

# The Digital Pill

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# **The Digital Pill: What Everyone Should Know about the Future of Our Healthcare System**

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To Carmen, Isabelle, and Michaela

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## About the Authors



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His research interests focus on the current fusion of the physical and the digital world into an Internet of Things. His current largest lab, the Center for Digital Health Interventions, investigates how digital technologies are changing our healthcare system. Elgar Fleisch and his team have published their results in over 600 scientific papers.

Elgar Fleisch is a co-founder of several university spin-offs and serves as a member of multiple academic steering committees as well

as supervisory boards including Robert Bosch, Mobiliar Insurance Group and Uniqa Insurance Group.

Born 1968 in Bregenz, Austria, Elgar Fleisch was trained in mechanical engineering, computer science and business administration. He received his PhD in Artificial Intelligence in 1993 and devoted his postdoc time to the “networked enterprise”. 2002 he was appointed full professor at University of St. Gallen (HSG), 2004 also at ETH Zürich. Elgar Fleisch spent his sabbaticals at MIT and Dartmouth College, both USA.



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Further mandates include the boards of Stadler Rail AG and Zurich Insurance Company Ltd. He is a Member of the Board of Trustees of Ernst Goehner Foundation, the Advisory Board of University of St. Gallen (HSG) and Member of the Assembly and Counsel of the International Committee of the Red Cross, Geneva. Moreover, he was appointed Honorary Professor for Business Administration at HSG in May 2017.



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His research interests focus on consumer behavior, market research, and product development. He has set up several labs, each collaborating with companies and international organizations. He has published extensively, more than 250 scientific papers and 15 books.

Born in 1964 in Germany, he graduated from Koblenz School of Corporate Management and completed his doctoral thesis in the field of consumer decision-making 1991. After his habilitation on the subject of means end chain analysis at University of Mannheim he was appointed as Full Professor to University of Mainz in 1997. In 2002 he moved to the University of St. Gallen.

# Foreword

Writing a book about the opportunities that digital technologies bring to the healthcare sector is a particular sort of challenge. Every day and everywhere across the globe, new health apps are created, as well as innovative approaches for using patient data to develop new treatments. They have the power to redefine the roles of patients and doctors, supplement drug-based treatments with digital ones, and facilitate a shift from curative to preventive medicine. There is also a tremendous opportunity to alleviate the burden on healthcare systems which, in many countries, are underfunded and already operating at their limits, and to provide proper medical care to many more people than in the past.

It is not possible to provide an overview of all these technological developments, to fully explore them, or to conclusively evaluate them at this point. So this book does not provide an exhaustive outline of digital technologies in the healthcare sector, but is more like a diary kept along a journey that is still ongoing. At the same time, it seems worthwhile to embark on this journey, because we currently have a unique opportunity to completely rethink our healthcare system and to actually reshape it as well. The time has come bring these digital options in the healthcare sector onto the stage of public discourse, and thereby help change all of our lives for the better. Which is why this book is written for laypeople, who are interested in the subject rather than as a purely academic treatise or textbook. It is focused more on the patient and less on the processes in hospitals or doctors' offices.

Exploring this topic has moved and captivated us as authors, too, because only at first glance is it merely about technology, apps, algorithms, data, and sensors. Much more fascinating are the stories behind it, the new opportunities that the digital world is opening up to humankind. In addition to all these opportunities, we are particularly moved by the further awareness that we are currently far from being able to provide each and every individual with access to the best medical care. With the help of apps, digital physician assistants, automated mini-clinics, telemedicine, etc., going forward many more people – regardless of where they live and what financial means are at their disposal – could have access to affordable and effective medical care. Digital technologies thus contribute to the democratization of the healthcare sector, which is an important step in offering people the hope of a brighter future, especially in developing countries.

The pandemic of 2020 has opened our eyes in many ways. It has also showed us the importance of digitalization in the healthcare sector, of keeping things up and running in times of physical distancing and of quickly and reliably collecting

and consolidating data when public health is at risk. In addition, the last months have shown us how much we as a society are capable of changing when it comes to moving toward digitalization.

