

# OUTLIVE

THE SCIENCE & ART  
OF LONGEVITY

PETER ATTIA, MD

WITH BILL GIFFORD

RETHINKING MEDICINE  TO LIVE BETTER LONGER



## Annotation

**\*\*A groundbreaking manifesto on living better and longer that challenges the conventional medical thinking on aging and reveals a new approach to preventing chronic disease and extending long-term health, from a visionary physician and leading longevity expert\*\* \*\*"** One of the most important books you'll ever read."--Steven D. Levitt, *New York Times* bestselling author of *Freakonomics***\*\*** Wouldn't you like to live longer? And better? In this operating manual for longevity, Dr. Peter Attia draws on the latest science to deliver innovative nutritional interventions, techniques for optimizing exercise and sleep, and tools for addressing emotional and mental health. For all its successes, mainstream medicine has failed to make much progress against the diseases of aging that kill most people: heart disease, cancer, Alzheimer's disease, and type 2 diabetes. Too often, it intervenes with treatments...

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The information and advice presented in this book are not meant to substitute for the advice of your family's physician or other trained healthcare professionals. You are advised to consult with healthcare professionals with regard to all matters pertaining to you and your family's health and well-being.

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Published in the United States by Harmony Books, an imprint of Random House, a division of Penguin Random House LLC, New York.

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Library of Congress Cataloging-in-Publication Data has been applied for.

ISBN 9780593236598

Ebook ISBN 9780593236604

*Book design by Andrea Lau*

*Cover design by Rodrigo Coral Studio*

ep\_prh\_6.0\_142982158\_c0\_r0

## **AUTHOR'S NOTE**

Writing about science and medicine for the public requires striking a balance between brevity and nuance, rigor and readability. I've done my best to find the sweet spot on that continuum, getting the substance right while keeping this book accessible to the lay reader. You'll be the judge of whether or not I hit the target.

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## **INTRODUCTION**

In the dream, I’m trying to catch the falling eggs.

I’m standing on a sidewalk in a big, dirty city that looks a lot like Baltimore, holding a padded basket and looking up. Every few seconds, I spot an egg whizzing down at me from above, and I run to try to catch it in the basket.

They’re coming at me fast, and I’m doing my best to catch them, running all over the place with my basket outstretched like an outfielder’s glove. But I can’t catch them all. Some of them—many of them—smack on the ground, splattering yellow yolk all over my shoes and medical scrubs. I’m desperate for this to stop.

Where are the eggs coming from? There must be a guy up there on top of the building, or on a balcony, just casually tossing them over the rail. But I can’t see him, and I’m so busy I barely even have time to think about him. I’m just running around trying to catch as many eggs as possible. And I’m failing miserably. Emotion wells up in my body as I realize that no matter how hard I try, I’ll never be able to catch all the eggs. I feel overwhelmed, and helpless.

And then I wake up, another chance at precious sleep ruined.

We forget nearly all our dreams, but two decades later, I can’t seem to get this one out of my head. It invaded my nights many times when I was a surgical resident at Johns Hopkins Hospital, in training to become a cancer

surgeon. It was one of the best periods of my life, even if at times I felt like I was going crazy. It wasn't uncommon for my colleagues and me to work for twenty-four hours straight. I craved sleep. The dream kept ruining it.

The attending surgeons at Hopkins specialized in serious cases like pancreatic cancer, which meant that very often we were the only people standing between the patient and death. Pancreatic cancer grows silently, without symptoms, and by the time it is discovered, it is often quite advanced. Surgery was an option for only about 20 to 30 percent of patients. We were their last hope.

Our weapon of choice was something called the Whipple Procedure, which involved removing the head of the patient's pancreas and the upper part of the small intestine, called the duodenum. It's a difficult, dangerous operation, and in the early days it was almost always fatal. Yet still surgeons attempted it; that's how desperate pancreatic cancer is. By the time I was in training, more than 99 percent of patients survived for at least thirty days after this surgery. We had gotten pretty good at catching the eggs.

At that point in my life, I was determined to become the best cancer surgeon that I could possibly be. I had worked really hard to get where I was; most of my high school teachers, and even my parents, had not expected me to make it to college, much less graduate from Stanford Medical School. But more and more, I found myself torn. On the one hand, I loved the complexity of these surgeries, and I felt elated every time we finished a successful procedure. We had removed the tumor—we had caught the egg, or so we thought.

On the other hand, I was beginning to wonder how "success" was defined. The reality was that nearly all these patients would still die within a few years. The egg would inevitably hit the ground. What were we really accomplishing?

