Digital health: heaven or hell?

How technology can drive or derail the quest for efficient, high quality healthcare

KPMG International

kpmg.com/healthcare

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Executive digest

> I think we're about to come to the next era of medicine …as much as 30 percent of what we do today we will do differently …how we evaluate patients, how we follow up on patients, how we bring the expertise in between clinicians, how we manage patients in a hospital, how we think about even the role of the hospital.
>
> **— Robert Pearl**
> Kaiser Permanente, US

Around the world there is an acceptance that health services are at least a decade behind other industries in the use of information technology to increase productivity and quality. Unfortunately, where healthcare often has stood out is in problematic, overspent and underwhelming IT implementations — from the UK's National Programme for IT (NPfIT), to the USA's Healthcare.gov, to developers like Google, who saw their innovations fail to take off. Paradoxically, even "successful" implementations have sometimes made efficient care delivery more difficult, rather than less, with recent surveys of US physicians showing electronic health records (EHRs) among the principal causes of professional frustration.

The approach of most healthcare providers to extracting productivity improvements through technology so far has focused on back office efficiency and improving simple transactions, while leaving the vast majority of patient-facing activity unchanged. While the hotel, transport, retail, communications and banking industries are almost unrecognizable from 15 years ago, the promise of 'digitally-transformed' healthcare has remained over the horizon for most systems.

Looking to those that have transformed the way care is delivered — and realized genuine efficiency and quality gains as a result — it is clear that success isn't achieved by replacing analogue processes with digital ones. It's about rethinking the purpose of services, re-engineering how they are delivered and capitalizing on opportunities afforded by data to adapt and learn. Where technological interventions have failed, technology has simply been layered on top of existing structures and work patterns, creating additional workload for healthcare professionals.

This report aims to cut through both the narrow ambitions of 'doing the same things, but digitally' and the often fanciful predictions of many reports about technology's potential to transform healthcare. We have examined the real-life stories of success and failure around the world to find out what really works in realizing productivity gains in health, how organizations can get this right (or wrong), and how the delivery of healthcare is realistically going to change in the years to come.

We have identified seven evidence-based big opportunities, and seven practical lessons to capitalize on them.

Seven big wins for technology to improve productivity

01

Using **decision support and standardized workflows** is a key step in realizing improvements. Systematizing care this way can reduce variation and improve the accuracy of decision making.

02

Rewriting the relationship with patients and caregivers by **providing tools for patient engagement and self-management**. 'Self-service' options can create more meaningful participation of users, more satisfying outcomes, and reduce the workload of paid staff.

03

Reducing costs through **more proactive and targeted care**, which allows providers to intervene earlier to keep people well, supported by powerful analytics.

04

Attacking the costs and harms of fragmented and duplicative services by **coordinating care** and supporting providers to collaborate more effectively.

05

Reducing referrals and readmissions by improving the ability of providers to get things right first time through **easier access to specialist expertise and advice**.

06

Improving resource management by using technology to plan staff rosters, patient flow, match capacity to demand and improve scheduling.

07

Creating **continuous cycles of learning and improvement** through a combination of analytics, improvement science and organizational development.

> It's imperative to remember that technology is an enabler — the focus needs to be less on implementing the system and more on implementing the changes in the business enabled by that system.
>
> **— Liam Walsh**
> KPMG in the US

Seven lessons on realizing these opportunities

We have found that substantial gains in terms of productivity and health outcomes are possible — and have been demonstrated — from specific areas of health IT. As the history of frequent disappointment and failure shows, however, digital technologies will not deliver these improvements on their own. Through interviews, analysis, and KPMG's own experience achieving digital transformation with healthcare providers around the world, we have identified **seven key lessons** from those that have successfully realized the benefits and overcome the setbacks.

1. **Transformation first:** Transformation comes from new ways of working not the technology itself. You need a transformation program supported by technology not the other way round. This is the fundamental lesson that underpins everything else.
2. **People problems not technology problems:** The majority of the issues faced along the transformation journey are people problems, not technology problems. These require sophisticated leadership and change management capabilities.
3. **System design:** There has been insufficient attention to the design of systems. Technologies need to solve problems recognized by people who are going to use them, be they patients or professionals. This requires a deep understanding of the work as well as the needs of the worker.
4. **Invest in analytics:** Far too often providers make significant investments in digital systems but overlook the capabilities to use the data collected — hence the payback is never seen.
5. **Multiple iterations and continuous learning:** Even with careful design there may need to be a number of iterations in the design of systems. This is a continuous process and there may be several cycles — some quite painful — before systems reach a tipping point where all of this investment starts to pay off.
6. **Support interoperability:** The inability to share and combine data between different systems is a major rate-limiting step to realizing the full benefit of technology in healthcare. A coordinated approach to minimum interoperability standards would help accelerate healthcare providers' digital journey.
7. **Sound information governance and data security procedures:** Data sharing requires strong information governance and security, particularly in the face of a growing threat from cyber-attacks. Action is required at a national and local level to help organizations hold and share data safely.

