A reimagined IT infrastructure for health care could reorient us from sickness to wellness

A new operating system for health care

Health data is all around us. Your electronic health records (EHRs) include your medical issues, test results, vital signs, allergies, prescriptions, and surgeries. Your health insurer's database collects the claims paid on your behalf. Your pharmacy may record your flu and covid-19 shots. Maybe a smartwatch counts your steps and measures your heart rate; perhaps a genetic testing company has your DNA. Some people have pacemakers that transmit information to their cardiologist or implanted sensors that continuously track their blood sugar.

What we don't have is a way to make this data all work together — a "personal health ecosystem," says Bharat Sutariya, MD, managing director in health care for Deloitte Consulting LLP and an emergency medicine specialist. The endocrinologist treating your diabetes doesn't have ready access to your eye exam results, which could help them preserve your eyesight. Your phone might contain vital medical information that emergency room (ER) staff needs to properly take care of you, but it has to be able to connect with the hospital's systems to transmit that data.

Dramatically better integration, however, is coming in the not-so-distant future, Sutariya says. And when it does, today's health information management will seem as antiquated as sending a telegram. "The cloud infrastructure that's becoming ubiquitous is going to

Key takeaways

- We are all awash with health data, but the medical system requires a shift in its underlying IT infrastructure — a new "operating system" for health care — to connect that information and promote better health.

- Interoperable electronic health records (EHRs) and a new legal requirement to support data sharing in the U.S. are key enablers for this new vision of connected health care.

- Supported by the next generation of health-care IT, this connectedness will allow advances including predicting and anticipating health outcomes, connecting health to environmental and social factors, expanding remote health monitoring, and providing personalized genome-based medicine.

unleash that potential," Sutariya says. "If you choose to share your data, your doctor will know about your steps and your stress level from the apps you use, and smart pill packs will be able to record whether you're taking your medication. If you have chest pain, paramedics will be able to access your records in the ambulance, and they'll exchange pre-hospital intervention history with the receiving hospital. The ER doctor will have your treatment already staged because they've got your complete risk profile, and they'll get you right to the cath lab."

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Bharat Sutariya, MD, managing director in health care, Deloitte Consulting LLP

A new understanding of the power of connected health data may kick off this shift. In the U.S., for example, the historically decentralized nature of health care has been a blocker, but recent legislation mandating interoperable core EHR data and asserting patients' ownership of their health data is changing this.

"These two provisions have started a movement that I believe is unstoppable," says Sutariya. "It's a game changer already, because the law says providers must share this data anywhere that the patient — who owns the data — tells them to share it." After an extended period of rulemaking, those provisions went into effect late in 2022.

Reimagining health care

Universal interoperability and data access have the potential to improve health care to the point where it's unrecognizable to today's patients. Here are just a few changes we can expect:

Anticipatory medicine. Analyzing data on millions of patients may allow us to predict the trajectory of a person's health at any point — even from birth, in some cases. EHRs will be able to match a patient with thousands of patients who share their characteristics, helping to identify which health risks are most urgent and which treatments are likely to work best for that individual.

These databases are already being compiled. Oracle Cerner, one of the largest EHR companies in the world, is offering its customers membership in the Learning Health Network: the cost of entry is their patients' deidentified data. The database now holds 100 million records from 100 health systems. David Feinberg, MD, chairman of Oracle Health, expects that these enormous databases will improve equity by including typically underrepresented groups in all kinds of health research. "These represent the United States much better than what you typically get in an academic trial," he says, "so industries like pharma are really excited to get to train their models on this data."

Population health. Your health is about more than just medical care — it's about whether there's a grocery store nearby, how safe your neighborhood is, and what's in the air you're breathing. A reimagined health information system could tie medical data to those environmental factors and make recommendations tailored to a

Anticipatory medicine is a powerful tool — and an equity challenge

Google has demonstrated the potential of "anticipatory medicine" with an AI-powered app to predict kidney failure. Simply alerting physicians as soon as their hospital patients get a test result showing high creatinine — a sign of failing kidneys — can cut diagnosis time from hours to minutes. Google improved on this by applying machine learning to the full medical records of more than 700,000 patients, analyzing more than 600,000 variables per patient, resulting in an algorithm that can predict kidney failure up to two days in advance with 90% accuracy. That's more time to take preventive action — possibly keeping a patient out of the hospital entirely.

Oracle's David Feinberg, who worked for Google when this research was done, calls the result "amazing" but also points out that training data came from the Veterans Affairs (VA) health-care system, where 93% of patients are men. The original model doesn't work nearly as well on women or nonveterans, and it needs much more training to improve its accuracy for these groups. "That's where equity becomes an issue," Feinberg says. "If you train the model on one situation and use it in a different situation, it could make health equity worse."

patient's specific situation: suggesting safe places to take a daily walk, for example, to someone who lives in a neighborhood that doesn't have sidewalks.

It could also rapidly address care issues caused by emergencies and natural disasters. "If there are forest fires in California, we can hone in on the affected areas, identify children who may be at risk for developing asthma, and provide them the appropriate interventions," says Sarah Matt, MD, vice president of healthcare markets, Oracle Health.