For all our enthusiasm for digital technologies, they are never an end unto themselves, but always an important means of improving medical care for humankind. Which is why this book is not simply intended to paint a picture of the course taken by the healthcare system or to illustrate digital applications using the examples of current startups and established corporations and organizations in the healthcare sector. Rather, our aim is – based on these technological opportunities – to identify and explore the principal response patterns and pillars of a new healthcare system. We offer these for discussion in the conviction that by implementing them, we could change people's medical care for the better. With the 25 patterns and five pillars of the healthcare system of tomorrow, we hope to stimulate debate, question the status quo, and even stir up controversy, invite criticism and meet with agreement – but, even more importantly, to point the way to a more effective and efficient healthcare system.

The image of a broad-leaved tree perhaps most clearly illustrates the goal we are pursuing with this book. We are not simply out to collect examples of digitalization from all over the world and pile them up like a colorful heap of leaves. Rather, we want to use the examples to depict the tree that carries the leaves – complete with its roots, trunk, sturdy branches, and slender twigs. These are what give the tree its structure and its strength, making it a thing that lasts for decades, yet is constantly growing and renewing itself, creating new shoots and letting old ones fall. The leaves come and go every year; the roots, trunk, and branches remain.

This book focuses in the five most important non-communicable diseases (NCD) – cardiovascular diseases, respiratory illnesses, diabetes, cancer, and mental disorders such as depression. These diseases cause great suffering among patients and negatively impact on the quality of life of many people. As they become more widespread, they are pushing the healthcare systems of many countries to their limits. The good news, however, is that NCD can be prevented or at least mitigated through lifestyle changes and preventive medicine. This is precisely where digital technologies come into play. They can be used to modify lifestyles, improve prevention and medical care, and develop innovative treatments. If we succeed here, we will not only be able to alleviate people's suffering, but also lighten the load on our healthcare systems. We use the example of NCD to illustrate the digital patterns of the healthcare sector, because they are responsible for the greatest global suffering and the greatest social costs. However, most patterns apply just as well to acute and contagious illnesses.

We have organized this book in three sections. Each can be read and understood separately without the information contained in the other sections. Readers who are interested in the development and consequences of NCD should start with Part I. If you would like to jump straight to the 25 patterns of digitalization, you can begin with Part II. And Part III brings together the lessons learned in the first two sections to form the five pillars of the healthcare system of tomorrow.

“Digitization” simply means the transformation of analog information into a digital, machine-readable format. In this book, we are talking instead about “digitalization”: digital transformation in the sense of using of all manner of information technologies to create new products, services, customer experiences, forms of collaboration, and business models. And what exactly do we mean by the book’s title, “The Digital Pill”? We are not using this juxtaposition of terms, which is almost paradoxical and therefore thought-provoking, to simply mean a tablet or treatment containing bits and bytes, but any use of digital technologies that changes our healthcare system, accelerates medical progress, or creates new therapeutic or preventive options.

