Health professionals have a lot on their minds: caring for patients, managing teams, keeping up to date with clinical developments and responding to broader agendas of quality and cost containment. This book offers up a quietly revolutionary invitation to rethink this enterprise by considering medicine in its rightful place within a much bigger planetary system. Here, we call this new way of thinking sustainable healthcare and believe it can help us deliver services of better quality, at lower costs and with less impact on the systems that sustain us. To this point in time the health sector has taken planetary health for granted, but now a body of evidence shows an earth system under stress. Half the rainforest is gone, extinction rates are soaring, the oceans are increasingly acidic and the planet is running a fever one degree above pre-industrial levels. We are just starting to realise how these planetary ailments impact on human health, with climate change famously described in the Lancet as ‘the biggest global health threat of the 21st century’ [1]. Though many health professionals are alive to these global issues, in the health professions, as in society at large, sustainability competes with many other pressing and more proximate concerns. Thus, there is a danger that we are collectively sleepwalking into a public health catastrophe. This book offers a new synthesis of sustainability and health, leading in later chapters to many ideas for practical action. Firstly, though, we want to explain why we need a revolution in our health systems, why nothing short of a revolution is going to be enough and what sort of a revolution we are talking about. Luckily it is a revolution from which we all stand to benefit.

The revolutionary road

Nineteenth century medicine witnessed the emergence of germ theory, which revolutionised our understanding of infectious disease. This new theory dispatched the then prevalent miasmatic paradigm, which held that disease arose from bad air. In the twentieth century, classical mechanics was
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revolutionised by quantum theory, in which, for instance, matter could be both particulate and wave-like. Such paradigmatic revolution requires two conditions. Firstly, there needs to be a build-up of anomalies, difficulties that cannot be solved by the dominant paradigm and which call its completeness into question. Secondly, a new paradigm must be waiting in the wings that accounts for the problems of the day and offers some hope of resolving them. We argue that the time for such a paradigmatic revolution in medicine is upon us. Biomedicine, despite its huge successes, cannot, of itself, provide solutions to the long term health needs of humanity. So, what are these anomalies and predicaments that are great enough to signal the need for a revolutionary new approach?

The verge of collapse

Readers in New York or Glasgow or Sydney may be forgiven for thinking that it is business as usual in healthcare. People value medical care and hold healthcare professionals in high esteem, with the enterprise enjoying enduring governmental support. There are plenty of patients, plenty of things to do to help them and a reasonable amount of money available to pay for it all. In many ways, then, these readers are right. It takes a lot of imagination to think beyond our immediate circumstances, to think globally and think in terms of our common and distant future. Because while, as we shall see, there are challenges facing us right now, there are more and greater challenges ahead. The greatest would be the collapse of civil society through some sort of man-made environmental calamity, as in science fiction movies like The Day After Tomorrow. This possibility feels remote. It probably also felt remote to the many societies which have experienced such collapses in recorded history [2]. Take for instance the fate of the Easter Islands communities. These remote islands were first spotted on Easter Day 1722 by the Dutch explorer Jacob Roggeveen. He encountered a small population, with small and leaky canoes, living on an island devoid of trees, but sporting 300 stone platforms and 887 giant, long-eared, and intently gazing, stone statues. How, thought Roggeveen, did these Polynesians voyage in such vessels from their nearest neighbour, Pitcairn, 1300 miles away, and erect such monuments without rope and wood? Paleobotanical research has demonstrated that the islands were originally thickly wooded with a huge and now extinct species of palm. So what happened? We know that from around AD 900 settlers arrived and used trees for firewood, cremation, sea-worthy canoes and timber for shifting statues. They also cleared woodland to create fields to feed their workforce and a population of around 15 000. We know that
by AD 1600 this complex tribal society had all but collapsed. All native land birds and mammals were extinct, all the trees gone and the stone quarries abandoned. The priestly caste was replaced by militia and the islanders turned to cannibalism. Of course, some people survived but by most reckonings in a much impoverished culture. Captain Cook visited the islands in 1774 and described the inhabitants as ‘small, lean, timid and miserable’. The Easter Island story concerns a tiny geographical locale. But today we face the collapse of a planetary system that will affect us all.

Living within boundaries

When we look back on the Easter Islanders cutting down their trees and subverting their culture, we feel incredulous that people could be so short-sighted. But how will future generations look back on us? Will ours be branded the Age of Stupid [3]? Collapsing cultures consistently fail to play by the rules – rules that contemporary science is starting to name and understand. In 2009, the journal Nature published a feature based on the work of the Stockholm Environment Institute on planetary boundaries [4]. In a number of distinct domains, these boundaries define the estimated limits of what we can do without causing serious adverse changes to the planetary system (Table 1.1). The Institute proposes, for instance, a boundary for the loss of biodiversity of ‘ten species lost to life per million species per year’ and a boundary of 15% of global land cover converted to cropland (the current figure is 11.7%).

