



## The Microbial Solution

***Bacteria follows the diet:  
How changing your microbiome changes your health***

By Peter Leighton

Our body is home to microbes. The intestines alone host over 100 trillion bacteria, constantly competing with each other in this environment we call the *microbiome*. In fact the microbes in our body outnumber human cells 10:1. Like the rainforest, the healthy human microbiome is a balanced ecosystem. And like an ecosystem, if equilibrium is destroyed, these imbalances affect every function in its environment, often resulting in a slow downward spiral.

Many of these bacteria are helpful and necessary for key biological functions, while some are harmful and invasive. Many factors affect this balance of power in the gut, including environmental and dietary influences. Age, stress levels, exercise, diet and use of medications all have an impact.

When there is a “good” balance of microflora in the gut, the body is more effective in the absorption of many nutrients, better able to repress the growth of harmful bacteria that cause illness, form a protective barrier that keeps harmful bacteria and pathogens from entering the blood stream, and actually train the immune system to better respond to pathogens.

Furthermore, microbes perform essential functions such as digesting food and synthesizing nutrients. Studies are also linking the microbiome to human mood and behavior, as well as gut health, human development, and metabolic disorders. The human microbiome has profound consequences for our health. It has been correlated with a wide range of health conditions, from obesity, heart health, and IBD to autism, anxiety, and depression.

Hippocrates famously stated, “*Let your food be your medicine, and your medicine be your food*”. His prophetic words provide a guiding light as more and more progressive thinkers are taking action to reverse the scourge of our modern time – the chronic diseases, allergies and health conditions resulting from what I call our *Malnutrition of Affluence*, the devastating health results of our lifestyle of abundance. But before I can outline an enlightened direction that offers such a promising paradigm shift to our health and wellness, perhaps a little context is in order.

## **Malnutrition of Affluence**

Traditionally, nutritional science has focused its attention on preventing malnutrition and deficiency diseases through the discovery and application of vitamins, minerals and other important micro nutrients. But as the western diet, hailed for its abundance of nutrition, migrated throughout the developed world, nutritional science has had to apply its ever evolving tools towards a greater problem; over-nutrition. As Paul Roberts, author of *The End of Food* notes, "...the ironic prospect that the most serious threat to health would very soon be...food."

Early humans relied on calories for survival. From foraging to hunting, man's diet was extremely diverse and relatively unpredictable. We ate from hundreds of crops and wild animals, offering exceptional biodiversity in our diet, and our bodies adapted to the inconsistent intake of nutrients with an amazing ability to maximize its efficiency. Soon man was domesticating animals and mastering agricultural practices, which resulted in incredible benefits in health and mortality, as well as facilitating changes in lifestyle. In a relative short time span, man was eating for taste and satiety as our modern agricultural and food practices were born.

Today, two key factors dramatically affect our health as it relates to our evolutionary process. First, rapid lifestyle changes have occurred which include diminished physical activity, increased mental stress, dramatic physical relocations and more cross-cultural interactions. Second, our diet has radically changed (knowingly or not), as we consume a far less diverse diet, depleted of many bioactive nutrients and bacterial species. Furthermore, the explosive use of antibiotics, both for personal use and in the industrial animal farms we rely on, has limited the diversity of bacterial species and is breeding "superbugs" – bad bacterial strains resistant to antibiotics. Since these changes have occurred so dramatically and quickly (in relative terms), our evolutionary process of adaptive response has not been able to keep pace.

### **Antibiotics: Too much of a good thing**

According to the Centers for Disease Prevention and Control, each year in the U.S., at least 2 million people become infected with bacteria that are resistant to antibiotics, and at least 23,000 people die each year as a direct result of these infections.<sup>1</sup>

Antibiotic-resistance is largely attributed to the routine use of sub-therapeutic doses of antibiotics on factory farms.<sup>2</sup> The factory farm industry says the antibiotics are needed to prevent disease—partly true, as animals confined indoors in cramped, inhumane conditions, are more susceptible to disease. But it's widely known that industry uses the drugs to grow bigger animals, faster.