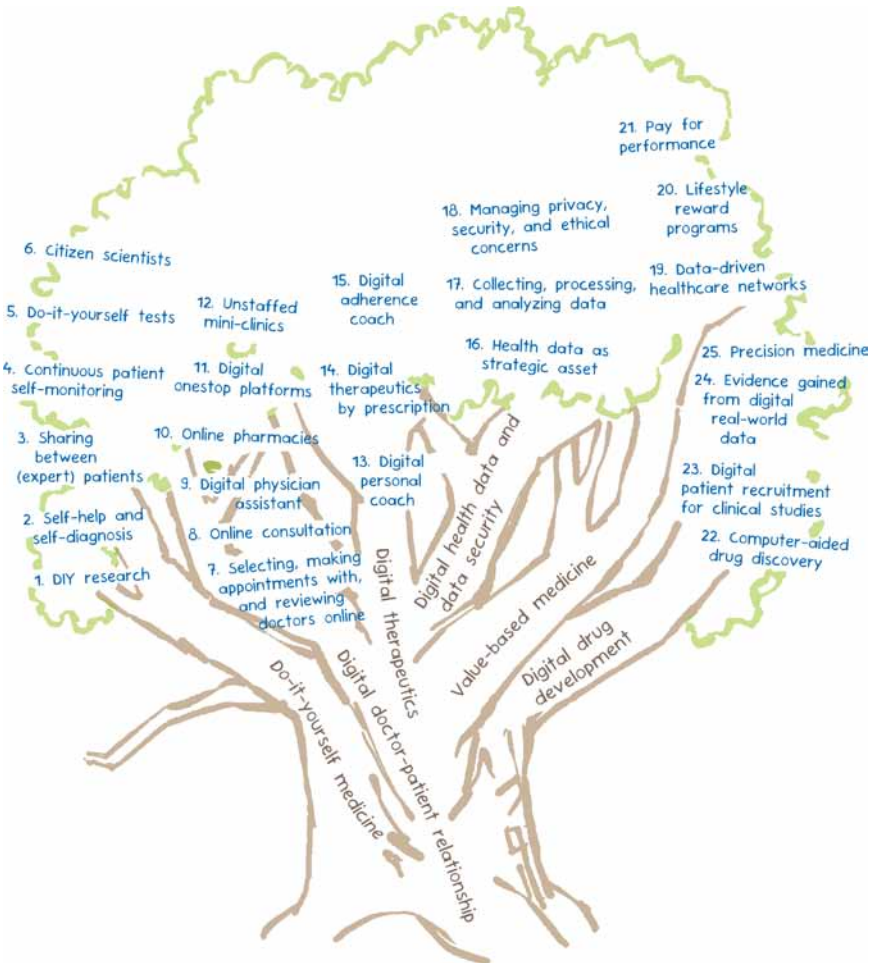
This book never could have been written without the inspiring, critical, and illuminating conversations with many people who are working to develop digital technologies for the healthcare sector and test them on the market. Troy Cox, Doug Hirsch, Andrew Thompson, Nat Turner, Zach Weinberg, Frank Westermann, Thorsten Wirkes, and many others will all shape our approach to digital therapeutics in the coming years with their medical experience, pioneering spirit, and entrepreneurial mindset. Through their expertise, they are making a significant contribution to ensuring that apps, innovative data analyses, and more will find their way into the healthcare sector. We thank them for taking the time to share their insights and their passion with us.

Many physicians, employees, colleagues, and experts, as well as prominent figures from medicine, government, business, and society, contributed their suggestions and feedback. Our thanks go to them all for their willingness to share their knowledge and experience. Among them were Lisa Marsch, Gerald Fleisch, David Gorgan, Tobias Kowatsch, Tim Jäger, Joseph Kvedar, Dave Kotz, Sandy Pentland, Florian von Wangenheim, Florian Wirth, and Felix Wortmann. The detailed, critical reviews, notes, and comments provided by Martin Brutsche, Thierry Carrel, Steffi Gassmann, and Christoph Stettler were particularly valuable, as were those of Daniel Grotzky. He was involved in the creation of this book from the very beginning and continuously sought the advice of his medical colleagues at F. Hoffmann-La Roche AG wherever there was uncertainty. A special thanks goes to Annette Mönninghoff. She took care that we never lost track on this exciting journey. Her inputs were most valuable and extremely helpful. Working with her was a great pleasure!

We particularly wish to thank Niall Kennedy of Emerald-Verlag and Patrik Ludwig of Campus-Verlag for their support. They have shown their enthusiasm for this project from the very start.

We hope we have produced a book that incorporates many different perspectives and contributes to an open, honest, multifaceted, and nuanced discussion of digital applications in the healthcare sector. As authors, we have been tremendously inspired by the potential of digitalization. And we have also been moved by the questions and challenges that have emerged in this context and which are addressed in this book.

