THE POWER OF DIGITALIZING HEALTH CARE

Digitalizing Health Care

Health care spending is rising at an unsustainable pace. Providers worldwide face pressure to deliver more and better care with fewer resources as population's age and the system-wide burden of chronic diseases increases.

Such trends, among others, drive the need for rethinking how health care is delivered. This is especially relevant in cases where health care provision is fragmented and focused on volume, as well as those where unwarranted variability, waste, and efficiency levels underperform against their respective benchmarks. Other industries as diverse as music and banking have embraced digital innovations and radically reshaped their operations to address similar needs. And in the process, they have created higher quality and more personalized customer experiences.

It's time for health care to become more digital.

Half of the respondents in a recent survey of 613 health care decision-makers believe that digital technologies will significantly disrupt their organization in the next three years.[1] The volume of data collected from imaging, laboratory diagnostics, and medical documentation is expected to grow 50 times year-over-year between now and 2020.[2] It is about time we start turning this data into actionable insights.

In the future, as digitalization accelerates, diagnosis will be quicker and more accurate, and tailored therapy will become available to every patient. Care teams will be fundamentally changed, built around the patient, their health, and their personal choices in terms of care.

Digitalization will also help patients to engage in managing their health based on their expectations as informed consumers. Successful providers will adapt their approach and embrace the trend of patient-as-consumer, partnering with patients to design care that suits their needs.

At Siemens Healthineers, we believe that health care will be digital, and that it will be better for everybody. Big data and digital technologies will revolutionize our understanding and treatment of disease and change the very nature of wellness and health care.

Other industries had a head start in harnessing the benefits of the digital revolution. But some of the brightest minds in the world are in the health care industry. We want to empower you and your teams with insights, ideas and solutions on your journey towards digitalizing health care—a transformation which has already started and will finally help you achieve better outcomes at lower costs.

Get more insights at siemens.com/healthcare-insights.

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1   https://med.stanford.edu/content/dam/sm/sm-news/documents/StanfordMedicineHealthTrendsWhitePaper2017.pdf

2   "Taking the Pulse of Health Care Transformation," Harvard Business Review Analytic Services Pulse Plus Survey, sponsored by Siemens Healthineers. October 2017

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Executive Summary

The acceleration of digital technology has enabled the disruption of many disparate industries. Yet health care, which represents about 10% of global GDP, has lagged other sectors. But that is about to change, as big data and the ability to crunch it will deliver actionable insights that will increase health care's reach, efficiency, accuracy, and value. And just in time, too, because the demand for services is on the rise at the same time that the need to rein in costs is becoming ever more acute. The aging of the large Boomer generation, the rising prevalence of individuals with multiple chronic conditions, the widely anticipated shortage of both primary care and specialist physicians, and ever-increasing health care costs all exert pressure on a system ripe for disruption.

Digital technology is doing this in multiple ways. Telemedicine, for instance, expands access while offering increased efficiency and accuracy. It's no wonder, then, that a recent survey of large employers found that 90% planned to offer their employees a telemedicine option by 2017, according to *Becker's Health IT & CIO Review*. And then there's the promise of artificial intelligence, which, by extracting actionable insights from vast amounts of patient data, opens the door to more accurate diagnosis, better treatment, and greater value. Observing that artificial intelligence "will become the stethoscope of the 21st century," Dr. Bertalan Meskó, who writes under the moniker The Medical Futurist, says that "automation through AI, robotics, or 3D printing will make health care more efficient and more sustainable. These new digital technologies will improve health care processes, resulting in the earlier and more efficient treatment of patients. It will eventually shift the focus in medicine from treatment to prevention. Moreover, medical professionals will get the chance to move from repetitive, monotonous tasks to the challenging, creative assignments."

Introduction

Health care organizations and providers worldwide are under pressure to deliver more and better care within limited budgets. In both developed and emerging economies, demand for health care services is increasing as populations age and the burden of chronic disease grows. As health care spending continues to rise, the call for greater efficiency in care delivery becomes ever louder.

DIGITALIZING HEALTH CARE BY:

GENERATION
Leveraging intelligently generated data

AGGREGATION
Connecting and aggregating data across the care continuum

ANALYSIS
Leveraging operational performance insights to drive accountability

OPERATIONALIZATION
Driving sustainable digital adoption through change management and continuous improvement

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According to the Agency for Healthcare Research and Quality, individuals with one or more **chronic conditions** account for **80%** of U.S. health care spending.