When I finally recognized the futility of this, I grew so frustrated that I quit medicine for an entirely different career. But then a confluence of events occurred that ended up radically changing the way I thought about health and disease. I made my way back into the medical profession with a fresh approach, and new hope.

The reason why goes back to my dream about the falling eggs. In short, it had finally dawned on me that the only way to solve the problem was not to get better at catching the eggs. Instead, we needed to try to stop the guy who was throwing them. We had to figure out how to get to the top of the building, find the guy, and take him out.

I'd have relished that job in real life; as a young boxer, I had a pretty mean left hook. But medicine is obviously a bit more complicated. Ultimately, I realized that we needed to approach the situation—the falling eggs—in an entirely different way, with a different mindset, and using a different set of tools.

That, very briefly, is what this book is about.

PART I

## CHAPTER 1

### The Long Game

From Fast Death to Slow Death

There comes a point where we need to stop just pulling people out of the river. We need to go upstream and find out why they're falling in.

—BISHOP DESMOND TUTU

I'll never forget the first patient whom I ever saw die. It was early in my second year of medical school, and I was spending a Saturday evening volunteering at the hospital, which is something the school encouraged us to do. But we were only supposed to observe, because by that point we knew just enough to be dangerous.

At some point, a woman in her midthirties came into the ER complaining of shortness of breath. She was from East Palo Alto, a pocket of poverty in that very wealthy town. While the nurses snapped a set of EKG leads on her and fitted an oxygen mask over her nose and mouth, I sat by her side, trying to distract her with small talk. *What's your name? Do you have kids? How long have you been feeling this way?*

All of a sudden, her face tightened with fear and she began gasping for breath. Then her eyes rolled back and she lost consciousness.

Within seconds, nurses and doctors flooded into the ER bay and began running a “code” on her, snaking a breathing tube down her airway and injecting her full of potent drugs in a last-ditch effort at resuscitation. Meanwhile, one of the residents began doing chest compressions on her prone body. Every couple of minutes, everyone would step back as the attending physician slapped defibrillation paddles on her chest, and her body would twitch with the immense jolt of electricity. Everything was precisely choreographed; they knew the drill.

I shrank into a corner, trying to stay out of the way, but the resident doing CPR caught my eye and said, “Hey, man, can you come over here and relieve me? Just pump with the same force and rhythm as I am now, okay?”

So I began doing compressions for the first time in my life on someone who was not a mannequin. But nothing worked. She died, right there on the table, as I was still pounding on her chest. Just a few minutes earlier, I'd been asking about her family. A nurse pulled the sheet up over her face and everyone scattered as quickly as they had arrived.

This was not a rare occurrence for anyone else in the room, but I was freaked out, horrified. *What the hell just happened?*

I would see many other patients die, but that woman's death haunted me for years. I now suspect that she probably died because of a massive pulmonary embolism, but I kept wondering, what was really wrong with her? What was going on before she made her way to the ER? And would things have turned out differently if she had had better access to medical care? Could her sad fate have been changed?

Later, as a surgical resident at Johns Hopkins, I would learn that death comes at two speeds: fast and slow. In inner-city Baltimore, fast death ruled the streets, meted out by guns, knives, and speeding automobiles. As perverse as it sounds, the violence of the city was a "feature" of the training program. While I chose Hopkins because of its excellence in liver and pancreatic cancer surgery, the fact that it averaged more than ten penetrating trauma cases per day, mostly gunshot or stabbing wounds, meant that my colleagues and I would have ample opportunity to develop our surgical skills repairing bodies that were too often young, poor, Black, and male.

If trauma dominated the nighttime, our days belonged to patients with vascular disease, GI disease, and especially cancer. The difference was that these patients' "wounds" were caused by slow-growing, long-undetected tumors, and not all of them survived either—not even the wealthy ones, the ones who were on top of the world. Cancer doesn't care how rich you are. Or who your surgeon is, really. If it wants to find a way to kill you, it will. Ultimately, these slow deaths ended up bothering me even more.

But this is not a book about death. Quite the opposite, in fact.

—

More than twenty-five years after that woman walked into the ER, I'm still practicing medicine, but in a very different way from how I had imagined. I no longer perform cancer surgeries, or any other kind of surgery. If you come to see me with a rash or a broken arm, I probably won't be of very much help.

So, what *do* I do?

Good question. If you were to ask me that at a party, I would do my best to duck out of the conversation. Or I would lie and say I'm a race car driver, which is what I really want to be when I grow up. (Plan B: shepherd.)

