



THE OTHER HEALTH CARE REVOLUTIONS

The Affordable Care Act may have gotten all the attention, but American medicine will be transformed even more profoundly by forces that neither the government, insurance companies, nor even doctors themselves can fully tame. It's already happening, and three trends provide a preview of the shape of things to come.

BY WILLIAM HANSON

AS with many healthy industries, medicine is constantly in ferment. Expansive forces generate new treatments and tools, as well as the specialists and specialties that deliver them. Then, limitations focus the application of the resulting new disciplines and cull out older ones that are no longer competitive. Like banking, manufacturing, and publishing, medicine is finally automating—albeit later. The relationship between the provider of the service and the consumer will be radically remade in the process. The consumer will have much more in the way of choice, autonomy, and leverage in the consumption of medical care, and the industry will become much more nimble as a result. Here is a glimpse at some of the solutions that are evolving in response to medicine's flaws, the threats they represent to the complacent, and the promise they may provide for patients in the future.

The App Store Will See You Now

In one of the best episodes of the iconic science fiction series *Star Trek*, the ship's doctor, nicknamed "Bones," is called upon to examine a sick man on the outpost. He concludes, "Heartbeat is all wrong ... temperature is ... [he pauses], Jim, this man is a Klingon." Dr. McCoy reaches this conclusion after examining the patient with his portable, universal diagnostic device, the tricorder.

While the tricorder was a figment of series creator Gene Roddenberry's imagination in the 1960s, and today's doctors still carry stethoscopes, ophthalmoscopes, and goniometers, we are getting closer to having an all-in-one portable diagnostic tool. This gadget is today's cell phone. Many of the features that *Star Trek's* writers attributed to Dr. McCoy's utility tool are now emerging from mobile device app stores.

ILLUSTRATION BY MARK ALLEN MILLER

The smart phone itself can already be used as a stethoscope. Its microphone can be placed against the chest or abdominal wall to pick up sounds emanating from deep within the body. The application has programmed “wizards” that can be used by the novice to diagnose different sounds based on the location, audio characteristics, and type of sound. The program uses sound filtering and noise canceling features that amplify distant heart sounds. Previously these special sound-processing features were available only on expensive, high-end stethoscopes, but they’re built in to this inexpensive smart-phone application.

I recently downloaded Stethoscope Expert (a product of Current Clinical Strategies), one of several stethoscope apps from the medical section of the Apple store. It’s advertised as a way to employ one’s iPhone as an electronic stethoscope. In fact, there are many uses for the application—it comes equipped with an acoustic library of normal and abnormal heart, lung, and bowel sounds. When the user selects a given example, like the cardiac “quadruple gallop,” the phone cues up a movie (using QuickTime, Apple’s proprietary media player) that shows an acoustic trace of the sound and plays the accompanying audio. The term *quadruple gallop* describes a cardiac rhythm in which there are four, rather than the usual two, lub-dub sounds with each heartbeat. It is reminiscent of the hoofbeats of a horse at full tilt and suggests that the patient has severe heart failure. Whereas medical students, nurses, or paramedical trainees might have the opportunity to hear this sound in a real patient only once or twice during the course of their education, they can listen to the app’s example over and over until they’ve got it down pat.

The Stethoscope Expert library contains a suite of more than 60 different murmurs, rubs, gallops, clicks, and rumbles characteristic of different heart problems. A collection of lung and bowel sounds provides brief descriptions, phonocardiograms and audiograms of each. There are old favorites like pulmonary “whispered pectoriloquy” and “egophony,” and bowel “borborygmi,” “tinkles,” and “rushes.” There’s even a spooky recording of the “death rattle” described so often

in old books—those written back in the day when ordinary people died ordinary deaths—at home. (The mind reels thinking about the technique for recording the rattle.) Used purely for its acoustic medical library function, this app has merit; but there’s much, much more!