As food processing and lifestyle changes took root in the 20<sup>th</sup> century, nutrition has played an increasing role in public health. The concept that disease could be caused by an excessive intake or imbalance of nutrients, as opposed to a lack of them, has begun to receive much attention only in the last 20 years. It seems that the more affluent we have become, the less nutritious is our diet.

### **Dietary changes and processed foods**

Post-industrial agricultural and food processing has removed phytonutrients heretofore thought "inactive" or useless. These compounds are routinely removed from plants through selective breeding and modern processing. Furthermore, we used to eat from over 800 plant foods; now most Americans eat only three, namely French fries (potato), ketchup (tomato) and iceberg lettuce. Modern practices are also introducing many chemicals to the plants and animals we eat, in efforts to increase yield and profitability. More and more studies have demonstrated a relationship between our (Western) diet and chronic diseases.

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<sup>1</sup> <http://www.cdc.gov/drugresistance/threat-report-2013/>

<sup>2</sup> <http://www.sustainabletable.org/257/antibiotics>

Diet is a big factor in chronic disease, responsible some say, for a third of most types of cancer. And our western diet, featuring large amounts of red meat and highly processed foods are often packed with large quantities of salt, fat, and sweeteners, not to mention hundreds of chemical additives.

The incidence of acute and chronic diseases is increasing worldwide, linked to the expansion of the western diet. This development is strongly associated with Western lifestyle, not just lack of physical exercise, mental stress, use of tobacco and alcohol, but also with consumption of refined and calorie-condensed foods, of which most create systemic inflammation that “paralyzes” the innate immune system and reduces resistance to disease.

The journal *Atherosclerosis* reported that volunteers eating a typical Western diet, consisting of 35% saturated fats, experienced increases in tumor necrosis factor-alpha (TNF-a) and interleukin-6 (IL-6): two cytokines actively involved in the inflammatory response. Chronic inflammation has been linked to a range of conditions such as heart disease, osteoporosis, cognitive decline and Alzheimer's, type-2 diabetes, and arthritis.

Researchers from the US' National Cancer Institute (NCI) report that increased consumption of red and processed meat may produce an increased risk of death from cancer or heart disease. This study follows years of research suggesting red and processed meats are linked to a host of ills. A previous study from the NCI reported high intakes of red and processed meats may raise the risk of lung and colorectal cancer by up to 20 per cent. The World Cancer Research Fund published a report in 2007 that directly linked diet to cancer, with alcohol and red and processed meats posing particular risks.

It's important to note that our ancestors ate meat, which was naturally lean because the wild animals fed on grass, one of the few natural sources of omega-3 fatty acids. Hence, their body fat had a higher proportion of the “good” mono-saturated and polyunsaturated fats, and less of the “bad” saturated fats.

Today's grain-fed livestock is specially bred not only to put on lots of fat, but also to partition that fat inside the muscle so as to produce a well-marbled piece of meat. By raising these animals in controlled and confined spaces on rations computer-designed to produce rapid weight gain and marbling, companies can maximize profits. In only about four months we can transform a six-month-old five hundred pound calf into a 1,350-pound, slaughter-ready steer. By comparison, a grass fed steer takes two years to reach a slaughter weight of barely 1,100 pounds.

Lest you think red meat is the only culprit, our agricultural processes have been affecting us in many ways. Today's scientifically bred produce grows so quickly that it contains measurably fewer micronutrients. Research done at the University of Texas in Austin concluded that recently grown crops have shown decreases of up to 38 percent in protein, calcium, vitamin C, phosphorus, iron and riboflavin when compared with produce from past decades. Of the 13 major nutrients found in fruits and vegetables, six have declined substantially.