If we can keep within these boundaries, say the authors, we have a chance of maintaining the favourable earthly conditions of the Holocene. The Holocene is a geological epoch, beginning about 12 000 years ago, characterised by a stable interglacial climate. Geologists now speak informally of the Anthropocene, a new period which marks the time from which we can observe the impact of humanity on the global system: its oceans, soils, atmosphere, climate and biosphere (Chapter 2). The bottom line is not comforting. We are, through our activities, already approaching or surpassing all of the planetary boundaries cited by the Stockholm Institute. For instance, the authors of the article in Nature give a threshold of 350 parts per million (ppm) of atmospheric carbon dioxide to contain global warming at less than two degrees above pre-industrial levels. Yet, in February 2012, the official figure from Hawaii’s Mauna Loa observatory put the figure at 394 ppm [5]. So even though it may seem business as usual in healthcare in the richer world, the system as a whole faces a number of serious challenges that fundamentally threaten its operation.

**Planetary Boundaries**

<table>
<thead>
<tr>
<th>Earth system process</th>
<th>Parameters</th>
<th>Proposed boundary</th>
<th>Current value</th>
<th>Pre-industrial value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>Atmospheric carbon dioxide concentration (parts per million by volume)</td>
<td>350</td>
<td>387</td>
<td>280</td>
</tr>
<tr>
<td>Rate of biodiversity loss</td>
<td>Extinction rate (number of species per million species a year)</td>
<td>10</td>
<td>&gt;100</td>
<td>0.1–1</td>
</tr>
<tr>
<td>Nitrogen cycle</td>
<td>Amount of N₂ removed from the atmosphere for human use (millions of tons per year)</td>
<td>35</td>
<td>121</td>
<td>0</td>
</tr>
<tr>
<td>Phosphorus cycle</td>
<td>Quantity of P flowing into oceans (millions of tons per year)</td>
<td>11</td>
<td>8.5–9.5</td>
<td>–1</td>
</tr>
<tr>
<td>Stratospheric ozone depletion</td>
<td>Concentration of ozone (Dobson unit)</td>
<td>276</td>
<td>283</td>
<td>290</td>
</tr>
<tr>
<td>Ocean acidification</td>
<td>Global mean saturation of aragonite in surface sea water</td>
<td>2.75</td>
<td>2.90</td>
<td>3.44</td>
</tr>
<tr>
<td>Global freshwater use</td>
<td>Consumption of freshwater by humans (km³ per year)</td>
<td>4000</td>
<td>2600</td>
<td>415</td>
</tr>
<tr>
<td>Change in land use</td>
<td>Percentage of global land cover converted into cropland</td>
<td>15</td>
<td>11.7</td>
<td>Low</td>
</tr>
<tr>
<td>Atmospheric aerosol loading</td>
<td>Overall particulate concentration in the atmosphere on a regional basis</td>
<td>To be determined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical pollution</td>
<td>For example, amount emitted to or concentrations of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in the global environment, or the effects on ecosystem and functioning of Earth system thereof.</td>
<td>To be determined</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Five contemporary predicaments

In this section we take a wider look at the general human situation through the lens of five contemporary predicaments. These are predicaments we are unlikely to sort out with the same style of thinking that helped to create them, but which are explicable and potentially solvable from a sustainability perspective (Figure 1.1).

Material inequality

Although the diversity of the human situation means that inequalities in material wealth are inevitable, the degree of inequality within humanity is anomalous. More than a billion people currently live in what the World Bank defines as extreme poverty with an income of less than US$ 1.25 (£0.79) per day. Nearly half of the world’s population lives on less than US$ 2 (£1.30) per day [6]. These income levels are not sufficient to meet basic human needs and are not remotely enough to support any advanced medical interventions in settings where people have to pay for services. For instance, a child developing insulin-dependent diabetes in an impoverished rural area may not receive insulin therapy because the cost would be beyond the means of the child’s family (Case study 1.1).

In contrast, the world’s wealthy are getting wealthier (as admittedly are the world’s poor). The United Nations University’s survey of the World
Case study 1.1 The fate of a child with diabetes in rural India

An eight-year-old girl called Sudha was admitted with DKA (diabetic ketoacidosis) soon after her diagnosis with Type 1 diabetes. On discharge, I explained to her parents the importance of insulin for survival. Sudha’s poor and illiterate parents were very attentive. Finally her father asked:

‘Doctor, if I understand you correctly, does Sudha have to take insulin injections every day for rest of life?’

‘Yes.’

‘What would happen if she stopped taking insulin?’

‘Well, she would slip into coma and if left unattended, would die.’

Three months later Sudha had died. Her father had quite intentionally stopped giving her insulin. To the outsider he appears inhuman, cruel and criminal. But for him, the choice was between the starvation of his other children versus treatment of a diabetic child.

The average annual family income in India is Rs 50000 (£750/US$1185). The cost per annum for insulin and syringes alone is Rs 15000 (£200/US$316). If blood glucose monitoring is included the cost is doubled.

With no health insurance cover, poor families find it difficult to commit over a quarter of their monthly income to the treatment of a diabetic child. The logic of poverty overpowers the logic of life.

Quoted, with permission, from a letter to one of the authors from Dr Sharad Pendsey, Consultant Diabetologist, Director, Diabetes Clinic and Research Centre, Nagpur, India and Managing Trustee, Dream Trust (www.dreamtrust.org).

