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The hospital is dead, long live the hospital!

Innovations that will shape the next generation of hospitals.

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Executive summary

The world is changing, and so are hospitals. In response to significant external forces, innovations in both how healthcare is delivered and how hospitals are structured are emerging. Through these innovations, hospitals can better position themselves to survive—and even excel—in tougher conditions.

Nine major forces are involved:

— Changes in patient populations and their needs

— Higher patient expectations

— Recognition that many types of care can be better provided in community settings

— Data suggesting that high-quality care requires high-volume centres, and the emergence of standalone single-specialty centres

— Advances in clinical knowledge and technology

— Impact of digital technologies on how healthcare is delivered

— Difficulties in attracting and retaining an appropriately skilled workforce

— Financial and funding challenges

— Requirements to measure quality

Whilst their relative importance differs from country to country, these forces are at play across the globe. To investigate how hospitals are responding, we have identified global best practices through interviews with healthcare experts in conjunction with extensive desktop research.

Our results show that contemporary healthcare providers around the world are facing several urgent imperatives: to strengthen clinical quality; increase the delivery of personalised, patient-centred care; improve the patient experience; and enhance their efficiency and productivity. As a consequence, providers are introducing innovations in care delivery—often to achieve multiple aims. These innovations include adopting lean and standardised processes to improve quality and optimise productivity, increasing the use of automation and nonmedical staff members to change how they their clinical workforce is deployed, employing new technologies to deliver better-quality care at lower cost, involving patients more closely in care delivery, and harnessing patient-generated data to personalise treatments. In our experience, the providers that are achieving the best results have put as much attention on change management as on the changes themselves. By addressing the mind-sets and cultures of both the clinical and nonclinical staff, these providers have increased their organizations' agility and realised lasting success.

(continued)

Executive summary (continued)

Many providers are also making a variety of strategic, structural changes to their hospitals, sometimes in response to incentives or payment reforms. Leading health-care delivery systems are pursuing three types of strategy as they strive to balance quality, access, and cost.

— Many large "regional hub" hospitals are seeking to increase volumes in specialised services to deliver high-quality care affordably.

— Smaller hospitals (sometimes called local or community hospitals) are forming networks to invest in infrastructure, share back-office costs, and attract and retain staff who want to undertake a range of clinical work. In some countries, such networks are also being formed by larger hospitals, again with the goal of sharing gains from economies of scale and volumes.

— Vertical integration is increasing amongst regional hubs, smaller local hospitals, community-based care and, in some cases, payer organisations. This last trend is making it easier for delivery systems to coordinate the full range of care and provide care closer to patients' homes.

Which of these strategies is best for a given healthcare provider depends on both the provider's starting point and local market conditions: for example, regulations, cultural beliefs, funding sources, competitive conditions.

Some countries may not yet be feeling the full force of the external factors reshaping their hospitals. We believe, however, that this is a case of "not yet" rather than "not ever." All hospitals today need to make choices about how to alter the way they deliver care. If they are to improve efficiency, meet the expectations and requirements of patients (and often payers), and attract and retain the best staff, providers need to continue to innovate.

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The world is changing for hospitals

Hospital care is changing rapidly and radically. Standalone hospitals, once the flagships of healthcare in many communities, are no longer the answer to some of today's most urgent healthcare needs. Neither are they islands that can ignore trends sweeping across our world. Hospitals must adapt and rethink their offerings to fit future needs.

Nine major external forces are affecting the work of hospitals. Whilst their relative importance differs country to country, these forces are at play across the globe.

Patient populations are getting older, and their needs are becoming more complex. The proportion of patients with more than one long-term condition is increasing. In the United Kingdom, for example, the proportion of these high-need patients increased from 32 percent in 2002 to 43 percent in 2012.[1] The cost of caring for these patients is up to eight times higher than the cost of caring for healthy adults.[2] More people are surviving heart attacks[3] and strokes[4] than ever before; however, they often require significant post-discharge care—40 percent of stroke survivors, for example, need support to perform daily activities after leaving hospital.[5] Similar trends in patient populations and cost burdens can be seen throughout Europe, as well as the rest of the developed and developing world.[6,7]

Patients have far higher expectations than before. Patients—along with their families and caregivers—expect to receive more information about their conditions and care, access to the newest treatments, and better amenities.[8] They also want greater involvement in healthcare de-

1 Department of Health Long Term Conditions Team. *Long Term Conditions Compendium of Information: Third edition*. UK Department of Health. 2012.
2 George J, Martin F. Briefing paper (4): Living with long term conditions. British Medical Association. 2016.
3 Schmidt M et al. 25 year trends in first time hospitalisation for acute myocardial infarction, subsequent short and long term mortality, and the prognostic impact of sex and comorbidity: a Danish nationwide cohort study. *BMJ*. 2012;344:e356.
4 Edwards JD et al. Trends in long-term mortality and morbidity in patients with no early complications after stroke and transient ischaemic attack. *Journal of Stroke and Cerebrovascular Disease*. 2017;26(7):1641–5.
5 Stevens E et al. The Burden of Stroke in Europe. Stroke Alliance for Europe, 2017.
6 Busse R et al. Tackling chronic disease in Europe: Strategies, interventions and challenges. European Observatory on Health Systems and Policies. 2010.
7 Multimorbidity: A Priority for Global Health Research. The Academy of Medical Sciences. April 2018.
8 Time to think differently: Public expectations and experience of services. The Kings Fund. 2012.

cisions and have higher standards. Many patients are increasingly acting as consumers,[9] a result of easier access to information and technology, the growth of "retail" models of healthcare that prioritise patient comfort and satisfaction (for example, dialysis centres that offer free Wi-Fi and television during the four-hour sessions[10]) and, in many countries, higher cost-sharing levels.