The future of healthcare: digital heaven or hell?

Some will look at the years ahead and see a glorious nirvana in which the messy and inefficient services of today are transformed into predictive, coordinated and personalized care. Others will see a dystopia of doctors becoming slaves to algorithms and patients drowning in a sea of data and additional expectations.

Both are possible, but a look at what leading providers have already achieved — described in this report — should be cause for optimism. We conclude with our own vision of how healthcare is likely to change in the next 10 years, including that:

— Computing will be much more ubiquitous, but much less visible

— A lot less time will be spent by staff on administrative tasks and routine communication, as automation, voice recognition and natural language processing become more commonplace

— New roles and competencies will be added to the managerial cadre as the shift to digital healthcare continues — most importantly advanced analytic capabilities

— Organizational and professional boundaries will be far less visible, as integrated information technology systems dissolve many of the current divides between primary, secondary and tertiary care.

Questions explored in this study:

— Why has it been so difficult to successfully deploy information technology in healthcare?

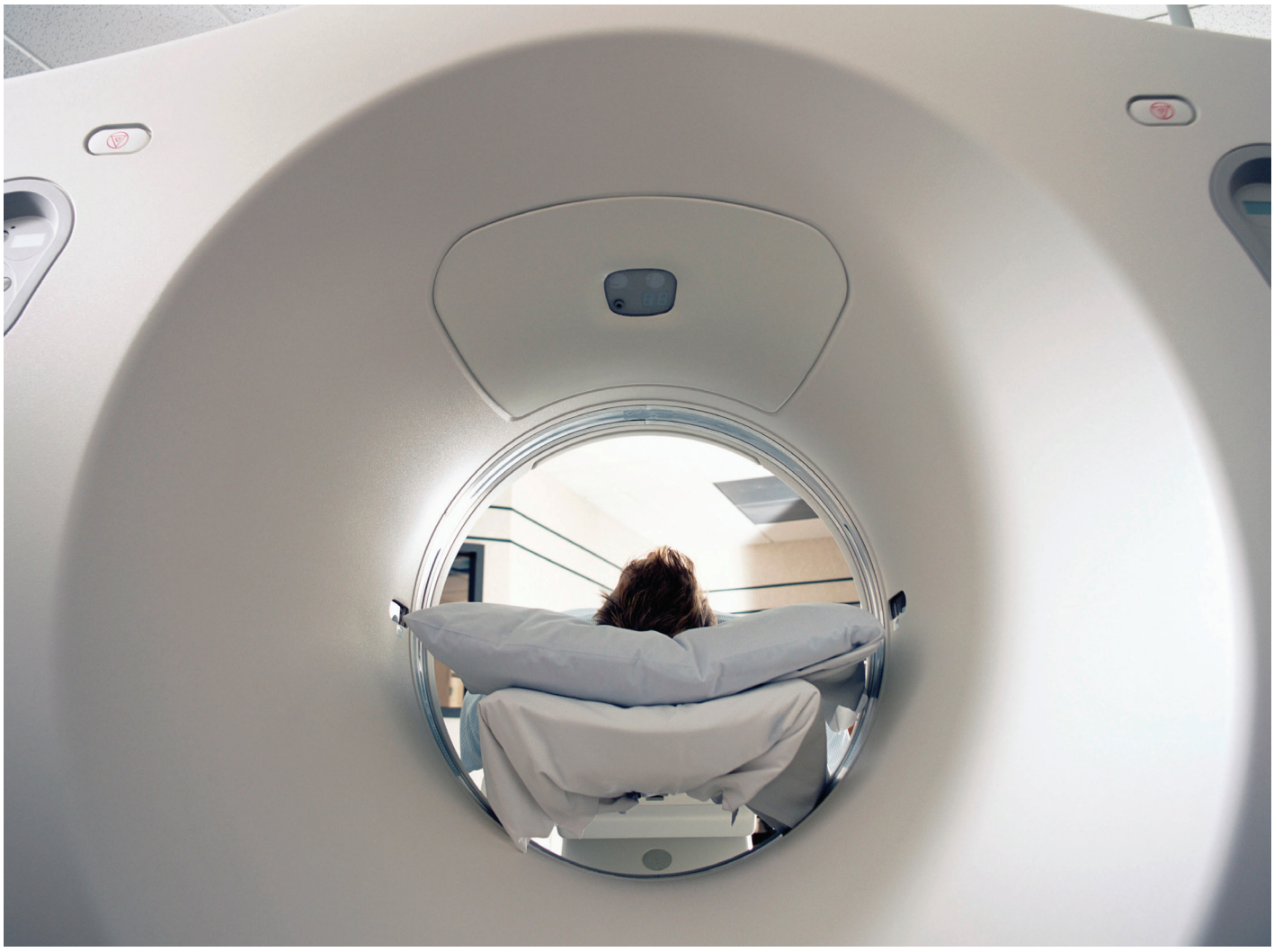
— What is the current digital healthcare landscape, and how will it evolve?