Distribution of Household Wealth documents the divide with stark statistics [7]. In 2000, the richest 1% of the world adult population owned 40% of global assets, while the poorest half owned only 1%. Income correlates with success in all of the United Nations’ Millennium Development Goals, including child health, universal education and putting an end to hunger [8]. The reasons for these differences in material wealth are complex and go far beyond the scope of this book. But although differences are material, the solutions may not be. This degree of material inequality indicates a profoundly dysfunctional global system. The United Nations, for instance, estimated in 1998 that the millennium goal of basic education for all could be attained by an additional global investment of US$6 billion (£3.8 billion).
In that same year people living in the USA spent US$ 8 billion (£5 billion) on cosmetics, the people of Europe US$ 11 billion (£6.9 billion) on ice cream and the world community US$ 780 billion (£492 billion) on the military [9].

Population and consumption

In October 2011, the world population reached seven billion from a pre-industrial baseline of one billion, and the US Census Bureau estimates that the population will rise to nine billion by 2040 [10]. This growth equates to creating a new city of a million people every five days from now to 2050 [11]. One reason for this growth has been the Green Revolution (Chapter 6), which has been fuelled by new, energy-intensive ways of making nitrogenous fertilisers and the development of new disease and drought-resistant strains of grain [12]. An estimated 50% of people today depend for their calories on food grown using such artificial fertilisers. More people require more food, space, water and energy. Because some people consume much more than others, there is a good argument that the chief metric should be not population numbers per se but the per capita impact of each person on the earth’s resources. The richest billion people on the planet consume, on average, 32 times as much as the remaining six billion [13]. The signs are that people in poorer countries now aspire to the sorts of lifestyles adopted in richer countries. Hence, any global transition to the western lifestyle will have a much greater impact than would be implied by population growth alone. Take, for example, an increasing appetite for meat in China and India (Chapter 6 gives an exposition of the environmental impact of animal protein). Rising consumption is, therefore, a greater threat than rising population. Fuelling such consumption is the rising tide of economic migration from poorer to richer economies, a tide that will certainly run stronger as climate change has its differential effects on the poorer world. This predicament lies in uneasy paradox with our first problem of inequality. We need the rich to consume less and the earth’s poorer citizens to draw more on resources than they do already (these twin concepts of contraction and convergence are explored further in Chapter 3). An advantage of convergence is that family size tends to reduce as communities emerge from the extremes of poverty, easing population pressures [14].

Resource depletion

The resources of the earth, such as fossil fuels, are limited and even the energy we can extract each year from the sun is finite. In 2005, analysts reported that we had consumed half of all the earth’s extractable reserves of conventional oil and gas [15]. They warned that remaining reserves would
be more costly and more risky to exploit, as we saw for instance with the Deepwater Horizon disaster of 2010, in which an explosion led to oil gushing unchecked from the seabed and the biggest spill in United States’ history [16]. This peak oil narrative holds true for conventional oils and gases, though the picture has become complicated because of the recent emergence of alternative hydrocarbon sources and extraction methods, such as shale oil and hydraulic fracturing. At current levels of consumption, supplies of conventional fuels are likely to be depleted by the end of the century, with much uncertainty over how alternative fuels, nuclear power and renewables will fill this energy void [15]. Experts predict substantive changes in the world economy as a result, including in the health sector [17]. If the supply of fossil fuels diminishes and prices rise, this will have severe implications for the delivery of healthcare, yet there is scant evidence that we are prepared for this transition. Imagine, for instance, running hospitals using 50% less energy than at present. Although such a situation might be desirable from a sustainability perspective, it would herald some fundamental changes in the way we realise our hospitals – changes that we need to start planning for now. The picture is set to be clarified in the next decade as the potential of alternative sources of hydrocarbons is established, though these will only worsen the problem of carbon emissions.

Water scarcity may turn out to be a bigger threat to global security than diminishing fossil fuels. Rivers such as the Rio Grande, the Nile, the Indus and China’s Yellow River struggle to reach the sea throughout the year. We are taking water from rivers, lakes and aquifers faster than it can be replaced by the hydrological cycle [18]. Hydraulic ‘fracking’ for shale oil, our best hope for obtaining fossil fuels as conventional oil supplies decline, is an intensely thirsty process, pumping millions of gallons of water deep underground. Since fracking also forces chemicals underground, it has the potential not only to deplete but also contaminate supplies. The UN Food and Agriculture Organisation (FAO) estimates that 1.8 billion people will experience water scarcity by 2025. City communities such as La Paz in Bolivia, which draw their summer supplies from glacial melt water, are particularly vulnerable as glaciers recede due to global warming. Other resources in danger of depletion include rare earth metals such as neodymium (which makes the powerful magnets used in wind turbines), phosphates used in fertiliser production and uranium for nuclear fission. Like the Easter Islanders we are set to run short of the raw materials that underpin the processes of our civilisation.