Recognition is increasing that care is better provided in a community setting. Patients benefit when their care is managed outside of the hospital whenever possible. Better primary preventive care for patients with chronic conditions reduces both the complication rate and need for hospital care.[11] Early post-surgical discharges can be made without increased complications and may improve patient satisfaction.[12] Conversely, longer hospitalisations can lead to significant loss of muscle strength in elderly patients—one study found that older people can lose up to 5 percent of muscle strength for each day of treatment in a hospital bed.[13] In addition, clinical advances are making it possible to perform a growing number of procedures in outpatient settings. At present, only a tiny percentage of total knee-joint replacements in the United States are being performed on an outpatient basis; orthopaedic surgeons there predict that 28 percent of those operations will move to outpatient settings within ten years.[14] Meanwhile, online healthcare platforms such as WeDoctor and Ping An Good Doctor in China and Practo in India are emerging, with a goal of keeping more patients out of hospitals. The trend towards increasing outpatient care is also reflected in the growth of free-standing retail clinics or urgent care centres in Australia, the United Kingdom, and the United States (although the development of this mode of provision has been slower in Australia than in the other countries[15]).

High-quality care requires concentration into specialised, high-volume centres of excellence. There is considerable evidence that the volume of activity is positively correlated with the outcomes delivered. This relationship has been proved in many areas of planned care—including joint replacement surgery,[16] cataract surgery,[17] paediatric surgery,[18] and cancer surgery[19]—as well as acute care (for example, for major trauma,[20] strokes,[21] and heart attacks[22]). One response to this evidence is the emergence (especially in Asia) of specialist providers that deliver standalone,

9 Pearl R. Are you a patient or a healthcare consumer? *Forbes*. October 15, 2015.
10 NephroPlus. Hemodialysis. Nephroplus.com.
11 Jonkman NH et al. Do self-management interventions in COPD patients work and which patients benefit most? An individual patient data meta-analysis. *International Journal of Chronic Obstructive Pulmonary Disease*. 2016;11:2063–74.
12 Gonçalves-Bradley DC et al. Early discharge hospital at home. *Cochrane Database of Systematic Reviews*. 2017;6:CD000356.
13 Department of Health Comptroller and Auditor General. Discharging older patients from hospital. National Audit Office. May 2016.
14 Unpublished McKinsey survey of practising US clinicians.
15 Harris P et al. The Australian public's preferences for emergency care alternatives and the influence of the presenting context: A discrete choice experiment. *BMJ Open*. 2015;5:e006820.
16 Ravi B et al. Relation between surgeon volume and risk of complications after total hip arthroplasty: Propensity score matched cohort study. *BMJ*. 2014;348:g3284.
17 Bell CM et al. Surgeon volumes and selected patient outcomes in cataract surgery: A population-based analysis. *Ophthalmology*. 2007;114(3):405–10.
18 McAteer JP et al. Influence of surgeon experience, hospital volume, and specialty designation on outcomes in pediatric surgery: a systematic review. *JAMA Pediatrics*. 2013;167(5):468–75.
19 Huo YR et al. Systematic review and a meta-analysis of hospital and surgeon volume/outcome relationships in colorectal cancer surgery. *Journal of Gastrointestinal Oncology*. 2017;8(3):534–46.
20 Zacher MT et al. Association between volume of severely injured patients and mortality in German trauma hospitals. *British Journal of Surgery*. 2015;102(10):1213–9.
21 Saposnik G et al. Hospital volume and stroke outcome: does it matter? *Neurology*. 2007;69(11):1142–51.
22 Fanaroff AC et al. Outcomes of PCI in relation to procedural characteristics and operator volumes in the United States. *Journal of the American College of Cardiology*. 2017;69(24):2913–24.

Sidebar 1

Digital technologies are affecting healthcare delivery in five principal ways

- Automating manual tasks to improve consistency and free up time for staff to provide patient care
- Enabling patients and caregivers to play a bigger role through greater access and interactivity
- Allowing real-time management of assets and flows, which can improve department throughput
- Implementing applications for real-time decision support, which can reduce variability in the type and timeliness of care received
- Enhancing connectivity between patients and clinicians even when they are not co-located (e.g., through remote monitoring)

high-volume care in such specialties as ophthalmology, cardiology, and nephrology. These providers effectively disintermediate general hospitals as a place for the provision of some types of specialist care.

Clinical advances are delivering better quality and outcomes. Advances in clinical knowledge have led to some truly astonishing achievements. For example, UK deaths from cardiovascular disease fell by 68 percent between 1980 and 2013, even though the prevalence of the disease hovered consistently around 3.5 percent.[23] Similar reductions have been observed in other developed countries.[24] The lower mortality is attributable to both better treatments (for instance, new surgical interventions, statins, thrombolysis, and stenting) and better understanding of the condition's causes, which eventually led to significant declines in smoking rates. Decreases in mortality from breast cancer are also striking—in the United States, for example, mortality declined by 34 percent from 1975 to 2010[25]—largely as a result new therapies (such as cyclophosphamide/methotrexate/5-fluorouracil [CMF] and tamoxifen) in the 1970s and adjuvant therapy in the 1990s, not better screening. For many patients, antiretroviral therapy has converted HIV/AIDS from being a deadly disease to a chronic condition.[26] The development of sofosbuvir and other new direct-acting antiviral medications has transformed the lives and prognoses of thousands of hepatitis C patients.[27] However some of the clinical advances are very expensive, and thus payers in some countries have raised questions about which ones to fund.

