FOREWORD BY



Naveen Jain with John Schroeter



Secrets of the Entrepreneurial Mindset **Revealed**

Learn how curiosity, imagination, and exponential innovation are creating life without limits

Naveen Jain is leading disruptions today that will reshape the world-and beyond. From redefining civilian space exploration to creating a path to free energy to disrupting healthcare and education. Jain is at the forefront of the exponential technology developments that will forever change how we live and work. In Moonshots, Jain reveals the secrets of the "super entrepreneur" mindsetthe catalyst for creating an exciting and abundant future. He then walks readers through the application of these powerful concepts in three moonshot initiatives that he is leading today-one of which is Moon Express, a private lunar venture that promises to open up the moon's vast resources for the betterment of humanity. In Jain's world, the term "moonshot" is meant both literally and figurative-**V**! Journey with Jain through these illuminating pages and awaken your own moonshot potential. It's a discovery that will change your life-and quite possibly the world.

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Probable impossibilities are to be preferred to improbable possibilities.



CHAPTER 14

Curing Healthcare



The road to health is paved with good intestines!



N THE U.S. WE SPEND A FIFTH OF OUR GDP ON HEALTHCARE—more than \$3.3 trillion. For perspective, that's more than the entire GDPs of Germany, the United Kingdom, and France—and closing in on that of Japan's. And while we pay more than twice *per capita* of other developed countries, our healthcare system delivers comparatively worse outcomes. In short, we're all getting screwed.

Elisabeth Rosenthal, author of the healthcare exposé *An American Sickness: How Healthcare Became Big Business and How You Can Take It Back*, explains why. "These days our treatment follows not scientific guidelines, but the logic of commerce in an imperfect and poorly regulated market, whose big players spend more on lobbying than defense contractors. Financial incentives to order more and do more—to default to the most expensive treatment for whatever ails you—drive much of our healthcare." Moreover, she notes that people in every sector of medicine are feeding at the trough: insurers, hospitals, doctors, manufacturers, politicians, regulators, charities, and more. "Even people in sectors that have nothing to do with health—banking, real estate, and tech—have also somehow found a way to extort cash from patients." In other words, the healthcare we get is exactly what the market's financial incentives demand. And they demand profit, not cured patients.

Moreover, Rosenthal outlines 10 "economic rules of the dysfunctional medical market," which include such rubrics as more treatment is always better default to the most expensive; a lifetime of treatment is preferable to a cure; there's money to be made in billing for anything and everything; prices will rise to whatever the market will bear. All true, except that I take exception to her use of the word "dysfunctional"; the system is functioning perfectly according to its objectives! When healthcare providers are paid for doing more, that's exactly what they will do. What's more, their largely uncontrolled profit-incentivized fee-for-service payment model means that medical services are unbundled and paid for separately. In other words, physicians are incentivized to provide more treatments because payment is dependent on the *quantity* of care, not its quality. (Keep this in mind the next time you visit a physician-owned clinic.)

If that were not enough—and apparently it isn't—providers employ sophisticated "coders" who classify procedures for billing purposes. If your medical billing statement is indecipherable, that's part of the game. Medical bills frequently contain line items for procedures that are "upcoded," that is, patients are billed at more expensive levels of service than were actually performed. Coding, in fact, became a profit center of its own for providers. Rosenthal observes,

"Highly skilled coders have contributed to higher costs for patients, because the salaries of this new layer of professionals and their years of education are reflected in our medical bills." This is really nothing short of medical extortion and oftentimes fraud but fraud that is nearly impossible to prove. And year over year, patients are on the hook for a higher percentage of their total healthcare costs. A particu-

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larly notable example of such abuse is the case of Elizabeth Moreno, who was billed \$17,850 for an unwarranted drug test—based on a single urine sample—that should have cost just \$100.92.

But what about the insurers? What does all of this mean for them? More money.

Insurance companies are like banks. They don't make their money on the premiums, they make their money on their *investments* of those premiums. The insurance racket is simply a way of securing capital. This is also why insurance companies do all they can to slash or delay payments on claims—it takes money out of lucrative investment vehicles. In the meantime, while

medical costs explode, insurers simply raise premiums, copayments, and deductibles. And now that they're also required to pay out 80 to 85 percent of premiums on patient claims, they need to make that 15 percent margin go further. That's why premiums are dramatically increasing every year—rising by double digits. If the slice of the pie has gotten smaller, the remedy is simple: *grow the pie*! This way, they stay whole. Where government regulations are concerned, insurance companies simply respond à *la* Alfred E. Newman, "What, me worry?"

I don't begrudge insurance executives for scoring tens of millions in compensation every year, but let this serve as a clue as to just how astoundingly profitable the insurance business is—especially when it is designed more for profit than actually delivering healthcare. This system requires ever-growing legions of sick people to keep this massive engine running. As Rosenthal sums up, "Hospital systems, which are managed by business executives, behave like predatory lenders." As such, the costs can only go up. And if we're all going to be living longer lives, then the future is going to get very expensive.