Remote monitoring. Connected gadgets will provide valuable data streams that help in ways both subtle and dramatic. "It can often be challenging for people to determine whether they're having a heart attack or a panic attack," says Matt. A bad call can result in a wasted trip to the ER – or worse. "In the future, I think we'll see increased access to devices that can help distinguish between the two events and route them to the appropriate care," she says. This function will have a twin benefit: true heart attack patients will be helped faster, and those with heartburn or anxiety can skip the ER and go right to treatments that will help those conditions.

These devices will turn up anywhere that continuous monitoring can produce actionable information. Withings recently introduced a device that makes any toilet a urology lab, tracking hydration, nutrient levels, ovulation, and other health indicators. This type of technology could also transform public health by detecting bacteria and viruses directly in the water system to sound early alarms on disease outbreaks.

Genomics for everyone. Already, the cost of sequencing a human genome has dipped below $1,000. Inexpensive data storage and rapid processing may eventually make it economically feasible to sequence everyone's genome: "Everyone will get their genome done at birth," predicts Feinberg. "And we can tell you then whether you have one of 77 disorders that are autosomal dominant. Then there will be polygenic risk scores that combine multiple signals in your genome with the information in your EHR and show that you're at high risk for Alzheimer's or heart disease. We'll know that some medications won't work for you, so your doctor will know not to prescribe you Heparin."

Because genomic discoveries are likely to continue at a brisk pace, each person's record will have to be updated
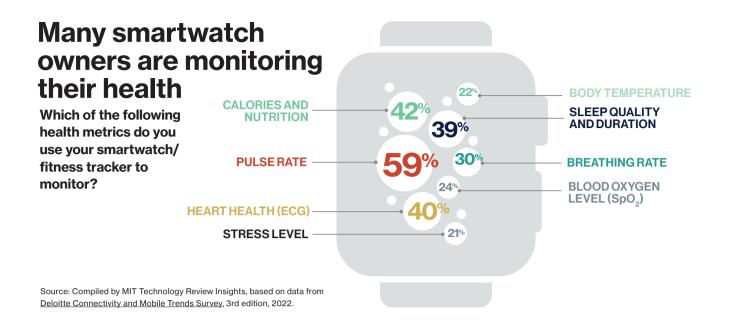
Electronic health record capabilities organizations plan to invest in

Capability	%
COMMUNICATION TOOLS (TELEHEALTH, MESSAGING)	**61**%
ONLINE APPOINTMENT SCHEDULING	**50**%
VIRTUAL REGISTRATION/ DEMOGRAPHIC COLLECTION	**47**%
CHATBOTS/SOCIAL MEDIA TO ANSWER OR DIRECT PATIENT QUESTION	**32**%
ACCESS TO VITALS/ABILITY TO ADD TRACKER DATA	**26**%
HEALTH AND WELLNESS EDUCATION	**21**%
SYMPTOM CHECKER/TRIAGE	**16**%
AUGMENTED OR VIRTUAL REALITY EDUCATION OR THERAPY TOOLS	**16**%

Source: Compiled by MIT Technology Review Insights, based on data from Delotte Future of EHR Survey, 2022.

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Many smartwatch owners are monitoring their health

Which of the following health metrics do you use your smartwatch/ fitness tracker to monitor?

CALORIES AND NUTRITION — 42%

22% — BODY TEMPERATURE

39% — SLEEP QUALITY AND DURATION

PULSE RATE — 59%

30% — BREATHING RATE

24% — BLOOD OXYGEN LEVEL (SpO$_2$)

HEART HEALTH (ECG) — 40%

STRESS LEVEL — 21%

Source: Compiled by MIT Technology Review Insights, based on data from Deloitte Connectivity and Mobile Trends Survey, 3rd edition, 2022.

periodically to reflect new knowledge, and users will be alerted about discoveries that apply to them. Participants in the National Institutes of Health's All of Us research program already get these routine updates in exchange for donating their deidentified genomic information to the project's database. Currently they can be alerted about 30 genes that affect their risk for developing certain diseases and another seven that affect how their bodies handle certain medications.

Toward a new operating system

Experts agree that health-care systems need an overhaul to make them more usable and reorient them toward improving health rather than just generating an accurate bill. "It's going to be hard work to hook all of these things together and make a broad ecosystem that's easy for a consumer," says Hashim Simjee, global Oracle health care leader and principal at Deloitte Consulting LLP. "How do you have a meta layer that pulls information together to say, 'I've got EHR data here, I've got my smartwatch data here, I've got data from my rowing machine and my bike here.'" Simjee expects that consumers could help drive this transition: "Consumer demand can be the nudge that
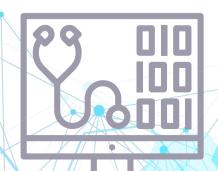
gets providers to integrate their data — or to risk losing a patient to a physician who can."

