A Case for Change: Disruption in Academic Medicine
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Abstract
Disruptive technologies allow less expensive and more efficient processes to eventually dominate a market sector. The academic health center’s tripartite mission of education, clinical care, and research is threatened by decreasing revenues and increasing expenses and is, as a result, ripe for disruption. The authors describe current disruptive technologies that threaten traditional operations at academic health centers and provide a prescription not only to survive, but also to prosper, in the face of disruptive forces.

Disruptive innovation is “a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors.” In his seminal book *The Innovator’s Dilemma*, C.M. Christensen explains why incumbent firms usually miss the next wave of change: “They are both focused on organizational needs under current paradigms and have the overriding goal of driving efficiencies into their current operational processes.” This seemingly rational behavior actually slows adaptation and hinders competitive solutions. Eventually, it is too late to institute necessary changes, and these established but less agile businesses fail.

Innovation is also disrupting every sector of academic medicine, largely because of unsustainable business models, changing workforce needs, and the need to improve the quality of care. This includes academic health centers, with their three missions of leading biomedical and clinical research, educating the next generation of health professionals, and offering comprehensive and cutting-edge care. If academic health centers make the same mistakes Christensen warns against, they risk being overtaken by more adaptable enterprises and fading in their overall preeminence and impact.

Disruptions in Medical Education
Often overlooked, however, is the need for disruptive innovation in medical education, which has far-reaching implications—not just for the job prospects of future doctors but also for the long-term quality of health care services in the United States and globally.

An important driver of disruption in academic medicine is the doubling, roughly every five years, of medical information and the even faster evolution of medical technologies. How can physicians absorb and retain this vast amount of knowledge given time constraints and cognitive limits? How can they keep up with new tools and the new skills they require?

Are we in medicine teaching the next generation of physicians skills, or are we teaching them adaptive expertise? In this notion, skill is the ability to perform a delimited set of tasks, such as diagnosis and treatment. By expertise we mean the adaptive ability to both efficiently use past knowledge and experiences and innovatively create new knowledge and ideas in response to novel problems. If medical school consists mainly of acquiring skills, then physicians risk obsolescence as new technologies come into play. However, if physicians are taught expertise, they will be able to adapt in highly complex, dynamic, and uncertain environments. The key is that how we teach students is probably as, if not more, important than what we teach.

What will happen when computers can diagnose, recommend treatment, and—in the process—make fewer medical errors? Will computers that are also up-to-date and available 24/7 replace some providers? Today, IBM’s Watson has partnered with WellPoint Inc., which operates in 14 states, to eventually guide treatment decisions for its 34.2 million members. Watson is both an answer to the information dilemma and an example of a technology that will disrupt traditional medical diagnostics and, by extension, education.

If machines like Watson can handle basic diagnosis and treatment, then health care teams essentially become the human interface between patient and machine. They will be the front line for translating machine-generated recommendations into personalized care attuned to the specific context of a patient. The new modality will become both high-tech and high touch, requiring physicians to nimbly meld human intuition and emotional intelligence with the outputs of expert computer systems.

It is sobering to reflect that the class of 2016 will still be practicing medicine in 2050. Most physicians today are spending the majority of their practice treating chronic diseases such as diabetes, heart disease, cancer, and HIV. Treatment of chronic diseases makes interdisciplinary teamwork extremely important. It requires the coordination of care between physicians, nurses, pharmacists, social workers, and other health care professionals.

Unfortunately, it is not clear where in modern medical education interdisciplinary teamwork is taught. Traditional lecture-based education is largely passive and an individual, rather than a team, effort. The Khan Academy has championed the use of the inverted classroom, together with the Socratic method. This learning model is designed to encourage thinking, questioning, and critical analysis of clinical cases, fostering what Socrates termed the adaptive ability to both efficiently use past knowledge and experiences and innovatively create new knowledge and ideas in response to novel problems.

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classroom where students learn at home on the computer and come to class to ask questions and solidify what they have learned through interaction with both their teacher and peers. Another example is Just In Time Teaching, where students answer multiple-choice questions before class. After reviewing the students’ answers, the professor can efficiently focus classroom activities on areas in which the students are having the most difficulty. Team-based learning is an efficient educational method where students form teams to answer questions based on readings completed before class. These techniques, in which students apply, rather than just reiterate, knowledge can them help achieve adaptive expertise.