This may be an unintended result of the genetically uniform, mono-cropping systems that now dominate our agricultural industry. American's are increasingly eating a diet that is devoid in essential phytonutrients to gain the advantages of convenience, taste and price.

Consumption of a high caloric diet lacking bioactive phytonutrients from fruits, vegetables and whole grains has resulted in a 70% increase in obesity in Americans, a problem so profound as to be declared an epidemic and public health issue by the Centers for Disease Control.

The effects of the “western diet” and lifestyle are spreading globally. Almost one third of western Europeans are overweight and 1 in 10 is obese. Male obesity in Japan has doubled since 1982 and the Japan Ministry of Education is recognizing how serious the problem is. Cardiovascular

disease will soon rein as the world's leading cause of death and disability, overtaking infectious disease and malnutrition.

With the advent of a highly processed American diet and changes in our eating habits since World War II, the consumption of essential plant-derived nutrients (phytonutrients) is on the decline. Despite consumer and physician awareness about the importance of eating a diverse diet many of the same forces that are contributing to the epidemics of obesity, cardiovascular disease and diabetes contribute to the poor dietary state of Americans today.

### **Orphaned Phytonutrients**

Modern food processing practices have depleted the diversity and quality of several classes of phytonutrients from the American diet; bioactive phytonutrients that are now demonstrating significant health benefit. The fact that these "orphaned phytonutrients" are now depleted from American's diet may be responsible (in part) for causing or worsening chronic diseases such as diabetes, cardiovascular disease and Alzheimer's.

Our post-industrial agricultural and food processing industry has devoted decades of work to removing certain phytonutrients heretofore thought "inactive" or useless. Most plants produce a host of phytochemicals to perform varying metabolic functions such as coloring agents (known as flavonoids) to protect against excessive sunlight and other stresses, and Sulforaphane (an astringent in broccoli) to discourage the plant from being eaten by animals. These compounds are routinely removed from plants through selective breeding and modern processing.

Modern science is now discovering tremendous value to these "orphaned phytonutrients". As sensitive and specific biotechnology and pharmaceutical R&D tools are being applied to nutrition science, more and greater data is confirming the health benefits of these compounds, and epidemiological studies are linking their depletion from the food chain to increases in chronic diseases. For example, the sulforaphane that has been selectively bred out of commercial broccoli because of its bitter taste has been found to stimulate enzymes in the body that detoxify chemical carcinogens. Similarly, while there are hundreds of flavonoids, science has been uncovering a host of exceptional health benefits they confer, most significantly their cardiovascular benefit. In fact, it is the anecdotal data offered by the "French Paradox" (the fact that the French diet is exceptionally high in fat, yet the French have a disproportionately low incidence of cardiovascular disease) that has led researchers to identify the grape flavonoids (from wine) as the bioactive phytonutrient responsible for such cardiovascular health benefits.

Evidence is mounting as to the benefits of phytonutrients. Time and again rigorous scientific studies document that the more fruits, vegetables and whole grains we eat, the less likely we are to suffer from diseases. In 128 of 156 human studies reviewed in one meta-analysis, there was found a strong relationship between intake of phytonutrients and cancer prevention.

These bioactive phytonutrients-- compounds in dietary fruits, vegetables and whole grains that have heretofore no recognized value in the diet but are now demonstrating an ability to combat and prevent disease-- are no less "valuable" than vitamins.

While it has been well established that insufficient intake of vitamins can result in morbidity and mortality, it should not be surprising that the same is true for orphaned phytonutrients. It strikes one as ironic that at the same time Americans began to supplement and fortify their diet with vitamins, they conversely have depleted whole classes of phytonutrients from the diet.