Health care spending accounts for 10% of GDP for countries in the European Union and is the global average too. The U.S. is the outlier, with health care accounting for nearly 18% of GDP. With aging populations needing more intensive levels of medical intervention, and with the growing prevalence of chronic diseases such as diabetes throughout their populations as a whole, developed nations face steep spending increases unless something can bend the cost curve. According to the Agency for Healthcare Research and Quality, individuals with one or more chronic conditions account for 80% of U.S. health care spending.

Emerging economies have their own challenges, among them underdeveloped health care infrastructures and smaller spending pools per capita. Yet they, too, face the rising prevalence of chronic conditions such as diabetes. According to the World Health Organization (WHO), about 80% of diabetes-related deaths occur in middle- and low-income countries, and diabetes deaths worldwide are rising, as are deaths from cardiovascular disease and cancer.

The rallying cry among health care policymakers and health system executives these days is "high-value care," and it's a goal that all can support: high-ROI health care that delivers a strong outcome weighed against cost. One result of this emphasis is increased focus on getting people in to see a primary care provider. Preventing disease rather than treating it after it has been established is better for the individual and cheaper for health care systems, and the same holds true for treating disease earlier in its course rather than later. Primary care services, too, are typically offered in lower-cost settings than is specialist care.

But demand for health care services threatens to outstrip supply. Meskó points out that the WHO forecasts a global shortage of about 4.3 million physicians, nurses, and allied health professionals. Furthermore, he says, "Care is often unavailable where it is most needed. Worse, with civilizational diseases like diabetes and obesity on the rise, health care costs are expected to grow even faster. American health spending will reach nearly $5 trillion, or 20% of gross domestic product, by 2021. The current practice of medicine is simply unsustainable."

What will catalyze change? Technology that empowers consumers and providers, benefiting them both while enabling greater efficiency in health care delivery. Specifically, technology that:

- Opens up access to providers from a more convenient setting, including the patient's home.
- Enables remote monitoring of patients, for instance of their blood glucose levels or blood pressure.
- Gives individuals knowledge and ownership of their own health and wellness.
- Increases accuracy, standardization, and efficiency.
- Permits seamless communication among providers and health systems.
- Leverages AI to integrate and analyze large amounts of data to improve health care among individuals and populations as a whole, via more accurate diagnostics and better-targeted treatments.

TECHNOLOGY MUST MEET THE NEEDS OF CONSUMERS AND PROVIDERS

Create access for more-convenient settings, including patients' homes	Enable remote monitoring of patients	Educate and empower individuals to be their own health advocates	Increase accuracy, standardization, and efficiency	Permit seamless communication among providers and systems	Integrate and analyze data

Telehealth, Telemedicine, mHealth

First, some definitions. *Telehealth* describes anything health-related accomplished via ehealth means. *Telemedicine* is a subset of telehealth that typically refers to the delivery of clinical services via telecommunications—that may include remote visits with a provider, transmission of radiologic images or lab tests to a distant center for interpretation, or home monitoring of a patient with the readings going to a provider, who can intervene if necessary. *mHealth*, for mobile health, includes telemedicine accomplished via mobile, as well as smartphone apps that allow consumers to educate themselves about health topics, monitor their physical activity, or track their eating patterns.

Telemedicine is already well established in mature markets and will continue to burgeon, with the global market forecast to be worth more than $34 billion by 2020. The U.S. is expected to account for about 40% of that market.

The large integrated health system Kaiser Permanente saw more patients online than in person in 2015, according to its CEO, Bernard Tyson, with satisfaction rates over 90% for patients who used the visit for urgent but nonemergency care. The health system also reports increased medication adherence among diabetes patients who used the Kaiser Permanente HealthConnect portal to order refills, as well as lower LDL cholesterol levels, compared with patients who did not use the portal.

A major success for Kaiser is its eye-screening program, which monitors about 370,000 individuals for common vision-threatening eye conditions, including diabetic retinopathy, the leading cause of blindness in adults. Says Dr. Donald Fong, director of the Kaiser Permanente Southern California Eye Monitoring Center, "At Kaiser we wanted to make screening more patient-friendly and more accurate. Screening for diabetic retinopathy in person is expensive and may be inaccurate."