My focus as a physician is on longevity. The problem is that I kind of hate the word *longevity*. It has been hopelessly tainted by a centuries-long parade of quacks and charlatans who have claimed to possess the secret elixir to a longer life. I don't want to be associated with those people, and I'm not arrogant enough to think that I myself have some sort of easy answer to this problem, which has puzzled humankind for millennia. If longevity were simple, then there might not be a need for this book.

I'll start with what longevity isn't. Longevity does not mean living forever. Or even to age 120, or 150, which some self-proclaimed experts are now routinely promising to their followers. Barring some major breakthrough that, somehow, somehow, reverses two billion years of evolutionary history and frees us from time's arrow, everyone and everything that is alive today will inevitably die. It's a one-way street.

Nor does longevity mean merely notching more and more birthdays as we slowly wither away. This is what happened to a hapless mythical Greek named Tithonus, who asked the gods for eternal life. To his joy, the gods granted his wish. But because he forgot to ask for eternal youth as well, his body continued to decay. Oops.

Most of my patients instinctively get this. When they first come to see me, they generally insist that they *don't* want to live longer, if doing so means lingering on in a state of ever-declining health. Many of them have watched their parents or grandparents endure such a fate, still alive but crippled by physical frailty or dementia. They have no desire to reenact their elders' suffering. Here's where I stop them. Just because your parents endured a painful old age, or died younger than they should have, I say, does not mean that you must do the same. The past need not dictate the future. Your longevity is more malleable than you think.

In 1900, life expectancy hovered somewhere south of age fifty, and most people were likely to die from "fast" causes: accidents, injuries, and infectious diseases of various kinds. Since then, slow death has supplanted fast death. The majority of people reading this book can expect to die somewhere in their seventies or eighties, give or take, and almost all from "slow" causes. Assuming that you're not someone who engages in ultrarisky behaviors like BASE jumping, motorcycle racing, or texting and driving, the odds are overwhelming that you will die as a result of one of the chronic diseases of aging that I call the Four Horsemen: heart disease,



cancer, neurodegenerative disease, or type 2 diabetes and related metabolic dysfunction. To achieve longevity—to live longer and live better for longer—we must understand and confront these causes of slow death.

Longevity has two components. The first is how *long* you live, your chronological lifespan, but the second and equally important part is how *well* you live—the quality of your years. This is called *healthspan*, and it is what Tithonus forgot to ask for. Healthspan is typically defined as the period of life when we are free from disability or disease, but I find this too simplistic. I’m as free from “disability and disease” as when I was a twenty-five-year-old medical student, but my twenty-something self could run circles around fifty-year-old me, both physically and mentally. That’s just a fact. Thus the second part of our plan for longevity is to maintain and improve our physical and mental function.

The key question is, Where am I headed from here? What’s my future trajectory? Already, in midlife, the warning signs abound. I’ve been to funerals for friends from high school, reflecting the steep rise in mortality risk that begins in middle age. At the same time, many of us in our thirties, forties, and fifties are watching our parents disappear down the road to physical disability, dementia, or long-term disease. This is always sad to see, and it reinforces one of my core principles, which is that the only way to create a better future for yourself—to set yourself on a better trajectory—is to start thinking about it and taking action *now*.

—

One of the main obstacles in anyone’s quest for longevity is the fact that the skills that my colleagues and I acquired during our medical training have proved to be far more effective against fast death than slow death. We learned to fix broken bones, wipe out infections with powerful antibiotics, support and even replace damaged organs, and decompress serious spine or brain injuries. We had an amazing ability to save lives and restore full function to broken bodies, even reviving patients who were nearly dead. But we were markedly less successful at helping our patients with chronic conditions, such as cancer, cardiovascular disease, or neurological disease, evade slow death. We could relieve their symptoms, and often delay the end slightly, but it didn’t seem as if we could reset the clock the way we could with acute problems. We had become better at catching the eggs, but we had little ability to stop them from falling off the building in the first place.

The problem was that we approached both sets of patients—trauma victims and chronic disease sufferers—with the same basic script. Our job

was to *stop the patient from dying*, no matter what. I remember one case in particular, a fourteen-year-old boy who was brought into our ER one night, barely alive. He had been a passenger in a Honda that was T-boned by a driver who ran a red light at murderous speed. His vital signs were weak and his pupils were fixed and dilated, suggesting severe head trauma. He was close to death. As trauma chief, I immediately ran a code to try to revive him, but just as with the woman in the Stanford ER, nothing worked. My colleagues wanted me to call it, yet I stubbornly refused to declare him dead. Instead, I kept coding him, pouring bag after bag of blood and epinephrine into his lifeless body, because I couldn't accept the fact that an innocent young boy's life could end like this. Afterwards, I sobbed in the stairwell, wishing I could have saved him. But by the time he got to me, his fate was sealed.