An additional, extremely novel feature is the ability to record a patient’s heartbeat or lung sounds “for the record,” for comparison over time—even for analysis by someone else or by some futuristic computer with heartbeat recognition software. This opens up a world of interesting and previously unimaginable possibilities. A patient’s heart, lung, and bowel sounds could, for example, easily be recorded into a medical record with each physical examination. A primary care physician might record a worrisome exam and send it in an email to a consulting cardiologist.

The app’s designers may have anticipated that this kind of software might not win immediate acceptance by the brotherhood of medicine. Perhaps they hedged their bets by putting in a few additional features to win over nonmedical app shoppers who weren’t sufficiently enticed by the ability to play doctor with their iPhone on themselves or, perhaps more enticingly, on others. This iPhone app can actually “listen through walls!” What teenage boy could pass this up?

I tried this application on myself. When I used the phone’s speaker to project the sound, all I got was a screeching wail of feedback. But when I used ear buds, as the company recommends, I could actually hear lung sounds quite well, as well as the rumblings of my stomach as it churned away on my lunch. It was harder to hear heart sounds, but the company also sells a stethoscope attachment that can be plugged into the bottom of the iPhone and that’s better suited to cardiac examination.

In its current form, the stethoscope app is not really suitable for true medical use, but it won’t be long before we’ll have a version that would work just as well as or better than today’s traditional medical instruments. Considering the capabilities of sophisticated music-recognition apps like Shazam and Soundhound that can identify the singer, title, and composer of most music after a sample of only a few bars, one can readily envision

something comparable for medical care.

The Stethoscope Expert isn’t the only smart-phone app designed to duplicate or demystify the magical things that only doctors were privy to back in the day. MIT researchers have designed NETRA, the Near Eye Tool for Refractive Assessment, to reproduce the techniques ophthalmologists and optometrists use to determine the prescription that a patient needs. With a specially designed mobile phone add-on piece, a non-specialist can determine how much refraction is needed to correct the vision of a near- or farsighted individual.

The patient looks through a lens at the phone’s screen and uses the phone’s controls to move parallel red and green lines closer and closer until they overlap. Depending on the degree of curvature of the eye lens, the overlap point will vary among individuals. The same process is repeated eight times, as the lines are rotated sequentially through 360 degrees to form a complete representation of the patient’s lens. Once the measurements are complete, special software calculates the prescription necessary to correct vision in that eye. The same process is performed for the other eye, and, with that data, a pair of corrective lenses can be made.

A UCLA professor, Aydogan Ozcan, and his group have developed a lens-free microscope weighing less than two ounces and designed to attach to most camera-based cell phones. Unlike traditional lens-based microscopes, the images in these inexpensive devices (less than \$10) are captured using a process known as diffraction, which permits the reconstruction of an image from the shadows that it casts. A light-emitting diode shines through a blood or saliva specimen, and because the cellular elements in the sample are semi-transparent, both the cells and their subcellular elements cast shadows. The shadows are reconstructed into holographic images of the cells, which can then be transmitted from the field to a pathologist in some remote location, usually a hospital laboratory, for analysis.

This technology will soon be deployed in Africa, where cell phones are plentiful but pathologists are sparse. Samples, such as blood smears, can be quickly loaded onto single-use chips that slide into the microscope; and because of

the large aperture of the sensor array, no special alignment or cleaning techniques are necessary—which makes this technology ideal for field use by relatively untrained workers.

Malaria is an example of a disease widely prevalent in Africa for which this technique is particularly suitable. A drop of blood can be applied to this “lab on a chip,” and the malarial parasites are easily identifiable.

While the typical telemedical analysis is done by an expert who analyzes an image sent using text messaging or email, Ozcan’s group has also developed an algorithm for local use. This is essentially an app that identifies and counts red cells, white cells, and microparticles like bacteria or parasites, permitting instantaneous on-site reports.

It is easy to imagine that technologies being developed for impoverished areas might eventually come to be used in medically well-served countries. The technology will improve, the cost will decrease, and the old methods will eventually be displaced.