This desiloing will need to happen on the provider and payer side, as well. Simjee says the ecosystem players will need to make their data more transparent and to begin talking to one another. "There is no cohesive platform today," he says, "that can connect from patient intake all the way through billing and potentially even link the insurance side of it." Established health-care systems may need to take decisive action — including substantial investment in IT infrastructure — to deliver on this radically new health care future.

A new health-care operating system could also connect frontline patient care to back-office operations in new ways. Sutariya imagines outcomes that could be spurred by a hypothetical heart attack patient: "The automated administrative system evaluates if the hospital provided an appropriate quality of care and adjusts the payment based on that. A connected enterprise resource planning (ERP) system says, 'now I need to restock the medications used to stabilize the patient in the ER.'

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Hashim Simjee, global Oracle health care leader, Deloitte Consulting LLP

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David Feinberg, MD, chairman of Oracle Health

A workforce management system recognizes the acuity of the patient, notes the need for a one-to-one nurse, and sends a real-time staffing forecast to management." Feinberg describes Oracle's ambitions as similarly end to end: "We're going to bring together EHR with supply chain, with human capital management, with ERP, with claims processing, with clinical trials."

As interoperable EHR data meets advances in data science and AI, health-care systems have an opportunity to empower innovation, optimize operations, and improve outcomes. If they modernize their technology stacks to take advantage of these advances, they can simultaneously meet the needs of patients, providers, payers, researchers, and regulators, all in service of improving human health. "The point is to get this information to whomever needs it," Feinberg says, "whether it's a government worrying about its population or a case manager worrying about 30 congestive heart failure patients or a mom caring for her child and her parents at home. Health care at its core is people caring for people, and we want to arm them with the technology that allows them to do that better."

Reform challenges extend beyond tech

The technology is promising, but to realize a new health-care future, other parts of the system also need an overhaul.

Payment models. Changing our focus to promoting health means paying for health-care services on that basis so providers won't face conflicting incentives. "Almost every major change in health-care delivery models has come as a result of a change in payment model," says Deloitte's Bharat Sutariya. Insurers have been trying to move toward "value-based reimbursement" for years, but progress has been slow. "Economic incentives are aligned everywhere else but the U.S.," says Oracle's David Feinberg. "When we go to our customers in the rest of the world and say, 'Hey, this thing improves quality and decreases costs,' they say, 'How fast can we do it?'"

Disparities and inequities. Any technology solution should support equity in health-care delivery. "Hospital at home," for example—a vision for how remote monitoring could give patients the advantages of the hospital from their own beds—has the right intentions but makes certain assumptions, says Oracle's Sarah Matt. "Though most patients would likely prefer to receive care in the comfort of their own homes, consider the patient experience if hospital at home services are provided during a heatwave in Texas, and the home doesn't have air conditioning," she says. "There are a multitude of factors that could play a role—whether infestations, spotty electricity, or no internet—and these disparities among in-home care settings only magnify the pervasive inequities that exist in our society. People can't have 'hospital at home' without first addressing these fundamental issues, and it's our society's responsibility to make that effort."

Privacy, security, and trust. Will people be willing to entrust their health information to these systems? Feinberg says yes—but only if we perceive we're getting high value in return. "When I use Google Maps, I'm telling them who I am and where I'm going," he says, "but it's worth it for the value the app gives me by telling me how to avoid traffic jams and what time I'll arrive." Similarly, technology could create value by giving a breast cancer patient advice on every step of the journey: how to explain the disease to their kids, how to manage leave from work, when and where to get a wig, how to interpret complicated test results. "We have to give more than we take," Feinberg says.

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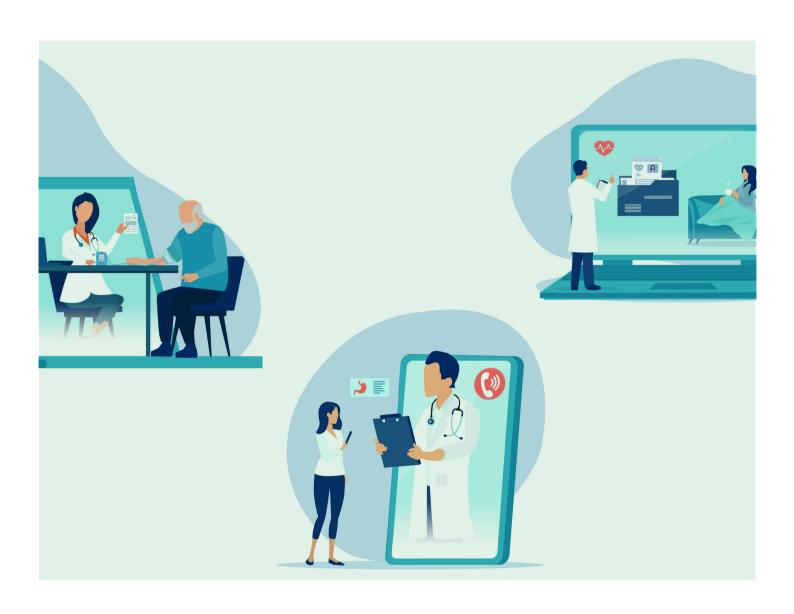
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