This ethos is ingrained in anyone who goes into medicine: nobody dies on my watch. We approached our cancer patients in the same way. But very often it was clear that we were coming in too late, when the disease had already progressed to the point where death was almost inevitable. Nevertheless, just as with the boy in the car crash, we did everything possible to prolong their lives, deploying toxic and often painful treatments right up until the very end, buying a few more weeks or months of life at best.

The problem is not that we aren't trying. Modern medicine has thrown an unbelievable amount of effort and resources at each of these diseases. But our progress has been less than stellar, with the possible exception of cardiovascular disease, where we have cut mortality rates by two-thirds in the industrialized world in about sixty years (although there's more yet to do, as we will see). Death rates from cancer, on the other hand, have hardly budged in the more than fifty years since the War on Cancer was declared, despite hundreds of billions of dollars' worth of public and private spending on research. Type 2 diabetes remains a raging public health crisis, showing no sign of abating, and Alzheimer's disease and related neurodegenerative diseases stalk our growing elderly population, with virtually no effective treatments on the horizon.

But in every case, we are intervening at the wrong point in time, well after the disease has taken hold, and often when it's already too late—when the eggs are already dropping. It gutted me every time I had to tell someone suffering from cancer that she had six months to live, knowing that the disease had likely taken up residence in her body several years before it was ever detectable. We had wasted a lot of time. While the prevalence of each of the Horsemen diseases increases sharply with age,

they typically begin much earlier than we recognize, and they generally take a very long time to kill you. Even when someone dies “suddenly” of a heart attack, the disease had likely been progressing in their coronary arteries for two decades. Slow death moves even more slowly than we realize.

The logical conclusion is that we need to step in sooner to try to stop the Horsemen in their tracks—or better yet, prevent them altogether. None of our treatments for late-stage lung cancer has reduced mortality by nearly as much as the worldwide reduction in smoking that has occurred over the last two decades, thanks in part to widespread smoking bans. This simple preventive measure (not smoking) has saved more lives than any late-stage intervention that medicine has devised. Yet mainstream medicine still insists on waiting until the point of diagnosis before we intervene.

Type 2 diabetes offers a perfect example of this. The standard-of-care treatment guidelines of the American Diabetes Association specify that a patient can be diagnosed with diabetes mellitus when they return a hemoglobin A1c (HbA1c) test result<sup>[\*1]</sup> of 6.5 percent or higher, corresponding to an average blood glucose level of 140 mg/dL (normal is more like 100 mg/dL, or an HbA1c of 5.1 percent). These patients are given extensive treatment, including drugs that help the body produce more insulin, drugs that reduce the amount of glucose the body produces, and eventually the hormone insulin itself, to ram glucose into their highly insulin-resistant tissues.

But if their HbA1c test comes back at 6.4 percent, implying an average blood glucose of 137 mg/dL—just three points lower—they technically don’t have type 2 diabetes at all. Instead, they have a condition called prediabetes, where the standard-of-care guidelines recommend mild amounts of exercise, vaguely defined dietary changes, possible use of a glucose control medication called metformin, and “annual monitoring”—basically, to wait and see if the patient actually develops diabetes before treating it as an urgent problem.

I would argue that this is almost the exact wrong way to approach type 2 diabetes. As we will see in chapter 6, type 2 diabetes belongs to a spectrum of metabolic dysfunction that begins long before someone crosses that magical diagnostic threshold on a blood test. Type 2 diabetes is merely the last stop on the line. The time to intervene is well before the patient gets anywhere near that zone; even prediabetes is very late in the game. It is absurd and harmful to treat this disease like a cold or a broken bone, where you either have it or you don’t; it’s not binary. Yet too often,

the point of clinical diagnosis is where our interventions begin. Why is this okay?

I believe that our goal should be to act as early as possible, to try to *prevent* people from developing type 2 diabetes and all the other Horsemen. We should be proactive instead of reactive in our approach. Changing that mindset must be our first step in attacking slow death. We want to delay or prevent these conditions so that we can live longer *without* disease, rather than lingering *with* disease. That means that the best time to intervene is before the eggs start falling—as I discovered in my own life.

