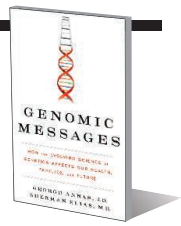
As the amount of personal genetic information we have access to grows, so, too, do the legal and ethical implications.

Genomic Messages
How the Evolving Science of Genetics Affects Our Health, Families, and Future
George Annas and Sherman Elias
Harper One, 2015. 303 pp.



GENOMICS

The future of health care

Making informed decisions in the age of genomic medicine

By **Henry T. Greely**

George Annas and Sherman Elias, two longtime experts on the medical and social implications of genetics, wrote *Genomic Messages* for nonexperts, to "help you make your own decisions about whether and how to use the evolving genomics in your own life." Annas, a law professor and bioethicist, and Elias, an obstetrician/gynecologist and medical geneticist, largely succeed in this aim.

Genomic Messages consists of a series of chapters on how genomic information might apply to individual health, including personalized medicine; the nature/nurture knot; pharmacogenomics; assisted reproduction (a digression that has little to do with genetics); prenatal, neonatal, and childhood testing; and cancer. Each chapter ends with a box with several summarizing thoughts for readers to consider: "It is unlikely that you or your physician will use genomics to determine your drug or dose in the near future," for example, or "There is no perfect genome and no genetically perfect fetus."

Useful real and hypothetical cases stemming from Elias's practice as a medical geneticist pepper these chapters, and the information is presented at a level interested general readers can understand. The advice tends to be conservative, expressed specifically in the context of human behavioral genomics. "We are easily seduced by genomics and need to keep our common sense fully engaged," they maintain. Some will consider the book too skeptical about what genomics can tell people today, although I think it generally hits a reasonable balance.

The biggest problem for the book is inherent in its subject. Genomics is just too many things: It is omnipotent and irrelevant; unchangeable or acutely responsive to its environment. It is about health and disease, as well as human enhancement. It can be used as a tool for tracing ancestry, from our ethnic forebears to more recent family, and it has become key to criminal identification.

The most common consumer genetic tests are undoubtedly those that purport to provide information about one's ancestry. The book says nothing about the strengths, weaknesses, benefits, and risks of such kits. Similarly, the implications of genomics for common diseases are a world apart from the lives of people trying to cope with rare genomic conditions. *Genomic Messages* does not, and cannot, provide the depth needed to inform those families. [Readers interested in a more in-depth treatment of the latter topic should consider the gripping new book *Orphan*, by Philip Reilly (*1*).]

The last two chapters shift the book's focus. In Chapter 9, the authors look at privacy issues, databases, and gene patents. Here, the book moves from what people may want to do to what policies they want in place, touching perhaps too quickly on many complicated issues. The authors sum up the chapter by saying "your DNA is yours—it's your property, and it contains information that is most important to you." But at other points they seem to hold a different opinion, urging regulation to define what genomic information should be conveyed and what information should be withheld from people. They also concede that families share DNA, making total control over one's own genome problematic. These issues are complicated, and the discussion does not go deep enough to produce well-informed readers.

The final chapter juxtaposes themes from dystopian science fiction with speculation based on cutting-edge research fields, discussing de-extinction, human cloning, transhumanism, immortality, and other futuristic scenarios. In these brief considerations, the book sometimes falls to pronouncements rather than analysis—for example, when the authors state, "Replication of a human by cloning could radically alter the very definition of a human being...." Is that true in a nontautological way? And is it reasonable to say that reviving extinct species is "simply unscientific and a waste of time and resources," without offering some relevant facts or arguments? Although these issues add drama, they detract from the stated mission of the book.

This book is strongest when it sticks to helping people figure out how they should use genomic technologies for their health and the health of their families. It does that well, although I am sure the authors would agree that their book should be a first step in an education that may need to include genetic counselors, medical geneticists, expert physicians, and others.

Sadly, this book comes at the close of a partnership between Annas and Elias that began in 1983. Elias died unexpectedly in July 2014, just after the book was completed. Through their 30 years of joint writing, Annas and Elias learned much about the intersections of genetics, society, and individual people. This book is a fitting culmination of that partnership, conveying that knowledge and wisdom to people seeking to understand their own "genomic messages."

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REFERENCES

1. P. R. Reilly, *Orphan: The Quest to Save Children with Rare Genetic Disorders* (Cold Spring Harbor Press, Cold Spring Harbor, NY, 2015).

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