Elgar Fleisch  
Christoph Franz  
Andreas Herrmann



# Preface

Thanks to the successes of modern medicine, the healthcare systems of this world are being pushed to their limits – the one-sided cost spiral is increasingly jeopardizing the access of disadvantaged populations to healthcare and, consequently, endangering the social order as well. Can the “digital pill” generate the veritable quantum leap that will cure our society?

Generally speaking, every healthcare system is under considerable pressure to change and digitalize. A lot could already be done today. However, many service providers are digitizing their paper-based processes in an inward-focused manner, squandering the opportunities of a real partnership-based digital transformation. Rarely do new applications result in more time for hands-on work with patients – for the most part, computer work is becoming more and more of a priority. At the same time, too much is at stake for the individuals concerned in the change process – fears of reduced income, loss of employment, or potentially less interesting work are dominating the discourse. So across the globe, money is being thrown away on unsustainable IT silo solutions. The slow grind of legislation, the strong segmentation of the healthcare market, the inertia of regulatory authorities, and, finally, the widespread fear of change on all sides also contribute to the preservation of the status quo. It must be remembered that changes in healthcare systems affect not only the employees working in the healthcare market, but, at a fundamental level, every citizen – and therefore every one of us. Maintaining each individual’s right to privacy demands the highest standards of ethics, processes, and technology, and gives rise to the question of who should own the data, who manages it, and who earns money from it. Although the individual right to privacy must remain intact, each individual can make an important contribution to public health by contributing their anonymized health data, whatever the source. Here, it is the volume of data that is important – the more complete the data is, the larger in quantity and the better in quality, the greater is the potential that can be mined by artificial intelligence. The necessary sociopolitical effort that is required, at least in Western style democracies, to establish such a data alliance, is comparable to the push that led to the creation of essential social services in twentieth century Europe. The logical conclusion is that the proceeds must belong to the innovators in the healthcare market, but primarily to the individual and to society as a whole. In truth, the hurdles posed by these challenges and expectations seem insurmountably high. Digital transformation requires time for cultural change to take place and social solidarity to arise.

In many countries, healthcare systems are governed by financial considerations. We might say that medicine is dependent on the infusion of money. An ungodly, supposedly “free” healthcare market reigns supreme, one that responds to financial incentives. Often enough, this is not governed by medical criteria, but, in a compartmentalized healthcare system, is subject to the special interests of the service providers and professional groups. This results in an inherent risk that the shifts generated by new incentives will lead to further distortions in the healthcare market that are not sufficiently focused on patient benefit. As long as there are enough resources available within the system, there is little pressure for revolutionary change. Popular wisdom tells us that “necessity is the mother of invention.” Healthcare systems, however, will steer the economies of many nations into dire straits in the foreseeable future, so that this state of necessity will slowly but surely spread across the globe – with poorer regions of the world never even progressing beyond this status in the first place. In other words, change will come – so let us approach it in a timely and controlled manner.

The Covid-19 pandemic in early 2020 gave the world a time-lapse demonstration of how this could work. Suddenly, medical concepts had to be rolled out in a matter of days. Medical knowledge evolved sometimes in a matter of hours – even health professionals were entirely dependent on information from the internet. During the lockdown, in many countries there was a minor revolution in the way we work. Working from home, virtual meetings, and remote training became widespread and widely accepted. Following the initial cancelation of all events, within weeks digital offerings were created to take their place and have now come to be seen as more than just a substitute and earned themselves a permanent place. Within days, consultations via video calls suddenly became billable, popular, and appreciated. The anticipated benefits from the use of contact-tracing apps suddenly seemed more important than the absolute right to privacy of the individual citizen – a new phenomenon, at least for Europe. So change is possible.