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On September 8, 2009, a day I will never forget, I was standing on a beach on Catalina Island when my wife, Jill, turned to me and said, “Peter, I think you should work on being a little less not thin.”

I was so shocked that I nearly dropped my cheeseburger. “Less not thin?” My sweet wife said *that*?

I was pretty sure that I’d earned the burger, as well as the Coke in my other hand, having just swum to this island from Los Angeles, across twenty-one miles of open ocean—a journey that had taken me fourteen hours, with a current in my face for much of the way. A minute earlier, I’d been thrilled to have finished this bucket-list long-distance swim.<sup>[\*2]</sup> Now I was Not-Thin Peter.

Nevertheless, I instantly knew that Jill was right. Without even realizing it, I had ballooned up to 210 pounds, a solid 50 more than my fighting weight as a teenage boxer. Like a lot of middle-aged guys, I still thought of myself as an “athlete,” even as I squeezed my sausage-like body into size 36 pants. Photographs from around that time remind me that my stomach looked just like Jill’s when she was six months pregnant. I had become the proud owner of a full-fledged dad bod, and I had not even hit forty.

Blood tests revealed worse problems than the ones I could see in the mirror. Despite the fact that I exercised fanatically and ate what I believed to be a healthy diet (notwithstanding the odd post-swim cheeseburger), I had somehow become insulin resistant, one of the first steps down the road to type 2 diabetes and many other bad things. My testosterone levels were below the 5th percentile for a man my age. It’s not an exaggeration to say that my life was in danger—not imminently, but certainly over the long term. I knew exactly where this road could lead. I had amputated the feet of people who, twenty years earlier, had been a lot like me. Closer to

home, my own family tree was full of men who had died in their forties from cardiovascular disease.

That moment on the beach marked the beginning of my interest in—that word again—longevity. I was thirty-six years old, and I was on the precipice. I had just become a father with the birth of our first child, Olivia. From the moment I first held her, wrapped in her white swaddling blanket, I fell in love—and knew my life had changed forever. But I would also soon learn that my various risk factors and my genetics likely pointed toward an early death from cardiovascular disease. What I didn't yet realize was that my situation was entirely fixable.

As I delved into the scientific literature, I quickly became as obsessed with understanding nutrition and metabolism as I had once been with learning cancer surgery. Because I am an insatiably curious person by nature, I reached out to the leading experts in these fields and persuaded them to mentor me on my quest for knowledge. I wanted to understand how I'd gotten myself into that state and what it meant for my future. And I needed to figure out how to get myself back on track.

My next task was to try to understand the true nature and causes of atherosclerosis, or heart disease, which stalks the men in my dad's family. Two of his brothers had died from heart attacks before age fifty, and a third had succumbed in his sixties. From there it was a short leap over to cancer, which has always fascinated me, and then to neurodegenerative diseases like Alzheimer's disease. Finally, I began to study the fast-moving field of gerontology—the effort to understand what drives the aging process itself and how it might be slowed.

Perhaps my biggest takeaway was that modern medicine does not really have a handle on when and how to treat the chronic diseases of aging that will likely kill most of us. This is in part because each of the Horsemen is intricately complex, more of a disease *process* than an acute illness like a common cold. The surprise is that this is actually good news for us, in a way. Each one of the Horsemen is cumulative, the product of multiple risk factors adding up and compounding over time. Many of these same individual risk factors, it turns out, are relatively easy to reduce or even eliminate. Even better, they share certain features or drivers in common that make them vulnerable to some of the same tactics and behavioral changes we will discuss in this book.

Medicine's biggest failing is in attempting to treat all these conditions at the wrong end of the timescale—after they are entrenched—rather than before they take root. As a result, we ignore important warning signs and miss opportunities to intervene at a point where we still have a chance to

beat back these diseases, improve health, and potentially extend lifespan.

Just to pick a few examples:

Despite throwing billions of dollars in research funding at the Horsemen, mainstream medicine has gotten crucial things dead wrong about their root causes. We will examine some promising new theories about the origin and causes of each, and possible strategies for prevention.

The typical cholesterol panel that you receive and discuss at your annual physical, along with many of the underlying assumptions behind it (e.g., “good” and “bad” cholesterol), is misleading and oversimplified to the point of uselessness. It doesn’t tell us nearly enough about your actual risk of dying from heart disease—and we don’t do nearly enough to stop this killer.