When all the experts tell us that the average lifespan is about 80 years, we believe it like some law of the universe. When someone dies at that age, we accept that they've lived a good long life. We've become *conditioned* to believe it, and like so many other things connected to our mindset, it becomes a self-fulfilling prophecy. ("Normal" cholesterol in a society where it's "normal" to drop dead of a heart attack really should not be considered a good thing.) We don't achieve more than we expect. The same can be said for our healthcare system. As such, entrepreneurs are presented with a massive opportunity to solve an equally massive problem. And you don't have to read between the lines to see that we're talking about disrupting the very foundations of the healthcare ecosystem, which, as we have just seen, is a big part of the problem. But first, we need to understand the lay of the land—the battlefield upon which this epic disruption will take place: the "medical-industrial complex."

First of all, the term "healthcare" is a misnomer. The healthcare industry is not concerned with health, it is concerned with illness. There is no profit in healthy patients in a system that has emerged to address symptoms and not their underlying causes. Treating symptoms leaves the underlying causes unaddressed. But solve the root causes and the symptoms disappear. Symptoms, though, are what is visible; it's very difficult to see the underlying problem. Consequently, it's easier for people to believe that a health problem has been solved if the symptoms can be eliminated. But this is like painting over rot: it might look good now, but underneath, it's still rotted. The healthcare system works the same way. You can eliminate a symptom, but the problem will just show up as a different symptom altogether. If a patient is suffering from depression, but the root cause is inflammation, you can suppress the depression, but the

continuing inflammation will show up as cancer, it will show up as Alzheimer's, it will show up as diabetes, it will show up as heart disease, it will show up as obesity—any or all of these things—because the inflammation is still active. The healthcare system is really good at suppressing one symptom at a time. But if you can solve the cause of the inflammation, then all the symptoms evapo-

What if we could not only live longer—maybe even two times longer—but enjoy good lifelong health, putting an end to premature death, misery, and wasted healthcare dollars?

rate. Attack the symptoms only, and the patient lives with the problem for the rest of what could be a severely shortened and less enjoyable life.

The healthcare system, then, is really a *sickness* system: it is inherently incentivized against the interests of the patient. Most people believe that the healthcare system is broken. It is not broken. It is doing exactly what it was designed to do: enrich its stakeholders.

We wonder why our medical costs are so high. High medical costs are not the problem; they too are a *symptom* of the problem. Again, our entire governmental, healthcare, and insurance infrastructures are focused on the symptoms. And the business of treating symptoms is one of the most profitable businesses on the planet. If advances in "fixing" the healthcare system have proven elusive, it's by design.

Today, the healthcare system itself has become an organism where the purpose of the organism is its own survival. As such, the pharmaceutical companies believe the best drug they can develop is the drug to which you have a lifetime subscription. If a drug actually cures a condition, then it is not a good drug. So their incentive is never to address the underlying condition, but to treat the symptoms. In other words, it is to their benefit that you remain sick.

The same is true of hospitals. Likewise, doctors need patients. And the insur-

ance industry is the protection racket that has grown up around it all. It sounds incredible, but the entire ecosystem depends entirely upon the continued illness of the population it purports to serve. Even organizations like the American Cancer Society, American Diabetes Association, Susan G. Komen, and others benefit from the continuance of these diseases. You can, in fact, be sure that nowhere will you find in the mission statements of any of these organizations the goal of putting themselves out of business because they are no longer needed. (And when you discover who their major sponsors are, the corruption of their agendas becomes even more painfully obvious.)

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It turns out that illnesses such as cancer, diabetes, heart disease, stroke, Parkinson's, Crohn's, Alzheimer's, arthritis, depression, and many other debilitating conditions share a common denominator: chronic inflammation. In fact, chronic inflammation is both a precursor and prerequisite to the onset and development of today's deadliest diseases. That's the culprit.

But it's also true that inflammation is a normal function of the immune system and is actually essential to the body's healing processes. When there is an injury or infection anywhere in the body, the immune system sends its "first responders"—inflammatory cells—to contain the damage and help heal it. We then experience inflammation as swelling and redness around the site of the problem. If it weren't for inflammation, wounds would likely become infected, with potentially deadly consequences.

Now, recall earlier our discussion about what happens when the amygdala's response is stuck in the *on* position: the brain gets locked into a persistent fight-or-flight state, which leads to anxiety and other mental and physiological disorders. Likewise, when the inflammatory response is continuously provoked into high alert, what was originally intended for our protection—like the fightor-flight response—turns on us as well. This prolonged "state of emergency" can then inflict serious damage upon our cells and organs, leading to disease. For example, sustained inflammation can cause the buildup of plaques that in turn stimulate additional immune response, generating a nasty feedback loop that ends up thickening arteries, which in turn can lead to heart attack or stroke. And by the same mechanisms, inflammation in the brain can lead to Alzheimer's disease.