Digital technologies have begun to affect how healthcare is delivered and have the potential for disruptive change. Digital technologies are driving multiple disruptions in care delivery, including a shift to self-service, remote access, and greater transparency. The types and volume of data available are exploding, which has important implications for clinical decision making. The sidebar, "Digital technologies are affecting healthcare delivery in five principal ways" discusses this in more detail.

Availability and expectations of the healthcare workforce are changing. The global workforce shortage of 7.2 million healthcare workers in 2013 is projected to grow to 12.9 million by 2035.[28] Shortages increase the strain on the workforce, leading to employee overwork and burnout.[29] Attracting students

[23] Bhatnagar P et al. Trends in the epidemiology of cardiovascular disease in the UK. *Heart*. 2016;102:1945–52.
[24] Global Burden of Cardiovascular Diseases Collaboration. The Burden of Cardiovascular Diseases Among US States, 1990-2016. *JAMA Cardiology*. 2018;3(5):375–89.
[25] Naroda SA, Iqbal J, Miller AB. Why have breast cancer mortality rates declined? *Journal of Cancer Policy*. 2015;5:8–17.
[26] Quinn TC. HIV epidemiology and the effects of antiviral therapy on long-term consequences. *AIDS*. 2008;22(Suppl 3):S7–12.
[27] Varadarajan T. The business of saving lives. *WSJ Opinion*. October 20, 2017.
[28] Global health workforce shortage to reach 12.9 million in coming decades. World Health Organization. November 11, 2013.
[29] Dixon L. The state of the health care worker shortage. Talent Economy. November 17, 2017.

to nursing programmes, for instance, becomes more challenging, which is why some hospitals offer large signing bonuses, college tuition, and free housing to employees and their children.[30]

Payers find it increasingly difficult to finance healthcare in line with increasing costs—which puts pressure on hospitals to deliver high-quality care more affordably. The rise of healthcare spending is expected to continue to exceed gross domestic product (GDP) growth in wealthy countries and in an increasing number of emerging economies. US healthcare spending has been projected to exceed 24 percent of GDP by 2040,[31] whilst spending on healthcare and long-term care in the European Union and Norway is projected to reach 13 percent of GDP by 2060.[32] Payers, employers, and governments are struggling to find funds to keep up with the high annual growth of healthcare costs, and thus they are putting more pressure on healthcare providers to deliver high-quality care affordably. Capital requirements and availability are also an issue, caused by ageing infrastructure and the need to invest in new technologies.

There are more requirements to measure and publish quality metrics and to receive financial bonuses for high-quality care. In the past, patients had limited information about the quality of their hospitals and doctors. Today, hospitals in Canada,[33] Scandinavia,[34] and the United Kingdom[35] are legally required to publish quality measurements. Mortality, readmittance, and infection rates are amongst the required metrics, and some healthcare providers are voluntarily releasing additional information. As more data becomes available, patients have a greater opportunity to assess hospitals—and even doctors—before deciding where and to whom to go. Moreover, in many cases, financial bonuses are being awarded for the provision of high-quality care. In Sweden, for example, performance-related payments are linked to quality targets and compliance with clinical guidance.[36] In England, National Health Service (NHS) providers have an incentive to support improvements in quality through Commissioning for Quality and Innovation (CQUIN) payments: they are given additional funds for delivering specified improvements, as set out in the NHS standard contract.[37] Increasingly, hospitals must have distinctive offerings for payers and patients to attract and retain their business.

All of the forces described above are putting pressure on hospitals to improve their operations—including their productivity. In response, innovations in how care is delivered are being developed and implemented. Hospitals are adopting many of these innovations to better position themselves to survive—and, in many cases, to excel. The following sections describe key innovations in healthcare provision and hospital structure. We expect the trend towards innovation to continue in all markets and all parts of the world (although the speed at which it takes hold may vary). Which of these strategies is best for a given hospital depends on both its starting point and local market conditions.

Note: *An addendum to this article, entitled "The nine forces changing the world for hospitals" provides more details about these forces. To obtain a copy of the addendum, readers can contact the authors of this paper.*

30 Kavilanz P. Hospitals offer big bonuses, free housing and tuition to recruit nurses. *CNN Money*. March 8, 2018.
31 Teitelbaum J et al. The financial sustainability of health systems: A case for change. A joint report from McKinsey and World Economic Forum. 2012.
32 Appleby J. Spending on health and social care over the next 50 years: Why think long term? The King's Fund. 2013.
33 Sutherland J, Repin N. Hospital quality policy brief. Vancouver: UBC Centre for Health Services and Policy Research. 2014.
34 KPMG. Through the looking glass: A practical path to improving healthcare through transparency—Scandinavia. KPMG International. March 2017.
35 NHS England. Clinical Services Quality Measures (CSQMs). NHS.uk. Accessed September 21, 2018.
36 Glenngård AH. The Swedish health care system. The Commonwealth Fund. Accessed May 3, 2018.
37 NHS England. Commissioning for quality and innovation (CQUIN) guidance for 2017–2019. NHS publications gateway reference 07725. March 2018.

