B O O K R E V I E W

The Gene: An Intimate History by Siddhartha Mukherjee, M.D.

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Health care in the United States of America is a complex topic fraught with the historical and emotional trappings of most political minefields. With so many health care companies and organizations focusing upon the endless minutiae of how to deliver, manage, and reimburse health care; embracing a "big picture" perspective is a path followed only by those rare innovators who are willing and discerning enough to embrace the unknown. In this review, I will focus upon a book that calls out to the latter group and speaks to the larger and more hopeful perspective of twenty-first century innovation in health care.

Through my lifelong fascination with the history of science and technology, I have navigated and explored the never-ending landscape of biomedical innovations as diverse as assisted reproductive technologies, cutting-edge human prosthetics, and other technological promises of a post-human vision. Many authors have intrigued me but Siddhartha Mukherjee, M.D., the author of "*The Gene: An Intimate History (2016)*," is one author who eloquently amplifies the potential of such a future world. In his most recent book, he reveals not only an amazing grasp of the history of (biological) science, but also a preternatural understanding of how health in general and our DNA specifically can impact, devastate, and even enlighten our everyday lives. Through his eyes, we can challenge and reimagine preconceived notions of health and wellness. And, through his powerful and historically informed gaze, we can recognize that we have entered a new era—one that will hopefully change the means and machinations of health, health care delivery, and anything related to it for decades to come.

Organized in a thought-provoking combination of chronological, historical events and thematic groupings; Mukherjee's book leads us through the convoluted and sometimes serendipitous discovery of the human genome. In an approach like his earlier book on the history of cancer; Mukherjee draws us into the story by weaving his personal stories, those of his patients, and the history of science into a powerful chronicle about how all these perspectives are so deeply connected (Mukherjee, 2010). Genetics, a relatively new science whose origins can be traced historically back to Gregor Johann Mendel's 1866 study of pea plants, is based upon a surprisingly simple concept—the forty-six chromosomes in the human genetic code (Mendel, 1866; Mukherjee 2010, 2016). These chromosomes, twenty-three received from one biological parent and twenty-three received from the other, contain thousands of genes that provide the master instructions to build, repair, and maintain a unique human being (Mukherjee, 2016). Clearly, as Mukherjee (2016) points out, this scientific discovery is fraught with the same paradox of simplicity and complexity inherent in the discovery of two other transformational scientific discoveries—the atom and the byte. On one hand, the human genome offers the promise of unlocking the mystery of human existence. By doing so, the field of medicine and our understanding of health and wellness can be revolutionized beyond our collective imaginations. On the other hand, it offers

the danger of man-made manipulation as evidenced by the gruesome application of human eugenics in 1940s Nazi Germany; an idea launched originally, by the way, by English and American reformers in search of a way to engineer human evolution. Mukherjee (2016) adeptly travels through a historical chain of post-World War II discoveries that reach their crescendo in the Human Genome Project, a global project to map and sequence the entire human genome. And, unlike the measured and objective image of the academic and scientific worlds that is typically portrayed to the public eye; Mukherjee (2016) exposes us to the backstage rivalry, politics, and maneuverings involved in the prolonged "race" to claim the genomic victory. Backstage politics aside, the draft sequence of the human genome was finally published in 2001 through a joint effort of the publicly funded Human Genome Project and the privately funded effort of Celera Genomics. To date, the modern science of genetics continues to uncover the mysteries of both the normal and abnormal behavior of genes. And, this transformational knowledge gives us a deeper understanding of diseases and how to prevent them. While the backstage politics is no doubt here to stay, the competition could possibly lead to new discoveries to help eradicate genetic disorders such as Huntington's disease or cystic fibrosis. For those in search of a historical understanding of the human genome and its fascinating evolution over time; Mukherjee's book offers us a thrilling journey and helps us to contemplate the possible implications for the practice of medicine and health care delivery, the notion of health and wellness, and how much we can or cannot control about our unique genetic codes in the end.

For the healthcare industry specifically, the implications are endless. And, according to Robinson (2016), as genomic medicine becomes more mainstream; it is even more important that health care professionals and companies stay informed of the dynamic changes in this field. Jimenez-Sanchez (2015) discusses some of the health care industry innovations that have emerged from the genomic revolution. For example, he contemplates its valuable contributions to the identification of genes associated with common diseases such as diabetes, obesity, cardiovascular disease, and cancers and how genomics will be merged with other technologies such as gene therapy and personalized drugs to eradicate such diseases. While these new technologies are no doubt changing the way such diseases are diagnosed and treated; they also offer the opportunity for astute, informed innovators to create companies that utilize these very technologies. For example, the emerging genomics and pharmagenomics industries exemplify this global market trend (http://medicalfuturist.com/top-companies-genomics/). While many social and ethical questions remain, successful innovators such as the personal genomics company 23andMe (https://www.23andme.com) the pharmagenomics company MyDNA (https://www.mydna.life), and the diagnostic genomics company Rosetta Genomics (https://rosettagx.com) are at the forefront of transforming the business and practice of health care. As the price of genome sequencing continues to fall drastically, the start-up potential will continue to grow exponentially. And so, Mukherjee's "*The Gene: An Intimate History*" is a book that arrived just in time for those who understand the critical need for a "big picture" perspective. It provides a powerful and insightful gaze into the history and journey of the human genome—a must read for anyone even remotely connected to or interested in its implications for the health care industry, health care delivery, and the transformation of health and wellness as we know it.

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