A whole host of factors underlie chronic inflammation, but one condition in

particular has established a clear link between it and most of these diseases: the "permeability" of the intestine walls, known more familiarly as "leaky gut syndrome." In short, if your intestinal wall becomes leaky, then tiny particles of undigested food, as well as pathogenic gut microbes, can escape the gut and enter the bloodstream, triggering the immune system to kick into action. If this condition persists for a prolonged period—that is, if the leaking continues—the immune response will also continue, attacking not only the "invaders," but ultimately inflicting damage in many areas of the body, leading to the raft of the inflammatory diseases that drive the mortality statistics.

In a healthy gut, a properly balanced community of "microbiota" keep the intestinal walls intact, thus maintaining a strong barrier between your gut and the rest of your body. But if the microbiota are out of balance, a *dysbiosis* results. For example, some of these gut microbes, especially those that feed on sugars, can do real damage to the intestinal lining, increasing its porosity. In fact, gut health is increasingly being linked to the presence of disease. And the gut, of

course, works on the same principle of computing: garbage in, garbage out. In other words, diet matters.

It turns out that Hippocrates, who lived around the 4th century BC, knew what he was talking about when he said, "Let food be thy medicine, and medicine be thy food."

Now, would you be surprised to learn that 70 percent of your body's immune cells live in your intestines? And that their interactions with the microbiota also living in the gut determine to a great extent how your The term "healthcare" is a misnomer. The healthcare industry is not concerned with health, it is concerned with illness. There is no profit in healthy patients in a system that has emerged to address symptoms and not their underlying causes.

immune cells behave? It's true that both your susceptibility to illness and your ability to fight it actually starts in your gut. It's not a great leap, then, to see that gut health must be an important key to a long and healthy life.

So I ask the audacious question: *what if we were able to make illness optional*? If we can eliminate the plethora of diseases caused by chronic inflammation conditions that have their origins in the gut—would we not also be well on our way to realizing a 2X—and maybe even a 3X—improvement in lifespan? Would not this possibility make for the greatest entrepreneurial moonshot of all?

Doubling Health Expectancy

In 2018 just one person in the world who was born in the year 1900 remained alive. And there's no one older, as far as we can tell. It's extraordinary, but should it

be? According to the Centers for Disease Control and Prevention, Americans can expect to live, on average, just 78.8 years. Some, though, are more optimistic: if you can hang on until 2030, the World Health Organization says you might make it to 79.5.

But is there really a hard stop on the human lifespan? It's possible that there is if we leave nature to its own devices. But must we?1 Whatever the case, what we do know is that just as most people live far below their potential, they also die well before their time. And the reasons are clear. The most recent National Center for Health Statistics data, from 2014, reported the number of deaths in the US from all causes to be 2,712,630. Here's how the numbers break out for the top 15 causes:

- Heart disease: 633,842
- Cancers: 595,930
- Chronic lower respiratory diseases: 155,041
- Accidents: 146,571
- Stroke: 140,323
- Alzheimer's disease: 110,561
- Diabetes: 79,535
- Influenza and pneumonia: 57,062
- Kidney disease: 49,959
- Suicide: 44,193
- Septicemia (blood poisoning): 40,773
- Chronic liver disease and cirrhosis: 40,326
- Hypertension (high blood pressure): 32,200
- Parkinson's disease: 27,972
- Noninfectious pneumonitis: 19,803

No surprises here, right? But if you look at the leading causes of death a hundred or so years ago, it becomes equally clear that we're living in a very different world today. In 1900 the average life expectancy was just 47 years. People then were far more likely to die of diseases like tuberculosis, gastrointestinal infections, diphtheria, and other infectious diseases that have largely been eradicated. Today, though, most causes of death are what we have come to understand, ironically, as "age-related"; the longer we live, the more likely we are to develop, for example, heart disease, cancer, or Alzheimer's.

In 1900, though, people died long before any of these diseases had a chance to manifest! But these comparisons don't clearly paint the picture. The world has come to suffer from a very different kind of epidemic in the form of *chronic* illnesses, and they take far more of us now. While infectious diseases have been declining for decades around the world, chronic health problems are more than compensating—they are *by far* the leading cause of mortality in the world, representing nearly three-quarters of all deaths.

What is most striking about these causes, though, is that nearly all of them aren't things that simply happen, but develop as a consequence of lifestyle choices. For example, you don't "catch" Alzheimer's, you *cultivate* it. Literally so. In other words, these diseases are preventable. As a further consequence—and as an exponentially growing insult to illness—these diseases consume the lion's share of all our healthcare dollars. People may be living longer, but the added years are often saddled with the burden of ill health that requires continuing—and expensive—medical attention. But what if we could not only live longer—maybe even two times longer—but enjoy good lifelong health, putting an end to premature death, misery, and wasted healthcare dollars? I believe we can accomplish all three of these goals. That's audacious, to be sure—maybe even crazy—but isn't that the first marker of a moonshot?