Digital transformation requires cultural change, a bird’s eye view, an outside perspective. Which is what makes this book a seam of gold that is well worth mining. Following strictly Hegelian dialectics, it maps the current state of the world’s healthcare systems in language that is easy to read and understand. It considers their current capacity for meeting the challenge of the prevention, treatment, and costs of the increasing number of cases of NCD in the context of the changing demographics of our aging population. This book outlines the immense, as yet unleveraged potential of digitalization in the areas of health maintenance and therapeutics, from which, like a phoenix from the ashes, ultimately rises a realistic and positive picture of how to arrive at a healthcare system that can master the challenges. It is richly and colorfully illustrated with vivid and touching examples from different corners of the world. The authors communicate 25 practical problem-solving approaches, which the book calls “response patterns,” that when combined, improve the resilience, fitness, and agility of healthcare systems, allowing positive outcomes for patients to materialize. Due mention is made of the extremely creative and pioneering global startup scene in the field of digital health and medicine. The potential risks associated with the new technologies are also given sufficient attention. After all, new developments invariably entail not

only positive effects but negative ones as well. The latter must be countered with appropriate measures. The risks of digital transformation must also be weighed against the risks of delayed action – as well as those of not pursuing it at all.

We must and will succeed in using digital medicine to consolidate forward-looking healthcare systems that are able to meet the challenges of the increasing number of non-communicable diseases in an aging society – through an increased commitment of resources to the areas of health maintenance, smart treatments and care models, digitally supported research, and innovation. Thanks to the scalability of digital care and medicine, all social classes, groups, regions, and even countries of this world can be granted access to an affordable healthcare system.

Martin Brutsche  
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and President of the Swiss Society for Pulmonology (until 2018)  
May 2020

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## Part I

# **Will the Healthcare System Become a Victim of its Own Success?**

### *Chapters*

1. Medical Progress is a Success Story that Comes with Consequences.
2. Non-communicable Diseases are Straining Our Healthcare System.
3. Digitalization Will Be a Key Success Factor for the Healthcare System of the Future.

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## Chapter 1

# Medical Progress is a Success Story that Comes with Consequences

*The main theses of this chapter:*

- The medical progress of the past 100 years is the investment of the century. In the space of only 100 years, our life expectancy has doubled.
- Antibiotics and vaccines played a decisive role in the battle against infectious diseases.
- As life expectancy has increased, however, this hasn't always meant improved quality of life in old age. The years we gain are often accompanied by chronic illnesses. Today we are better equipped to survive diseases such as heart attacks or cancer but as a result, we more and more frequently have to live with these illnesses.
- Without the mutual support provided by those with health insurance or the support of taxpayers (in the case of state-funded systems), medical progress does not reach everyone.
- More than half of all Americans who file for personal bankruptcy do so as a result of medical debt.

Let's start with some good news: In only 100 years, our life expectancy has doubled. And not just in wealthy, developed nations. As the twentieth century began, a human being could expect to live about 40–46 years. In the meantime, average global life expectancy has risen to 72 years. In India today, people actually live three times as long as their ancestors did 100 years ago; life expectancy in that nation has increased from 24 years at the beginning of the twentieth century to all of 69 years [1, 2]. These numbers stand for billions of human lives – people who now enjoy more wealth, education, and longevity than any other generation that ever lived on our planet. If we consider that human beings have been around for more than 150,000 years, this amount of progress in only one century is nothing less than spectacular.

What made this amazing success story possible? Of course it doesn't just come down to medical advancements. Growing prosperity, improved nutrition,

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and better hygiene – clean drinking water, regular waste, and wastewater disposal – as well as the peace that spread across Europe and other parts of the globe following the two world wars have all played a part. However, the primary reason for the increase in life expectancy is the progress made in combating infectious diseases. Until a few centuries ago, such illnesses were the most common cause of human mortality. Becoming infected was often a death sentence, one that robbed many of life during infancy. At the beginning of the twentieth century, one in 10 children in the United States still died before their first birthday. Back then the most common causes of death in young children were pneumonia, influenza, tuberculosis, and gastroenteritis [3].

