

## INTERVIEW

**Disruptive Innovation: Can Health Care Learn From Other Industries? A Conversation With Clayton M. Christensen**

When the conditions are right, a new business model can find a place in the market and increase consumers' options for health care.

by **Mark D. Smith**

**ABSTRACT:** Clayton Christensen is one of America's most influential business thinkers and writers. A professor at Harvard Business School, Christensen is perhaps best known for his writings on disruptive innovation in such books as *The Innovator's Dilemma* and *The Innovator's Solution*. In this interview with the California HealthCare Foundation's Mark Smith, he argues that the answer for more affordable health care will come not from an injection of more funding but, rather, from innovations that aim to make more and more areas of care cheaper, simpler, and more in the hands of patients. Christensen has been an adviser to several new companies in health care. [*Health Affairs* 26, no. 3 (2007): w288–w295 (published online 13 March 2007; 10.1377/hlthaff.26.3.w288)]

**Mark D. Smith:** You've written extensively about the phenomenon of disruptive innovation in many industries. Can you briefly describe what *disruptive innovation* means?

**Clayton M. Christensen:** A disruptive innovation is a technology that brings a much more affordable product or service that is much simpler to use into a market. And so it allows a whole new population of consumers to afford to own and have the skill to use a product or service, whereas historically, the ability to access was limited to people who have a lot of money or a lot of skill.

**Smith:** Can you give me a couple of examples?

**Christensen:** One great example would be the personal computer. When I was first out of school, if I needed a computer, I had to take my punchcards to the corporate mainframe center

and give them to an expert there who ran the job for me. Because computing was so expensive and required so much skill, we just didn't compute very often. But when the PC emerged, it made it so affordable and simple that even somebody without money, like me, and without skill, like me, could own a computer. At the beginning, I could only do the simple things for myself. I had to take the complicated problems to the mainframe center where the expert ran the job. But as the PC became more and more capable, I actually didn't have to become trained as a computer scientist. The technology allowed me to do more and more sophisticated things in a convenient, lower-cost setting, and ultimately, just application by application, the PC system—when I say system, I mean both the retail system and

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system of use—sucked applications, one by one, out of the expensive mainframe context into the low-cost and convenient PC context. And the whole world was transformed. We consume much more computing at much lower cost and much greater convenience. And so we're all better off, except the mainframe companies who got disrupted.

A wireless telephone is similarly a disruptive technology. Voice over Internet protocol [VoIP] telephony is a disruptive technology. Southwest Airlines is disruptive relative to conventional airlines. And so on.

### The Uninsured

**Smith:** That description—that there's a set of customers that isn't profitable to a given industry and therefore not well served by it—reminds me of many of today's uninsured people. What do you think this model in other industries might have to offer for one of our most difficult social issues?

**Christensen:** I'll offer a historical example. When computing began, the machines were incredibly complex and expensive, and so only a few people owned mainframe computers, and you had to have a lot of expertise to operate them. So most people just didn't have access. How was computing going to be made accessible to more people? Would we somehow try to drive down the cost of a mainframe computer or cut the pay of the operators of the mainframe systems? Of course not. Someone had to develop a personal computer that was affordable and simple.

So the way that we can make health care accessible to the uninsured isn't to get the today's health care institutions to somehow become low cost or to get the expensive specialist physicians to somehow accept pay cuts. Rather, we will make it accessible for those people only by enabling or making more capable lower-cost providers and lower-cost venues of care. An example would be technology that allows you to do in an outpatient clinic or doc-

tor's office things that historically you had to do in a hospital, and by enabling nurses to do things that historically a doctor had to do. Those would be disruptive innovations in the context of health care.

### Disruptive Innovation And Health

**Smith:** One of the complicating factors here is that health care isn't really one industry—it's more like ten or twelve different industries. It seems as if there could be a different level of

potential for disruptive innovations in different “sub-industries” within health care. Can you talk about where you think disruptive innovation has the best chance of lowering cost and improving quality in the system?