It's one thing to examine the causes of death; it's quite another to examine the causes that underlie the causes. We've been learning quite a lot about this in recent years. So much so that when we ask the audacious question, "What if we could make illness optional?" it's actually not as crazy as it sounds.

So how long *should* we expect to be able to live? The folks at Polstats wondered about that and ran a fun simulation to determine life expectancy if all natural causes of death were magically eliminated. The answer? 8,938 years. And that's because, odds are, an "unnatural" cause would eventually catch up with us, e.g., an automobile accident, getting shot, dying in a fire, falling down stairs, drowning, falling off a ladder, or going down in a plane crash. Now, I don't think anyone believes that we can extend human life expectancy 1,000-fold, but how about just a 2X improvement? Could we achieve that much? And an improved "healthspan" to go with it? Framed that way, it suddenly seems a lot more doable. Especially when you begin to understand what's *really* going on in the human body.

But what, exactly is the microbiome? In short, it is a diverse ecological community of microorganisms that reside within the gastrointestinal tract. But that's not what's interesting about it.

What if I told you that you really aren't what you think you are?

In human DNA, there are about 20,000 protein-coding genes. If that number seems impressive, the nematode worm has about 22,000. But get this: the microbes in your gut produce as many as 20 million genes! That's a lot of bioactivity that is not your own. Our bodies are really just a container for the over 100 trillion microorganisms that live in and on us, including over 10,000 species of bacteria. These organisms live with us in a "commensal" relationship: we quite literally eat together at the same table. But the microbiome does more than that—it performs the heavy lifting in providing nourishment to our cells and enables the function of our metabolic and immune systems. Interestingly, its role in our health has been largely overlooked until very recently.

It turns out that this "forgotten organ" is really the wellspring of our wellbeing—and, on the shadow side, the source of many of our diseases. We've now learned that Parkinson's, for example, begins in the gut, not in the brain as previously thought. Therefore, prevention must begin in the gut. Ninety percent of

If we can eliminate the plethora of diseases caused by chronic inflammation—conditions that have their origins in the gut—would we not also be well on our way to realizing a 2X—and maybe even a 3X—improvement in lifespan? Would not this possibility make for the greatest entrepreneurial moonshot of all? your serotonin is produced in the gut. Therefore prevention and treatment of depression and anxiety must begin in the gut (depression is now known to be linked to ongoing low-grade inflammation in the body). Many conditions from allergies to autoimmune diseases are all related to the diversity of the microbiota. The microbiome also plays central roles in vitamin production, nutrient absorption, hunger, detoxification, and how we process and utilize carbohydrates and fat. And thanks to the gut-brain axis, it also affects mood, libido, and general outlook on life. It's remarkable, really. And we've only just found this out. This is especially re-

markable because the microbial cells we host outnumber our "human" cells 10 to one. We are, in fact, more bacteria than we are human! Because we are such composite creatures, a proper equilibrium between the human host and the microbiome is essential for good physiological function.

You'd think that the medical community would have picked up on this ear-

lier. Every chronic disease, whether it is anxiety, depression, autism, Parkinson's, Alzheimer's, obesity, diabetes, cancer—*every one of these conditions*—is directly influenced by the microbiome. In research paper after research paper after research paper we find the same conclusion: the condition of the microbiome is the key to human health.

But ask your doctor about the state of your microbiome, and you'll likely get a blank stare in return. This is starting to change now, but the medical schools don't teach much, if anything, about the role of the microbiome in human physiology and health. And if your doctor is older, he'll likely know nothing about it. Yet the peer-reviewed journals issued by all the leading sources—Reed Elsevier (now RELX group), Wiley-Blackwell, Springer Nature, Taylor & Francis, Sage—are publishing an exponentially growing number of research articles on the topic. Moreover, The NIH Common Fund Human Microbiome Project (HMP) was established in 2008 with the mission of generating research resources for studying human microbiota and their role in human health. All this to say that the microbiome has finally gotten the scientific respect it deserves. It is no longer fringe.

The Greatest Story Never Told: An Alternate Take on Creation

Three and a half billion years ago hordes of single-cell eukaryotes, bacteria, fungi, and

viruses of every stripe roamed the planet. Life was hard for these creatures; they had to forage for their food, the environment was harsh, and it took ages for them to travel even short distances. Over the millennia they became increasingly disgruntled with their lot in life. Having reached the limit of their tolerance, they convened a special council, led by Master, the most intelligent and developed among the vast microbial community.

The assembly, numbering in the quadrillions, was not only the largest crowd size ever recorded, it was unruly. Many in the great multitude were emaciated while others were agitated, chanting and waving signs carrying slogans reading, "Power to Microbes," "We're Taking Over," and "We Demand Change."