But then the tide turned. More than any others, two medical innovations have proven to be particularly effective weapons in the fight against infectious diseases and therefore responsible for the increase in human life expectancy: antibiotics and vaccines. The story of the discovery of penicillin, the first antibiotic, has become a modern legend that most of us learn at school. Bacteriologist Alexander Fleming returned to his laboratory in London after a long summer vacation with his family. He had a reputation as an excellent researcher but an untidy one. Before leaving town, Fleming had started some bacteria cultures in Petri dishes. When he went to examine them upon his return, he saw that one of the cultures was contaminated and mold was growing in the Petri dish. When he looked more closely, Fleming noticed that the bacteria culture was not growing in the area surrounding the mold. So he started studying it, and discovered it belonged to the genus of *Penicillium*. This was why he named the new substance he went on to develop “penicillin.” It was to become the most effective substance available for fighting bacterial infections at the time.

Fleming’s discovery marked the start of the age of antibiotics. “When I woke up just after dawn on September 28, 1928, I certainly didn’t plan to revolutionize all medicine by discovering the world’s first antibiotic, or bacteria killer. But I suppose that was exactly what I did,” as Fleming would later say [4, p. 366]. Antibiotics like penicillin have saved hundreds of millions of human lives. Exact estimates are difficult to make – but the antibiotics produced by the pharmaceutical companies Pfizer, GlaxoSmithKline, and Roche alone have been prescribed billions of times since their approval. In addition, it is hard to imagine that medical advances like organ transplants would ever have been possible without antibiotics.

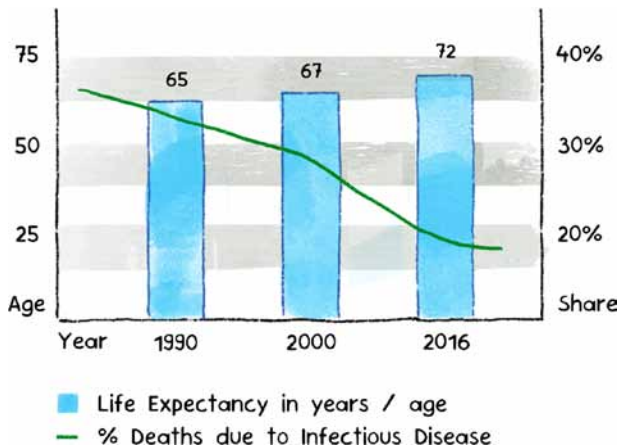
Alongside antibiotics, the development of vaccines played a major role in raising human life expectancy. The amazing success of vaccines becomes particularly clear when we look at the first viral disease – a disease caused by a virus – for which one was developed: smallpox. Wolfgang Amadeus Mozart suffered from it, as did Abraham Lincoln and Josef Stalin. These three men survived, although some bore considerable scars for life. Smallpox is one of the most dangerous and deadly diseases ever to affect the human race – every third person who contracts it will die as a result. Even in the twentieth century, more than 300 million people died of smallpox before it was finally declared eradicated in 1980 [5].

And what made this possible? The development and distribution of the smallpox vaccine.

When a healthy person is vaccinated, they are given a weakened form of the virus to stimulate the production of antibodies in the immune system. If the vaccinated person later comes into contact with the actual pathogen, their immune system is prepared and can fight and destroy the virus.

Edward Jenner, a country doctor from England, is considered one of the fathers of the widespread immunization that we know today. Many of his patients were milkmaids, who often became ill from cowpox, a milder form of the pox-virus. And Jenner noticed that none of the milkmaids caught the dangerous and often deadly form of the human virus. Based on this observation, he developed a method in which he inoculated healthy individuals, including his own son, with the secretion from cowpox blisters. The subjects then experienced a mild form of the infection. Later Jenner infected the same individuals with the dangerous smallpox virus – and miraculously, they remained unaffected. This marked the birth of mass immunization, which even today is still called “vaccination” – revealing the origin of the practice. Because “vacca” is nothing other than the Latin word for “cow” [6].

