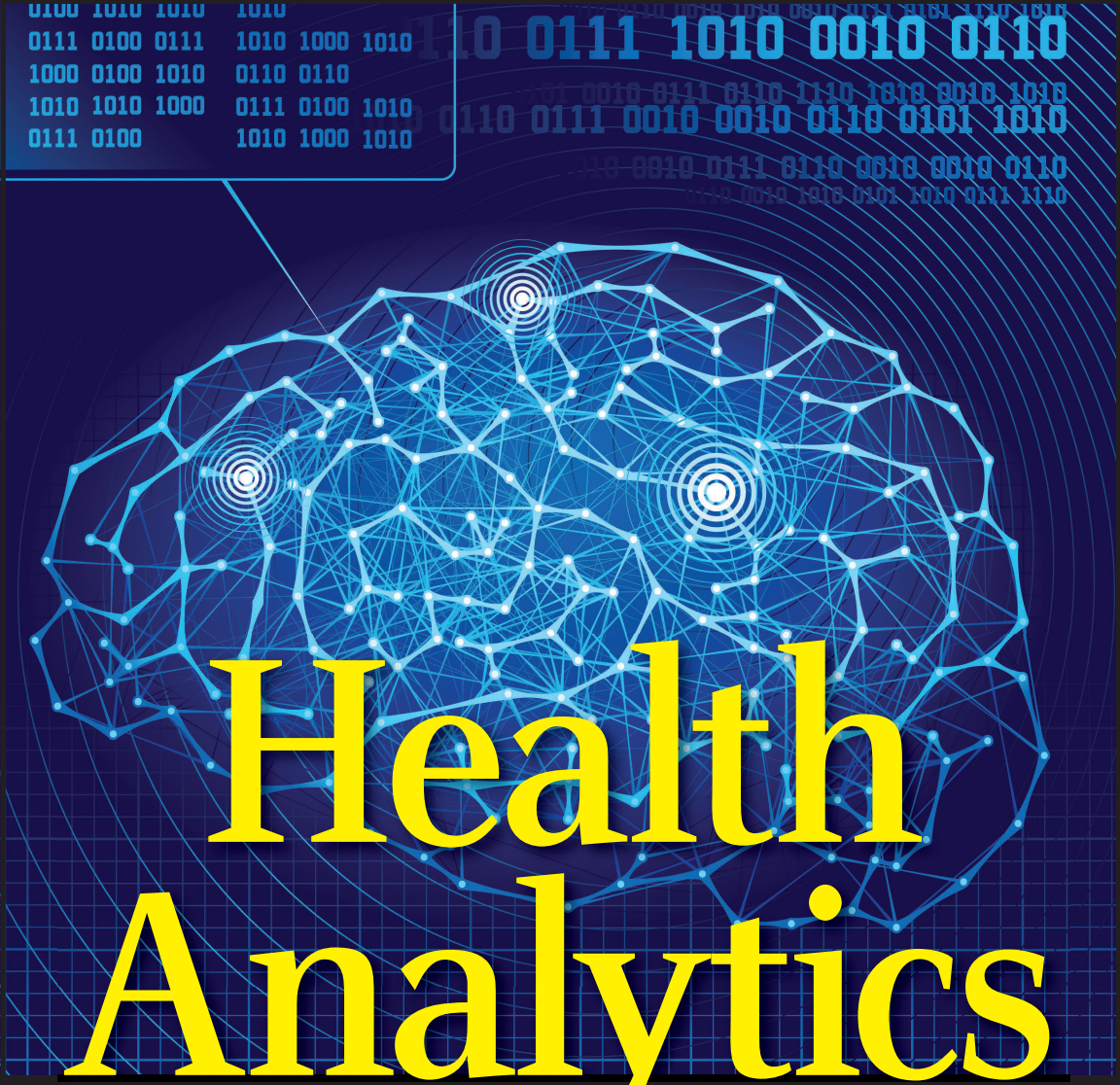

Health Analytics

Gaining the Insights to Transform Health Care

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CHAPTER 1

A Changing Business for a Changing Science

THE GATHERING

It was actually a really great idea at the time: let's collect what we know.