Innovations in clinical care delivery

In hospitals around the world, innovations in care delivery are being introduced. These innovations often have multiple goals: to strengthen clinical quality; increase the delivery of personalised, patient-centred care; enhance the patient experience; and improve their efficiency and productivity. Each of these goals is an urgent imperative for hospitals today.

Adopting lean processes

Amongst hospitals, enormous variation exists in how services are delivered, resulting in significant differences in both the quality of care and unit cost of care delivery. This variation exists within hospitals, across hospitals within a region or a country, and across countries. Unwarranted variation in English NHS acute hospitals, for example, is estimated to cost an excess £5 billion a year (out of a total budget of £55.6 billion[38]). Similar costs have been seen in other countries.[39]

Lean, standardised processes—learned from best-practice peers and aided by artificial intelligence (AI) and digital control centres—are being adopted by hospitals to ensure consistently high-quality care and improve productivity. For example, the Beth Israel Deaconess Medical Center in Boston has worked with data scientists from Amazon and Google to analyse seven petabytes of data and develop operational tools to help the health system use its resources more efficiently when delivering clinical care. For instance, AI is being used in operating theatres to more accurately predict how much time to schedule for a particular patient-surgeon combination, which has increased efficiency by 30 percent.[40]

The Vall d'Hebron University Hospital in Barcelona provides another example of how dedication to lean processes is shaping the clinical environment. In the hospital's new operating room, a process engineer, who is not medically trained, spends all day thinking about how to rationalise processes and improve outcomes. To support efficient patient and staff flows, display screens allow staff to regularly monitor operating room logistics.

Workforce reform

In response to the increasing cost of care provision and the worsening shortage of healthcare professionals, hospitals around the world have started to reallocate tasks to different types of staff to free up time for those highly trained to perform activities for which specific education and qualifications are critical.

Aravind Eye Hospitals, a cataract surgery specialist in India, has expanded the use of technicians in the operating room to assist surgeons with specific tasks, which enables the surgeons to be more efficient and treat many more patients. Today, technicians make up about 60 percent of Aravind's workforce. In addition, Aravind has expanded the role of its nurses, which it calls mid-level ophthalmic personnel, to perform all hospital tasks other than operations and diagnoses.[41]

Similarly, many countries have increased the responsibilities of nurses. In England, nurses with special training in specific areas are

[38] Lord Carter of Coles. Operational productivity and performance in English NHS acute hospitals: Unwarranted variations. Department of Health. February 2016.
[39] Kelly AS et al. Prospective identification of patients at risk for unwarranted variation in treatment. *Journal of Palliative Medicine*. 2018;21(1):44–54.
[40] Interview with John Halamka, Chief Information Officer, Beth Israel Deaconess Healthcare, 23 February 2018.
[41] Pandey S et al. Why Indian nonprofits are experts at scaling up. Stanford Social Innovation Review. Spring 2017.

authorised to prescribe certain medications and manage diseases in their specialty.[42] In parts of the United States, anaesthesia care is provided by certified registered nurse anaesthetists (CRNAs). In 2017, US CRNAs administered anaesthetics approximately 43 million times.[43]

Two recent McKinsey reports, *The Productivity Imperative for Healthcare Delivery in the United States* and *The Future of Work*, have highlighted the potential for technology to address some of the workforce shortages in healthcare.[44,45] For example, automation may be able to reduce wait times and increase productivity, enabling doctors and nurses to focus more effectively on improving patient outcomes. Machines could also take on routine activities such as registration, checkout, and some dispensing of prescription drugs.

Technological improvements in inpatient care

Automation, technology-enabled scheduling of patient and staff time, and decision assistance—including computer vision (the use of computers to analyse and interpret digital images)—are three ways in which technology is already shaping the delivery of care in many hospitals.

In recent years, a few hospitals with an especially high degree of service automation have opened. For example, the Humber River Hospital (HRH) in Toronto launched its brand-new, high-tech facility to patients in October 2015. CEO Barbara Collins had previously found that "only 38 percent of staff time was spent with patients; the rest was spent on charting, walking around, and supply collection." With a new hospital twice the size of three old facilities but with the same operating budget, HRH set out to automate as many manual tasks as possible, both to enable staff to spend more time with patients and to give them the systems and technology needed to create an environment for highly reliable care. Today, HRH has automated approximately 80 percent of its

back-of-the-hospital services, such as pharmacy, laundry, and food delivery.[46] In addition, it is using technology to improve frontline clinical care. (See the sidebar "Humber River Hospital (Toronto) is using technology to improve frontline care".)

Scheduling resources in an efficient and cost-effective way is challenging, and at many hospitals, these tasks are often left to individuals with limited training or experience. To solve this problem, a team from Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, developed an AI robot for automating hospital scheduling of doctors and nurses. The tool anticipates room assignments and suggests which nurses to assign to patients for different procedures. When the team tested the tool in a tertiary care centre's labour-and-delivery ward, 90 percent of the recommendations were accepted. Furthermore, the solution received positive feedback for creating a more even workload, given that it could consider all the scheduling constraints and complexities that are often difficult for humans to grasp quickly.[47]

Real-time decision support, including computer vision, offers many advantages to hospitals. It not only proactively identifies and alerts staff to patients whose clinical status is deteriorating, but also reduces errors and saves staffing costs through more accurate and efficient processes. Complex algorithms are increasingly able to match—and even outperform—the diag-

[42] NHS at 70: The changing role of nurses. HCL Workforce Solutions. May 4, 2018.
[43] Certified registered nurse anesthetists fact sheet. American Association of Nurse Anesthetists. Updated September 17, 2018.
[44] Sahni N et al. *The Productivity Imperative for Healthcare Delivery in the United States*. McKinsey report. February 2019.
[45] Manyika J, Sneader K. Automation and the future of work: Ten things to solve for. McKinsey Global Institute. June 2018.
[46] Kutscher B. Inside North America's first all-digital hospital. Modern Healthcare. April 30, 2016.
[47] Gombolay M et al. Robotic assistance in coordination of patient care. Proceedings of Robotics: Science and Systems. June 2016.