**Christensen:** You've asked a good question, and I'm not sure I know the answer. But I can describe generically what

**“We will make health care accessible for the uninsured only by enabling or making more capable lower-cost providers and lower-cost venues of care.”**

would have to happen in order for that to work. If you have the same surgeons performing the surgery in the same way, but just in a different environment, then you wouldn't expect to see a big impact on cost. But if the technology to perform the surgery became more routinized, so that the ability to perform the surgery correctly every time was more embedded in the equipment and the procedure than the intuition and skill of the doctor, that's the mechanism by which the cost would come down. And so, for example, the cost of LASIK [laser-assisted in situ keratomileusis] surgeries has come way down, as a result of its becoming essentially an automated, standardized procedure that almost doesn't even require the skill of an ophthalmologist. I bet you that if you decouple or disaggregate the data, you would find that those procedures that have become routinized and standardized, with the “skill” to some extent embedded in devices or equipment, you would find that costs have gone down. Where people are just doing the same thing in the same way but in a different venue, you wouldn't expect to see

much decrease.

**Smith:** Let's talk about how extensive you really believe disruptive innovation could be in health care. It's easy to take an example like LASIK surgery, because it really behaves like a consumer product: It's generally completely elective, and insurance doesn't cover it, so people are making personal economic decisions. Not surprisingly, we've seen costs come way down, and people are paying a lot of attention to outcomes and quality. Something like a hip replacement might be in the middle (generally elective, but with a bigger impact on quality of life), and we're seeing more and more people travel to other countries for lower-price care. Then, on the far end, we have things like cancer for which treatment is much less elective and is generally covered by insurance. Do you think that disruptive innovation has a role to play in all of these areas?

**Christensen:** The LASIK example is a good one. It follows a very clear disruptive-innovation paradigm in that the "skill" has moved from an eye surgeon to a machine. While you still need a high-cost person to do a diagnosis, the bulk of the work has been completely routinized. Because people pay out of pocket, all of the providers and suppliers have to really think about the most cost-effective way to do things. If it doesn't represent good value to consumers, they won't spend the money on it.

When you get to hip replacement, you enter interesting territory. Here much of the cost and "skill," as it were, have also moved from the surgeon to the device. But because the procedure is generally covered by insurance and a surgeon is still involved, there have been no real cost pressures. What's interesting here is that U.S.-trained surgeons are beginning to do a lot of these in other countries, where the costs can be one-tenth of what they are here.

Finally, we get to the really complex stuff. Take the case of angioplasty. No one would argue that open-heart surgery isn't a complex undertaking and that people who need it aren't very sick (or very costly to the system). The history of angioplasty provides some guidance here. Cardiac surgeons resisted it quite vocally. It was interesting, because you would think

that everyone would prefer a less invasive, less traumatic, less costly procedure—patients and doctors alike. But angioplasty moved business from cardiac surgeons to cardiologists, and this affected income streams and historical relationships. Big change in health care is hard for many reasons, but we can't underestimate the importance of these two.

## HSA's And The Individual Market

**Smith:** So does this suggest that the individual-market health savings account (HSA) approach to insurance, which is quite controversial in the health policy world, is a necessary precondition to the operation of these forces? Those who tout the benefits of HSAs believe that they will make people more price-sensitive, better-informed users of health care—that they'll create a market in which disruptive innovation can play a bigger role. The larger goal might be characterized this way: By creating some pain for consumers, they will change the services offered in the market—that is, cheaper, higher-quality services will be offered because consumers will finally have an incentive to push the market. After all, if you're choosing between a \$150 doctor visit and a \$39 MinuteClinic visit, this choice might drive your behavior and help develop a market for MinuteClinic. But the 20 percent of people who are responsible for 80 percent of the costs are often choosing between a \$47,000 hospital bill and a \$45,000 hospital bill—neither of which is something they can pay out of pocket. Can you think of anything that will result in similar pressure being applied to the high-cost segments of the markets, where we pay through an insurance mechanism and are likely to continue doing so?