So cameras are now in place in primary care offices, and the images are read by a certified ophthalmic technician off-site. Previously, diagnosis rates for the progressive condition used to vary significantly between physicians, by as much as 1,500%, says Fong. That meant that some patients were receiving false positives, and some—much more worryingly—were receiving false negative results. Fong says they knew they were missing cases because the prevalence rate among their diabetes patients was roughly half the national average.

Now, says Fong, diagnosis rates have evened out, with variation down to about 20%, and prevalence is in line with national averages. The center has launched a pilot to monitor glaucoma by having trained technicians measure the optic nerve. Programs are in place as well to monitor some 6,000 patients for medication-related eye damage.

"Our telemonitoring program is more accurate, more patient-friendly, and more cost-effective than screening in person," says Fong.

TELERADIOLOGY OFFERS CONVENIENCE TO REFERRING PHYSICIANS, HOSPITALS, AND PATIENTS, AND IT DELIVERS GREATER ACCURACY AT LOWER COST. DR. JOHANNES SCHMIDT-TOPHOFF

"When you **increase convenience**, you increase utilization. That is good for those patients in need of care, but at the same time my studies have found **increased low-value utilization** as well," says Dr. Ateev Mehrotra.

Accuracy, convenience, and efficiency are likewise part of the value proposition offered by Heidelberg-based Curagita, the leading independent radiology services company in Germany. Its CEO, Dr. Johannes Schmidt-Tophoff, says that teleradiology, despite some legal restrictions in Germany, offers convenience to referring physicians, hospitals, and patients, and it delivers greater accuracy at lower cost, thereby encouraging high-value utilization. Also promoting such, says Schmidt-Tophoff, is built-in decision support: "We offer electronic ordering in referring clinician portals, with built-in prompts that help referring clinicians determine if referring to radiology is appropriate."

In Germany, teleradiology is mostly used for nighttime emergency needs. Elective use—for instance, for second opinions—has been implemented selectively. One example is the double-reading of prostate mpMRI (a type of imaging) within the RaDiagnostiX network.

Schmidt-Tophoff expects that the next several years will see continued advancements in computer-aided diagnosis for teleradiology, as well as for other telemedicine applications. In Germany, legal restrictions and financial reimbursement will have to bridge the gap between demands for higher quality and volume on one side, and an increasing shortage of radiologists on the other.

Barriers to the spread of telemedicine include licensure restrictions on practicing across state or country lines, physician and hospital resistance, and reimbursement models, says Susan Dentzer, president and the CEO of Cambridge, Mass.–based Network for Excellence in Health Innovation (NEHI) and former senior policy adviser for the Robert Wood Johnson Foundation. About 90% of health care could occur in lower-acuity settings than where it is delivered now, she says, and that includes patients' homes via telemedicine. The reimbursement model isn't there yet in the U.S. But she is very optimistic about the imminent burgeoning of telehealth nonetheless, as policy catches up to consumer choice and health systems search for better ways to deliver cost-effective care.

John Kravitz agrees. He is chief information officer of the Danville, Penn.–based Geisinger Health System, a large integrated health system. For him, telemedicine is a cost-effective way to meet the challenge of providing more care to more people at lower cost, a necessity given the expansion of Medicaid rolls under the Affordable Care Act.

It is notable that for several years, he says, Pennsylvania has reimbursed televisits at the same rate as regular in-office visits. Thus Geisinger is continually refining its telemedicine service offerings.

He says that the technology has long been in place, but one barrier has been provider resistance to using it; some doctors were reluctant to give up the familiarity of an office visit. But that has faded as digital technology has become ubiquitous.

Kravitz comments that an integrated health care network helps Geisinger experiment and move forward. "Given that we have an integrated delivery network, with some 35% to 40% of those we insure using our health system, we can effect change pretty quickly. It's our incubator."

BARRIERS TO THE SPREAD OF TELEMEDICINE INCLUDE LICENSURE RESTRICTIONS ON PRACTICING ACROSS STATE OR COUNTRY LINES, PHYSICIAN AND HOSPITAL RESISTANCE, AND REIMBURSEMENT MODELS, SAYS SUSAN DENTZER, PRESIDENT AND CEO, THE NETWORK FOR EXCELLENCE IN HEALTH INNOVATION.

McKinsey & Company research finds that, since 2011, venture capitalists have **invested more than $14 billion** in companies developing consumer-oriented **digital and mobile** health care apps in the U.S.