Millions of people are suffering from a little-known and underdiagnosed liver condition that is a potential precursor to type 2 diabetes. Yet people at the early stages of this metabolic derangement will often return blood test results in the “normal” range. Unfortunately, in today’s unhealthy society, “normal” or “average” is not the same as “optimal.”

The metabolic derangement that leads to type 2 diabetes also helps foster and promote heart disease, cancer, *and* Alzheimer’s disease. Addressing our metabolic health can lower the risk of each of the Horsemen.

Almost all “diets” are similar: they may help some people but prove useless for most. Instead of arguing about diets, we will focus on *nutritional biochemistry*—how the combinations of nutrients that you eat affect your own metabolism and physiology, and how to use data and technology to come up with the best eating pattern for you.

One macronutrient, in particular, demands more of our attention than most people realize: not carbs, not fat, but *protein* becomes critically important as we age.

Exercise is by far the most potent longevity “drug.” No other intervention does nearly as much to prolong our lifespan and preserve our cognitive and physical function. But most people don’t do nearly enough—and exercising the wrong way can do as much harm as good.

Finally, as I learned the hard way, striving for physical health and longevity is meaningless if we ignore our emotional health. Emotional suffering can decimate our health on all fronts, and it must be addressed.

—

Why does the world need another book about longevity? I’ve asked

myself that question often over the last few years. Most writers in this space fall into certain categories. There are the true believers, who insist that if you follow their specific diet (the more restrictive the better), or practice meditation a certain way, or eat a particular type of superfood, or maintain your “energy” properly, then you will be able to avoid death and live forever. What they often lack in scientific rigor they make up for with passion.

On the other end of the spectrum are those who are convinced that science will soon figure out how to unplug the aging process itself, by tweaking some obscure cellular pathway, or lengthening our telomeres, or “reprogramming” our cells so that we no longer need to age at all. This seems highly unlikely in our lifetime, although it is certainly true that science is making huge leaps in our understanding of aging and of the Horsemen diseases. We are learning so much, but the tricky part is knowing how to apply this new knowledge to real people outside the lab—or at a minimum, how to hedge our bets in case this highfalutin science somehow fails to put longevity into a pill.

This is how I see my role: I am not a laboratory scientist or clinical researcher but more of a translator, helping you understand and apply these insights. This requires a thorough understanding of the science but also a bit of art, just as if we were translating a poem by Shakespeare into another language. We have to get the meaning of the words exactly right (the science), while also capturing the tone, the nuance, the feeling, and the rhythm (the art). Similarly, my approach to longevity is firmly rooted in science, but there is also a good deal of art in figuring out how and when to apply our knowledge to you, the patient, with your specific genes, your history and habits, and your goals.

I believe that we already know more than enough to bend the curve. That is why this book is called *Outlive*. I mean it in both senses of the word: live longer and live better. Unlike Tithonus, you can outlive your life expectancy *and* enjoy better health, getting more out of your life.

My goal is to create an actionable operating manual for the *practice* of longevity. A guide that will help you Outlive. I hope to convince you that with enough time and effort, you can potentially extend your lifespan by a decade and your healthspan possibly by two, meaning you might hope to function like someone twenty years younger than you.

But my intent here is not to tell you exactly *what to do*; it’s to help you learn *how to think* about doing these things. For me, that has been the journey, an obsessive process of study and iteration that began that day on the rocky shore of Catalina Island.

More broadly, longevity demands a paradigm-shifting approach to medicine, one that directs our efforts toward preventing chronic diseases and improving our healthspan—and doing it now, rather than waiting until disease has taken hold or until our cognitive and physical function has already declined. It’s not “preventive” medicine; it’s *proactive* medicine, and I believe it has the potential not only to change the lives of individuals but also to relieve vast amounts of suffering in our society as a whole. This change is not coming from the medical establishment, either; it will happen only if and when patients and physicians demand it.

Only by altering our approach to medicine itself can we get to the rooftop and stop the eggs from falling. None of us should be satisfied racing around at the bottom to try to catch them.

#### SKIP NOTES

\*1

HbA1c measures the amount of glycosylated hemoglobin in the blood, which allows us to estimate the patient’s average level of blood glucose over the past ninety days or so.

\*2

This was actually my second time making this crossing. I’d swum from Catalina to LA a few years earlier, but the reverse direction took four hours longer, because of the current.

## CHAPTER 2

### Medicine 3.0

#### Rethinking Medicine for the Age of Chronic Disease

The time to repair the roof is when the sun is shining.