Climate change

In October 2011, an independent and previously sceptical team of climatologists from Berkeley, California, confirmed findings from other centres
that the average surface temperature of the earth has risen by one degree since 1950s [19]. This observation persists after adjusting for the possible confounding effects of *urban heat islands*, which are metropolitan areas that are considerably warmer than their surrounding rural areas. We know that the cause of this warming is mainly carbon dioxide from the burning of fossil fuels and that no other mechanism could account for the rapidity of the change (Chapter 2). The earth’s poles are particularly sensitive. According to data from the US National Centre for Atmospheric Research, the extent of arctic sea ice has declined by 30% since 1979 [20]. With the melting of continental ice in Antarctica and Greenland comes the possibility of rising sea levels and the inundation of coastal communities. If evidence of current global warming is incontrovertible, it is much less certain how global warming will proceed as the century unfolds. We also do not know whether change will remain gradual or hit a tipping point as the earth system flips into a new and hotter state. The potential impacts of climate change on human health are huge and mediated particularly by loss of food security, through flood and drought, direct effects of extreme weather, expanding habitat for disease vectors such as malaria and the inevitable health consequences of mass migration from stricken areas [1]. Because of these pressing effects on health the whole of Chapter 2 is devoted to understanding the science of climate change and its impacts.

**Loss of biodiversity**

Perhaps we can rescue the climate, but once a species is extinct there is no going back. The current rate of extinction is thought to be between 100 and 1000 times the estimated background extinction rate (there are difficulties knowing for certain of the extinction of creatures such as ants at large in the Amazon basin). Many organisms are already ‘functionally extinct’ because they exist in numbers too small to have noticeable presence within their local ecosystems. Iconic examples include the Yangtze River Dolphin and the Iberian Lynx. The sociobiologist E.O. Wilson estimated in 2002 that, at current rates, one-half of all species on earth would be extinct in 100 years [21]. People seem remarkably unaware of the scale of what is happening – the greatest extinction event since the one 65 million years ago, when the dinosaurs and half of life on earth were wiped out by a meteorite or volcanic upheaval, or both. In our times a quarter of mammals, a third of those vulnerable amphibians, a quarter of corals and a quarter of freshwater fish are threatened [22]. Humanity has a long history of causing extinction of large mammals through direct predation; this still accounts for why so many species of fish and other cetaceans (marine mammals) are endangered. On land the mechanism of contemporary extinction has more to do with
the depletion of habitats, as marshes are drained and forests cleared. Around half of the original six million square miles of tropical forest present in 1947 has now been destroyed. Current projections suggest that by 2030 we will be left with just 10% of the original coverage [23]. In specific pockets, such as Haiti, the tropical canopy is almost completely gone.

The impacts of such losses are incalculable and it takes particular imagination to grasp the impact of all this on human health. There is, for instance, the loss of plants and animals which might have turned out to have been of direct medicinal use. In his book *The Future of Life*, E.O. Wilson relates an anecdote in which a Bornean tree is discovered to yield a medicine active against HIV [21]. On returning to the remote swamp from where they gathered their sample, collectors found the tree had been felled and no more could be found. Luckily a specimen showed up in the Singapore Botanic Garden. What is harder to appreciate is how by removing species we ‘damage ecosystems, collapse food webs and ultimately undermine the planetary life-support system on which our species depends’ [24]. This is why we study systems in more depth in Chapter 3.

**Crises in healthcare**

So far we have defined five predicaments that confront us: inequalities, overpopulation with rising consumption, resource depletion, climate change and loss of biodiversity. We could add more, such as soil erosion, oceanic acidification and armed conflict. These predicaments are, of course, intimately interwoven. For example, fossil fuels have fuelled the development that stimulates population growth, which impacts on land use and, hence, biodiversity. We cannot solve these predicaments by simply doing more of what we are doing already. The threat to our lifestyle is our lifestyle. For instance, we will not be able to address the issues of material inequality by striving to bring the consumption levels of everyone up to the level of those in the wealthiest countries, as we are already exceeding the carrying capacity of the planet. These big picture predicaments are often removed from the daily work of healthcare professionals in the world’s richer countries, though certainly not for those working in poorer ones.

Healthcare is a part of the global system like any other ‘industry’ and faces its own related suite of pressing predicaments [25]. Here we cite five crises in health, drawing on the *Oxford English Dictionary* definition of crisis as a ‘time of difficulty, insecurity, and suspense’ (Figure 1.2). Having defined these crises we go on to show, in this chapter and in the book as a whole, how sustainable healthcare offers at least the hope of solutions to the troubles of our times – solutions that the healthcare community will have a central role in bringing to life.
Crisis of chronicity

We know that the global population is growing. It is also aging. Japan, for instance, is estimated to be the ‘oldest’ nation that has ever existed, with one in ten of its citizens being over 75 years of age [13]. This demographic explains, in part, the shift in healthcare’s orientation from the treatment of acute illness to the management of chronic disease. Chronic disease has always been with us but is emerging as the primary preoccupation of many healthcare systems, especially in higher-income countries. Take diabetes as a sentinel diagnosis, the prevalence of which is rising rapidly across the world. The number of people diagnosed with Type 2 diabetes in the United States rose by 33% between 1990 and 1998 [26]. Projections suggest that 29 million people will live with this condition in the United States by 2050 [27]. Diabetes is significant because it underpins trends in many other chronic health problems, such as heart disease and stroke. But why is diabetes becoming such a big a problem? The answer lies in a complex mix of demography, keener diagnosis and the worldwide emergence of another global health crisis – obesity. According to the World Health Organization (WHO), more people die from being overweight than from malnutrition [28]. The 500 million world citizens who are obese are at greater risk of diabetes, cancer, heart disease and a prodigious number of other ailments [29]. A particularly worrying trend is the emergence of obesity in children (Chapter 6). Healthcare systems across the world also face high burdens
of cancer, autoimmune disease, respiratory disease and chronic infectious diseases such as HIV/AIDS and tuberculosis. Though we do not understand all the causes of these diseases, science has shown strong associations with modern sedentary lifestyles and the western diet. Being still is dangerous for our health. Never have we moved our bodies around the world so much without actually moving our bodies. In later chapters we will see how lifestyles and diet also contribute to our global environmental ills.