However, such an approach begs the question: How many, and what kind of faculty members do we really need to teach in this curricular model? In an inverted classroom model, the delivery of course material will raise the standard of education and produce economies of scale. Online lectures, texts, and multimedia presentations can be accessed simultaneously by thousands of students. Multidisciplinary teachers will be needed to facilitate students’ synthesis of material in a collaborative discussion-oriented environment. As a result, medical schools will require fewer teaching faculty and will be able to free up resources to invest in areas where hands-on teaching adds value and cost savings.

**Disruptions in Clinical Care**

Driven by the need to lower costs, and aided by new technologies, patient care is moving from the academic health center to the outpatient setting, community hospitals, and, ultimately, to wherever the patient happens to be. Clearly, these and other changes in the site and type of care will have a dramatic impact on academic health centers’ finances and on medical education.

Of note, megastores like Walmart are beginning to offer a host of services including primary care clinics staffed by physicians, nurse practitioners, dentists, and pharmacists. These innovations are already having a dramatic impact on the sites of primary care delivery. For the academic health center, these “docs in the box” are a direct threat to clinical revenue because of their lower cost of entry into the marketplace and lower fixed costs of practice.

The Affordable Care Act will eventually extend health care coverage to approximately 30 million more Americans. With limitations on physicians’ time and an unequal distribution of physicians’ services, especially in rural settings, telehealth is a technology that will disrupt the way medicine is practiced by simplifying and expanding access to specialty care while decreasing the use of hospital outpatient services. This is not surprising, because although physicians provide patients with information, expertise, and support, there is considerable pressure to see more patients in less time. An important question is how often direct physical doctor–patient interaction is necessary. As with any new modality, there are potential barriers to adoption of telehealth technology. These include state restrictions on reimbursement, issues with hospital privileges and interstate credentialing, malpractice fears, physician culture, internet bandwidth, and, most important, how to educate the workforce to effectively use telehealth.

What is the evidence that telehealth is worthwhile? It has been shown to reduce the cost of Medicaid in California and improve the quality of care for the state. However, most of the studies evaluating telehealth have been descriptive. In one major exception, the UK National Health Service used a multisite, cluster-randomized trial to study the effect of telehealth on use of secondary care and mortality. The setting was 179 general practices in three rural areas in England and included 3,230 people with diabetes, chronic obstructive pulmonary disease, or heart failure recruited between May 2008 and November 2009. Telehealth was associated with significantly lower mortality (4.6% versus 8.3%), lower rates of emergency admission, and shorter length of stay. However, in spite of these benefits, the study was unable to show overall cost savings.

Although today’s students and residents are very comfortable with technology, telemedicine provides unique educational challenges. Telemedicine does not provide complete access to the patient, particularly with respect to the tactile aspects of the physical exam, so trainees must be more comfortable with incomplete data and tolerant of ambiguity. As they consider their futures, they must also understand that fewer specialists may be needed. Trainees also need to be aware of the changing job description of the future physician practicing telehealth. More than a bedside clinician, a telephysician needs a different skill set than is presently taught in most medical schools. Finally, we need to teach our students to embrace change as this technology evolves. For example, haptic technology will make remote physical exams possible, and improvements in robotics may allow for surgeons to operate at great distance from their patients.

Transcending care from the inpatient to the outpatient setting will disrupt both graduate and undergraduate medical education. Funding models will need to change, as graduate medical education is largely supported by inpatient care (direct and indirect medical expenses). As care moves from the inpatient setting, not only will hospital revenues be affected but so will graduate medical education. Medical students will need to be educated in ambulatory settings that are patient-centered medical homes and that fully integrate primary and specialty care. Many believe that we will face a shortage of primary care physicians because of the newly insured under the Affordable Care Act and the aging population. However, some disagree and argue that physicians can and should be replaced by other providers, nurses, physician assistants, and pharmacists. Nevertheless, from a medical educational perspective, perhaps the best way to increase primary care’s attractiveness for our students is to model the part of primary care that is most fun—namely, allowing students to follow patients over time. Whereas Flexner advocated for centralizing medical education in the hospital setting, the new paradigm is the integrated longitudinal clerkship. Only with integration across disciplines can team-based care, patient centeredness, and stewardship of limited resources be truly modeled and taught.