— What are the biggest opportunities for technology to improve productivity and the practical lessons for achieving success?

The current digital healthcare landscape

There is a new and rapidly changing healthcare landscape globally, where digital technologies are becoming increasingly normalized into the everyday delivery of healthcare. Alongside changes within hospitals and clinics, there is a growing consumer-based movement. This creates both top-down and bottom-up momentum for change.

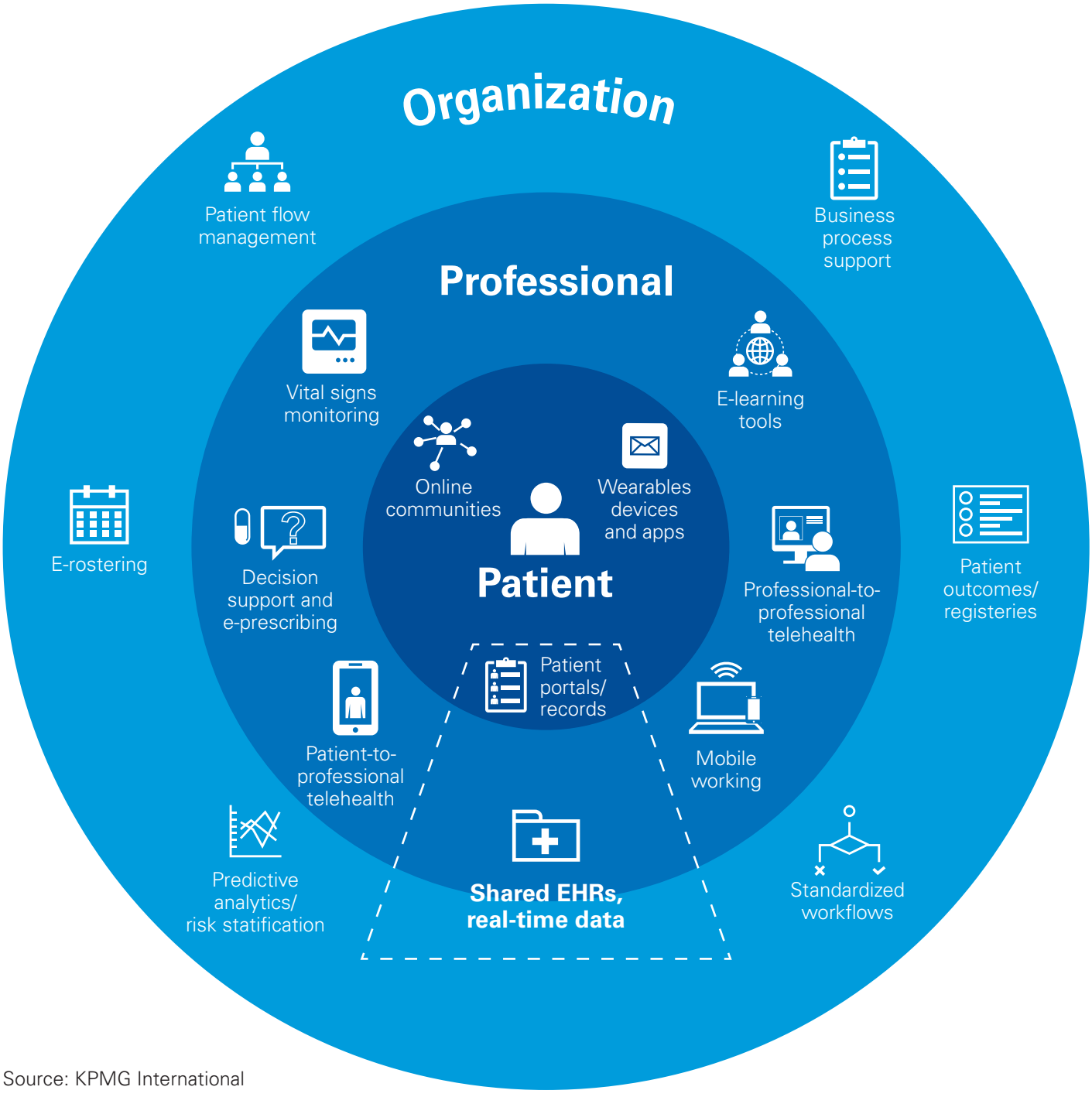
The diversity of different tools and how they interact can be hard to comprehend. Figure 1 provides a high-level overview of the future digital landscape. Patient-facing technologies are at the center, reflecting the impact that this new ecosystem of self-monitoring and decision support will have on their experience and quality of care. Other technologies are broadly categorized as professional-facing and organization-facing depending on their primary user and value in enhancing individual patient care or improving care systems. The electronic health record straddles the system as a whole, reflecting the pivotal role it plays in any digital strategy. It is the foundation upon which many of the other applications are built.