Crisis of cost

Richer nations invest vast and increasing sums of money in healthcare, most of it in the treatment of the chronic conditions referred to earlier. This expenditure continues at a time when most governments are seeking ways of spending and borrowing less. These two trends seem impossible to reconcile. European nations spend around 9% of their Gross Domestic Product (GDP) on healthcare; the United States spends an exceptional 17.4% [30]. The US Congressional Budget Office estimates that if the United States health budget continues to grow at current rates, the nation will be spending an unthinkable 31% of its GDP on healthcare by 2035 [31]. The high cost of healthcare is down to another complex mixture of factors as people live longer and accrue diagnoses. In the United States, for instance, one in two adults live with a chronic condition [32]. As medical science progresses, we find more things to do at higher cost. For instance, MRI scanning is now almost a routine procedure. And new drugs, especially for life-threatening disease, are often inordinately expensive: for example, 21 tablets (5 mg) of the myeloma treatment lenalidomide (Revlimid®), the subject of Adam Wishart’s mordant documentary The Price of Life [33], cost the United Kingdom taxpayer an improbable £3570 (US$ 5643) [34]. In systems that are based on reimbursing physicians through private insurance companies, there are strong reverse incentives to cost containment. The more things health professionals do, the more they get paid. And the more insurance companies pay out to providers, the more they pass on in premiums. Predictably, these premiums can soon become unaffordable, so that in 2009 an estimated 50.7 million persons in the United States had no health insurance whatsoever [35]. In 2007, 625 of personal bankruptcies in the United States were due to medical fees that could not be paid [36].

Crisis of compass

If healthcare is unsustainably expensive in the rich world, we could at least hope that we are benefitting from the very latest scientific medicine and
that this colossal expenditure is resulting in our better health. However, existing data do not uniformly support this optimistic hypothesis. On the contrary, evidence suggests that spending on healthcare is being invested in interventions that do not improve health. For instance, the *Dartmouth Atlas Project* has shown that patients who live in regions of the United States with a higher intensity pattern of care where they receive more visits, undergo more imaging examinations and are more frequently admitted to hospital, show no better survival rates than those living in regions with lower-intensity healthcare [37]. Billions are spend each year on coronary angioplasties and stents, yet a randomised controlled trial, published in April 2007 in the *New England Journal of Medicine*, found that these two procedures do not prolong life or prevent heart attacks in patients with stable coronary disease when compared to pharmaceutical approaches [38]. We also know from comparing data between nations that there is a poor correlation between expenditure on healthcare and longevity. For example, although Chileans and Americans enjoy similar average longevity (78.6 versus 78.3 years), healthcare spending per capita is, according to the Organisation for Economic Co-operation and Development (OECD), six times greater in the United States – and 25 times greater than in the famously low-cost Cuban system [39]. These data suggest that a high proportion of healthcare funds is being misspent, however well meaning and culturally reasonable the reasons behind this spending may be. This is, in part, due to the conflation of healthcare as part of a system of *care*, with healthcare as profit-driven *industry*. An independent review calculated that US pharmaceutical companies spent US$ 57.5 billion (£35.6 billion) in 2004 on promoting their products, giving them weighty influence over the delivery of care which is, inevitably, dominated by medication, even in less overtly commercialised systems [40]. And medication use is on the up in many clinical fields. For instance, the health service in England issued 39 million prescriptions for antidepressants in 2009, compared with 20.1 million in 1999, with no evidence that England is a happier country as a result [41].

Developments like these herald what we call the ‘crisis of compass’ – a crisis in the purpose and direction of the healthcare enterprise. And what if ‘care’ is not only ineffective but actually harmful [42]? In 2009, there were 1.2 million visits to US emergency rooms due to the misuse of prescribed medications [43]. Even when used correctly, medicines can cause grave harms which are often not initially apparent. According to research published in *The Lancet*, between 88 000 and 140 000 excess cases of serious coronary heart disease occurred in the United States over the market-life of the anti-inflammatory *rofecoxib* (Vioxx®) before it was withdrawn in 2004 [44]. Even health promotion may have unforeseen problems. For instance, the United Kingdom’s £96 million per annum *National Breast Screening Programme* is mired in controversy as epidemiologists debate whether it causes more
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harm than good [45]. So judicious use of investigations, medications and surgery will remain at the heart of good medicine. But, as we argue in Chapter 10, just because some treatment is possible does not mean that it is desirable. The direction we advocate is toward better health with, paradoxically, less healthcare, putting a firmer emphasis on broad, holistic and mainly preventative interventions. A welcome and convenient truth is that such interventions, be they preventative or therapeutic, are also, typically, much kinder on the planetary system.