Around 300 B.C., the ancient library of Alexandria was created. The largest library in existence at the time, it contained the accumulated knowledge of hundreds of thousands of papyrus scrolls. Being located at the port city of Alexandria, the library benefited immensely from the international trade moving through the city's ports as ships, traders, and merchants from around the world conducted their business and travel. Historians today believe that in many cases travelers through Alexandria's port were actually required to surrender any books in their possession for a period of time so that the librarians at Alexandria could copy the literature and add it to their growing mecca of human knowledge. It is said that there was so much papyrus being consumed in support of the library that parchment became a growing medium for documents and books due to papyrus shortages.

Imagine for a moment being a researcher visiting that library for the first time. Sitting in dusty library stacks looking around at maybe

300,000 scrolls and parchments, the thought of how to find what you were looking for must have been a little overwhelming. There was no computerized index of content here (though the Alexandrians are said to have developed some form of coding system), no guarantee that what you were looking for would be found in the stacks at all, that it would be in a language you spoke, or that you would find all of what you sought as opposed to just a portion of the knowledge. My guess is if you knew exactly what single document you were looking for, an Alexandrian librarian could have probably helped you find it. But if you were trying to gather previously disparate information together to gain insights or make a decision, those dusty stacks must have looked tall indeed.

Over 2,000 years later, the story has not changed much in the practice of medical science. We managed to upgrade from papyrus to parchment, and through federal subsidies we have incentivized people to make their parchments electronic. But most of our stacks are still tall and intimidating. Medical information isn't stored in a centralized library—it is spread out all over the world, some locations known, others hidden and locked away, unpublished, or even unknown. We don't share a common language. And we don't require people to share their knowledge—some do voluntarily, some do under extreme duress, and others simply decline. Like the researcher standing at the Alexandrian library help desk, if we know a document exists, we might be able to find someone to help us locate it. But there are no guarantees that it exists, where it might be, what condition it might be in, or how useful it might be to our purpose.

As a visitor to Alexandria, if you aren't able to read that latest sidesplitting play by Sophocles, no one experiences physical harm. If you aren't able to discover and explore the common themes in Platonic writings, entire segments of the population do not suffer. But in a world where our ability to aggregate and consume medical information has not advanced considerably over reading papyrus, lives are damaged. People suffer. Patients even die.

The good news is that other aspects of Alexandrian society—financial trade, communications, and retail—all grew up over the past twenty centuries. We now send and receive orders, remit payments, participate in individual and group dialogues, and countless

other advances by structuring and standardizing data through information technology (IT). Beyond simply conducting business, we can actually analyze and improve business—our information and technology allow us to ask new questions and derive new insights about people, products, markets, behaviors, and processes. Can health care evolve to become such an insight-driven ecosystem?

HOW CAN MEDICINE BECOME SMARTER?

This book is about health analytics. It is about helping organizational leaders understand how advanced analytics can be used to improve medical outcomes, increase financial performance, deepen relationships with customers and patients, and drive new medical innovations. Beyond the theoretical, we endeavor to create a road map—a framework for how industry executives and leaders can construct an actionable plan for evolving health and life sciences through the more intelligent application of information.

Let's be honest: analytics scares some people. It sounds like you need an advanced math degree to even have a conversation about it. It can make professionals who are otherwise world-class experts in their fields a little uncomfortable. It sounds technical. And, perhaps worst of all, can you really trust statistics?

The answer, of course, is no, you absolutely cannot trust statistics . . . at least not in isolation. You cannot trust a single blood test or electrocardiogram (EKG) reading to fully diagnose and treat a patient, either. But those tests and readings provide critical information to experienced professionals who can then take actions to develop hypotheses, execute additional tests, and combine empirical and experiential data to make decisions. Analytics are no different—they combine data to offer a new source of information. And just as most physicians do not need to know how to build an EKG machine in order to use EKG readings, our goal in this book is to provide enough information about health analytics to empower nontechnical, nonmathematical industry professionals to take advantage of the tremendous promise inherent in health analytics.