Fujitsu has developed communication standards for medical devices and cell phones. The Fujitsu phone uses the Bluetooth wireless protocol to gather information from similarly equipped machines that measure blood pressure, heart rate, blood sugar, and weight. While these phones are intended to store and forward the data to doctors at remote locations, the next wave of apps will allow a patient to record, interpret, and analyze his own data. We’re likely to see much more in the way of applications that allow each of us as patients to have more control over the acquisition of useful data for preventative and chronic health care.

As of this writing, there are already more than 6,000 medical or health applications in Apple’s App Store, and the numbers increase every day. Many of these apps are focused on the consumer rather than the provider. There are apps to track caloric intake, exercise, and weight. This might reduce the necessity for weight-loss programs or change how we approach health education. There are specific applications allowing diabetics to follow the levels of a diabetic marker called hemoglobin A1c in their blood. These apps can track the individual patient over time, as well as the individual patient com-

pared to others with the same disease in the same geographic area.

Cell phone medical tools are new, and the ways in which they’ll be used in medicine is evolving all the time. To be sure, innovative physicians are already using smart phones for expert advice and for applications that facilitate charting and prescribing. But it’s clear that some of the most innovative mobile tools will come from consumer-oriented products, or from tools originally designed as inexpensive alternatives to traditional devices.

Medical students were not traditionally high-tech oriented, but they now live at the cutting edge of technology. They are extremely savvy about new paradigms, transitioning smoothly from telephone to text to social networks for different types of communications, while their medical teachers are often much less comfortable with the era of electronic communications. Today’s students will begin their careers just as electronic health records become prevalent. And they’ll help to define the best ways to use these new tools that will dramatically alter the delivery and consumption of health care, right before our eyes.

Survival of the Fit

I recently interviewed a cardiac surgeon who wanted a job working entire weekends, day and night, Friday night through Monday morning, in one of our intensive care units. His story was an interesting cautionary tale about what evolutionarily unfit doctors can look forward to in the world of Life after Health Care Reform. Dr. Bryan Scherr (not his real name) had a blue-ribbon CV. He’d graduated from Yale University with a degree in physics and headed to Stanford University for medical school. Bryan had gone on to UCLA for an internship and back to Stanford for his surgical residency, eventually completing training in vascular and cardiothoracic surgery at UCLA and Stanford.

Dr. Scherr went on to enter a lucrative private practice in cardiac surgery in California. However, for reasons he didn’t explain, his private practice broke up toward the end of 2008. Now 62 years old, Scherr had found it impossible to find cardiac surgical

work, so he adapted and began to work taking care of patients other surgeons had operated on. He found part-time jobs in an intensive care unit in New York, and another in California, and he had applied to work at our unit in Philadelphia as well.

There in my office that day I had a 62-year-old, highly trained heart surgeon with no obvious disabilities who had at one point worked his way to the very top of a heap consisting entirely of people who’d been plucked from the tops of other heaps, only to be reduced to flying around the country working nighttime shifts in a series of ICUs between airplane rides.

How, I asked myself, could this possibly have happened? It reminded me of those nature films where some once-proud king beast, perhaps now missing a few teeth or an antler, is up and ousted from the pack by a young, bold new competitor. If he survives the joust, he’s then forced to wander the land, feeding off scraps and carcasses.

The operations Bryan Scherr performed three or four times a week in his prime were probably a mix of heart valve replacements and coronary arterial bypass procedures, more popularly known as CABG or, in the layman’s vernacular, *cabbages*. The first CABGs were done in the early 1960s by pioneers like Dr. Rene Favalaro, an Argentinian from humble beginnings who trained and began his medical career in South America but eventually emigrated to the United States and Ohio’s famed Cleveland Clinic.

The operation eventually became so common that more than a million CABG operations were performed in the United States between 1988 and 2003. But, almost imperceptibly at first, something happened to change what had been a steadily increasing trend over the last few years of that 16-year period.