These victories don’t mean we can rest on our laurels. Keeping infectious diseases in check is an ongoing battle, as the recent painful experience of the coronavirus pandemic shows. We need to keep developing new generations of virostatic agents and vaccines; novel viruses and bacteria have to be countered with good pandemic preparedness. Skepticism about vaccines among some segments of the population and the resulting insufficient vaccination rates, has caused a



**Fig. 1.1.** *We Live Longer and Die Less Frequently of Infectious Diseases: Life Expectancy and Percentage of Deaths Caused by Infectious Diseases.*  
**Source:** Institute for Health Metrics and Evaluation, University of Washington (2019). Share of death from infectious disease of total deaths, Worldwide, All Genders; Life Expectancy in Years.

resurgence of almost forgotten diseases like measles. So intervention and education are important here as well. But one thing is certain: vaccines and antibiotics have turned the tide in our fight against communicable diseases, resulting in a fundamental change in our understanding of human health. In 1990, one in three people still died of infectious diseases; today it's only one in five. These advances also meant an increase in life expectancy, most recently from 65 years in 1950 to 72 years today (Fig. 1.1). This development bears witness to the success of medical progress but is also the source of new challenges.

### *More Years – To Suffer Ill Health?*

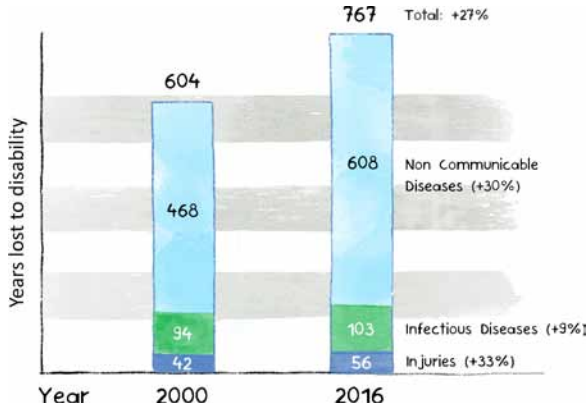
For the most part, more years of life also mean better quality of life. In the past, it was normal for every family to have at least one child who died young. It was rare to live to see your great-grandchildren. Between 1950 and 2000 life expectancy in Germany, for example, rose from 64.6 years for men and 68.5 years for women to 78.4 and 83.4 years, respectively [7]. But these longer lives also presented society and individuals with new problems.

Medical advancements have not only led to a decrease in infectious diseases, but also enabled us to successfully treat many non-infectious diseases that would almost certainly have proved fatal a hundred years ago, like cardiovascular disease and cancer. However, there is a fundamental difference here to our fight against viruses and bacteria – because unlike infectious diseases, non-communicable diseases (NCDs) often cannot be cured, but only halted or slowed. A study by the University of Southern California shows that we are not “healthier” per se and therefore live longer. Instead, thanks to medical progress, today we are better equipped to *survive* diseases such as heart attacks or cancer – but as a result, we more and more frequently have to live with these illnesses [8].

Before the medical innovations of the twentieth century, a disease usually ended in either recovery or death. Today many of the years of life we have gained are frequently also years, in which an individual will endure one or multiple diseases. This can mean substantial suffering for the patient and their family, and poses new challenges for healthcare systems.

Health economists came up with an indicator for this in the late 1990s, which they called “years lost to disability,” or YLD. This means years that the person missed out on because they were severely impaired by their illness. Sometimes the indicator is expressed as “years lived with disability,” which paints a somewhat gentler picture. The World Health Organization (WHO) calculates this figure by multiplying the percentage of people affected by the average duration of a disease and a weighting factor [9]. The weighting factor indicates the health impairment caused by a disease, so it is lower for diabetes, for instance, than for cancer (Fig. 1.2).