**Christensen:** Yes. You have a little bit of a chicken-and-egg problem there, Mark. Another analogy: When RCA made vacuum tube-based televisions and radios, most people couldn't afford them, and they were sold through a distribution channel: appliance stores. The appliance stores made most of their money not by selling the TVs and the radios themselves, but through the repair of the burned-out vacuum tubes in the appliances

they already had sold. Sony came along with this simple transistor radio. It was disruptive relative to RCA. Sony tried to get distribution through the appliance stores because that's where radios and TVs were sold. The appliance stores wouldn't give Sony products the time of day because they didn't have vacuum tubes in them, and therefore the stores couldn't make money if they sold the Sony products.

Thank goodness for Sony, K-Mart was arising just at the time Sony was trying to disrupt the industry, and K-Mart wasn't able to sell vacuum tube-based products because it couldn't service them. And so a whole new system emerged, so that it wasn't just Sony that disrupted RCA, it was K-Mart that disrupted the appliance stores. Almost always that's the way it works. It's not just a product-for-product or service-for-service disruption. It's a system disrupting a system. So you can see why health policy people get indigestion when all you do is to say, Let's substitute health savings accounts for the current reimbursement system. You just give people money and say, Now, you go pursue your own health care. And the person to whom you just gave money has strep throat, and they're looking at going to a regular doctor's office and facing a three-hour wait and then it's going to cost them \$150, or maybe that person is going to say, I just won't go to the doctor. And maybe that's all right, maybe it's not, you know? But you can see why the health policy people would worry about this.

If along with HSAs there were companies like MinuteClinic, then you could see how, oh my gosh, I've got my own money and I can choose whether I go to a doctor's office and get soaked \$150 to get diagnosed for my strep throat, or I could go to a MinuteClinic and for \$39 in fifteen minutes, they're going to not only give me a diagnosis, but a prescription for the medication. You can see how people would actually be delighted to have the HSA solution and a MinuteClinic, because they can get the job done cheaper, faster, and more conveniently. So if there were a totally different system out here that could disrupt the existing system and enable these types of choices, then

HSAs might be seen as good news. But when we just present it as HSAs in the old system, it really is a pretty ambiguous thing.

### Chronic Disease

**Smith:** You've had diabetes mellitus for many years. How has your having a chronic disease informed your outlook on the health care system and on innovation within it?

**Christensen:** That's a great question. About a year after I was diagnosed, the handheld personal blood glucose meter became available. With that meter, I could develop all of my own algorithms on an hour-by-hour and day-to-day basis for how to manage my disease. And so I got to the point where I really only needed to see my primary care physician once every other year because I had much more information about how I was doing than did my personal care physician or diabetologist. So when I'd go to visit my physician, she would ask me how I was doing. And I would give her all of the information about how I was doing. And the physician just didn't have much value to add. But I'd still have to go—she wanted me to get this HbA1c test (glycosylated hemoglobin), which is a better measure for how well controlled, over the long term, your blood sugar is.

And I didn't get the test very often because it's very inconvenient. I have to make an appointment, go to the hospital, they draw blood out, they take three hours to get that thing done, and then they would report the results not to me but to my physician. And then I had to call the physician to get the result. Then this new company came along—I saw an ad in the *Diabetes Forecast* magazine. For just \$16, they mailed me a little kit. I put two drops of blood on a strip, mailed it back to them, and three days later, they sent me my HbA1c score. And I'd just give them my MasterCard number, and every quarter they'd send me the kit, I'd bleed on the strip, I'd send it back, I get my results. So I really didn't need to go to the hospital for that anymore.

But then there was one more test, called the microglobulin test, to see whether my kidneys were still doing all right. I was supposed to have one of these once or twice a year, and I

just wasn't getting them because it was so expensive and inconvenient to have to go to the hospital—actually, my insurance would cover the cost if I went to the hospital or the doctor's office to have these tests, but it's not the cost of the test for me, it's the inconvenience and the opportunity cost of taking a big chunk out of my day. Thank goodness, the mail-order company came up with a microglobulin test. So now twice a year they send me this kit, and I just have to dip the strip into a urine sample, send it off to them, and back comes my microglobulin score. And so I actually have no need ever to see a physician.