Before we can talk about the opportunities, though, we need to begin to baseline where our patient—the health ecosystem—is today.

COMPLEXITY EXCEEDING COGNITION

The human brain remains the most sophisticated computing device known to humankind. With a theoretical storage capacity measured in petabytes, fully autonomous hierarchical functioning, and near-instantaneous latency to inputs, the brain is one of nature's truly greatest marvels.

And yet, this incredible device has a number of well-documented shortcomings:

1. The human mind cannot simultaneously consider more than about four pieces of information at one time. For example, consider the myriad of tradeoffs associated with buying a car: new versus used, buy versus lease, standard versus premium features, brand prestige, acquisition costs, maintenance costs, safety profile, insurance, vehicle performance, dealer incentives, customer service, fuel economy, depreciation . . . even with the power of the human brain at the ready (and accepting that people value each factor differently), is it easy for you to pick your next car? More than likely, you do what most people do to help you make this decision. They decide on a small subset of factors that are most important to them, reducing the factor count closer to four. They look to their own prior experience with cars to infer what might be best. They ask friends for recommendations, zeroing in on a single factor—consumer sentiment. And they look at periodicals like *Consumer Reports*, which reduce the complexities to "editor's choice" and ranked lists. Do physicians make decisions using a similar approach? Do executives? You bet.
2. The human mind uses undisciplined principles in weighing the importance of information. For example, the human mind places greater emphasis on the first information it receives about a topic (the primacy effect), and the most recent information it has received about a topic (called the recency effect). These principles operate regardless of whether the information is actually valuable or even accurate. Other examples of undisciplined mental principles include biases due to expectations (e.g., selective

perception, confirmation bias, contrast effect, expectation bias), inaccurate perceptions of probabilities (e.g., availability heuristic, base rate fallacy, illusory correlation, neglect of probability), the nature of the information itself (e.g., negativity bias, valence effect, bizarreness effect), and skewed perceptions of risk versus reward (pseudocertainty effect, risk compensation, loss aversion).

3. The human mind cannot easily detect its own biases. For example, people tend to read more about topics that match their interests and experiences. They also tend to associate with people who are like them. Though intuitively each one of us would agree that such biases only make sense, we are often unable to discern the degree to which these natural biases influence our ability to gather information and make decisions that might run counter to our own perspectives. If you think of everyone as viewing the world through their own particular lens, we can never fully appreciate the imperfections that might exist in our own.

These effects, among others, illustrate some of our human biological and cognitive barriers that do not preclude practicing smarter medicine, but call us to bring more discipline to the practice. In a world where decisions are made on a limited set of data and experience—when decisions are easy—it really isn't a problem. But unfortunately, the world of medicine is not such a world.

The storage and processing capacity of an individual's mind is fixed; modern analytical computing infrastructure, however, is virtually infinitely scalable. Did your research question just get twice as hard to answer? Did you just find three times the volume of information to analyze? No problem—we can just add more computers to work on the problem and still get you an answer quickly. In contrast to the limits of the human mind, there are no problems in medicine today that exceed our technology's ability to analyze data and draw conclusions. The limits are on the information we have available to us, our ability to formulate the right questions, and our determination in pursuing analytics as a disciplined lens to improving health outcomes and costs.

Throughout this book, we will explore the rising role of electronic data in understanding and improving health care. For now, let's try and frame the situation as follows:

1. The volume and complexity of health-related data (clinical, administrative, financial, behavioral, social) being generated today exceeds the capacity of the human brain to digest and draw conclusions.
2. The volume, diversity, and interdependencies in research data being generated today preclude the timely adoption of medical insights by individual medical practitioners and industry executives without the aid of analytical technology.
3. This problem of complexity is growing exponentially.