For him, digital technologies are the route to delivering high-quality care at a lower cost. "Managed care is really challenging, but telemedicine offers solutions. Don't want to flood emergency departments with patients who don't need to be there? We triage them via telemedicine; those who need to go on for emergency care are treated in the emergency department, but we're able to redirect others to more appropriate care settings. The bottom line is that managing care is more efficient when you can triage with telemedicine to get the patient to the right level of care," he says.

Dr. Ateev Mehrotra, an associate professor of health care policy and medicine at Harvard Medical School and a hospitalist at Beth Israel Deaconess Medical Center, inserts a note of caution. "When you increase convenience, you increase utilization. That is good for those patients in need of care, but at the same time my studies have found increased low-value utilization as well," he says.

Mobile Apps and Individuals' Engagement in Self-Care

Improving health is a universal goal of doctors, patients, health systems, and public and private payers. But the interactions that individuals have with their providers in a medical office account for only a fraction of their health outcomes. Behaviors—whether determined by environment, lifestyle, background, or a combination thereof—account for a large proportion of a patient's health and well-being.

The proliferation of mobile apps to help people manage their own health promises to make a real change in individuals' lives. By 2018, as many as 1.7 billion people worldwide will use mobile health apps, according to a Deloitte report, *2016 Global Health Care Outlook: Battling Costs While Improving Care*. People who are engaged in their own health care have better outcomes, and preventing disease or treating it early is better for the person and more cost-effective; these apps offer a chance for individuals to identify problems early on while motivating them to adopt better health behaviors.

A recent McKinsey & Company research report points out that digital and mobile apps can be especially helpful for people with chronic conditions. According to a wide-ranging survey the company conducted of consumers, 48% of those with a chronic condition preferred an online health coaching and tracking approach over in-person coaching (28%) or a phone call (18%). In terms of convenience and cost, online wins. An additional factor could be that a phone call or visit from a person may feel intrusive to some, whereas using an app affords both privacy and self-determination.

Although the McKinsey study notes some differences in smartphone ownership, and hence in mobile app use, among age groups, once awareness is there, the study finds little difference between Boomers and Millennials in the use of online scheduling services, for instance.

Their research also finds that, since 2011, venture capitalists have invested more than $14 billion in companies developing consumer-oriented digital and mobile health care apps in the U.S. In 2015 alone, about 40% of the more than $4.5 billion invested in the health care mobile/app sector targeted consumer-oriented products and services.

The wearable Fitbit is the most well-known of these, tracking activity, sleep, weight, and more. The same functions can be downloaded onto users' mobile phones,

as well. A plethora of other health and wellness apps exist—for instance, Strava, which measures bike rides and runs and compares the user's results with those of other Strava users, leveraging key behavioral science principles around the role of collaboration and competition in changing behavior. Omada has a consumer-focused digital behavior-change program for those at risk for diabetes, heart disease, or stroke. Within 12 months, the average Omada user lowers the risk of diabetes by 30%.

Many apps are free and available on multiple devices.

For Meskó, the rise of mobile apps changes the status quo of medicine: "Patients empowered with knowledge can take action," he says. When patients are educated and proactive, he says, "we physicians have to become their guides in the jungle of health care information."

At the same time that providers are being pushed forward by the proliferation of digital health startups, health care system leaders are questioning how they can leverage this rise in consumerism. While hospitals still hold the vast majority of data, captured in electronic health records, needed for patients to truly understand their health status, most health care systems still operate with fragmented data, leading to challenges in generating actionable insights for their providers.

Years of unsuccessful, expensive integration efforts make many skeptical of the real possibilities of digital health technologies, including mobile apps. Electronic health records have added to physicians' workloads; they require training to use, and it takes providers time to enter clinical data during and after the patient's visit. Consumer-generated health data can be valuable for providing a broader picture of the individual's health and habits between office visits, but means to upload that data into an electronic health record and integrate it with clinical data are limited.

And in emerging markets, the rise of health apps, including those that connect with providers, may allow a better health care infrastructure to be created—one that leapfrogs models in more mature economies and better meets consumer needs.

Big Data, Artificial Intelligence, and the Promise of Better Care

As electronic health records, health information exchanges, and wearables proliferate, a greater quantity of patient data is available from more sources than ever before. This offers challenges as well as opportunities. One opportunity already being realized: using electronic health records to identify gaps in care—for instance, patients who missed annual screenings or did not refill crucial medications—then closing those gaps. Keeping patients on track for care is not only good for their health but also makes more sense from a cost perspective.