The latest research into the microbiome is making further shocking revelations. It seems that the changes in our diet are causing a shift in the diversity of our microbiome; or some suspect it is the other way around. Since so much of the cells in our body are bacterial, and these bacteria cells proliferate based upon the foods they prefer, many scientists are speculating that the western diet is proliferating "bad" bacteria species, which compete against "good" bacteria. For example, with an abundance of simple carbohydrates and saturated fats, certain bacteria gain an advantage

and overpopulate the gut, limiting the growth of more healthy bacteria, and perpetuating the biological signals to eat more of the same. That's right, perhaps it is the over abundance of "bad" bacteria that is signaling your brain to eat more junk food!

Compounding the bacterial revelations that may be driving biological changes in our body is the over use of antibiotics. As with any ecology, the diverse bacterial colonies in our body are being disrupted and many species are being eliminated. As with the *Orphaned Phytonutrients* discussed earlier, it turns out that these heretofore-unrecognized bacterial species quietly living among us may have profound effect; their depletion may be our demise.

For instance, it was discovered many years ago that a specific species of bacteria, *h. pylori*, was related to gastric ulcers. So a concerted effort to exterminate the *h. pylori* bacteria was undertaken and, sure enough, the incidence of ulcers declined. But then a strange thing happened. There was a concurrent increase in GERD (acid reflux), which has led to an epidemic: Over sixty percent of adults will have GERD symptoms this year. As it turns out, the *h. pylori* bacteria have the positive effect of suppressing stomach acid secretions. Researchers are now recognizing that the thousands of bacteria strains living in our bodies are there for a reason. At some point, a single species may be needed to perform a function that no other species can. If we no longer host this missing species of bacteria, our survival may be threatened.

### **Diet & Lifestyle**

But depletion of the diversity and quality of phytonutrients and bacterial species from the Western diet is only half the dietary setback. Compounding the problem facing Americans in post-industrial society is a change in dietary habits and lifestyle that is seriously eroding American's health. Teenagers drink almost three times the amount of soft drinks than they did in the 1960's. Researchers warn that this trend will leave teenagers at higher risk of heart disease, osteoporosis and diabetes later in life. Twice as many American children today are eating snack foods than did kids 20 years ago, according to the US Department of Agriculture, and 91% of Americans don't get the recommended minimum five servings of fruits and vegetables per day. Sadly, French fries and potato chips account for 25% of kid's vegetable intake, only exacerbated by a sedentary lifestyle. Teenagers are consuming 17% less energy than in the 1960's but are still gaining weight, a statement about the poor quality of their diet and lack of exercise. And support for the theory of bacterial depletion.

### **Paying the Price**

Only now are we beginning to reconcile the effects of our "modern" diet and lifestyle. Today in America, 60 million people have cardiovascular disease, 16 million suffer the debilitating effects of type 2 diabetes, 10 million people have cancer and nearly 20% of the population has high cholesterol. National healthcare expenditures exceed \$1 trillion, representing over 14% of GDP, a larger share of GDP than any other industrialized country.

As the economic forces drive change in the American healthcare system, and advances in science and technology impart greater insight into the health benefits of bioactive phytonutrients and a diverse microbiome, there will likely be a paradigm shift from the treatment-oriented "sick care" system we now have, towards a prevention-based true healthcare system.

As with all revolutionary changes, there is an exponential acceleration of the process whereby at some undefined point, critical mass is achieved and there is no turning back. Signs of acceleration abound in the current marketplace. Genomics research has gained significant insight into disease predisposition and gene expression. Technological advances in assay development and discovery techniques are rapidly delivering the capability to characterize and assess the bioactive health benefits of phytonutrients and specific probiotic strains. The popular movement against GMO has accentuated the interest in and growth of organic and sustainable agricultural practices, and will likely force broader changes in agricultural and food processing procedures. And consumer trends illustrate a growing interest in the diet-disease link and better nutritional habits. For instance, Seventy five percent of Americans surveyed believe food and nutrition play

the greatest role in their health. In fact, 54% believe food can treat an ailment and more than 50% of households are currently using food/beverages to treat or manage specific health issues.

