling in and out also helps encourage metabolic flexibility, where the body can easily switch between running on carbohydrates and fat stores. One factor to consider if you are doing intermittent fasting with caloric restriction is that you don't want to do it continuously long term, or you risk losing too much muscle tissue, which is critical for longevity and quality of life.

- Some plant compounds may mimic caloric restriction and lead to xenohormesis, activating autophagy. Some of these include polyphenols in coffee, oleuropein in extra virgin olive oil, resveratrol in red grape skin, fisetin from strawberries, catechins in green tea, and curcumin found in turmeric.
- Heat therapy - This works by increasing the production of heat shock proteins (HSPs). Deformed and damaged proteins drive the aging process and need to be repaired or digested, and cleaned up to be made into new proteins. HSPs help proteins refold into the proper shape to perform normally, and they break down and recycle proteins that are too damaged to repair so they don't accumulate. Heat therapy also improves cardiovascular fitness, insulin sensitivity, blood sugar and blood pressure. It helps detoxify toxic chemicals and metals in the body, helps your immune system fight infections and cancer, and boosts growth hormone, needed for repairing and rebuilding your tissues, joints, skin and hair. Any type of heat therapy works, including saunas, hot baths and even hot yoga!
- Cold therapy - Science supports the benefits of cold therapy such as cold water swimming, cold showers, cold plunges, and cryotherapy, which is available at centers around the country. Staying in a very cold environment for too long will result in hypothermia and death, but just the right temperature for the right amount of time can have profound health benefits, including boosting endorphins, strengthening the immune system and lowering inflammation, boosting metabolism and weight loss, improving circulation, and stimulating the vagus nerve, which activate your body's deep relaxation response. It increases focus, mental clarity, and the pleasure neurotransmitter dopamine. It also shunts blood away from your skin, driving oxygen and nutrients to your internal organs. You can build up slowly, starting with warmer temperatures and short duration treatments. Examples include a 1-2 minute cold shower, or a 1-4 minute cold bath. One great way to detoxify is to do a sauna or hot bath first, increasing overall circulation, followed by a cold plunge to quickly flush

your lymph system, carrying old waste and debris from your body back to the liver to be processed.

- Light therapy - We are light detecting devices. Our skin, our eyes, and our brain all receive light that, in turn regulates our circadian rhythm and many other biological processes. Morning bright light, including blue light, in the morning and daytime resets our circadian clock; short exposures to blue light can help treat depression, circadian sleep disorders, and seasonal affective disorder (SAD) in the winter, but prolonged exposure decreases life span in animal models and increases the risk for cancers, obesity, diabetes, and psychiatric disorders. Constant light exposure (thanks to indoor nighttime lighting) tricks our body into an endless summer, the time when our evolutionary pathways required us to store fat for the winter and slow our metabolism. Red and near-infrared light, on the other hand, acts as a very mild form of stress that activates protective mechanisms in cells. It stimulates the mitochondria to make more energy in the form of ATP. This then increases the productivity ton of natural anti-inflammatories and anti-oxidants and speeds up healing. Long-wavelength infrared and red-light therapy can improve eyesight, cognitive ability, physical mobility, stimulate hair growth and improve skin aging. There is a term for it: photobiomodulation. There are now many red light devices that can be purchased online for different purposes.

Finally, if you are interested in learning more about functional medicine, besides the information in this included in you Functional Medicine Workup notebook, I recommend Mark Hyman's book "Young Forever" - a lot of this handout is based on that book. Also, there are some people who I follow on YouTube that I think provide a lot of science based helpful information, and that some of you may be interested in learning from. They are:

Mark Hyman - A leader in the field of functional medicine for many years, has written many books. He has a ton of videos on YouTube with lots of information on the basic principles of functional medicine.

Dr Alex Wibberley- An ER physician in the UK. Relatively new on YouTube, has a lot of really great videos on the basics of preventative health. He explains concepts very clearly in an easy to understand way; very informative. I really love his videos.

Leonid Kim MD - An Internal Medicine Physician who is also board certified in Obesity Medicine. Gives very sound science supported advice on optimizing metabolic health, and health in general.

Nutrition Made Simple - Dr. Gil Carvalho, an M.D. PhD. Very smart guy who reviews the scientific literature, especially regarding cardiovascular health.

Physionic - If you really want to “nerd out” and do a deep dive on what published studies have to say about the latest on supplements and optimizing health. Dr. Nicolas Verhoeven is a researcher with a PhD in Molecular Medicine and Cell & Molecular Physiology. He specializes in translating complex scientific studies on health, metabolism, and nutrition into actionable information.

Dr. Michael Ruscio, DC, DNM - If you want to do a deep dive on gut health, the microbiome, probiotics and treatment approaches to GI problems from a functional medicine perspective, this guy goes through the medical literature to let you know what the studies and the science have to say about optimizing your gut health.

FoundMyFitness - This is Dr. Rhonda Patrick’s YouTube channel. She is a PhD. Biomedical scientist and prominent health educator specializing in nutritional biochemistry, aging, and disease prevention. She is widely known for translating complex scientific research into actionable insights.

Nash Jocic, PhD - He is a very successful former bodybuilder. If you want really good advice on how to maximize muscle growth, I think he is the best on YouTube. You don’t have to want to be a bodybuilder to learn about the best way to add lean muscle mass. I do think he undervalues the importance of complex carbs from plants and vegetables and a balanced diet (he is focused on protein), but you can still learn a lot from him.

Movesmethod - lots of good videos on improving mobility and strength to keep you moving into old age

Will Harlow - Over-Fifties Specialist Physio - practical exercises starting from basic abilities that older people can do at home to increase balance and functional strength for everyday activities