Crisis of compassion

One of the effects of delivering so much in healthcare is that health professionals have become very busy, with more patients having more ‘done’ during shorter hospital stays and clinic visits. Whilst our therapeutic systems have advanced, there has not been a corresponding advance in our ability to meet the human needs of those in our care. In fact, by some indicators, the clinical frontline of medicine is uncomfortably short of humanity. The UK’s Care Quality Commission found in 2011 that almost half of hospitals did not meet basic standards for nutrition and dignity in the care of elderly patients (Box 1.1 shows some extreme examples) [46].

Of course, individual doctors and nurses would never condone these depressing stories of neglect, but neither can we argue that they are exceptional. In a medical culture that focuses primarily on targets, costs and demonstrable physical disease, the humanity of individual patient care can get marginalised. In United Kingdom hospitals, a culture of ‘shift working’ has risked the fragmentation of individual care, as has the demise of ‘personal lists’ in family medicine, where patients receive the majority of their care from a single doctor. When suffering from routine ‘minor’ medical problems, patients want easy access to care, but when they are more seriously sick there is no substitute for caring longitudinal relationships, physical touch and attention to basic things such as nutrition, pain relief, dignity and privacy. Empathic skills, such as the ability to convey a sense of hope, do not figure highly in the modern medical curriculum and the evidence, though conflicted, points to medical students becoming less empathic as they progress through the clinical years [47]. Health professionals in training are also not themselves always treated with dignity and compassion. According to correspondents to an American Medical Association article on humanism, hospital Residents reported sarcasm, dysfunctional mentors, excessively long working hours, ridicule when seeking time off due to ill health, and doctors driven by the need to pay off huge educational loans as being common problems [48]. It is a paradox that while compassion is a relatively unlimited and ‘free’ resource, we are busy driving it out of the system, draining our limited
Box 1.1 Quotations from ‘We have been listening, have you been learning?’ A report by the UK’s Patients Association, 2011 [47].

‘As you can imagine, my mother was horrified when she then turned up in hospital to discover dad sat beside his bed, quite literally sitting in his own faeces… In general during dad’s time in hospital the nursing staff treated him as an object that they had to treat rather than a human being who should be included in his care and given the dignity that he deserves.’

‘Even despite the often poor care he was receiving, my father had nothing but praise and gratitude for the people caring for him, and thanked them every time. However, to us he said that nobody cares in here what happens to you.’

‘The horrible thing is that my mum was not alone in this situation. I witnessed the old lady in the bed opposite being left with a bowl of steaming hot soup which she pulled towards her before I could stop her, and poured it all over her upper legs. When the nurse was called she said she was busy and would be along in a minute! The lady suffered scalding to her legs and the doctor had to be called.’

‘Mum has always been very particular about her appearance and personal hygiene. We found it hugely distressing to find her with dirty fingernails and dirty teeth. She also had food all over her clothes. We took an apron in with us for mum to wear when she ate, but it was barely used, unless a member of family was present.’

‘She was not given a choice of food, calcichews for her bones, was not hoisted, not hydrated nor visited by a physiotherapist. Every day that I visited, the first thing she said was “Give me a drink!” It was only after I repeatedly insisted that my mother be offered these things that she gradually was given them over the weeks that followed.’

and ‘expensive’ resources in the process. We need to consider compassion as another element of quality in healthcare which may sit in healthy tension with indicators such productivity and throughput (Box 1.1).

Crisis of carbon

The carbon crisis is, understandably, not one recognised by most health professionals, but is in fact the crisis dealt with most directly in this book.
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Healthcare consumes a great deal of energy on powering buildings, transport and the procurement of goods and services. The US Government’s energy efficiency office, Energy Star, estimates that healthcare organisations in the United States consume US$ 8.8 billion (£5.5 billion) of energy per annum [49]. The NHS Sustainable Development Unit (SDU) attributes a full 3% of the carbon footprint in England to NHS-related activity [50]. While energy in Western societies appears to be plentiful and relatively cheap, we are facing two major challenges. Firstly, as stated earlier, the amount of energy at our disposal is likely to reduce as the century unfolds and the supply of cheap conventional fossil fuel begins to dwindle. Secondly, the effects of carbon dioxide emissions from fossil fuel consumption are powering climate change, and climate change is set to be a major challenge to global health (Chapter 2). So, healthcare is part of the problem in common with all other industries, and will also be called upon to be part of the solution. We come back to this predicament repeatedly in the book, particularly in Chapter 5 on ‘low carbon care’.

And so we conclude this catalogue of crises: of chronicity, cost, compass, compassion and carbon. As with the global predicaments detailed above, these five crises in healthcare are, of course, strongly interconnected. While cheap energy has helped build the freedoms of modern culture, we have often built these without respect for the ‘planetary boundaries’ that constrain us. Our wit in harnessing fossil fuels has allowed the human population to grow and consume exponentially, but those same fuels have allowed our habits to become sedentary and our diets industrial. Healthcare has also become more industrialised, bringing affordable medicine to millions. But where unchecked, such healthcare has also led to grossly inflated costs and prolific activity that contributes directly to carbon emissions – often without confirmed benefits to human health.