Most studies show that the number of CABGs peaked in about 1996. By this time, many ambitious community hospitals saw that the ability to advertise cardiac surgery as a service line represented an evolutionary edge over competitors. Whole teams were recruited to hospitals all over the US during the early 1990s, including cardiologists, cardiac surgeons, the perfusionists who run heart-lung bypass machines and

intensive care staffs. But an interesting thing happened over the three- or four-year span between 1996 and 1999. The overall number of CABGs started to decrease, subtly at first, but quite clearly by 1999—yet the number of new cardiac programs kept on increasing.

The community hospital administrators who were building these new programs hadn't cottoned to the fact that their food source was about to be in peril. By 1999, the majority of CABGs, by percentage, were being done at so-called low-volume hospitals, which typically have less-good outcomes. And because there were more programs doing CABGs every year while the number of patients needing them didn't increase at the same rate, each program was doing fewer of these surgeries than they had a few years earlier. The more experienced, high-volume programs were getting hit harder as patients were being siphoned off to new low-volume hospitals, and reimbursement rates were being cut by insurers. In effect, what had been boom times with a reliable food source for cardiac surgeons, and the dependent consultative medical and nursing specialties, all of a sudden went bust. This all happened about midway through the career of the now-itinerant Dr. Bryan Scherr.

So why did the number of CABG surgeries start to decline? Was it because we stopped eating Cheese Whiz-covered fries that had been cooked in tasty trans fats? Were new cholesterol drugs working miraculous cures? Had everyone stopped smoking? In a word, no.

What really happened was that cardiologists got wise. For years they had been diagnosing patients with coronary disease, doing the angiograms, and then sending them off, one by one, to a prima donna cardiac surgeon who would "bang out" a few CABGs between golf games before retiring in his brand-new Mercedes to his multi-million-dollar home. The cardiologist, in turn, drove home hours later in his Honda to a much more modest, split-level home. During the commute, he perseverated about ways to level the playing field.

Then along came the revolutionary balloon coronary angioplasty, coronary roto-rooters, coronary vascular stents, and increasingly sophisticated ways for a cardiologist to "operate" on the

heart without ever picking up a scalpel. These innovative cardiologists developed clever new techniques allowing them to reopen blocked heart vessels non-invasively, thereby eliminating the need for cardiac surgery in all but the most complicated cases.

By the late 1990s, with these new techniques, cardiologists had in effect figured out a way to steal the cardiac surgeon's bacon. What ensued in many small hospitals over the succeeding decade was analogous to those televised scenes from the African veldt where some proud lion king is hunched down anxiously over the carcass of an animal that his queens have brought down and is surrounded by a pack of hungry, disrespectful hyenas. The dogs move ever closer, eyes sparkling in the night, making that eerie laughing sound that hyenas make. And in every show I've ever seen, the lion eventually gives it up as a bad job and skulks away.

Maybe, I said to myself as I ended my interview, this is what had happened to Dr. Bryan Scherr, the wandering cardiac surgeon.

Gastroenterologists have figured out non-operative ways to remove gallstones, cauterize bleeding ulcers, and reshape the stomach to treat obesity—traditionally all things that a general surgeon would do during an operation under anesthesia. Cardiologists are now working on ways to repair and replace heart valves using catheters inserted through the blood vessels very much like the ones they use to put stents in the coronaries. They are thereby finding another way to do the work of, and bedevil, cardiac surgeons who have always done these operations while a patient is on cardiopulmonary bypass and then only after cutting open his chest. Radiologists, gastroenterologists, and general surgeons all compete to do another procedure: placing a feeding tube through the skin into a patient's stomach. And a variety of different surgical specialists insert tracheostomy breathing tubes into the neck. Everybody wants to "own" their own procedure.