Master rose and calmed the crowd. "My fellow microbes," he said. "We have a solution to all our problems. A solution that will see to every one of our needs. No more hardship, no more cold, and no more wondering where the next meal is coming from." The crowd roared with excitement.

"Tell us more, Master! What is it?"

Their leader continued. "It's amazing, really. Trillions of us can live inside each one of these units that we've managed to modify to meet our specific needs. You'll be responsible for maintaining them, though. You'll have to do your part to keep them healthy. And if you do, they will deliver all the food you'll ever need right to your door. And also, because they're so incredibly mobile, they be for us a great ship that will help us colonize the world, planting new communities wherever they go. Yes, my fellow microbes, we are going to take over the world! We are going to see great change! You will be empowered at last!" With that, thunderous applause rose from the assembled throng and resonated throughout the great primordial valley.

They christened these great ships "humans" and these units did indeed deliver every one of Master's promises. The massive and diverse ecosystem of organisms prospered and multiplied with the ushering in of this amazing new age.

In time, though, the microbial community again began to worry, and called for another special council to address the new concerns. "Master," they beseeched. "These hosts you've built for us, they're getting quite sophisticated. If they become smarter than us, then we just might lose control. They might rise up and dominate us. Our very survival could be threatened! What ever will we do?!"

Again, Master rose and calmed the anxious crowd. "Microbes, microbes, you're worrying about nothing. You see, we really did think of everything."

"How so, Master? How will we ever be able to subdue this monster we've created?"

"It's a secret, microbes, but I'll share it with you. Among you in this very assembly are your ancient brothers. You know them as mitochondria. Well, we've managed to sneak them right into humanity's cells. Built them right in, we did. And the humans are not even aware of it. These amazing brothers of ours—equipped with their own DNA, mind you—actually provide all the energy to the humans' cells. They are the power plant that keeps the human machine running. So you see, humanity is completely dependent upon our bacterial brothers to keep them alive. And all their siblings, whether they reside in the host cells or in the gut with you, are in constant communication. They're in on this with us. If humanity ever really gets out of control, we'll just pull the plug, and they will be finished."

"Master," they replied with some relief. "That's brilliant, but we're concerned about something else they've developed—this thing called a *brain*. Won't they eventually find a way to outsmart us?"

"Microbes!" Master's impatience began to show. "To what lengths must I go to show you that everything is under control? Let me ask you something. Where do most of us live?"

"Right here, in the human's gut," they answered. "But we're talking about the brain!"

"We know all about that brain," said Master. "Which is why we planned ahead. We laid down a cable that directly connects the gut to the brain. We're actually hardwired right into it. It turns out that the humans found out about this little detail, but we're not worried. They're still pretty clueless. I'll tell you just how clueless they are. Can you believe they gave this little highway a name? They call it the Vagus nerve, thinking that what happens in the gut stays in the gut. How wrong they were! Let me tell you, microbes, as you well know, what happens in the gut goes *everywhere*!"

"Yes, Master," they responded, still not completely satisfied. "Are you saying that we can we actually control that brain? It seems to have a mind of its own!"

"Ah, yes, that's how it *seems*," answered Master. "That's the most brilliant part of all. You see—and this is biggest secret—we just let them *believe* they're in control. You've heard of this chemical neurotransmitter called serotonin? They utterly rely on it. Where do you think they get it? They get it from *you*, my dear microbes! 90 percent of it comes from right here, in the gut. We produce it for them, making it out of the food they give us. In fact, we control a whole raft of these neurotransmitters that travel up and down this Vagus nerve. And through them, we control their behavior, we control their emotions, we control what they *think*. We control the horizontal, we control the vertical—we control it all! And we do it all along this superhighway. Yet like any good leader, we let them believe they're the ones making the decisions. But now you know that *we're* the ones pulling the strings. These humans are just our puppets. You, my fellow microbes, working together, are the puppet *master*. So sit back and relax. We are in complete control. We've totally got this. We really have taken over the world!"

This little tongue-in-cheek story aside, it is true that the microbiota that live in the gut control many aspects of the human host for its own benefit. And when it's not happy, neither are you. That unhappiness manifests as diabetes, Alzheimer's, Parkinson's, obesity, many cancers, and a host of other disorders caused by the chronic inflammation that results from dysbiosis in the microbiome. And remarkably, the state of that microbiome is entirely dependent upon what its human hosts feed it. But there's another catch.

Where the microbiome is concerned, it turns out that one man's food is another man's poison. What we've now learned is that there is no such thing as a universally healthy diet. The food that might be good for you is not necessarily good for me. And the food that's good for me today may not be good for me four months from now. That spinach you thought was so healthy? 30 percent of us cannot digest it properly, with the consequence being inflammation. It's also true that 50 percent of people who believe they are doing their bodies a favor by eating blueberries, raspberries, or walnuts are actually doing no good at all, or may even be doing harm. Yet we treat our bodies like a black box with little to no understanding of what's really going on inside it. And we all pay the price for that ignorance.