Navigating this new landscape is challenging for organizations and their leaders and there are many pitfalls. There is no doubt, however, that technological transformation will be one of the major differentiators between successful and unsuccessful providers over the next decade. The pressures of cost and expectations of quality mean that doing nothing is not a sustainable option. This report aims to help healthcare organizations grasp the biggest opportunities to significantly improve outcomes, experience and efficiency.

While the design and development of digital healthcare technologies is still predominantly taking place in western nations, emerging markets are adopting and adapting many of these innovations at an ever-growing speed and increased scale at a lower unit cost. This raises the possibility of a global convergence of digital healthcare capabilities, with nimble systems 'leapfrogging' the established infrastructure and delivery models of richer nations.

Figure 1: An overview of the digital healthcare landscape



Source: KPMG International

Why has it been so difficult to successfully deploy information technology in healthcare?

> The history of technology, as it enters industries, is that people say, 'This is going to transform everything in 2 years.' And then you put it in and… nothing happens. And people say, 'Why didn't it work the way we expected it to?… . And then, lo and behold, after a period of 10 years, it begins working.
>
> **— Robert Wachter**
> UCSF School of Medicine

From the UK's scaled-back 'NPfIT', to ObamaCare's bug-stricken exchanges, to Australia's underwhelming uptake of national personal health records, the recent history of health IT has not always been smooth. Examples of spiralling costs, slow take-up and elusive productivity gains are found in virtually every health system around the world. Why has healthcare delivery been so resistant to digital transformation, and when big investments have been made why have strategies so often failed to pay off?

Examining the stories behind setbacks at local and national levels, perhaps the most important lesson of all is that becoming a digitally enabled healthcare provider isn't about replacing analogue or paper processes with digital ones. Where implementations have failed, technology has often simply been layered on top of existing structures and work patterns, creating additional workload for healthcare professionals. The technologies that have released the greatest immediate benefits have been carefully designed to make people's jobs or the patient's interaction easier, with considerable investment in both the design of the tool and the redesign of ways of working.

A pattern that appeared time and again in the stories examined was great expectations of new technology clashing against an initial period of frustration and reduced productivity. Benefits would eventually materialize — often after 2 or more years — but weathering this 'digital dip' was an important hurdle that has led to many transformation strategies being scaled back or even abandoned.

A case in point is electronic health records (EHRs). These are an essential foundation to any digital strategy, but rarely do they produce any immediate benefits to the frontline. In reality, most organizations see an initial phase of added inefficiencies before the tools that work off the EHR (patient flow management, e-prescribing, automated alerts and data transfer) are developed, implemented and get to work. The unexpected pain of the initial EHR implementation has caused many providers to get stuck in the dip — unable to roll back to previous systems, but unwilling to invest further to get the benefits.