As argued already, these predicaments cannot be solved by the system that created them. We need new ways of thinking and acting. The sustainability paradigm we offer here is of course not new; it has roots back to the conservationists of late nineteenth century America, such as John Muir and Henry David Thoreau. In the twenty-first century, sustainability has moved from the fringes to the mainstream of politics and academia. Many institutions now have cross-faculty institutes concerned wholly with responses to global environmental change [51]. Even the British Medical Journal carried ‘The Greening of Medicine’ as its cover headline in January 2012. Sustainability cannot be cast as a paradigm in the formal scientific sense. The predicaments it addresses are set on too broad a canvas and our response is as much about political will as scientific theory. What is new here is the application of these ideas at the heart of the modern medical enterprise, where up until recently they have been largely overlooked. And what is paradigmatic is
that sustainability requires us to see all things differently, considering, for instance, not just *cost* but *carbon cost* of common things like medicines and clinic visits. We call this new way of seeing ‘greening the medical gaze’.

**Greening the medical gaze**

In his influential book *The Birth of the Clinic* (1963), Michel Foucault (1926–1984) introduces the concept of the ‘Medical Gaze’, which refers to what doctors *see* when they view a patient and their predicament [52]. Seeing is more than a purely physiological process of light and neuronal pathways; it is a process of meaning-making. Health professionals learn how to ‘read’ visual objects such as microscope slides, X-rays, laboratory reports and even people for signs of diagnoses such as anaemia; we have borrowed this concept and applied it to our current situation, calling for an extension, or ‘greening’ of the medical gaze. While in the eighteenth century the medical gaze lighted upon the sick man in his home, in modern medicine it focuses on the results of clinical examination, blood tests and medical imaging in the clinic or hospital bed [53]. What we need now is a gaze that includes in its sweep how medicine sits within the Earth system as a whole, a subtle but revolutionary change of perspective from atomistic to holistic and from unbridled to sustainable development. This gaze does not supplant biomedicine. Rather it fits it into a necessarily bigger picture.

**Sustainability defined**

Environmental sustainability is too complex an idea to succumb to a unitary definition but, where the term is broached, consistent themes emerge. Sustainability is about looking after things now so that they can be enjoyed not only by us up to the end our lives but also by future generations. There is a sense of the long term, which is the antithesis of political expediency. The focus is on resilience, permanence and cycles rather than linear and unremitting growth: a steady-state approach rather than a frontier mentality. A seminal sustainability text is called, simply, *The Limits of Growth* [54]. Sustainability is concerned with relationships and how the different aspects of the earth system, such as climate, oceans, animals and plants, best work together. It is concerned, on one hand, with resources and how we can preserve them, and, on the other hand, with waste products and how we can best reduce or dispose of them. Thinking sustainably acknowledges planetary boundaries (Table 1.1) and seeks ways for humans to thrive within them. It views humans as guardians and stewards, not owners. The sustainability paradigm is values driven, seeing it as, for instance, unfair if the Earth’s
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resources are exploited by some communities at the expense of others, including communities as yet unborn, with no choice or voice. We unpack the sustainability paradigm in more depth in Chapter 3, where we draw on the insights of systems theory. Sustainability then is not a single theory but a collection of tools, or lenses (theoretical, scientific, ethical and political), that bring possibilities into our field of vision that have until now gone unnoticed in our peripheral gaze – the perfect antidote to a ‘crisis of compass’.

Up to now the medical sector has taken the gifts of the planetary system for granted. But by considering the sustainability perspective, health services will, for example, consider fossil fuel a precious resource that could provide hydrocarbons for medical plastics and pharmaceuticals into the deep future. To use fossil fuels as fuels does not make a lot of sense. If instead we go for active travel, walking and cycling instead of flying and driving we help keep oil and coal in its ideal environment – under the ground. And, at the same time, we improve our mood, become physically stronger and healthier, and stop emitting the exhaust gases which contribute to climate change and bad air in our cities. Observe how a single sustainability approach (active travel) is able to tackle a number of major predicaments at the same time. This is referred to as a virtuous cycle: what is good for the environment is also good for health (Chapter 3).

Social sustainability

This book focuses mainly on the environmental aspects of sustainability but UNESCO’s campaign to promote sustainable development concentrates as much on the social as on the cultural. While financial and environmental sustainability are fairly intuitive concepts, social sustainability is more complex. It is about fostering communities that build capacity, develop skills, create social cohesion, improve health equity and champion resilience whilst at the same time looking after the physical environment. The Young Foundation stable of ventures, such as the UK’s Open University, Which? Magazine and NHS Direct, is an excellent source of ideas and innovations in this area, accessible through its comprehensive website [55].

In Chapter 3 we explore the importance of diversity in the creation of resilient systems. Cultural diversity, like biodiversity, is something intrinsically worthy, which also contributes to the health of the whole. For instance, there are traditional approaches in medicine, such as Ayurveda, with its focus on diet, yoga and meditation, which might serve as models for the design of modern sustainable practice [56]. Like plants and animals, our languages are under threat of extinction, and with them cultural perspectives, developed over thousands of years, can die too. It is estimated that by 2050, half the world’s 6000 languages will no longer have living speakers [57].
Social sustainability, then, is about preserving humanity’s cultural heritage whilst encouraging social practices that enhance resilience, such as social justice, gender equality, religious tolerance, inter-generational equity, fair sharing of natural resources and basic education for all (in particular of women). The resulting social resilience has major medical implications, as research shows that people with strong social networks live longer healthier lives compared to those who are poorly connected in social terms [58]. Building communities is for this reason a legitimate part of the medical enterprise.