For the first time, though, we, as entrepreneurs, have a shot at making chronic illness truly optional. We saved the microbiota and enabled it to flourish; let's give them an opportunity to return the favor. After all, they have a stake in this too!

Learn more about the science of the microbiome and the amazing gut-brain connection at moonshotsupdate.com

But let's get back to why this matters in the context of disrupting the medical-industrial complex. In short, it means that if you can maintain good gut health, then that good gut health will keep the rest of you healthy. If the gut microbiota are in dysbiosis, then you're up for all the diseases caused by the chronic inflammation that inevitably results—the very conditions that we know to slash human life expectancy *at least* in half.

This also means that if we are fundamentally healthy, then doctors can get back to the proper business of true healthcare, which is treating *acute* conditions. But it also means that their workload will be reduced by more than 70 percent—the amount of care currently consumed by preventable chronic diseases. What's more, it also means that the pharmaceutical industry's drug development pipeline will dry up accordingly. Healthcare costs will then plummet, and a good portion of that 20 percent of our GDP dedicated to healthcare can be put to far better use. So how would this actually work? Well, let me tell you how I came to this in the first place.



As we've seen, the current medical system looks at health problems from the wrong end of the scope. The entire system is geared toward treating the symptoms of a problem, and symptoms are what keep the healthcare industry in

business. The opportunity for disruption lies in the possibility of detecting and eliminating problems long before they have the opportunity to manifest as symptoms. That simple change in perspective is both radical and empowering. It changes everything. And it is the single greatest threat to the medical-industrial complex that makes billions of dollars on the backs of human suffering.

While working with NASA on Moon Express, I was exposed to the most amazing technologies, many of which could be harnessed to benefit humanity. Yet there they were, just sitting, undeveloped and unused. It was mind-boggling. The US government has invested hundreds of billions of dollars funding scientific research. When I realized that very few people were working to exploit the research, I had my "eureka" moment. The technology that I am now commercializing with my company Viome is just one of them. And I discovered it at the Los Alamos National Lab—a national security research institution that develops scientific and engineering solutions to ensure the safety, security, and reliability of the US nuclear deterrent, as well as to reduce global threats

and solve other emerging national security and energy challenges. Quite a charter. Their work in biothreat reduction is what caught my attention. It extends across many areas, including detection technologies, bioforensics, pathogen analysis, and understanding host-pathogen interactions for better vaccine development. It was in this context that the Lab was tasked with quickly and accurately identifying any pathogen that might be present in the human body.

What they came up with actually provides a complete view into everything that is going on inside the body. If we are fundamentally healthy, then doctors can get back to the proper business of true healthcare, which is treating *acute* conditions. But it also means that their workload will be reduced by more than 70 percent—the amount of care currently consumed by preventable chronic diseases.

It occurred to me that we could apply this same technology for wellness—a lateral application if there ever was one. If we know what's going on inside the body, then we can tweak it and keep people healthy—and particularly so if we were to apply artificial intelligence to all the complex biological data we're able to amass. So I licensed the core technology and formed Viome.

Once we obtain FDA approval, we'll be able to diagnose every single disease,

because we'll know what is being expressed by every pathogen, and we'll be able to see exactly what's active in the body. This is actually far more than a new spin on personalized medicine, because it's analyzing the body at a molecular level. And because we're testing our participants every month, we're also generating a critical mass of longitudinal data, which means that if an illness occurs over time, we will be able to find a predictive biomarker for it. In the context of a disease like Alzheimer's, we believe we'll be able to detect it—and potentially cure it—20 years before the onset of symptoms.

Now look at what's happening in genetic sequencing—another area that's ripe for disruption. It takes a long time and costs a lot of money to sequence one's DNA. But the researchers at Los Alamos realized that instead of looking at the DNA for the information of interest, they needed only to consider the RNA. If the information of interest is not being expressed, then we don't really care. Secondly, 90 percent of all the RNAs are concerned with housekeeping; we know exactly what they do. Removing them from the mix leaves us with only 10 percent to sequence. And when we do just that, we're able to see everything that's going on in the gut lining. So not only has the cost of the thing come down by 90 percent , we are actually able to offer monthly testing at a consumer price point. That's disruption.

This is the magic of the big, audacious idea—why it actually is easier to accomplish a moonshot than a lesser goal: it enables you to attract the best talent and raise funding on the best possible terms. It's so exciting to think about what's going to happen in the next 10 years. But we actually don't have to wait that long. Right now, we can identify every single gene expression of every organism in the gut—not only *what* they are, but what the community of microbiota are actually *doing*. Are they, for example, producing the short-chain fatty acids that our body needs? This aspect alone of the metabolic activity of the microbiome il-

lustrates why gut health is so vital. We're all told to make sure we have enough fiber in our diet. But why? It turns out that it's not the fiber *per se*, but what your gut microbiota does with it. In short, they ferment the fiber and produce a short-chain fatty acid called butyrate, which plays a significant role in preventing diseases from autoimmunity to obesity to colon cancer. It also has a great deal to do with how you respond to medical treatments. In the case of

colon cancer, for example, treatment is only effective when a high-fiber diet is combined with the correct bacteria in the gut. If there is a deficiency of those critical microbiota, then the treatment will actually do no good. But your doctors won't tell you that.