Medicare has a reimbursement schedule that's based on a system of what are called RVUs or relative value units, which is designed to characterize the work

intensity of the things doctors do so as to prorate payments. The things with the highest relative values include heart, liver, and lung transplantation; intracranial blood vessel repair; hand reimplantation; and pancreas and esophagus removal. All of these procedures have relative values greater than 50, while the essential day-to-day activities of health care like office consultation, subsequent hospital care, and emergency department visits are valued at around 1. Put simply, a given hour of the higher-valued activity is, under the Medicare payment scheme, 50 times more valuable than an hour of what might well be preventive care. Under today's reimbursement schemes, thinkers are paid less than doers. As one family practitioner put it, this is one of "the errors of traditional health care, namely paying more for such [things] as cutting, injecting, and imaging, than thinking."

The Medicare valuation system was devised largely by a group of physicians, and while one may quibble, it's a system that has stood the test of time and has adapted as new procedures have been developed. The highest-valued activities are the medical *tours de force*, procedures developed by doctors and procedures that only doctors will ever perform. But there's a whole lot of competition at the lower end of the value scale.

Optometrists compete with ophthalmologists, and nurse midwives, with obstetricians. Nurse anesthetist organizations portray their members as just as good as, but less expensive than, physician anesthesiologists. The American Association of Nurse Anesthetists recently adopted a strategic plan requiring all of their newly credentialed nurses to become "Doctors of Nurse Anesthesia Practice." And while the patient of the future will be wheeled off to the operating room by an anesthesia doctor, they'll have no idea, unless they ask, whether their provider is a doctor-doctor or a nurse-doctor.

Nurse practitioners, too, are moving to mandatory "doctoral preparation." The American Association of Nurse Practitioners has prepared their own strategic "roadmap" by which it will advance the "terminal degree for advanced practice nursing from the Master's to the Doctor of Nursing Practice (DNP) by the year 2015." As we'll see, nurse practitioners can now be found in many medical

offices, working side by side with doctors as well as in stand-alone urgent care centers and—in what may prove the most disruptive new model of medical care—drugstore walk-in clinics.

How The General Practitioner is Changing His Spots

Not long ago my wife said, over dinner, that she had recently taken the kids to get their vaccinations at a MinuteClinic. I thought to myself: “Wait! What? Aren’t they those drugstore doctors!? In fact, come to think of it, are they even doctors!? I think they’re actually nurses! Like my wife! ... Oh.”

Now, I was in a quandary. As far as I was concerned, these MinuteClinic people are what many of my physician brethren would identify as “The Enemy.” Some of my doctor friends would probably even say that they’re nurses just masquerading as doctors.

My wife went on to explain that she had gone to MinuteClinic because she couldn’t deal with the concept of waiting two hours or more to get the kids their shots. And every other adult at the table, except me, was already nodding his or her head vigorously. “Yes!” “Yes!” They, too, had had it with the long waits in doctor’s offices and thought the MinuteClinic idea was perfect for this kind of thing.

It’s pretty ironic that my wife and I, who, as a nurse practitioner and doctor, respectively, are the ultimate medical insiders, would ever need to resort to something like the MinuteClinic to get flu shots for the kids. But that’s why the company’s business model makes so much sense and why CVS bought what was originally called QuickMedx in 2006. It has subsequently installed these nurse-run clinics in many of its stores around the country.

My wife’s visit to our local CVS-based MinuteClinic typifies most such encounters. She needed seasonal flu shots for our three boys, and she knew from long years of experience with our pediatric practice that any attempt to engage in anything other than a scheduled appointment less than six months in advance would involve entering into what sounds like a bullfight.

The MinuteClinic is more like a beauty salon. There’s a menu of services.

The client chooses the desired service, gets it, and leaves. My wife selected three seasonal flu shots at \$30 a pop, the kids got them, and she left 10 minutes later. Completely painless, except for the kids of course, and my wife was able to buy hair and dental products while they were getting stuck.