—JOHN F. KENNEDY

I don’t remember what the last straw was in my growing frustration with medical training, but I do know that the beginning of the end came courtesy of a drug called gentamicin. Late in my second year of residency, I had a patient in the ICU with severe sepsis. He was basically being kept alive by this drug, which is a powerful IV antibiotic. The tricky thing about gentamicin is that it has a very narrow therapeutic window. If you give a patient too little, it won’t do anything, but if you give him too much it could destroy his kidneys and hearing. The dosing is based on the patient’s weight and the expected half-life of the drug in the body, and because I am a bit of a math geek (actually, more than a bit), one evening I came up with a mathematical model that predicted the precise time when this patient would need his next dose: 4:30 a.m.



Sure enough, when 4:30 rolled around we tested the patient and found that his blood levels of gentamicin had dropped to exactly the point where he needed another dose. I asked his nurse to give him the medication but found myself at odds with the ICU fellow, a trainee who was one level above us residents in the hospital pecking order. I wouldn't do that, she said. Just have them give it at seven, when the next nursing shift comes on. This puzzled me, because we knew that the patient would have to go for more than two hours basically unprotected from a massive infection that could kill him. Why wait? When the fellow left, I had the nurse give the medicine anyway.

Later that morning at rounds, I presented the patient to the attending physician and explained what I had done, and why. I thought she would appreciate my attention to patient care—getting the drug dosed just right—but instead, she turned and gave me a tongue-lashing like I'd never experienced. I'd been awake for more than twenty-four hours at this point, but I wasn't hallucinating. I was getting screamed at, even threatened with being fired, for trying to improve the way we delivered medication to a very sick patient. True, I had disregarded the suggestion (not a direct order) from the fellow, my immediate superior, and that was wrong, but the attending's tirade stunned me. Shouldn't we *always* be looking for better ways to do things?

Ultimately, I put my pride in check and apologized for my disobedience, but this was just one incident of many. As my residency progressed, my doubts about my chosen profession only mounted. Time and again, my colleagues and I found ourselves coming into conflict with a culture of resistance to change and innovation. There are some good reasons why medicine is conservative in nature, of course. But at times it seemed as if the whole edifice of modern medicine was so firmly rooted in its traditions that it was unable to change even slightly, even in ways that would potentially save the lives of people for whom we were supposed to be caring.

By my fifth year, tormented by doubts and frustration, I informed my superiors that I would be leaving that June. My colleagues and mentors thought I was insane; almost nobody leaves residency, certainly not at Hopkins with only two years to go. But there was no dissuading me. Throwing nine years of medical training out the window, or so it seemed, I took a job with McKinsey & Company, the well-known management consulting firm. My wife and I moved across the country to the posh playground of Palo Alto and San Francisco, where I had loved living while at Stanford. It was about as far away from medicine (and Baltimore) as it

was possible to get, and I was glad. I felt as if I had wasted a decade of my life. But in the end, this seeming detour ended up reshaping the way I look at medicine—and more importantly, each of my patients.

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The key word, it turned out, was *risk*.

McKinsey originally hired me into their healthcare practice, but because of my quantitative background (I had studied applied math and mechanical engineering in college, planning to pursue a PhD in aerospace engineering), they moved me over to credit risk. This was in 2006, during the runup to the global financial crisis, but before almost anyone besides the folks featured in Michael Lewis's *The Big Short* understood the magnitude of what was about to happen.

Our job was to help US banks comply with a new set of rules that required them to maintain enough reserves to cover their unexpected losses. The banks had done a good job of estimating their *expected* losses, but nobody really knew how to deal with the *unexpected* losses, which by definition were much more difficult to predict. Our task was to analyze the banks' internal data and come up with mathematical models to try to predict these unexpected losses on the basis of correlations among asset classes—which was just as tricky as it sounds, like a crapshoot on top of a crapshoot.

What started out as an exercise to help the biggest banks in the United States jump through some regulatory hoops uncovered a brewing disaster in what was considered to be one of their least risky, most stable portfolios: prime mortgages. By the late summer of 2007, we had arrived at the horrifying but inescapable conclusion that the big banks were about to lose more money on mortgages in the next two years than they had made in the previous decade.

In late 2007, after six months of round-the-clock work, we had a big meeting with the top brass of our client, a major US bank. Normally, my boss, as the senior partner on the project, would have handled the presentation. But instead he picked me. "Based on your previous career choice," he said, "I suspect you are better prepared to deliver truly horrible news to people."