We can also see whether or not the microbiota are producing the essential vitamins including B vitamins B12, thiamine, and riboflavin, and Vitamin K.

The "essential" nutrients and vitamins listed on the products you buy are socalled because the human body can't make them—the microbiota synthesize them for us. Indeed, the human body is a *supraorganism* composed of nonhuman and human cells that work together in a beautiful symbiosis—but only when properly diverse, which is largely a function of diet.

The human body along with consciousness—may, in fact, be the real "last frontier" and an amazing platform for unimagined entrepreneurial opportunity.

Many people have told me that this

idea of making illness optional is one moonshot too far—that mining helium-3 on the moon and revolutionizing the energy industry will be a walk in the park compared with taking on the healthcare industry. They tell me that I'd be fighting powerful forces with tremendous reach, deep pockets, and far-reaching political influence. But what if we can completely flank the industry? What if we don't even make it about healthcare? What if we simply stick to helping people not get sick?

Of course, we have preventive medicine, but it is mostly concerned with the early detection of existing disease states, and it is expensive. By the way, it is illuminating that the FDA has not labelled aging as a condition in need of treatment. While the FDA regulates many *symptoms* of aging, such as osteoporosis, heart disease, bone loss, diminished mental capacity, etc., it tends to be harder to prove a preventative than it is to prove a drug that treats disease. Moreover, preventive medicine plays into the whole healthcare system game. Primary prevention in the form of diet and exercise, though, is the most basic tool in preventive care arsenal. But how inspiring is this? Apparently, it's not inspiring at all.

In terms of diet, the food Americans eat is not only ultra-processed, but laden with salt, fat, and sugar. Foods rich in fat and sugar, especially processed foods, are more easily digested by the system, but they are not a good source of food for the microbes inhabiting the gut. The result is a less diverse microbiome and less critical communication with the body's systems. Consequently, the average American male has a body mass index just barely under the medical definition of obese, while, according to the CDC, 36 percent actually *are* obese. More shocking is a Mayo Clinic study concluding that only 2.7 percent of all adults exhibit healthy lifestyle characteristics. But here's the real irony: we actually *think* we're doing pretty well! According to an NPR poll, 75 percent of respon-

We know where this is headed: we can project the point at which the necessary technologies will intersect, and when they do, we'll be there to meet them. In the meantime, we can begin to build the stack with known technologies and with hooks that anticipate the missing pieces. dents ranked their diets as "good, very good, or excellent." Clearly, we have a major disconnect.

In many respects, a great many illnesses are already optional. Perhaps the real moonshot here is not in taking on the healthcare system, but just getting people to care at all about their health! That, though, is something we *can* inspire. By simply understanding the marvel of how our bodies actually work, what our potential as human beings really is, and that

illness truly can be optional for ourselves *and for our loved ones*—to say nothing of sparing the bank account and saving our economy—I believe we can turn this state of affairs around. This outcome is actually something that people can visualize—and who wouldn't want to be part of bringing that world into existence—a world where our spouses, children, parents, and dear friends would not become sick and die before their time, which should be a very long time? We're venturing into fascinating territory that has only now come into view. The human body—along with consciousness—may, in fact, be the real "last frontier" and an amazing platform for unimagined entrepreneurial opportunity.

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When I started Viome, I didn't see the microbiome as its focus. My thesis was always the question, "What if we could make illness optional?" Microbiome science was never the goal. While we speak of the microbiome, it's really only the vehicle by which we will achieve our goal. It's how we're moving not only the needle, but the goalpost.

Viome is not the only company working in the microbiome space. Others have been there for years. But none of them has preempted the conversation to the larger opportunity: making illness optional. *That's* the moonshot. When you set out to do something that is as audacious as eliminating illness, the very idea becomes a source of inspiration. It becomes a magnet. In the early going, we may not even know exactly how we'll pull off this big idea, but the very visualizing of the possibility is exciting. And that possibility allows you to attract the best and brightest minds, who will then come alongside you and help make it happen. This is the magic of the big, audacious idea—why it actually is easier to accomplish a moonshot than a lesser goal: it enables you to attract the best talent and raise funding on the best possible terms.