MinuteClinic offers a menu of services under the heading “minor illness exam” for about \$60 or a co-payment with the patient’s insurance company. This includes the diagnosis and management of things like flu symptoms, sore throat or earache, nasal congestion, and urinary tract infections. “Minor injuries” such as blisters, burns, bug bites, splinters, and lacerations are priced similarly. Covered “skin conditions” include cold and canker sores, chicken pox, scabies, and shingles. MinuteClinic can also screen for high blood pressure (\$30), diabetes (\$40), and asthma (\$95). The practitioners will perform a variety of specialty examinations for camp, school, college, or sports that cost between \$30 and \$40. Pregnancy testing is \$50. Ear-wax removal, oddly, is a little bit of a bargain, costing three dollars less than most other procedures. Almost every service costs less than \$100.

MinuteClinics are designed to run lean. The patient enters relevant information into the clinic’s electronic medical record software via a touch screen while waiting to be seen. The clinician then follows a series of logic-driven questions once she’s in the room with the patient. The company compares this to a pre-flight checklist, and the logic is designed to arrive at a diagnosis and a focused treatment plan. Most importantly from a liability standpoint, the computer’s software is designed to determine whether or not the client’s problem lies within a suite of common, readily characterized illnesses and, if so, to recommend a treatment course that’s consistent with nationally accepted clinical practices. These best-practice algorithms are drawn from professional societies like the American Academy of Family Physicians, the American Academy of Pediatricians, and the Institute for Clinical Systems Improvement. MinuteClinic also makes it very clear that they know when to refer a patient for issues that fall outside their defined scope of engagement.

Almost 90 percent of retail medical clinic visits are for one of 10 common conditions that would otherwise require a visit to a primary care physician or emergency room. A typical visit requires no appointment and takes 15 to 20 minutes. The transaction costs one-third less than an urgent care appointment and three-quarters less than an emergency department evaluation. And because most of these visits are goal-oriented, the patient typically leaves with a solution and is therefore a satisfied customer who will probably return. Like many medical transactions, these represent a set of clear-cut, uncomplicated problems that could be addressed in a brief encounter but typically aren’t at traditional medical facilities because of the tremendous inefficiencies of the latter in delivering sub-acute care.

Harvard Business School Professor Clayton Christiansen and Dr. Jason Hwang co-authored a 2009 book entitled *The Innovator’s Prescription: A Disruptive Solution for Healthcare*. They suggest three alternative approaches that business executives might adopt to reduce health-care costs to their companies. The first is to encourage their employees to use health-care retailers like MinuteClinic, the second is the formation of partnerships with integrated health systems like Kaiser Permanente, and the third is to set up their own clinics based on a retail model. Christiansen is best known for his studies of innovation, in particular, “disruptive innovations”—ones that enter a market at a relatively low cost and with modest goals but eventually go on to transform that market entirely.

Christiansen and Hwang (a former Kaiser Permanente physician and Harvard Business School graduate), as well as a growing number of companies, believe that retail medical care represents an efficient, effective alternative to the traditional, oftentimes dysfunctional, alternative. Several seemingly unrelated trends suggest that there is good reason to pay attention to the evolution of retail medicine. Rising deductibles, for example, are likely to make consumers more conscious of the price differential between an emergency department visit, with the invariably lengthy wait, versus a

convenient, much less expensive visit to a retail medical facility. As much as 20 percent of routine primary care visits are for diagnoses that fall within the limited number of conditions on which retail clinics concentrate. This includes the evaluation of flu-like syndromes and minor skin conditions as well as routine medical evaluations.

Handled properly by retail providers, a significant volume of business could get siphoned away from primary care physicians, urgent care centers, and emergency rooms. And as with many disruptive innovations, there is a niche for the innovator's entry into a market that doesn't appear, at least at the outset, to present a big threat to the incumbent. Because of the typically low reimbursement rate for care provided to patients with these issues, most physicians don't see the loss of these patient visits as a problem. The problem, as with all disruptive innovations, is mission creep.