**Smith:** Oh my God! That's a seditious comment.

**Christensen:** With a chronic disease, so much of the information that's required to provide care actually arises on a day-to-day and hour-to-hour basis in the life of the patient. And to somehow try to extract all of that information and elevate it up to the level of the physician so that the physician can use her judgment and skill to then send information back down to me on a what should I do on an hour-to-hour, day-to-day basis, that's a very unsatisfactory solution. Better to bring some of this information and understanding about the disease down to the patient—to actually cut the physician out of the loop. Unfortunately, there are quite a few endocrinologists who have a hard time supporting themselves now because patients have been enabled by these technological advances to provide care for themselves. The question you asked is, Does the technology add cost or reduce cost to the system? In this case, it's lower cost to the system, and it's so liberating to be able to manage my own disease. I can actually fudge and eat ice cream because I know exactly how many units of insulin I have to take in order to offset the impact of the glucose in my blood.

**Smith:** That description of your self-care for diabetes sounds like an empowered consumer's dream. It sounds like it's actually very high-quality care, and yet much of your writ-

ing about disruptive innovation in other industries proceeds from an acknowledgment that change happens by the introduction of a product that is of lower "quality" in some ways than the products that currently dominate that market. There was no great outcry with the introduction of crappy rebar steel or crummy disk drives, but isn't there a bedrock unacceptability of advocating "lower-quality" care?

**Christensen:** Yeah. You know, in a lot of ways, Mark, I overstate the case, and I call disruptive technology "crummy" and "low quality." But I do it to be entertaining and provocative.

In health care, the comparable thing was angioplasty for coronary artery disease. Originally, it was provided by heart surgeons, and every time they had to do an angioplasty, they couldn't spend that time doing open-heart surgery. So they were actually quite delighted to hand off angioplasty to the cardiologists. And then the cardiologists got better and better and better. Was angioplasty a crummy technology? Well, relative to the kinds of sophisticated solutions that open-heart surgery could provide, it was not nearly as good. But relative to the options that were available to people with partially occluded arteries, angioplasty was great news. It was so much better than what previously had been available that they were delighted to have a product that wasn't as good as open-heart surgery. And so quality can only be expressed relative to what the patient's other options were at the time it became available. I think that's where you get the dilemma. If you ask patients to accept the solution that is lower quality than what is available, you'll have trouble. The whole trick is to bring affordable and simpler care to people like the uninsured poor whose option is nothing at all, or poor customer service, or long waits, or high-cost visits to emergency rooms and clinics. Some of these solutions are actually viewed, from the patient's point of view, as very high-quality solutions.

**"Quality can only be expressed relative to what the patient's other options were at the time an innovation became available."**

**Smith:** But isn't that in some ways a social decision that we've made by default? That is to say, with a different tax policy or a different set of budget priorities, we could buy the uninsured into the same system that you and I have. So won't there be some objection to a solution that is "better than what's available for them?" Shouldn't we be trying to create a one-tier system, so that what's available for them is what's available for me or you?

**Christensen:** Well, that certainly is one policy alternative, but, man, is it expensive. Think of it—just abstract away from America, and you've got about a billion people in China that don't have access to high-quality health care at all. So should we invest to build hundreds and hundreds of medical schools in China so that we can train doctors who have all of the skill and all of the expense of high-quality U.S. physicians to provide for all of their health care needs—simple and complex? Boy, that would be very expensive. But the other alternative might be to commoditize the doctors and invest more in diagnostics so that you actually don't need expensive physicians and you don't need expensive hospitals to provide the 85–90 percent of health care events that arise in the lives of typical people. Maybe nurses could provide this care in clinics and doctor's offices. A model like that could bring much more health care to many more people. So you can either try to replicate the costly system for the people who do not have access to it and somehow find a way to pay for it, or you can say, Let me just create a very different system. And in other industries, the second answer historically has provided higher quality and greater access with lower cost to more people.