Taking that a step further is predictive analytics, which crunches data to anticipate the likelihood of a costly event such as hospitalization. The advantage of this approach to improving health outcomes and controlling costs is the opportunity to intervene before the patient's condition has deteriorated to the point where a high-cost hospital admission is necessary.

The challenge of all this data is how to make sense of it, and that's where artificial intelligence (AI) opens astonishing possibilities, says Meskó. As he wrote in a recent blog, the data fire hose isn't shutting down anytime soon. "There is so much data to utilize: patient medical history records, treatment data—and lately information coming from wearable health trackers and sensors. This huge amount of data could be analyzed in details not only to provide patients who want to be proactive with better suggestions about lifestyle, but it could also serve health care with instructive pieces of information about how to design health care based on the needs and habits of patients."

In other words, it helps patients better safeguard their own health while creating a learning health system in which outcomes are registered in real time and used to continually refine diagnosis and treatment. AI is currently being applied to

ANY KIND OF DEVICE THAT SENSES AND COMMUNICATES HEALTH DATA IS PART OF THE SO-CALLED HEALTH CARE INTERNET OF THINGS

THE CONVERGENCE OF CONSUMER-DERIVED DATA, ADMINISTRATIVE CLAIMS DATA, AND CLINICAL DATA IS ONLY EXPECTED TO ACCELERATE.

FEATURED EXPERTS

Bernard Tyson
CEO, Kaiser Permanente

Dr. Donald Fong
Director, Kaiser Permanente Southern California Eye Monitoring Center

Dr. Johannes Schmidt-Tophoff
CEO, Curagita

Susan Dentzer
President and CEO, Network for Excellence in Health Innovation (NEHI)

John Kravitz
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Dr. Ateev Mehrotra
Associate Professor of Health Care Policy and Medicine, Harvard Medical School and Hospitalist, Beth Israel Deaconess Medical Center

Dr. Bertalan Meskó
The Medical Futurist

Tom Davenport
President's Distinguished Professor of Information Technology and Management, Babson College

everything from drug discovery to radiologic image interpretation, automating repetitive tasks, speeding up interpretation, and offering insights into disease subtypes and progression that allow for better treatment.

Internet of Things

Any kind of device that senses and communicates health data is part of the so-called health care internet of things, or IoT. Expectations of growth in this sector are robust. Tom Davenport, the President's Distinguished Professor of Information Technology and Management at Babson College, says that the health IoT will become "the most important and prolific source of real-time health data that we will have."

Business Insider's research arm, *BI Intelligence,* forecasts that the health care IoT, excluding wearable consumer devices, will grow from approximately $95 million in 2015 to $646 million in 2020. In this category will be everything from thermometers to electrocardiograms to "smart" hospital beds and medication dispensers. By 2020, *BI Intelligence* predicts that there will be 24 billion IoT devices on Earth, or about four devices per human being on the planet.

One example is a blood glucose monitoring device that works via a small sensor on the individual's abdomen. A filament extends from the sensing pad to just under the wearer's skin, to measure and display glucose levels every 5 minutes. After wearing the device for up to 7 days, the individual returns to the provider's office, where the data is downloaded from the receiver to the provider's laptop, displaying a full picture of levels over time. The health IoT will empower consumers to safeguard their own health and seek affordable, responsive care at their convenience. Hospital discharge can occur earlier when the patient can be safely monitored in a lower-acuity setting, including his or her own home. The benefits there alone are considerable: the patient is typically more comfortable at home; hospital settings carry known risks, such as hospital-acquired infections; and, of course, the patient's home is a much more cost-effective setting than is a hospital bed.

The convergence of consumer-derived data (for instance, from wearable devices), administrative claims data, and clinical data is only expected to accelerate, forecasts McKinsey. Experts McKinsey consulted predict that within three to five years, we will see a number of companies emerge that specialize in population health management, health information systems, and health care data and analytics, based on their ability to integrate data from disparate sources and use it to target individual and population health.

Data interoperability is one key to reaping the benefits of this sector, but advances are being made at record pace. Consumer demand in all markets, aided by technology, will drive disruption in the health care industry. The potential upsides in the digital transformation of health care in the next three to five years are significant, for health care systems, payers, and consumers alike. And, of course, for smart organizations that find high-tech solutions to health care's biggest challenges—among them access, quality, and cost—while meeting consumers' demand to be engaged, informed guardians of their own health.