Sidebar 2

Humber River Hospital (Toronto) is using technology to improve frontline care

- Staff are equipped with personal digital assistants so they can connect directly with patients who have hit their call buttons, thereby reducing hallway traffic
- Blood pressure, temperature, and other vital signs are automatically transferred to the patient's electronic health record
- Lab testing is fully automated. Once a sample for testing is sent to the laboratory, human hands never touch it again, which reduces the risk of human error and contamination. Test results are delivered within approximately one hour, and staff are informed of abnormal results on their portable devices
- A closed-loop, fully automated medication administration system matches each bar-coded medication to the bar code on a patient's armband; the system not only documents medication administration for the nurses, but also has virtually eliminated medication errors
- Automated guided vehicles reduce staff's need to transport supplies, food, linens, and non-narcotic medications
- Radio-frequency identification (RFID) in staff name badges allows for silent tracking in the event that a staff member presses a button signalling a need for assistance during a stressful situation with a patient or family
- RFIDs are also incorporated into stretchers and wheelchairs, allowing tracking of the location of the nearest available equipment
- A central command centre enables visualisation of the full hospital, including bed status and incoming emergency room patients. Visualisation and artificial intelligence make rapid decision making and efficient patient flows possible, since patient care coordinators can prioritise patients and solve logistical challenges on the spot

nostic accuracy of clinicians. Image-based diagnostics using AI-enabled computer vision can create opportunities to achieve improved performance and greater accessibility. A tool that outperforms the best-trained specialists can provide diagnoses from any location in the world using the imaging equipment already available. In fact, several tools can be used with mobile-phone cameras. Examples include:

- Mobile platforms developed by a Stanford University team can detect skin cancers using mobile-phone images with the same accuracy as dermatologists.[48] These platforms provide a route for quick, accessible screening for melanoma worldwide.
- ET Medical Brain, Alibaba's cloud-based solution, combines data hosting and image diagnostics at hospitals in China. Recent successes include a tool to detect thyroid cancer from ultrasound images that has an 85 percent accuracy rate, an improvement on human accuracy levels of 60–70 percent.[49]
- CellScope's application allows a smartphone or tablet to be used as a high-power microscope to identify parasite levels in blood samples from people with onchocerciasis, thus opening an opportunity for advanced diagnostics in remote environments. This technology has been used to guide treatment strategies with a specificity of 99.7 percent.[50] CellScope, a private US company, has patents in the United States and China and has done field studies in Cameroon, Hawaii, India, the Ivory Coast, Thailand, and Vietnam.[51]

[48] Esteva A et al. Dermatologist-level classification of skin cancer with deep neural networks. *Nature*. 2017;542:115–8.
[49] Xiao E. Alibaba cloud doubles down on healthcare for its AI business. Tech in Asia. Mar 29, 2017.
[50] Kamgno J et al. A test-and-not-treat strategy for onchocerciasis in Loa loa–endemic areas. *New England Journal of Medicine*. 2017;377:2044–52.
[51] CellScope. Patent Information. Cellscope.com/legal.

Many decision-support and computer-vision technologies are new and still not in widespread use—in some instances, because of a lack of research or evidence; in other cases, because of difficulties adapting them to local systems. Some contracts have been paused or terminated as a result. For example, Rhön-Klinikum, one of the largest German providers, terminated collaboration with its previous vendor after working together for one and a half years. The reason, said Rhön-Klinikum, was "the gap between aspirations and reality,"[52] in part because medical guidelines differ in different countries. Rhön-Klinikum now cooperates with an Austrian big-data service provider, Mindbreeze.

Moving care outside the hospital by using new technologies

As technology improves and allows remote care to achieve patient experience and clinical quality that is at least on par with traditional face-to-face care, a range of clinical services will likely shift to remote modalities through telemedicine and online consultations. Hospitals, by either building their own platforms or harnessing existing technologies, can reduce their costs whilst still providing service to patients. In the future, remote-access technologies and the ability to send a large amount of data very quickly are expected to continue changing healthcare delivery in several ways. For example:

Connecting patients to specialists directly. Visits that do not require physical examination (such as medication adjustments based on symptoms or readily available lab data) or for which critical data can be gathered remotely (for example, blood pressure measurements that automatically upload to an electronic health record) are amenable to telemedicine. Intermountain Healthcare, based in Salt Lake City, Utah, uses an improved staffing model to support remote patient consultation, which reduces the need for patients to take time off work and enables specialist input at an early stage in a patient's evaluation.[53]

Similarly, India's Aravind Eye Hospitals uses telemedicine to serve rural patients in locales where physicians are unwilling to travel or work. With the help of the International Agency for the Prevention of Blindness, Aravind set up five IT-enabled vision centres from which telemedicine consultation could be provided. More than 90 percent of patients received appropriate care at these vision centres. Each centre is linked directly to Aravind's base hospitals in Tamil Nadu, Chennai. This system has allowed Aravind to continue to provide high-quality care without charging needy patients—a group that is more than 60 percent of the hospitals' beneficiary population.[54]