### **Role Of Technology In Costs**

**Smith:** I'm struck by the fact that if you ask most health policy experts and lots of practitioners why health care costs so much and what the future holds, they would say that one of the main culprits is technology. But your line of thinking seems to suggest that technology, rather than being the problem, is actually part of the answer. I wonder if you'd talk about that paradox for a moment.

**Christensen:** Yeah, that's a good point. There are two ways that technology can get deployed in health care. One is to help the experts in the health care system do even more sophisticated things that historically were not possible to do, so ultrasound or MRI [magnetic resonance imaging] screens allow people to see things in greater detail and at an earlier stage that historically just weren't possible. When you bring technology to the experts to do more sophisticated things, in fact, it does bring a lot of cost into the system. But when you deploy the technology to commoditize the caregiver, to enable a lower-cost provider to do something that historically had required higher cost, then it actually takes cost out of the system. So you can't just make a blanket statement about the technology. You have to be subtle about what kind of technology we are talking about and how it will be deployed in the business.

If you go back to the mid-1960s, in the computer industry, there were probably 100 people who had the skill to design a mainframe computer. IBM employed most of them, so IBM dominated the industry. But over time, as the science and the technology became better understood, most of the complicated problems that had required the skill of these 100 computer designers actually got resolved inside the Intel microprocessor. When Intel started to sell its processor, it still took a lot of electrical engineering expertise to build a viable computer around the processor. In the fourth generation, Intel stopped selling just a bare processor and started to sell, instead, a chipset. Inside of that chipset, Intel solved almost all of the complicated technological problems associated with the design of the computer. In fact, Intel made it so foolproof and idiot-simple that an electrical engineer with a B.S. degree from a Taiwanese university could build a computer and start a computer company—and hundreds of them did. And then competition among all of those computer makers in Taiwan drove prices down and grew the market, and Intel made all the money.

Essentially what Intel did, as it integrated forward, was that it commoditized computer design, and it made the design of a computer

almost a rules-based activity. What does that mean for nurses? There is a set of procedures, especially with acute care, where you can precisely diagnose: You have this disease or you don't. So now there's a precise diagnosis for strep throat. You apply the test, and the patient has it or doesn't. Whereas it used to take some skill for a caregiver to be able to diagnose it, now it actually doesn't take skill, and the caregiver has been commoditized by the precise diagnosis. That means that somebody with a lot less skill can actually give a better diagnosis faster and at lower cost than could the expert a generation ago. One by one, as we gained the ability to diagnose precisely for a disease state and then another disease state and then another, that's the mechanism by which nurses can take on more of the work than doctors. You wouldn't ask one of those Taiwanese electrical engineers to go design a mainframe computer, because that really had to be done by the experts. Similarly, you likely wouldn't ask a nurse or a medical assistant to do the kind of thing that is not yet rules-based. But as the world moves that way, it will enable less-trained people to do more and more.

I think there are three classes of medical problems. The first class are problems I'd call acute and amenable to precise diagnosis, which then enables rules-based therapy. And I actually would put even cancer in that category, in that I bet you fifteen years from now, most cancers—which at this point seem to be just very nonstandard and expertise-intensive to diagnose and treat—have the potential to become rules based. So it's that class of rules-based acute diseases, I think, that are most amenable to a disruptive approach.

The second class is chronic diseases that people just are learning to live with—lupus and diabetes and so on. I think that they're amenable but in a lower-impact way, in that I don't think the cost of dealing with these chronic diseases will drop as much through disruption. But the sort of business model that American Healthways in Nashville is bringing to the management of chronic disease, I think, is really quite disruptive—actually lower cost and more efficacious than the conventional

doctor-centric mode of caring for these chronic diseases.

The third class—the high end, nonstandard, medically complex cases—I don't think you can address through disruption. But I do think that we need to begin addressing it. We need to try to improve quality and bring costs down for this group by applying the rules of the Toyota production system to the hospitals that care for them. The evidence is beginning to roll in; not a lot of hospitals have begun to do this, but some have. In a service or a manufacturing setting, when somebody redesigns processes to conform to these rules, they find that the overhead cost in the operation—this is overhead per unit of direct labor—drops by about 65 percent. And that's because the expediting, the scheduling, the unscheduled down time, and the materials handling—scrap and rework—those costs just disappear. The direct cost, the cost of direct labor, falls by about 7 percent. And that is mainly because people stop working around problems—they just solve the problems.