So what does this mean in practical terms? It means that the future practice of medicine is more than stethoscopes and scans. It means that clinical sciences and administration functions must become information-driven disciplines. It means that health enterprises of all types must develop new competencies in information and advanced analytics, increasingly relying on more sophisticated decision support to help optimize patient-centered care management and produce improved cost structures. In short, health and life sciences professionals of all levels must acknowledge the required use of advanced analytics to consistently make the best choices for their patients and businesses.

LEARNING FROM OTHER INDUSTRIES

There is some good news in all of this: the path ahead has already been cleared, at least in spots. If there is a silver lining in health care's cloud of lagging in its use of IT, it surely is that other industries have already figured out how to leverage information and advanced analytics to drive better performance.

One of my colleagues in the SAS Center for Health Analytics and Insights is fond of saying that her grocery store knows more about her health than her health insurer. And she is right! Think for a moment about all of the information available through grocery loyalty programs.

- What do I eat?
- Am I cost conscious (e.g., use coupons) and/or do I purchase discretionary items?
- Have I ever bought *Fitness* or *Pipes and Tobaccos* magazines?
- Do I buy more processed foods or whole foods?
- Am I brand loyal, and in what areas?
- Do I purchase a lot of over-the-counter medicines, and which ones?
- What sorts of promotions, buying incentives, and brand conversion tactics work on me?
- Which newspapers do I read (coupon codes being specific to a distribution channel)?

Retailers have experience in collecting, aggregating, analyzing, and continuously improving their business based on data. So do financial services firms who know your income, where and how often you shop, how reliable you are in paying bills, and more. Telecommunications companies know who you talk to, what types of communication you prefer (voice, chat, email, SMS), how much you use the Internet, and what tactics entice you to switch carriers.

In short, other industries have found ways of leveraging information and analytics to develop better products, improve profitability, increase customer service, and drive business performance. Those same opportunities exist in health care as well.

Consider a lady I met named Nancy.

NANCY

"Mr. Burke, this is Nancy from your bank's fraud department, how are you today?"

Up until answering this cell phone call, I was doing fine. At that particular moment, I was a little unsure.

"I'm fine, Nancy, what can I do for you?"

"Sir, we are just calling because we noticed some suspicious activity on your credit card. Are you by chance in Spain doing some gambling?"

"No, Nancy, I'm actually driving with my wife in the mountains of North Carolina." I started to add that I had a few other sins for which I could confess, but thought better of it.

"That's fine, Mr. Burke. We're calling because we noticed some unusual activity on your credit card. It appears the card information is being used by an unauthorized user, so we have deactivated the card and will send you a new one."

"Ok, Nancy. And just so I know, when did these transactions occur?"

"A few minutes ago."

Nancy was obviously on top of things, and she did a great job in saving my credit. But I knew something that Nancy probably didn't know; namely, that advanced analytics was responsible for flagging the fraudulent transaction. Even though I bought a lot of products and services online with that credit card, I knew from reading a case study on her company that sophisticated software capable of understanding my behavioral profile was able to discern that this was out of the ordinary. I don't purchase gambling services. I don't purchase overseas products and services. I don't usually make credit card purchases online during business hours. Nancy's analytics were able to do something that I used to do in a childhood game: figure out which one of these things is not like the others.

By some estimates, the health care industry loses in excess of $65 billion every year to fraud. Fraud is just one example of an analytical solution space that can be transferred from other industries to health care.

CHARACTERIZING HEALTH ANALYTICS

Health and life sciences are a rich field of opportunities for analytics. And though priorities vary across organizations and geographies (e.g., cost, safety, efficacy, timeliness, innovation, and productivity), it is worth noting that most, if not all, of the analytical capabilities needed to drive systemic changes in health care are already available in commercial software. The challenge for industry leaders should not be creating or finding the technology; rather, the challenge is linking business transformational programs to an analytical strategy:

- How can health analytics be consistently characterized and operationalized within and across organizational boundaries?
- How does anyone assess an organization's actual analytical capabilities?
- What is the relationship between a specific institution's strategy/business plan, and the corresponding implications in terms of analytical capability and capacity? What are all of the ways that analytics might help transform the business, and how can priorities be developed against those options? What are the focus areas?