### **New Tools are offering Solutions**

Both scientists and consumers are now recognizing this problem and are moving to take an active role in maintaining health & wellness through nutrition. For instance, integrating the new tools of biotechnology and nutrigenomics, innovative solutions are being created and applied to a new generation of “wellness” foods. Consumers want lifestyle solutions, where validated science and functional benefit meets pleasure and convenience.

Recognizing that many chronic diseases are closely related to diet and lifestyle, scientists are focusing much study towards how nutrition can optimize and maintain cellular health. This requires advanced understanding of nutrient interaction and metabolic processes at a cellular level, specifically the interaction of nutrients and their relationship with proteins and gene expression. Nutrigenomics is the study of this relationship between gene activity and cell function, and how food, genes and lifestyle interact in human health.

Nutrients from the diet, in relation to lifestyle events, not only nourish the body but send specific signals to the cells through transcript factors, which change gene expression (or how genes behave) and metabolite production. As a result, different nutrients (different diets) affect an individual’s gene and protein expression differently. In other words, what we eat changes the way our body acts and reacts. Certain diets, interacting with certain genotypes, can lead towards chronic diseases (or the prevention of them). This helps explain why two people eating the same diet may respond very differently.<sup>3</sup>

Biotech advances are identifying new compounds and the utility of existing food constituents that can support health & wellness. Through bioinformatics and genomic research, it is becoming increasingly possible to identify and predict the impact of diet on genotypes. For instance, a 3-week nutritional intervention with virgin olive oil may alter the expression of genes related to atherosclerosis. One of the goals of nutrigenomics is to devise genetic-based nutritional interventions to prevent, delay or treat diseases. But on a more practical (and user-friendly) basis, nutrigenomics provides insight into the effects of bioactive compounds and their effect on human health, which is currently aiding in the development of functional foods.

### **Functional foods: You are what you eat**

Nobel Laureate Elie Metschnikof studied the longevity of Balkan peasants, who ate a diet consisting of large quantities of fermented milk. In theorizing why they had such robust lifespan, he suggested that aging was a result of proteolytic microbes producing toxins in the large bowel. As the body digests proteins, these proteolytic bacteria produce toxic by-products including phenols, indols and ammonia. As it turns out, the lactic acid in fermented milk inhibits the growth of the proteolytic bacteria. Metschnikof believed that fermented milk would seed the intestine with “healthy” bacteria (lactic acid) and thus suppress the growth of “bad” bacteria.

From this early theory of bacterial homeostasis in the gut, the study of probiotics began to take root. But not until the last 50 years has advanced science truly leveraged these insights into practice, seeding a prolific industry based around the introduction of “good” bacteria to the gut.

Functional foods, at its basic, are foods that deliver a functional biological benefit beyond “basic nutrition”. Besides the calories, fats, carbohydrates and protein needed for survival, the foods we eat provide phytochemicals and bacteria (or prebiotics, the food for bacteria) that are essential to health and wellness. This supports a better, more diverse ecosystem in the microbiome, which triggers a host of biological events in our body.

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<sup>3</sup> <https://www.youtube.com/watch?v=O1x7MunkjCc>

Emerging science is opening our eyes to a whole new approach to finding intestinal nirvana, or homeostasis as others may call it. It's called Probiotics. The hundred trillion bacteria in the body of an adult human contain about 4 million distinct bacterial genes, with more than 95% of them located in the large intestine. This unique ecosystem in the gut is called the microbiome.

If you have an optimal microbiome in your gut, you will lead a healthy and happy life, free from digestive discomfort and even reduced cravings.