Robert Wachter, in his recent book *The Digital Doctor*, notes that poorly designed systems have led to significant increases in time spent on data entry and multiple unhelpful alerts — with some research showing nearly half of emergency physicians' time spent on data entry. A 2013 RAND survey of physicians across the US found widespread dissatisfaction with EMR systems, concluding that although most approved of the EMRs "in concept", in reality they were among the principal causes of professional frustration and dissatisfaction.

Examining the widespread failures to derive the full value from digital technologies in healthcare, and what separates the stories of success, we have distilled seven important lessons about how to achieve real benefits from a digital strategy:

1. **Transformation first:** Transformation comes from new ways of working not the technology itself. Organizations need a transformation program supported by technology not the other way round. This is the fundamental lesson that underpins everything else.
2. **People problems, not technology problems:** While digital systems often become the lightning rod for criticism in a change program, in reality many of the problems encountered in these stories are people-based, rather than technology-based. Overcoming these issues requires organizations to invest at least as much into the programs of organizational development as they do into the technology. Clinical and administrative leaders need to have a deep knowledge of both technological and frontline care systems, and be able to reimagine how work is done. Clinical champions can help with this.[1,2] In the US, it is now increasingly common to have Chief Medical/Nursing Information Officers — often at Board level. These 'hybrid' professionals offer a valuable combination of technological skills and understanding of clinical workflows and culture, and are in strong demand.
3. **System design:** There has been insufficient attention to the design of health IT systems historically. New investments need to solve the problems and needs of the people who are going to use them, be they patients or professionals. Successful implementations take great pains to understand the complex interplay of the 'thoughtflow' (how clinical decisions are made), the "workflow" (how they are acted on) and any new information technology. The misalignment of one or more of these three factors explains a large proportion of the failed or challenged health IT implementations in recent history. Achieving alignment requires meaningful involvement of staff and a dedicated effort to secure continued buy-in. Too often the users of these systems are treated as passive recipients of change and new systems are ill-suited for the complex, high-risk operating environments of frontline services.[3]
4. **Invest in analytics:** Improving productivity requires extensive redesign of work processes, the use of predictive models to allocate resources, anticipate demand and intervene earlier and the ability to learn and adapt. None of this is achievable without analytical skills being loaned or acquired by the organization and, ideally, new tools being made available to clinicians in real time. Successful providers have made significant investment in developing their own analytical and software development capacity. This enables them to generate the learning and insight from the data collected within clinical and non-clinical systems.
5. **Multiple iterations and continuous learning:** Implementing technology is an on-going transformational change program. Even with careful design there may need to be a number of iterations in design.

> Happy users is the golden criteria for the success of HIT implementation. Users should be effectively engaged throughout the project cycle. Talk to them, work with them to get what they want, realize and have them check whether it's what they want. Then repeat.
>
> **— Dr Kim Liu**
> KPMG in China

[1] Boonstra A, Versluis A, Vos J (2014) Implementing electronic health records in hospitals: a systematic literature review. BMC Health Services Research 2014, 14:370