Retail medical care is already showing signs that it wants to grow beyond its modest initial scope. Whereas the company initially confined itself to the management of acute conditions and vaccines, it added cholesterol, blood pressure, and diabetes screenings in 2003 and now provides ongoing monitoring of those conditions as well as of asthma. Although the American Academy of Family Physicians was an ally at one point, co-signing explicit formal relationships with several retail health providers, it saw enough of an evolving threat that it issued a statement in 2010 saying that it "opposes the expansion of the scope of services of Retail Health Clinics and, in particular, the management of chronic medical conditions in this setting."

Medicine has plenty of examples of innovations from within that have disrupted traditional treatments or service models. For example, coronary balloon angioplasty was initially used only for a very limited subset of patients with coronary narrowings or blockages and therefore didn't appear at first to represent a threat to cardiac surgeons. But, as we've seen, subsequent innovations, such as improved catheters, stents, and techniques, eventually led to the emergence of a whole new sub-specialty. And coronary lesions are now being treated pharmacologically with statin-class

drugs, which may, in turn, eventually eliminate the disease and the need for interventional cardiologists altogether.

Emerging data about retail care suggests that these nurse-practitioner-run clinics do well with acute medical conditions. In an evaluation of nearly 60,000 cases of sore throat over a one-year period, 99 percent of the time, retail providers did not prescribe antibiotics to the two-thirds of the patients with a negative strep test. More importantly, they did prescribe appropriate antibiotics for the one-third with a positive test. Another study looking at the management of earache, sore throat, and urinary tract infection at retail clinics showed that visits for these conditions cost substantially less compared to costs at doctor's offices, urgent care centers, or emergency departments. The preventative care and quality scores were comparable at retail clinics, doctors' offices, and urgent care centers but lower in emergency departments.

One of the key attributes of truly disruptive technologies is the fact that they enter the market at the bottom, where profit margins are small and the threat to the incumbent technology appears to be minimal. A cycle then ensues in which the disruptor innovates continuously, while the incumbent retreats up-market to retain higher-end and more profitable customers. The disruptor is driven to improve to enhance profits, while incumbents are fighting a series of retrenching battles until they are finally marginalized into a small corner, or gone.

To truly disrupt, retail medical clinics can't just be plugged into existing health networks; they must develop their own direct connections to employers, insurers, and patients, bypassing hospitals and doctors. Christiansen notes that one key lesson from successful revolutions of the past is that the energies of the incumbents are typically focused on improving the top end of their products. They complacently disparage seemingly simplistic technological innovations. Physicians who are trained to use the literature and their intelligence to diagnose and manage their patients find it inconceivable that a simple computer algorithm might perform as well as or better than they do. The threat, however, is very real.

There is a war underway in medicine to take the once highly individualized and intuitive diagnostic and treatment algorithms that were unique to each physician and codify them into best practices. If you think of a medical best practice as just another widget, like a cell phone, a computer, or a digital camera, you can imagine a process through which it evolves. Widgets, be they algorithms or products, can be subjected to ongoing study and continuous improvement, and best-practice widgets, once defined, can be tested for accuracy, efficacy, and efficiency.

One can even imagine that through this evolutionary process, once-clunky best-practice widgets will eventually evolve to become as sleek and functional as today's smart phones and cameras. As they're formalized, they can get coded into software as decision-support tools that can be administered just as readily by a doctor, or a nurse practitioner, or even by the patient herself. It is entirely feasible that much of the cognitive work now performed by medical providers will eventually become so objective, precise, and encodable that the doctor himself might become obsolete.

I don't personally believe this mechanized version of the future will ever become real because I think the most important element of the interaction between the doctor and the patient is fundamentally human. Medicine evolved from altruistic activities like mutual grooming and feeding that are common to species throughout the animal kingdom. However, we do need to find our way to some model of medical care that balances the opportunities provided by advances in medical technology with what's best for the patient.

We're in a cutthroat era of medical evolution. Change will be fast-paced. Individuals or specialties that are slow to adapt will fall behind. Medicine is indeed entering its own brave new world. ♦

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