This was not unlike delivering a terminal diagnosis. I stood up in a high-floor conference room and walked the bank's management team through the numbers that foretold their doom. As I went through my presentation, I watched the five stages of grief described by Elisabeth Kübler-Ross in her classic book *On Death and Dying*—denial, anger,

bargaining, sadness, and acceptance—flash across the executives’ faces. I had never seen that happen before outside of a hospital room.

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My detour into the world of consulting came to an end, but it opened my eyes to a huge blind spot in medicine, and that is the understanding of risk. In finance and banking, understanding risk is key to survival. Great investors do not take on risk blindly; they do so with a thorough knowledge of both risk and reward. The study of credit risk is a science, albeit an imperfect one, as I learned with the banks. While risk is obviously also important in medicine, the medical profession often approaches risk more emotionally than analytically.

The trouble began with Hippocrates. Most people are familiar with the ancient Greek’s famous dictum: “First, do no harm.” It succinctly states the physician’s primary responsibility, which is to not kill our patients or do anything that might make their condition worse instead of better. Makes sense. There are only three problems with this: (a) Hippocrates never actually said these words,<sup>[\*1]</sup> (b) it’s sanctimonious bullshit, and (c) it’s unhelpful on multiple levels.

“Do no harm”? Seriously? Many of the treatments deployed by our medical forebears, from Hippocrates’s time well into the twentieth century, were if anything *more* likely to do harm than to heal. Did your head hurt? You’d be a candidate for trepanation, or having a hole drilled in your skull. Strange sores on your private parts? Try not to scream while the Doktor of Physik dabs some toxic mercury on your genitals. And then, of course, there was the millennia-old standby of bloodletting, which was generally the very last thing that a sick or wounded person needed.

What bothers me most about “First, do no harm,” though, is its implication that the best treatment option is always the one with the least immediate downside risk—and, very often, doing nothing at all. Every doctor worth their diploma has a story to disprove this nonsense. Here’s one of mine: During one of the last trauma calls I took as a resident, a seventeen-year-old kid came in with a single stab wound in his upper abdomen, just below his xiphoid process, the little piece of cartilage at the bottom end of his sternum. He seemed to be stable when he rolled in, but then he started acting odd, becoming very anxious. A quick ultrasound suggested he might have some fluid in his pericardium, the tough fibrous sac around the heart. This was now a full-blown emergency, because if enough fluid collected in there, it would stop his heart and kill him within a minute or two.

There was no time to take him up to the OR; he could easily die on the elevator ride. As he lost consciousness, I had to make a split-second decision to cut into his chest right then and there and slice open his pericardium to relieve the pressure on his heart. It was stressful and bloody, but it worked, and his vital signs soon stabilized. No doubt the procedure was hugely risky and caused him great short-term harm, but had I not done it, he might have died waiting for a safer and more sterile procedure in the operating room. Fast death waits for no one.

The reason I had to act so dramatically in the moment was that the risk was so asymmetric: doing nothing—avoiding “harm”—would likely have resulted in his death. Conversely, even if I was wrong in my diagnosis, the hasty chest surgery we performed was quite survivable, though obviously not how one might wish to spend a Wednesday night. After we got him out of imminent danger, it became clear that the tip of the knife had just barely punctured his pulmonary artery, a simple wound that took two stitches to fix once he was stabilized and in the OR. He went home four nights later.

Risk is not something to be avoided at all costs; rather, it’s something we need to understand, analyze, and work with. Every single thing we do, in medicine and in life, is based on some calculation of risk versus reward. Did you eat a salad from Whole Foods for lunch? There’s a small chance there could have been *E. coli* on the greens. Did you drive to Whole Foods to get it? Also risky. But on balance, that salad is probably good for you (or at least less bad than some other things you could eat).

Sometimes, as in the case of my seventeen-year-old stab victim, you have to take the leap. In other, less rushed situations, you might have to choose more carefully between subjecting a patient to a colonoscopy, with its slight but real risk of injury, versus not doing the examination and potentially missing a cancer diagnosis. My point is that a physician who has never done *any* harm, or at least confronted the risk of harm, has probably never done much of anything to help a patient either. And as in the case of my teenage stabbing victim, sometimes doing nothing is the riskiest choice of all.

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I actually kind of wish Hippocrates had been around to witness that operation on the kid who was stabbed—or any procedure in a modern hospital setting, really. He would have been blown away by all of it, from the precision steel instruments to the antibiotics and anesthesia, to the bright electric lights.

While it is true that we owe a lot to the ancients—such as the twenty