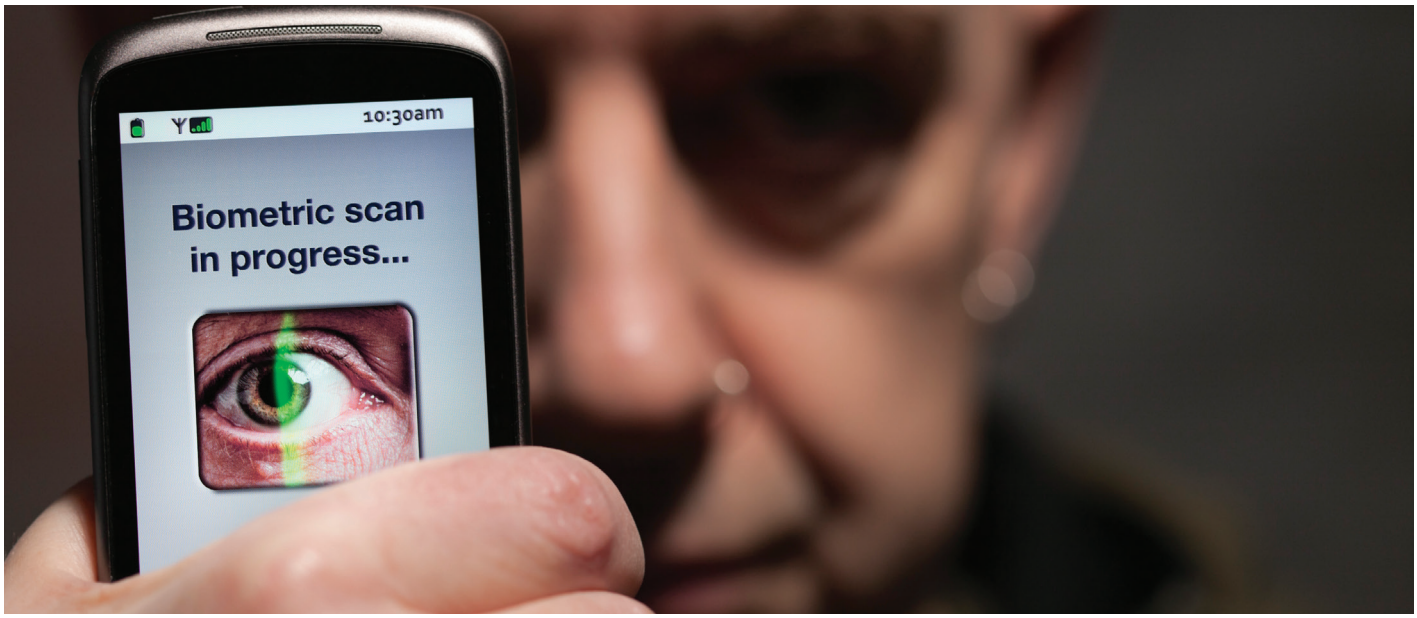
[2] Broderick A, Lindeman D (2013) Scaling telehealth programs: lessons from early adopters. New York: The Commonwealth Fund, 2013

[3] Cresswell K et al. (2013) Ten key considerations for the successful implementation and adoption of large-scale health information technology. J Am Med Inform Assoc 2013; 20(e1): e9–e13

> Thought flow impacts the decision-making process, that is, it either enhances or makes it worse through the way we display digital information on a computer monitor or on a mobile device, so the concept of presenting the right information, to the right person, at the right time is very important.
>
> **— Richard Bakalar**
> KPMG in the US

This is a continuous process and there may be several cycles — some quite painful — before systems reach a tipping point where all of this investment starts to pay off. Stories of failure often show a tendency to overestimate short-term gains and focus on reducing the costs of transactions rather than major changes in workflow, automation and process redesign. Above all, commitment to an on-going journey — rather than a big bang — is at the heart of success.

6. **Support interoperability:** To support coordinated care and realize the benefits set out in this report, it is essential to facilitate data contextual sharing across multiple settings. There are also a number of things organizations can do to aid interoperability. First, while customizing EHRs is important to productivity, over-customization may inhibit data sharing even when the same system is in use across multiple network providers. Secondly, while there is no consensus on whether a single system is better than multiple systems linked through middleware, it will be important to ensure you have weighed up the benefits of both. As Kaiser Permanente have found "horizontal integration trumps vertical maximization".
7. **Sound information governance and data security procedures:** A KPMG survey of 223 healthcare payers and providers found 81 percent have been compromised by cyber-attacks in the past 2 years — and only half felt they were adequately prepared to withstand attacks.[4] Sound information governance procedures are essential to ensure confidential patient data is used safely and effectively. Robust and transparent IG mechanisms are also instrumental in giving patients the confidence to willingly share their protected health data across care settings — a hurdle that has created significant setbacks for England's care.data system.[5]



[4] Bell, G. and Ebert, M. (2015) 'Health Care and Cyber Security: Increasing Threats Require Increased Capabilities' KPMG.
[5] Triggle, N (2014) Care.data: How did it go so wrong? BBC News

Seven opportunities to drive improvement

Looking at the highest performing and most digitally enabled healthcare providers around the world, as well as 'frugally' innovative organizations in emerging economies, seven opportunities to drive improvements in productivity and quality of care stand out.

We explore each of these opportunities in turn, citing the evidence that exists, the potential scale of benefit, and some implementation lessons specific to each.