**Disruptions in Research**

A final driver of disruption is the changing nature of research. In 2012, researchers at the University of California, Los Angeles, used an online game accessible by cell phones and personal computers to teach laypersons, including children, to diagnose...
malaria in infected red blood cells.18 This project allowed large numbers of public nonexperts to view digitally captured images of red cells and identify those infected with malaria. Because gamers are by nature competitive, the project eventually achieved a diagnostic accuracy rate of 98.75% when compared with expert pathologists who served as the reference group. Using similar principles, one can imagine using the public to quickly and efficiently analyze large data sets from research studies. Crowd-sourcing allows many different people to collaborate without the need for direct physical interaction. Considering the high costs of clinical trials, including patient enrollment and data analysis, crowd- and cloud-sourced options could provide a more efficient and less expensive way to enroll larger numbers of patients and analyze larger amounts of data in less time.

The ability to collaborate without physical interaction and to do so with many people in real time will disrupt the definition and funding models of research. The traditional single principal investigator (PI) in a lab doing research may be a vanishing breed. External funding agencies such as the National Institutes of Health (NIH) are beginning to allow multiple PIs on projects, and grants are recognizing that the team-based research is important and perhaps even superior to the single-PI model.19 Who, though, when there are hundreds or thousands of contributors in crowd-sourced research, gets the credit? Research performed in such a fashion raises the question of study ownership, integrity of the data, peer review, distribution of funding, and acknowledgment. Are medical schools ready for such changes?

It has been estimated that for every research grant dollar received by a medical school, the institution must spend an additional 26 to 40 cents to support that research.20 Given that most academic health centers must substantially support their research and teaching through revenues derived from ever-decreasing margins in clinical care, it is not hard to imagine that many will have to restructure their research enterprises. What is likely to happen is an increased differentiation amongst academic health centers, with the top 10% or 20% garnering a larger piece of the research pie, the lower 10% or 20% abandoning research, and the group in the middle forced to make real changes, including partnering with other centers.

Conclusions

Every mission of the academic health center is under threat of disruptive technologies and changing economics. Examples from business have taught us that companies that survive disruption do so by being agile, experimental, problem driven, and solution agnostic.21 As noted, academic health centers are likely to be more differentiated than they are today as they will increasingly emphasize one or two missions over others. A possible scenario is that many institutions will jump off the “NIH treadmill” and give up the increasingly futile attempt to catch those in the top 20%. These institutions’ research programs will be smaller and more highly focused on areas where they feel that they can make a real difference. Another potential scenario is that institutions will dramatically reduce the hours faculty spend on teaching as the education of health professionals becomes more “national,” taking advantage of increasingly sophisticated digitized platforms. And a possible scenario in the clinical arena suggests that academic health centers will form highly networked clinical partnerships with a wide variety of care providers, ranging from health systems and hospitals to long-term care providers. As a result, there will be a mix of cultures and priorities that will challenge the traditional ethos of academe. The academic health center of tomorrow may look nothing like today’s. This is probably a good thing if academic health centers are to survive the era of disruption.

To survive and prosper in the dynamic environment of the future, academic health centers will have to radically change. Only through careful strategic planning, balancing resources with mission, and overcoming resistance to change will academic health centers prosper in the era of disruptive innovation.

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My painting The Orphans honors baby Cephas, an AIDS orphan in Zambia, Africa. He was taken to a clinic because of severe dehydration secondary to gastroenteritis. Overnight, Cephas’s peripheral IV catheter fell out, and since there was not another catheter in the clinic, he received no further fluids. Cephas died the next day.

In the painting, the orphans stand in a Kitwe cemetery holding their sheet metal “gravestones.” A sea of red earth mounds representing the graves of children dead from AIDS surrounds them. For the same reason I painted The Orphans I wrote the poem "Baby Cephas" to remind us that poverty-stricken orphans die every day.

Baby Cephas

Rain pounded the earth his funeral day
As women huddling under a torn
Umbrella wailed a Bemban dirge, broken
By thunder that cracked like the black pastor’s
Fist banging his thick Bible as he knelt down
Over baby Cephas’s small pine box
Asking God if the pouring rain was Him
Crying over all the dying orphans
Piling up under the earth? Then we should
Build another ark because the tears are
Going to flood this land. The rain ceased and
Light rays glowed through the purple clouds
That gleamed down on baby Cephas’s grave.

The rasp of the gravedigger’s shovel jabbed
The damp air as we trudged away. The thud
Of wet earth dumped onto the wood casket
Echoed like a drum as we plodded through pools
Of red sludge. The thick mud stuck to our shoes
Clinging to us like orphans who begged us
Not to leave them alone again.

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Cover Art
Artist’s Statement: The Orphans