Connecting specialised doctors in one area with primary care physicians (PCPs) in another area, to share knowledge and provide training. For example, Partners Healthcare in Boston, Massachusetts, introduced an e-consult initiative through which PCPs can request a specialist opinion. A PCP sends the service a question (linked to the patient's record); the service then routes it to the appropriate specialist, who reviews the record and provides written guidance within 48 hours. In a study of 27 primary care practices, referrals were avoided in 65 percent of the cases, and in two-thirds of these cases, there was no further referral in the following six months.[55] A similar programme connecting PCPs to nephrologists in Canada found a 45 percent reduction in referrals.[56]

Even though new technologies promise cost savings and increased patient satisfaction in the near term, adoption has been slow, for several reasons: cost, lack of payment models for remote consultations, privacy and security concerns, difficulty accurately triaging patients according to visit types, and resistance to change in healthcare practices to accommodate new modalities.[57]

[52] Frankfurter Allgemeine Zeitung. March 6, 2018.
[53] Molpus J. Intermountain Health CEO is bullish on telemedicine. HealthLeaders. June 13, 2017.
[54] Shainesh G, Kulkarni S. Aravind Eye Care's vision centers—reaching out to the rural poor. Indian Institute of Management Bangalore. October 1, 2016.
[55] Ferris T. e-Consults in ambulatory specialty care. Hospitals in Pursuit of Excellence case study. 2014.
[56] Keely E et al. Nephrology eConsults for Primary Care Providers: Original Investigation. *Canadian Journal of Kidney Health and Disease*. 2018;5:2054358117753619.
[57] Kruse, CS et al. Evaluating barriers to adopting telemedicine worldwide: A systematic review. *Journal of Telemedicine and Telecare*. 2018;24(1):4–12.

Patient involvement in care delivery

Contemporary patients are value-conscious, demand high quality, and increasingly compare healthcare providers to leaders in customer experience such as Amazon and Apple. To manage these new expectations, hospitals are offering digital solutions to increase patients' involvement in, and visibility into, their care.

Emerging initiatives are giving patients increased control of care scheduling and medical records. In Sweden, a nationwide healthcare service, "1177 Vårdguiden", allows patients to schedule and cancel appointments online, view their medical records, keep track of and renew prescriptions, and get support and treatments online.[58]

Hospitals are also beginning to offer care options that provide more personalised input from patients and their treatment teams. For example, a Johns Hopkins team in Baltimore has introduced the Corrie Health app to aid recuperation after a heart attack—from discharge to recovery. The app allows patients to track medications and physical activity, as well as stay in tune with indicators for recovery, such as heart rate, blood pressure, and mood. The data is shared with care teams to aid a successful recuperation.[59]

Harnessing patient-generated data

Expanded data sets that include genetic, lifestyle, and physiological data can improve the precision of healthcare diagnoses and treatment. Increasing investments are being made to collect data across these dimensions on population-sized samples, pinpoint key risk factors for disease development, and identify biomarkers for effective treatment.[60] Personalising treatment offers the possibility of reducing overall healthcare-provision expenditures by 5–9 percent and

increasing average life expectancy by two to 15 months.[61]

Today, most treatment decisions are based on standardised guidelines, using evidence from clinical trials. However, as the cost of DNA sequencing has plummeted, some hospitals have started using genetic analysis to personalise care. In specific cases, treatment can be tailored to the genetics of the patient or the disease. For example, Dana-Farber Cancer Institute, based in Boston, uses genomic sequencing in 40 percent of leukaemia and lung cancer patients to select specific targeted therapies. Recent results demonstrate that genetics can also be used to identify patients at risk of steroid-induced growth stunting.[62]

Precision medicines can also be informed by real-time data capture. An example is mPower, an iPhone app developed by the University of Rochester Medical Center in Rochester, New York. mPower creates a clearer picture of Parkinson's disease progression by measuring the user's dexterity, balance, gait, and memory. Researchers have already gained greater insight into the factors that make symptoms better or worse, such as sleep, exercise, and mood.[63]

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58 Så fungerar vården i Stockholm. 1177 Vårdguiden. 1177.se.
59 Marvel FA et al. Digital health innovation: A toolkit to navigate from concept to clinical testing. *Journal of Medical Internet Research*. 2018;20(1):e2.
60 Large, population "biobank" datasets have been collected by the UK Biobank, deCODE genetics, CARTaGENE biobank, Qatar Biobank, Estonian Genome project, and the Nord-Trøndelag Health Study, among others.
61 Henke N et al. The age of analytics: Competing in a data-driven world. McKinsey Global Institute. December 2016.
62 Hawcutt DB et al. Susceptibility to corticosteroid-induced adrenal suppression: A genome-wide association study. *Lancet Respiratory Medicine*. 2018;6:442–50.
63 mPower. Living with Parkinson's Disease. Parkinsonmpower.org.

Innovations in organisational structures

Increasingly, healthcare providers are making strategic structural changes to achieve and maintain access to high-quality, cost-efficient care. In some cases, payment reforms are providing incentives or other support for the effort.