**Sustainability and health services**

Why should busy clinicians and managers devote time and energy to this agenda? Perhaps they are already convinced by the scientific evidence, or aware of the possibility of virtuous cycles and the need for energy resilience [50]. In the UK NHS there is also a statutory requirement for larger organisations to come in line with binding Government targets for an ambitious 80% reduction in carbon emissions by 2050 [59]. The *triple bottom line* is a succinct way of summarising the value of sustainability for the health professions. Firstly, sustainability can save money. Heat that is escaping from a poorly insulated building has to be paid for by someone. Avoiding unnecessary investigations means there is more money around to fund other more useful activities. Secondly, a sustainable approach leads to better health outcomes. If we focus on areas for improvement, such as better school meals, less advertising of processed food and health education for mothers, we might hold back the rising tide of obesity in children, who we know go on to become less healthy adults. Thirdly, sustainability nurtures the earth system. For instance, low carbon healthcare helps stem global warming and its attendant ills like drought and flooding. Remarkably, in 2010, the UK’s Royal College of Physicians named sustainability as one of its seven domains of *quality* in healthcare [60]. The more we have explored sustainability the more clear it becomes that sustainable care is high quality care: lean, responsive and compassionate.

**Ethics and exemplars**

It would be wrong to caste sustainability as something managerial. The greening of the gaze is also about doing the *right* thing, an ethical position that brings out new aspects of old principles. For instance in the *Hippocratic Canon*, which forms the foundation of western medical ethics, we have the twin injunctions to do good and not to do harm. Sustainable healthcare
applies these same ethics, not just to individual patients but to all life and the systems that sustain life. This is not lame environmental altruism, because we depend wholly on these systems for our survival. Whatever we do to the environment, we do ultimately to ourselves. Similarly, social justice takes on an ecological dimension. We need to ask ourselves: who owns the resources of the earth, how are they distributed and to what extent do we allow individuals to create wastes, such as carbon dioxide, that effect the whole of humanity?

Doctors have been instrumental in confronting many risks to health, for instance in their continuing tussle with the tobacco industry [61]. In an era of increasing mistrust in authority, nine in ten adults in the United Kingdom say they trust doctors to tell the truth [62]. This makes medics the most trusted profession in the United Kingdom, which brings with it not only important responsibilities to use this trust wisely but also significant leverage with individuals and in public debate. Although the number of health professionals embracing the implications of sustainability may still be relatively small, their impact based on this trust and leverage is growing steadily. Encouragingly, paradigmatic change is typically driven by the values and vision of individuals and small groups doing the groundwork, and waiting for a critical mass to emerge. Think of Semmelweis, derided for suggesting, in 1847, that puerperal fever in Vienna maternity hospitals was caused by contagion transmitted on the hands of medical students, in an era before the wide acceptance of Germ Theory. For those who are predisposed to think sustainably, engaging in these issues becomes not just an interest but a way of putting core values into practice.

**Sustainability positive**

Talk of boundaries, depletion, crisis and predicament underpins this opening chapter. Addressing these issues is the first and necessary step in a healing journey, an acceptance that all is not well. That process can be unwelcome and punctuated with denial and even resentment, as is discussed in Chapter 3. The word sustainability rightly conveys a sense of conservatism, preserving resources and reducing waste. But sustainability also unleashes huge opportunities for creative thought and healthcare entrepreneurship. We are drawn, for instance, to a model from rural China where health workers are paid when their patients are well but not when they are sick. Such new thinking will draw on resources whose supply is not likely to ‘peak’, resources such as knowledge, community, compassion and cooperation. A sustainable society will have less of some material things but more of other things, like civic trust, common purpose and individual and community wellbeing [63]. In short,
we feel positive about the journey towards a sustainable future, even if the road ahead looks tortuous and uncertain.

**About this book**

In this chapter we have presented the idea of the sustainability paradigm as a necessary and quietly revolutionary response to the challenges of our time. We looked at predicaments in society as a whole and specifically in medicine, where we focused on the alliterative crises of chronicity, cost, compass, compassion and carbon. We have also given an outline of what sustainability means and boldly claim that it can deliver on the triple bottom line of quality of care, environmental protection and cost containment. The remainder of this book is about clothing these ideas in clear thinking, scientific evidence and practical ideas for transformative action. In Chapter 2 we take a non-technical look at climate science and review the current evidence for global warming and its likely impacts on health. In Chapter 3 we grapple with the concept of sustainability, drawing on systems thinking to arrive at a more nuanced definition, at the centre of which lies the idea of resilience. We also explore the difficulties of engaging with issues that are, on one hand, very unsettling and, on the other hand, seemingly remote. This chapter also introduces some of the necessary terminology of sustainable healthcare. The core ideas of the book culminate in Chapter 4 where we offer a vision for a sustainable health system. Chapters 5 to 11 are concerned with the practical application of these ideas to the organisation of clinical care, including chapters on food, transport, buildings and end-of-life care. We conclude, in Chapter 12, with a look at how health professionals can further their engagement with sustainability.

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