If we examine the trend, we see a steep increase – by somewhat more than one-quarter since the turn of the millennium – in the number of years in which people are affected by illnesses. In other words, more and more people worldwide are living with a serious disease. Many suffer for years, sometimes unable to work and



**Fig. 1.2.** *We Live with Disease for Many Years: Years Affected by Disease in Millions.* **Source:** World Health Organization (2017). Includes maternal, perinatal, and nutritional cases.

severely restricted in their daily lives. In 2016, this came to a total of 767 million years of illness worldwide. This trend has been driven by non-infectious chronic illnesses, commonly known as NCDs. The increase in mental illnesses has been particularly strong in recent years. We will discuss NCDs in more detail later in this book.

Length and quality of life don't always go hand in hand. Just because we more frequently "survive" diseases today doesn't mean that human suffering has decreased.

This initial examination shows that medical progress has been a success story – people are living longer and longer lives. However, we also live much longer with illnesses, and this often causes a lot of human suffering, for patients and their families alike.

### ***Medical Progress also Means New Challenges***

In addition to vaccines and antibiotics, the last 100 years have seen medical advances such as new diagnostic and treatment methods that make it easier to fight disease. Blood tests and imaging methods such as computer tomography, ultrasound, and X-ray help physicians diagnose diseases. Cancer can be treated with radiation, surgery, and chemotherapy, and dialysis machines filter the blood in the event of kidney failure. The list of advancements is long and significant.

But what are the consequences of this progress? We live longer and longer, we live in greater prosperity, and we can more frequently declare victory in the battle against disease. More and more grandparents not only live to see their grandchildren born, but also how they thrive and grow, finish school, get married, and start their own families. In the past, this was the exception rather than the rule. But these gains also bring new challenges.

### ***Economic Consequences***

This progress literally comes at a price: it has made medical care more and more expensive in recent years. Treatment-related costs have been rising substantially for years. Take kidney failure, for example: Being diagnosed with kidney failure was once tantamount to a death sentence, but today, with the help of dialysis and kidney transplants, patients can live for many years. In Germany, to name but one example, dialysis treatments cost more than 25,000 euros per patient and year [10]. So where in the past no costs were incurred, today hundreds of thousands of euros are needed. This raises an important question: Who pays the bill?

Historically, it was of course the patients and their families who footed the bill. That was until the beginning of the twentieth century, when health insurance companies began selling policies that let the insured spread the risk, or state-financed healthcare systems distributed the costs among taxpayers. In practice, in most countries today, we find a mix of these three forms of financing.

Because even now, medical costs are not always borne entirely or even mostly by the public or private systems. For many people, illness means economic insecurity. In countries without mandatory universal health insurance, in particular – such as the United States, most African countries, and some Asian nations – falling ill often leads to the loss of hard-earned prosperity gains. While in nations such as Germany or Switzerland people seldom have to dip deep into their personal reserves to treat a serious disease, an estimated 11 million people in Africa fall into the poverty trap every year, because they are forced to rely on credit to cover the costs of medical treatment, which they then are unable to repay [11]. In India, patients pay 62% of all medical expenses out of their own pocket. Which means that many live in fear, not only of the disease itself, but above all of the resulting debt that could ruin their lives [12].

Many people in the United States find themselves in a peculiar situation. In almost no other nation is the contrast between the enormous achievements of medical progress and the challenges confronting the healthcare system more striking. In no other nation is more medical research conducted or new medications approved more quickly; nowhere else are there as many top-notch hospitals and pharmaceutical or biotech companies. But at the same time, in some areas, the country has long been facing real challenges in supplying all segments of its population with modern medical care.

The financial plight of Americans without health insurance is clearly evident when you look at the GoFundMe crowdfunding platform. This website lets people launch appeals for donations, which can then spread virally over the internet. Most of the time, hundreds of people donate small sums of 5–50 USD. The stories behind these calls for assistance are often heartbreaking. On the platform you'll find mothers and fathers who can no longer support their families, because they have cancer, as well as parents of young, gravely ill children who are overwhelmed with the heavy financial burden of medical costs. How must it feel not to be able to obtain the best possible medical treatment for your child because you don't have the money?