Three broad types of structural changes are helping to maintain the balance of quality, access, and cost:

Larger "regional hub" hospitals are seeking to increase volumes in specialised services. These hospitals aim to deliver high-quality care affordably. Mergers, affiliations, or structural system reconfiguration (to hub-and-spoke models, for example) to redirect tertiary or quaternary patients to regional hubs support these moves.

Smaller, local, or community hospitals with the potential to thrive independently are forming networks or groups. The networks help the hospitals achieve three aims: increase their ability to invest in infrastructure, share back-office costs, and attract and retain staff who want to undertake a range of clinical work. Forming networks or groups also creates an opportunity to share best practices across hospitals and adopt the best ways of working. These hospitals generally focus on providing services for more common conditions to ensure they can achieve suitable caseloads for maintaining quality.

Regional specialised hubs, local community hospitals, and other types of community-based care are vertically integrating. These entities aim to improve their ability to coordinate the full range of care and provide care closer to patients' homes, in response to patient needs and expectations. They may also take on population health management.

Larger regional hub hospitals

Around the world, many hospitals are consolidating services to increase volumes in specialised services. The result is larger regional hubs.

In England, clinical networks have been created for major trauma, acute stroke care, and acute cardiac care, the result of which is a smaller number of higher-volume, nationally accredited centres whose quality and volumes are monitored via national clinical audits.[64] This approach has resulted in a network of 27 major trauma centres and 75 cardiac intervention centres, as well as networked care delivery for acute stroke. Patients in need of these services are now routed directly to a specialist centre, bypassing small, less specialised hospitals. The development of major trauma centres has increased the odds of postinjury survival by almost 20 percent in the past five years, saving the lives of more than 1,600 victims.[65] In London, the number of hyper-acute stroke centres has been reduced from 31 to eight, with resulting improvements—from 2008 to 2012, there was a 7-percent reduction in length of stay and a relative reduction in mortality of 15–17 percent.[66]

In Denmark, the government and the country's five health regions invested €550 million in new "super hospitals," with the aim of improving the quality of the entire hospital system and structure. The structural modernisation arose from both the need for increased specialisation to provide higher-quality care and the shift to out-of-hospital treatment for low-need patients.[67]

In the Netherlands, four hospitals in Friesland combined their clinical services into one location in 2017; in 2018, seven hospitals in North Holland and nine in South Holland formed a single service for prostate

[64] Examples of these audits include: The Trauma Audit & Research Network (Performance comparison: Trauma care. Tarn.ac.uk); Healthcare Quality Improvement Partnership (Rising to the challenge: The fourth SSNAP annual report 2017. HQIP. November 29, 2017); and Myocardial Ischaemia National Audit Project (Weston C et al. Heart attack in England, Wales and Northern Ireland: Annual Public Report April 2015–March 2016. NICOR. June 27, 2017).

[65] NHS. More than 1,600 extra trauma victims alive today says major new study. England.nhs.uk. August 20, 2018.

[66] Morris S et al. Impact of centralising acute stroke services in English metropolitan areas on mortality and length of hospital stay: Difference-in-differences analysis. *BMJ*. 2014;349:g4757.

[67] Styrket akutberedskab—planlægningsgrundlag for det regionale sundhedsvæsen. Sundhedsstyrelsen. June 26, 2007.

cancer treatment. The changes were designed to improve quality of care by making sure that surgery was performed by the highest-qualified specialists. The changes have been encouraged by Dutch payers, who are seeking to finance the top institutes in each specialty.[68]

Networks built around specialty hubs improve specialist utilisation whilst delivering higher-quality care. In some specialties, this effort has been supported by technological innovations. For example:

— In the United States, Avera Health reported that it achieved cost savings of $62 million, reduced critical-care bed-days by 11,000, and avoided 260 deaths in one year by using an electronic intensive care unit (eICU) system to provide remote specialist care to rural hospitals in South Dakota.[69]

— Emory Healthcare in Atlanta, in collaboration with Macquarie University in Sydney, has taken this concept further by staffing eICUs during out-of-hours periods with intensive care specialists located in Australia.[70]

Resistance to structural change is common in many countries, however. Sometimes, as in the Netherlands, providers are autonomous, and there is no regulatory authority to decide which procedures can (or must) be performed in each hospital. This is not the case in many other countries, though. Another problem is that hospitals and clinical staff are often reluctant to give up part of their offerings because of concerns about loss of revenues and the diversity of work. However, the trend towards consolidation—a result of increasing recognition of the benefits of centralisation—is gaining public support and political approval.

Smaller hospitals forming networks or groups

At the same time, smaller or more remote hospitals are increasingly forming community-based networks to increase the likelihood of their survival. In the United States, 80 rural hospitals closed from 2010 to 2017, and an additional 700 are believed to be at risk of closure.[71] Many of the at-risk hospitals are small, with fewer than 25 beds, but provide the only hospital services for more than 35 miles.

One community-based network, Intermountain Healthcare, based in Salt Lake City, Utah, has grown from 15 hospitals in 1975 to a network of 22 hospitals and more than 185 clinics today.[72] Other examples of networks or groups include Tenet and HCA in the United States and Asklepios and Rhön Klinikum in Germany.