Capacity utilization also increases significantly because you understand the bottleneck. So those kinds of innovations would be implemented in the tertiary care hospitals that care for medically complex individuals. I think that there are better ways to run those hospitals, and we know how to do it. We just haven't implemented these solutions.

### Care Overseas

**Smith:** What about the phenomenon we're beginning to see, in California and across the country, of people traveling abroad for things like hip replacements and bariatric surgery?—Would you consider this disruptive innovation?

**Christensen:** It's a great example. If I could just maybe build on that: Both Toyota and Southwest Airlines had similar roots as these hospitals in Thailand or India or Tijuana, in that at the beginning their cost advantage was really rooted in lower-cost resources, primarily labor. But labor is a very transitory economic advantage. And if they're going to survive, they have to transform what is a labor

cost advantage into process-based advantages. And so Wal-Mart did that, and Southwest Airlines did that, and Toyota did that. I would bet that the hospital in Tijuana doesn't follow fundamentally different processes than one in America. Maybe they do. But the very fact that they're there—I would expect that competition over time forces them to create and improve processes, which then will come back to the United States, just as Toyota's processes have come back to the United States in the plants that Toyota builds in the United States. So I guess I would say that "medical tourism" is the first step. A "self-pay" scenario makes people much more sensitive to cost differentials and encourages them to look for a market for lower-cost solutions, and we see Americans seeking out these medical and surgical services abroad, so you really would have to call this a disruptive innovation.

**Improvements From Technology**

**Smith:** One last question. We've talked about the role of angioplasty as opposed to open-heart surgery—something that in another industry might have dramatically reduced the cost of revascularization and driven lots of business to angioplasty but that in health care was kind of shadow-priced right below the cost of coronary artery bypass graft (CABG). This is typical in health care. Where we see high-end marginal improvements in technology, we see costs going up rather than down—which is part of why so many health policy people cite technology as the problem rather than the answer to health care costs. What is it about health care that allows the kinds of technical advances that in other industries would lead to dramatic reductions in cost to actually lead to higher costs? What's the essential lesion, if you will, in either the policy apparatus or the market that allows that cost-decreasing pressure that we see with the substitution of capital for labor in so many other industries to work—if anything—in reverse in health care?

**Christensen:** A good point—and a great question. A few thoughts about what happened in the case of angioplasty. The technology was

not well understood, and risks weren't understood, and the best-practice methodologies weren't well codified in practice. Regulations were put into place that required what was intrinsically a lower-cost method to be surrounded by high-cost infrastructure. So for a very long time you had to have a heart surgeon in waiting in the off chance that something went wrong in the angioplasty so that you could rush that surgeon in. And it had to be done in high-cost hospitals, and so there are lots of costs around it that were put into place for very rational reasons during the nascent years of the technology. In other environments, as the technology becomes codified practice—well understood and the risks taken out—the practice of that would have migrated into an overhead structure that was commensurate to the risk and complexity of the problem. I think that regulation, as well as the strength of the professional unions and associations, has trapped the process in a high-cost infrastructure. So I would say that's one difference. But it's a difference that could be addressed with the proper understanding and the proper incentives.

**Smith:** Thank you, Clay, for your insights. As affordability becomes a bigger and bigger issue in health care—for the uninsured, the insured, and those who pay for insurance—there may be lessons from industries such as computers and airlines. While many more Americans have access to those goods and services than a generation ago, health care seems to be moving in the opposite direction. Perhaps we have something to learn from disruptive innovations in other fields.

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*This interview is the sixth in a series of interviews with leaders in the biomedical sector, sponsored by the nonprofit Institute for Health Technology Studies, or InHealth, which recognizes that innovation in medical technology plays a vital role in better and more cost-effective health care. The series focuses on individuals who are either innovators in their own right or in a position to foster novel research.*