When I went out and asked people to imagine living in a world where illness was optional, nobody ever asked me how we'd do it! Then one day I got a call from Guruduth "Guru" Banavar, the head of IBM Watson research. He told me he'd been working on this problem for 20 years. As one of the world's leading figures in artificial intelligence, the one thing he knew he was missing was data, and that if he could get his hands on the data about what's going on inside the human body, then he could figure out the rest. As a consequence of that call, Guru joined the company as our CTO, building out our AI platform, and working alongside our chief science officer, Momo Vuyisich, the former leader of the Applied Genomics team at Los Alamos National Laboratory. Dr. Helen Messier, MD, PhD left her job at Human Longevity working for Dr. Craig Venter to join me in the moonshot to make illness optional. After all, what's the point of living longer if you are going to be

sick and suffering? And on our scientific advisory board are Ray Kurzweil and medical luminaries from UCLA, Harvard Medical School, Scripps Research Institute, and others. It's incredible,

We're essentially taking a healthcare problem and making it a big data problem.

really. When people of this caliber come together over a cause they believe in, others in the industry take notice. Before long, Vinod Khosla, the legendary Silicon Valley venture capitalist, reached out, and ended up taking a lead role in the Series A funding round. This is what a moonshot initiative can do. The bolder the idea, the bigger the opportunity, and the easier it actually is to accomplish.

So how will we get there? A world free of illness is not something we can do in a year or even 10 years. But we can bootstrap everything we need in order to get the ball rolling. There are still many unknowns, still much research to do, and additional technologies needed that don't yet exist. But we know where this is headed: we can project the point at which the necessary technologies will intersect, and when they do, we'll be there to meet them. In the meantime, we can begin to build the stack with known technologies and with hooks that anticipate the missing pieces. We can start by simply helping people feel better today, because we already have what we need to do that, even as we build the crucial datasets that will enable the next steps of our AI platform. And we're learning fast as we go—so fast that as we move further down this road, no one will be able to catch us.

We also know that the technologies we'll ultimately need in order to scale are progressing on exponential curves. But because it will take a few years to build the underlying infrastructure, we start today, bootstrapping the company and engaging consumers with the artificial intelligence tools we have now that are already enabling us to make correlations, taking us a step closer to removing chronic illness from the face of the Earth—and without pharmaceutical drugs.

As to competition, we're transcending the notion altogether. Our so-called competitors are irrelevant because we've fundamentally moved the goalpost for them as well. We're essentially taking a healthcare problem and making it a big data problem. Our ultimate competitors will be the Googles of the world, not the pharmaceutical companies. If you're the CEO of Pfizer, you think your competition is coming from Merck. If you're a really forward-looking CEO you might think your competition is coming from the biotechs. But competition is always hiding in plain sight, and you'd have missed it. While the pharma industry execs are reading the same industry rags, going to the same conferences, talking only to each other, they're not learning anything. Healthcare is a big data problem, and as such there is no more trial and error. That will fundamentally change the way healthcare is done.

At the end of the day, our bodies are biochemical entities. As such, they are more an *ecosystem* than a single organism—an ecosystem made up of microbial cells living in community with our own cells. Because we'll be able to understand everything that is happening in this "community," which, when unbalanced, is responsible for chronic diseases, we can indeed potentially create a world where chronic illness is optional. It's exciting to think that autoimmune diseases such as diabetes, rheumatoid arthritis, muscular dystrophy, multiple

sclerosis, and fibromyalgia—all of which are associated with dysbiosis in the microbiome—can actually become a thing of the past.

There is far more about the microbiome and its role in human health that I'd like to share, but it's beyond the scope of this book. If you'd like to learn more on this topic, you can find a wealth of informational resources at www.viome.com. I hope you'll be inspired to find your own moonshot in this exciting, stimulating, and incredibly wide-open space.

1. The so-called "Hayflick Limit" is based on the discovery that *telomeres*—the caps at the end of each strand of DNA that protect our chromosomes, like the plastic tips at the end of shoelaces—diminish each time cells divide. It appears that the limit of how many times a cell can replicate itself is, on average, about 50, after which the cell runs out of telomeres and enters its last days—the senescent, or zombie state discussed in Chapter 2. The cell stops dividing, but it continues its nasty inflammation-inducing business. Interestingly, researchers have translated this rate of cell division to a maximum human lifespan of 120 years. So perhaps we really are rigged with a genetic time bomb. But maybe that bomb can be defused. If we can refresh cells with a new supply of telomere-lengthening *telomerase*, then we can keep resetting the cell division count back to zero, meaning that even if a cell is 50 generations down the line, it can be reborn, thus fending off the Grim Reaper that is otherwise the Hayflick Limit. Or maybe not. It turns out that cancer cells also benefit from telomerase, which makes their uncontrolled division even more robust. Clearly, we need more research, but ironically, the National Institute of Aging invests only 2 to 3 percent of its budget in this area.

Praise for Moonshots

This brilliant must-read book by Naveen Jain provides the key to unlocking the emerging new era of abundance, turning the page forever on the old and obsolete scarcity-driven mindset. Here is a powerful book that will give you the confidence to launch your own moonshot and solve any grand challenge you choose.

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