**Some of the beneficial effects of probiotics include:**

- Since lactic acid bacteria convert lactose into lactic acid, several strains of probiotics have demonstrated benefit to individuals who are lactose intolerant.
- The presence of probiotics vastly improves digestion and nutrient absorption.
- Lower incidence of colon cancer among higher consumers of probiotics has led to clinical research in this area. Several studies have found certain probiotic strains exert anti-carcinogenic effects. Some pre- and probiotics may suppress the activity of certain enzymes in the colon, possibly reducing the production of toxic and carcinogenic metabolites, according to a study published in *European Journal of Clinical Nutrition*.
- Probiotics reduce the levels of microorganisms such as E.coli, and salmonella in the gut, and they restrict pathogens ability to release into the bloodstream. A study published in *The Lancet* showed that 59% of subjects did not develop rotoviral diarrhea when a probiotic was administered before infection. The meta-analysis showed that the risk of necrotizing enterocolitis, one of the most common gastrointestinal problems in premature babies, might be cut by 74% with probiotic supplementation. They also observed a 53% reduction in the risk of mortality.
- Both acute and travelers diarrhea are effectively treated with probiotics, and several strains have been effective at treating antibiotic-associated diarrhea. The *British Medical Journal* published a study demonstrating a 22% drop in the number of cases of diarrhea when probiotic drinks were consumed by hospital-bound elderly patients who were receiving antibiotics.
- Inflammatory bowel disease can be modulated by probiotic consumption, as well as other inflammatory allergic responses.
- Several probiotic strains have demonstrated improvement in treating irritable bowel syndrome and colitis, although there are only a handful of probiotic products on the market claiming to target the condition. IBS affects between 10 and 15 per cent of the population. Furthermore, a series of probiotic studies on mice have presented positive results in protecting newborns from intestinal infections and reducing inflammatory bowel disease. Probiotics may boost the number of bowel movements and relieve constipation, suggests a pilot study from the Netherlands.
- Clinical studies have demonstrated probiotic's ability to lower cholesterol, as it seems to inhibit re-absorption.
- Probiotic milk has shown an ability to reduce blood pressure.
- Probiotics protect against pathogens and help stimulate immune response. They also have demonstrated an ability to reduce respiratory tract infections and severity and duration of rotavirus infections. A study published in the *British Medical Journal* showed that children who drink probiotic milk have lower incidences of respiratory illnesses than

those who do not drink the milk. The study showed a 17% reduction in the occurrences, as well as a reduction in the number of antibiotic prescriptions.

- Workers who take probiotics daily are less likely to be off work with common illnesses, such as colds and gastroenteritis, than workers who don't. An exploratory study published in the open access journal *Environmental Health* shows that workers who took a daily dose of probiotic bacteria were 2.5 times less likely to take sick leave than workers who took a placebo. Supplementation of probiotics can reduce the duration of the common cold by nearly a quarter, research has suggested. One study published in *Clinical Nutrition* compared the effects of probiotic supplements with standard vitamins and minerals and found that the probiotic bacteria shortened episodes of the common cold and reduced the severity of symptoms.
- Probiotic bacteria could not only help fight viruses but they may also protect against autoimmune diseases like diabetes. Results from a clinical trial showed higher numbers of different types of white blood cells after subjects had consumed probiotics. Increased white blood cells have been linked to the protection against type 1 diabetes.
- Several studies confirm probiotic benefit in the treatment of urinary tract infections and bacterial vaginosis.
- Studies have shown some probiotics promote oral health by killing the bacteria that foster dental carries.
- Probiotics produce short chain fatty acids that are converted into energy.

### **Microbes and weight management**

The bacterial make up of our gut is interacting with us in a ways that drive our biology. As bacteria eat food (and as indicated, if you change your diet you change which bacteria species proliferate in the gut, and that in turn changes the foods you crave), they secrete metabolites and by-products that affect hormones and a host of biological activity including metabolism.

Scientists have used germ-free mice to study how the microbiome can affect weight and obesity. They showed that a high-fat, high-sugar diet changes the microbiome and that this promotes obesity<sup>4</sup>. Further investigation illustrates that it's these microbial changes that encourage increased consumption of "bad" types of foods. Furthermore, in other studies researchers introduced the microbiome of normal weight ("lean") individuals into the gut of overweight subjects; the overweight individuals lost weight.<sup>5</sup>

It is in our gut where the vagus nerve connects 100 million nerve cells to the base of the brain. What you consume triggers a host of events in your gut that affects your entire body. Some bacteria can make us crave fats and sugars, contributing to obesity. Scientists believe these unique bacteria generate a preference for foods rich in their favorite diet, perhaps leading to negative consequences for their host.

