CHAPTER 1

Ponce's Dream

EVEN HAD THE sixteenth-century explorer Juan Ponce de León found the fabled fountain of youth, it may not have saved him from the fatal consequences of the Native American's arrow that found its mark during his second and final visit to the land he called Pascua de Florida. The compelling thing about his quest is that he risked his life chasing so wispy a rumor. But then the vision of perpetual, even apparent, health is a potent motivator; ask any plastic surgeon or cosmetic manufacturer.

The promise of at least prolonged, if not perpetual, health no longer rests on rumor. Existing and emerging science and technology give substance to the hope, even the expectation, that we can understand enough about health and how to keep it to let us live longer and better than we could have imagined even a decade ago. That knowledge and how to deal with it is what we call Predictive Health, defining what health is and detecting and correcting the earliest unhealthy tendencies long before there is any evidence of disease. The challenge of translating that knowledge into practice involves more than science and technology. Realizing the possibilities will require major changes in how human beings—scientists, health practitioners, and politicians, as well as people in general—think and behave. We can have health care—predictive health care—that is accessible, affordable, humane, ethical, and efficient. We can do it, if only we can figure out how.

Biomedicine in the United States is largely focused on disease; that is, organ failure. We spend most of our resources—money and people—in both biomedical research and clinical care on understanding and treating disease, even though disease is a very late consequence of long malfunctioning processes and is often irreversible. Research with this focus births dramatic (and expensive) interventions that too often have less than optimal effects on quality of life. Fully a third of the national Medicare budget is spent in the final year of life, and a third of that amount is spent in the last month of life, often on expensive and futile treatments in intensive care units. This arrangement is not sustainable. We may have the best disease care system in the world, but we do not have the best health-care system.

Health has been defined traditionally as the absence of disease, a definition without much utility in a health-focused system (theoretically, to declare a person healthy it would be necessary to rule out every possible disease, at best an impractical effort). Social need, cost, and fundamental discoveries will force major changes in health care, shifting the goal from treating disease to maintaining health. New programs of this sort with novel titles are already appearing at major academic institutions and health-care companies. That shift should gather momentum as the tools for measuring health and predicting disease proliferate and improved efficiency and cost/benefit ratios become more apparent.

The shift in focus of biomedical research has been slower to develop. We need to focus the formidable power of the research enterprise—basic, translational, and clinical—on developing a positive definition of health in quantitative terms. This would provide powerful new tools for health surveillance, assessing risk, and premorbid diagnosis, as well as rationales for new interventions at early stages of unhealth that would preclude progression to overt disease.

Driving this new paradigm for health care are the rapidly advancing fields of genomics and proteomics. Lee Hood, founder of

the Institute for Systems Biology in Seattle, predicts that the technology for genome sequencing (genomics) and measuring serum concentrations of a thousand or more proteins (proteomics) will be easy and cheap enough to be applied to individual health care within a decade or so. Other technologies, including nanotechnology and molecular imaging, could add detail to characterizing health, further enhancing the ability to measure health and detect tendencies to develop disease.

Not long ago, within the lifetime of many of us still practicing medicine, a dominant ethic held that death was a medical failure. Everything possible was done to keep people technically alive—to prolong the agonal gasp. In this more enlightened time, doctors have more respect for the inevitability of death and feel obliged to dignify that event as much as possible, but death is still the enemy to be conquered. In the new paradigm, it is disease, not death, that will be the medical failure.

The ease with which data are gathered is changing the landscape, enabled by the discipline of bioinformatics. Masses of information about the most intimate molecular events essential to life and health come from a drop of blood or the few cells dislodged from the inside of a cheek by the gentle scrape of a cotton swab. The irrepressible urge of scientists to classify and categorize information has added the suffix "ome" to descriptors of life processes: genome, epigenome, transcriptome, proteome, metabolome, even interactome. Such labels make scientists feel better about bodies of information too big and complex for the unaided human brain to fathom.

Fortunately the creativity of the human brain has let us make an electronic end run around that complexity. Computer power can domesticate the "omes" into tractable knowledge that is comprehensible to mortals and yields rationales for constructive action. Not only will we understand life processes at a level beyond what we can now imagine, but we will learn how to influence those processes to keep

them working right—data, evidence, and hard facts will ultimately trump intuition.

Technologies developing at near-breakneck speed are continually increasing the possibilities. Nanotechnology is an example. Machines the size of a molecule could be manufactured and engineered to sense events in cells and alter them in specific ways that encourage normal functions. These "nanoparticles" (including one breed dubbed "quantum dots") could be injected into a vein, targeted to specific cells, and have their behavior and actions tracked by special detectors outside the body, providing incredibly detailed and precise data, collected with minimal violation of one's person.

Emerging generations of devices integrated with sophisticated electronics can produce exquisite images of organs (and before long, even individual cells) without so much as touching the imagee. Holographic displays of those images are eerily realistic. The most arcane of anatomical crannies could be examined in astounding detail while avoiding the discomfort and humiliation imposed by the proliferating number of medical scopes.

Numerous other technologies will make it possible to define health and detect the earliest unhealthy tendencies. This very personal information will identify new targets for intervention and provide the means for tracking the results. This is individual, personalized health care. Testing new treatments will not depend on statistical evaluations in large groups. Effects will be measured in each person, and conclusions about treatments will be just as specific.

However, science and technology will only provide some tools. Turning these advances into a health-care system will force us to reckon with ethical, social, behavioral, economic, political, legal, and commercial issues that science alone will not solve. Advances in each of those areas should proceed in parallel with scientific developments, informed by rich transdisciplinary dialogue. Communication among a broad spectrum of disciplines will happen only if scholars,

investigators, and practitioners have both the motive and the opportunity to interact.

The cold fact is that the system will follow the money. What will be done—what research and what health care—will be what the people footing the bill (mostly governments and insurance companies) decide to pay for. Although a unique convergence of science, technology, and social milieu can make the change possible, the economics are complex, and the implications of change are threatening. The decision makers will have to muster the will and good sense to make it happen. There is a window of opportunity, but it may not be large.

Predictive Health will not realize Ponce de Leon's dream. It will not confer immortality or eternal youth, but it could make mortal events a brief and amiable consequence of the human organism having exhausted its natural span of life. Too many of us—like Carleton Hensley, a Baltimore steelworker who will accompany us throughout this book—live long enough to retire from a grueling job but not much longer. Too few of us—like Hilda Echt, an affluent Atlantan—thrive for a century despite occasional physical challenges. In the contrasting experiences of these two real people we will find, if not a path to the fountain of youth, then maybe something better. As many of us as possible should age with grace and die with painless dignity of natural causes. How can we do that?