For small hospitals, a network can make it possible to reduce individual costs by co-investing in IT-enabled infrastructure and by sharing management and back-office functions. Forming a network can also provide additional advantages to small hospitals that are geographically close to each other. For example, it can give the hospitals access to larger volumes of patients to support high-quality care. In

68 de Kruif F. Operaties gebundeld in Maasstad. NRC. June 15, 2018; van Aartsen C. Negen ziekenhuizen vormen prostaatkankernetwerk. Zorgvisie. June 7, 2018; and van der Meij R. Binnen twee jaar een borstkankercentrum in Friesland. Leeuwarder Courant. Updated July 20, 2017.
69 Royal Philips. Avera Health achieves significant cost savings and improved patient outcomes in rural areas with Philips eICU program. Cision PR Newswire. February 26, 2018.
70 Al Idrus A. Philips partners on Australia's first remote ICU monitoring program. FierceBiotech. September 23, 2016.
71 Zach E. Death by a thousand cuts: Rural health care in decline. Center for Health Journalism. May 12, 2017.
72 National media highlight Intermountain's strategic direction. Intermountain Healthcare newsroom.

addition, networks can strengthen the hospitals' value proposition for staff, who can undertake a greater range of clinical work in their local communities. Staff members can also share innovations and best-in-class management practices with the other facilities in the network.

Vertical integration

A third ongoing structural change is vertical integration, which makes it possible for hospitals to offer a greater range of services, from primary and community care to acute and post-acute care. Some hospitals push vertical integration even further, taking on functions not traditionally associated with inpatient care, such as population health management (often, by offering health insurance). For example, Intermountain Health and a number of other US hospital networks now offer health insurance plans to local residents.[73]

In other cases, hospital networks are taking on population health management by becoming accountable care organisations (ACOs). In this model of healthcare provision, a provider, or group of providers, takes responsibility for the provision of healthcare to a defined population. Typically, the ACOs are paid a fixed amount to provide care and are expected to reduce per-patient costs while achieving predefined quality of care metrics.

For example, the Northumbria ACO in England, which includes a hospital, primary care providers, and the local council, serves a population of more than 320,000. The organisation has developed programmes for specialist emergency care, urgent care, and primary care services (accessible seven days a week) and is redesigning community and social care services. This approach has created new opportunities for Northumberland to integrate care and increase technology use along the patient pathway.[74]

Similarly, Clalit, an Israeli ACO, insures more than 50 percent of the country's population, operates primary and specialist clinics, and owns hospitals that account for about one-third of Israel's hospital beds.

McKinsey analysis suggests that vertical integration has several benefits. Some of them pertain to the quality of care, which is enhanced by the ability to share full patient data and to ensure seamless continuity of care. (For example, patients can be "handed over" to community clinics prior to hospital discharge.) Other benefits derive from the ability to attract personnel by offering multidisciplinary training and career paths that involve both hospital and community settings. In addition, financial benefits are realised by optimising care by matching each patient's actual needs with the larger capacity available across the healthcare system.

From a regional or national perspective, the downside of all three types of innovative structures is that it can give strong market power to an organisation that offers a substantial proportion of all hospital capacity and care delivery in a particular area. Many countries have put in place regulations to prevent such market power from leading to higher prices or lower quality of care.[75]

[73] National media highlight Intermountain's strategic direction. Intermountain Healthcare newsroom.
[74] Northumbria Healthcare NHS Foundation Trust. Key facts about us. Northumbria.nhs.uk.
[75] Szostak DC. Vertical integration in health care: The regulatory landscape. *DePaul Journal of Health Care Law.* 2015;17(2):65–120.

Moving forward

In this article, we have outlined the many ways in which hospitals are changing and will continue to change. Major forces that are affecting hospitals now include rapidly changing healthcare needs due to demographic and epidemiological factors, the advent of technology-enabled healthcare systems that can deliver care in radically different ways, and the changing expectations of both the healthcare workforce and, crucially, healthcare consumers.

New entrants and disrupters will be a powerful force in all geographies and, in some cases, may reshape the whole healthcare ecosystem. Technology—be it robotics for surgery, remote monitoring, data collection and sharing systems, artificial intelligence, or precision medicine—will fundamentally change the way in which patients and clinicians interact with each other and participate in the healthcare system.

We are certain that how healthcare is provided will change: some types of care provision will shift to be closer to home or will become self-care; others will be consolidated. In most parts of the world, the increased focus on both clinical quality and patient experience will continue—or accelerate. In some countries or markets, hospitals might use their current organisational advantages to position themselves as the core of whole healthcare delivery systems. In other areas, primary and community care providers may finally deliver on their long-term promise to move a lion's share of patient care out of hospitals.

We are also certain that accepting the need for change will not be sufficient on its own to enable providers to succeed in the future. Rather, the best results will be achieved by those providers that put as much attention into change management as they do on the changes themselves. No change effort will achieve its goals unless it includes a strong focus on altering the mind-sets and cultures of both the clinical and nonclinical staff. In our experience, providers that approach change management in this way have increased their organizations' agility and realised lasting success.

Influenced by regulation, funding, competition, population dynamics, and other external factors, the emerging picture will differ amongst countries. In all cases, to be truly sustainable and successful, hospitals will need to consider what they can do to improve the quality and efficiency of service delivery, how they can adopt technology to support those changes, and which strategic choices they should make to the services they provide, the patients they serve, and the partners they work with.

Whilst hospitals have already undergone significant changes since they were first established more than a thousand years ago, our sense is that changes in the next 10 years will be far more significant than those hospitals experienced in the past 20 to 30 years. Change may not necessarily be apparent in all countries now, but we believe that this is a case of "not yet" rather than "not ever".

We cannot predict the rate at which different healthcare systems will change or exactly what the hospitals of 2030 will be like. However, they are highly likely to be very different from what we think of as an average hospital today.

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