I have already illustrated the increasing evidence of how our "modern" diet is changing the make up of our microbiome. Between the processed foods, lack of biodiversity in our diet and lifestyle changes including the over use of antibiotics, it's no wonder why we are seeing dramatic increases in chronic disease, allergies and weight gain, even when calories are reduced.

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<sup>4</sup> J. S. Flier, J. J. Mekalanos, Gut check: Testing a role for the intestinal microbiome in human obesity. *Sci. Transl. Med.* **1**, 6ps7 (2009).

<sup>5</sup> <https://www.youtube.com/watch?v=8CSZJECh6ss>



**“The use of antibiotics may be eliminating bacteria that help people regulate appetite and metabolism”**

-Wall Street Journal

In fact, the bacteria that colonize in our gut influence our sense of taste, they can produce toxins to make us feel bad, and they can influence the quality of our mood. Even chronic diseases such as diabetes are being tracked to changes in the microbiome.<sup>6</sup>

The scientific research demonstrating a link between gut microbiome and weight management is gaining strong momentum, as researchers are confirming the involvement of intestinal bacteria in obesity.<sup>7</sup>

**“Obesity problem answers might be in the bugs in our stomachs”**

—ABC World News

It seems that our diet changes the make up of our microbiome and that, in turn, affects the foods we crave, the way we feel and the way our body absorbs nutrients. It can become a vicious cycle. Or it can be as simple as changing our microbiome.

**Functionally Targeted Probiotics**

Companies such as OpenBiome, a research company which emerged out of MIT, are supplying hospitals around the country with prescreened human stool. These stool samples are used for fecal transplant, a somewhat invasive but highly successful procedure to treat deadly intestinal infections such as *C. difficile*. “C Diff” is unresponsive to antibiotic therapy. The concept is simple: the patient is missing a bacteria strain that can fight the harmful and resistant strain causing injury. The prescreened strain from someone else’s stool is introduced to the patient through a nasal tube or enema.

We are now able to facilitate the same concept in a much more targeted, and certainly less invasive manner. With advanced gene sequencing we can identify many bacterial strains that have specific functional benefit. By isolating and cultivating these strains, we can provide them to consumers who have depleted colonies of these strains, so as to proactively bring them into a healthier state of balance.

Our so-called modern plagues—obesity, diabetes, asthma—relate to how crucial parts of our gut microbiomes have been wiped out by the overuse of antibiotics or (in many cases) an overreliance on C-section births, which appear to deprive newborns of crucial bacteria.

Whether as a maintenance for sufferers of one of dozens of gastrointestinal disorders, or as a safe approach to weight management, mood enhancement or cholesterol reduction, *functionally targeted probiotics* are an emerging solution to better health and wellness.

Because of their inability to survive passage through the stomach, most basic yogurt cultures are not able to provide significant benefit beyond supporting digestive health and immune function. This problem of survivability through the harsh digestive process has been one of the biggest reasons why probiotics took so long to gain favor among the masses. But as research has advanced, industry now has several robust delivery applications and probiotic strains that are proving successful not only in surviving digestion, but also surviving the manufacturing process that would otherwise kill most strains of bacteria. And these advanced probiotics are addressing another issue that has hampered the advancement of probiotics in the marketplace: shelf stability.

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<sup>6</sup> <http://www.nutraingredients.com/Suppliers2/Cause-of-diabetes-could-be-changes-in-bad-gut-bacteria>

<sup>7</sup> <http://www.sciencedaily.com/releases/2014/11/141106132204.htm>



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