In order to answer these questions, we need to start characterizing analytical opportunities. For example, most health analytics applications today can be seen to exist on a continuum between *business* analytics (e.g., cost, profitability, efficiency) and *clinical* analytics (e.g., safety, efficacy, targeted therapeutics), as depicted in Figure 1.1. All of these analytical applications are important, but those closer to the extremes are easier to manage because their scope does not cross into as many different business and information domains.

Whereas organizations have created initiatives targeting the extreme ends of the continuum (e.g., an activity-based costing initiative at a hospital), the largest challenges still reside in moving toward the middle of the continuum—linking clinical and business analytics into a more comprehensive view of health outcomes and costs. Furthermore, in order to successfully link the business and clinical perspectives, data from all

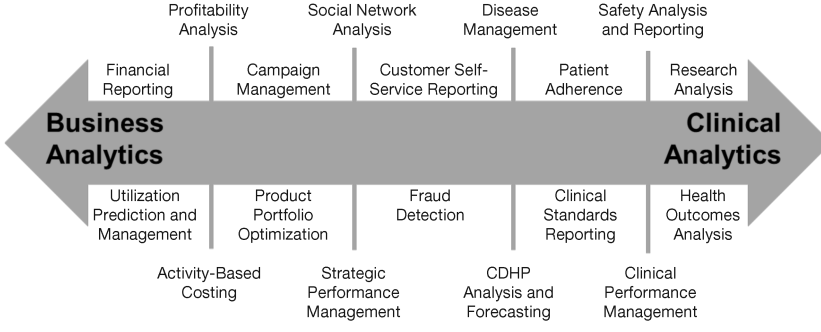

Figure 1.1 The Business-Clinical Analytics Continuum.
Source: Burke, J. (2010). "The World of Health Analytics." In *Health Informatics: Improving Efficiency and Productivity*, Ed. Stephen Kudyba, CRC Press.

three traditionally siloed markets—care providers, health plans, and researchers/manufacturers—must be joined in order to produce a more complete picture of quality, efficacy, safety, and cost. This concept—which we term *convergence*—is the topic of the next chapter. But before that, we will expand on characterizing health analytics through a device called a capability map.

THE GATHERING REVISITED

Most people who have heard of the great library at Alexandria probably also know of its tragic loss due to fire around 48 B.C. Though the exact details of the library's destruction have been somewhat obscured by history, it is clear that vast quantities of human knowledge were irrevocably lost. The *really great idea* fell victim to the most basic of risks we still face today in information management: backups.

On August 29, 2005, Hurricane Katrina made landfall in the U.S. state of Louisiana. Beyond the catastrophic losses in lives and property, an estimated one million people lost their medical information, which was stored in paper charts on racks very similar to Alexandrian library stacks. Katrina makes very tangible the impacts of our information immaturity: medical practitioners who suddenly don't know how to safely and effectively treat geographically displaced patients, and patients who—even if they were receiving optimal care before—now face suboptimal treatment plans, lost time, increased risks of complications, and disease progressions. Like our Alexandrian ancestors who walked through the ashes of once-available knowledge with what must have been a profound sense of loss, we must look at situations like Katrina with a renewed sense of passion for how to improve health care.

If your doctor handed you a bill on papyrus, what would you think? If your primary care physician whipped out a scroll and told you it was your medical chart, would you have confidence in their medical practice? If a drug researcher showed you a room filled with dusty stacks of research data and told you this was how they know that drug is safe and effective for you, would you take that pill? We are closer to these seemingly ludicrous examples than many industry professionals like to admit.

But the situation is changing.

ANALYTICS

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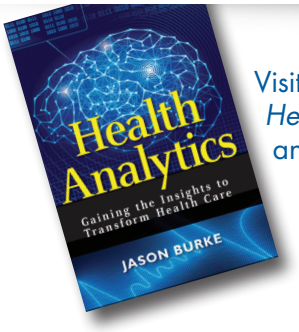

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