The Risks of Innovation in Health Care

EC: Editor's Choice

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Abstract

Innovation in health care creates risks that are unevenly distributed. An evolutionary analogy using species to represent business models helps categorize innovation experiments and their risks. This classification reveals two qualitative categories: early and late diversification experiments. Early diversification has prolific innovations with high risk because they encounter a "decimation" stage, during which most experiments disappear. Participants face high risk. The few decimation survivors can be sustaining or disruptive according to Christensen's criteria. Survivors enter late diversification, during which they again expand, but within a design range limited to variations of the previous surviving designs. Late diversifications carry lower risk. The exception is when disruptive survivors "diversify," which amplifies their disruption. Health care and radiology will experience both early and late diversifications, often simultaneously. Although oversimplifying Christensen's concepts, early diversifications are likely to deliver disruptive innovation, whereas late diversifications tend to produce sustaining innovations. Current health care consolidation is a manifestation of late diversification. Early diversifications will appear outside traditional care models and physical health care sites, as well as with new science such as molecular diagnostics. They warrant attention because decimation survivors will present both disruptive and sustaining opportunities to radiology. Radiology must participate in late diversification by incorporating sustaining innovations to its value chain. Given the likelihood of disruptive survivors, radiology should seriously consider disrupting itself rather than waiting for others to do so. Disruption entails significant modifications of its value chain, hence, its business model, for which lessons may become available from the pharmaceutical industry's current simultaneous experience with early and late diversifications.

Key Words: Health care, change, innovation, risk, experimentation, evolution

J Am Coll Radiol 2015;12:342-348. © 2015 Published by Elsevier Inc. on behalf of American College of Radiology

EXPERIMENTS AND RISKS

In facing change, a previous recommendation was for radiology to experiment in the realm of the "adjacent possible" [1]. The easiest adjacent possible experiments are variations of current practices and business models. An evolution analogy reveals two different kinds of experiments, early and late diversifications, which have different risk profiles. It behooves radiology to understand, look for, and distinguish them, certainly within the imaging domain, but also inside and outside health care. We shall see in radiology that variants of current business models are late diversifications with low risk, whereas new business models are early diversifications with high risk. This article suggests considering higher risk experiments.

The clarion call to organizations, professional groups, and individuals for "adaptation and innovation on a massive scale" in response to health care changes entails risk [2]. From a system point of view, whether you call it "adaptation" or "innovation," it is fundamentally experimentation [1]. The experiments are just that—experiments whether one perceives them as precipitated by an event, the Patient Protection and Accountable Care Act, or driven by scientific development, such as deoxyribonucleic acid (DNA) sequencing. Evolution continually experiments to create new species or subspecies, which incur risk when facing natural selection. That determines survival, replication, or extinction. Adaptation or innovation experiments in health care, including new organizational structures, new business models, new care models, new IT solutions, new technologies, and so on, incur risk when facing market, patient, and professional selection forces, which determine their fate. I tap into evolution using species and subspecies as an analogy to new and variant business models respectively [3].

All business models must generate cash, and they do so by using different components to construct a value chain. Different business models are defined by significant differences in value chain components. If radiologists

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1546-1440/15/$36.00 ■ http://dx.doi.org/10.1016/j.jacr.2014.09.026

work in capitated organizations as a cost center, in private practices as a profit center, or as salaried employees of universities, they are in different business models even though their clinical work is similar. Cash is generated differently in each. Our interest is in experiments that are capable of altering business models. Some innovations, such as tracking inventory by using radiofrequency identifiers and MR fingerprinting, just change business or clinical practices without altering the business model. Some innovations sound like new business models, but are not. As spectacular as CT and MR technologies were at their introduction, they did not disrupt radiology's business models. They produced value chain variants, but cash was still generated in the same way, albeit in higher amounts. The variants were subspecies rather than new species, because the acquisition device component was only a variant; it still generated images, only differently.

Sometimes experiments string together components into an entirely new value chain. In the past, a business model built around an Internet search engine did not exist. Many experiments were run; some failed (Netscape), and some survived (Google). Some survived by completely reassembling the advertising value chain, going from print area to clicks. These were new species, new business models. In medicine, a new business model example would be concierge private practice, in which real cash is generated by monthly retainers independent of service volume.

Human experiments are attempts to change in response to or in anticipation of change. Experiments carry different risks depending on their intrinsic characteristics and on whether one runs or merely observes them. This article concentrates on the intrinsic nature and provenance of experiments. Paradoxically, experimentation generates not only risks but also options to counterbalance them [1,4]. Health care systems increasingly experiment to create options. Anticipating the need to manage population health risk, some experiment in care delivery using accountable care organizations (ACOs), while others experiment in consolidation to increase size and scale [5]. Health care entrepreneurs experiment with new companies evidenced by a recent spike in health care and biotechnology initial public offerings [6]. Radiology should ask, What is the risk profile of experiments surrounding us? Are we participants or observers?

Evolution reveals two fundamental types of experiments, "early diversification" and "late diversification," which differ intrinsically in character and in risk. The evolution analogy reveals important distinctions between them. Some detail is necessary because their temporal sequence relative to selection forces is important in assessing risk (Fig. 1). *Early* and *late* refer to the relationship of the two types of experiments to each other, not to any time interval from what may be perceived as a triggering event. Assigning causality in complex systems is problematic, and any set of conditions can precede either or both diversifications [1].

MULTISCALE EVOLUTIONARY ANALOGY

Using varying terminology, temporal sequences of design change in the evolution of complex systems have been identified [7,8]. The order of experiments matters. One sequence is based on speciation, nature's way to innovate. It starts with early diversification, during which a remarkably large number of "experiments" generate a wide range of new species (Fig. 1). Another sequence occurs at the molecular level, with the creation of many new molecules, termed *neutral diversity expansion* [8]. Dramatic early design expansions inevitably face selection pressures, which unfortunately end on a down note, with most new designs disappearing. Species experience a "decimation" stage, during which an equally remarkable burst of extinction occurs, reflecting the high risk to participants (Fig. 1). At the molecular level, this selection is termed *selective diversity contraction* [8]. By appearing at multiple scales, this temporal sequence reveals its generality.

Species designs surviving decimation form the "early standardization" stage and ultimately transition to late diversification, during which additional experimentation is limited to variations of surviving designs [7]. The design range is much narrower than early diversification. Late diversification, not being followed by decimation and having a low extinction rate, poses lower risk to participants and to observers, with one important exception noted below (Fig. 1). Transitions between diversifications and extinctions form steps in the punctuated equilibrium (PE) pattern of system change, meaning that they are unpredictable, more sudden than expected, and usually of indeterminate causality [1]. Many lineages in complex systems, be they animal species, cars, computers, TVs, medical services, and so on, trace out this sequence in a PE pattern [9].

LATE DIVERSIFICATIONS

Let us work backward because late diversifications are easier to understand. These experiments carry lower risk to participants because the designs, rather than being untested new ones, are ones already tested by natural selection, ie, decimation. They have early diversification