

# The promise of personalized medicine: A business-focused perspective

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In 1997, Harvard Business Professor Clayton Christensen published the book, *The Innovator's Dilemma*, a landmark publication that coined the term “disruptive innovation.”<sup>1</sup> The book crystallized a new entrepreneurial approach that, many credit, led to the internet revolution and the rise of the tech giants that dominate the technology-driven world today. The essence of disruptive business theory is that large incumbent businesses are often outcompeted and replaced by competitors with product offerings that are so cheap, and of such low apparent usefulness and quality, that initially they aren't considered threats by the companies that are eventually destroyed.<sup>2</sup> Examples of disruption abound: currently, many areas of manufacturing are poised to be disrupted by 3-D printer technology.<sup>3</sup> Initially considered useless toys, 3-D printers are now being used to print stem cell-derived biological tissue and reusable superalloy rocket motors. Christensen's insights gained him exalted status within the tech sector and millions of entrepreneur disciples.

In 2009, after a series of battles with chronic and acute illness, Christensen published a second book, *The Innovator's Prescription*, describing the medical industry as a complex interconnected web of third-party health insurers, medical professionals, and regulatory bodies.<sup>4</sup> The author recast the practice of medicine as three interconnected businesses, separating diagnosis, treatment, and communication into a “Solution Shop”, “Process Business”, and “Managed Network”, respectively.

**The solution shop:** This “business” comprises the diagnostic activity of healthcare workers. Once a problem is diagnosed, a doctor can prescribe a course of treatment to cure the patient. Because the doctor cannot control external and unknown risk factors, the uncertainty associated with this activity generally necessitates a fee-for-service pricing model.

**The process business:** After diagnosis, a course of treatment can begin. In this business model a “material” is taken in and undergoes a well-studied process that adds value to it. In this case, a patient is treated and cured of disease or ailment. Generally, process businesses operate on a pay-for-outcome model, but this is not the case for healthcare.

**The managed network:** This part of the healthcare business facilitates communication between experts, and also to patients suffering from chronic diseases, spreading state-of-the-art information about medical practices to interested parties. This type of business usually operates by a fee-for-membership model.

The deconvoluted business model accentuates how each segment of the healthcare market informs and guides the other by a circular feedback mechanism. Currently, doctors are primarily responsible for diagnosis and treatment and the two are often blended together in an iterative cycle until the problem is solved. It is apparent that optimized

diagnosis and networking practices would lead to more efficient treatment delivery, and that small diagnostic improvements could have magnified effects in terms of efficient expenditures and the pricing of care. The high value of improved diagnosis and networking, because of its magnified effect on the cost of treatment, makes it an attractive target for disruptive innovation.

## The future of medicine in a personalized world

It is obvious to an astute reader that personalized or precision medicine is primarily, in the parlance of Christensen's theory, an improvement to the Managed Network and Solution Shop diagnostic business models. Legions of entrepreneurs and investors are eager to implement disruptive personalized diagnostic technologies that they envision will allow doctors to track the health of individual patients accurately enough to eventually implement a fee-for-outcome model on the process, or treatment side, of the tripartite medical system. Though this dubious future is at best a long way off, personalized approaches to medicine are progressing towards improved diagnostic success along three main trajectories: bioinformatics, personalized diagnostics, and big data analytics. These three broad areas, and how they are poised to change the way we diagnose disease, are described below for the interested reader.

### Bioinformatics

Bioinformatics is the study of molecular biology using modern computational methods. In medicine, these technologies are being applied to large data sets of human genome sequences in an effort to extract meaningful links between a patient's health and their genetic makeup. This powerful technique promises, in the near term, to have significant impact in the area of pharmacogenetics, early disease diagnosis and treatment, and personalized chemotherapy, among others.<sup>5</sup>

### Personalized diagnostics

Fully implementing a personalized approach depends on the collection of mass amounts of data in order to understand an individual's specific healthcare needs in a meaningful way. Two main avenues of progress are being vigorously investigated. The first is the comprehensive evaluation of individuals through a suite of diagnostic tests to measure genetic and other biomarker data across thousands to millions of variables. These data can inform bioinformatic models and be cross-referenced to existing databases to evaluate a patient's health against the current body of published medical knowledge. The second disruptive personalized diagnostic approach is the use of extremely inexpensive point-of-care, or patient-operated diagnostic devices to persistently monitor health metrics over time.<sup>6</sup> A well-known example of this type of device is the home electrocardiogram machine.<sup>7</sup>

### Big Data Analytics

Distinct from bioinformatics is a second computer-aided diagnostic analysis with a much larger scope: big data analytics.<sup>8</sup> This personalized approach expands the breadth of information used to diagnose disease to include all available data. Big data personalization will correlate

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everyday data on a patient's purchases, movement, heart rate, sleep schedule, social media activity, and other metrics with medical data gathered through traditional bioinformatics. In this scheme, low-quality data can be used to accurately track individual and population-level health and inform genetic and biomarker diagnostic data sets.

### **The power of change—getting involved**

Changing population demographics, as Canadians age, guarantees that fundamental changes are coming to the medical system in this country. Personalized approaches are an attractive avenue towards maintaining a sustainable healthcare system. The pace of progress in the quest for effective, widely available, personalized medicine depends on the participation of medical professionals from all segments of the industry—and doctors in particular. Rather than threatening the existing system, these disruptive changes can help preserve healthcare in the face of spiraling, unsustainable cost increases.<sup>9</sup>

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