1. Decision support and standardized workflows
2. Patient engagement and self-management
3. More proactive and targeted care
4. Better coordinated care
5. Improved access to specialist expertise
6. Improved resource management
7. Continuous cycles of learning and improvement

Decision support and standardized workflows

> You come in with a stroke, the admitting physician with one click of the computer now creates the entire workflow from everything from the [real logic] to the laboratory to the diet to the physical therapy and medication.
>
> **— Robert Pearl**
> Kaiser Permanente, US

A major problem in all health systems is that care often falls short of evidence-based good practice. For example, studies have estimated that diagnostic error exists in 10–15 percent of cases and a study of prescribing errors found 52 errors per 100 admissions.[6,7]

Technologies which aid clinical decision making and workflow offer substantial opportunities to reduce variation in care while improving the accuracy and speed of decision making. In the future this support will not only come from access to clinical guidance and prompts but the automated interpretation of clinical data, including genomics.

There is strong evidence that decision support tools can improve the quality of clinical decision making and some evidence it can lower costs.[8,9] However, clinical decision support systems (CDSS) also bring challenges and may be met with suspicion by clinical staff who fear erosion of their autonomy. CDSS range from very passive electronic aids, such as hyperlinks to guidelines, to extremely pro-active one-click flow mechanisms. It is likely that over the coming years there will be a gradual trend of moving from advice for specific, discrete clinical scenarios to much broader-looking, proactive advice to health workers.

Decision support tools including physician order entry

CDSS are often combined with computerized physician (or provider) order entry systems (CPOE), through which medications, tests and procedures are ordered.

When replacing hand-written, physically conveyed systems, integrated CPOE and CDSS systems can offer significant time savings and safety gains. The literature suggests a number of valuable benefits:

- Between 23 and 92 percent reduction in laboratory turn-around-times[10]
- 48 percent reduction in medication errors[11]
- Reduced need for ancillary staff[12]

Decision support is not just for doctors, it can provide a powerful resource for other staff, particularly in settings where they may not have easy access to other clinical staff and patients.

Standardized workflows and 'one-click flows'

CDSS can be further developed to build protocols into customized workflows, effectively standardizing an entire care pathway. Clinicians treating patients on this pathway therefore have unambiguous processes to follow and tasks to complete, ensuring consistently

6 Berner ES, Graber ML (2008). Overconfidence as a cause of diagnostic error in medicine. Am J Med;121(5 Suppl): S2–23.

7 Lewis PJ, Dornan T, Taylor D, et al. Prevalence, incidence and nature of prescribing errors in hospital inpatients. Drug Saf. 2009;32(5): 379–389.

8 Jaspers, M. W. M., M. Smeulers, et al. (2011). Effects of clinical decision-support systems on practitioner performance and patient outcomes: a synthesis of high-quality systematic review findings. Journal of the American Medical Informatics Association 18(3): 327–334.

9 Fillmore C L, (2013) Systematic review of clinical decision support interventions with potential for inpatient cost reduction. BMC Med Inform Decis Mak. 2013; 13: 135.

high standards of care. While this sits at the very proactive end of the spectrum, clinicians should still deviate where needed to meet individual patient needs. Indeed, at Intermountain Healthcare, where standardized clinical workflows have been developed, clinicians are encouraged to tailor the pathway to individual patients, improving system learning.

Standardized workflows can be taken a step further through "one-click flows" or "one-click ordering". Information is pushed to a "workflow engine" to initiate the process which then sets in motion all the tasks and processes required for that specific workflow.

While the productivity and care coordination benefits of such a system are obvious, "one-click flows" can be very difficult to implement. The process must be agreed across multiple teams, and even organizations, and followed up with a significant nurse training effort.

Specific lessons

Avoiding alert fatigue: Some hospitals average 20,000 physician alerts per month. Where there are a large number of alerts, they may be over-ridden and ignored by clinicians.[13] There are a number of ways to address this problem, including reducing the number of alerts, making essential alerts stand out from others (through sound and colors) and requiring a response from clinicians to a particular alert (such as answering a question).

Don't rush into an automated technological solution: When Intermountain thinks about standardizing clinical workflows, they work on paper first. This gives them a chance to see how it works in practice and consider improvements — before integrating it into the technology.

Use protocols as a tool for learning: No protocol will ever be right for every patient. Clinicians will need to adapt and use their own judgement. One unexpected hazard might be over-compliance: Intermountain experienced problems where clinicians were too ready to adopt the default prescribing choice, leading to inappropriate care in some cases.

Intermountain's approach to standardizing clinical workflows

Step 1: Choose a high priority clinical process and lay out an evidence-based, best-practice guideline for that process. It doesn't have to be perfect at this stage.

Step 2: Integrate it into clinical workflows via the EHR laying out the clinical pathway for a condition once a clear diagnosis has been made.

Step 3: Capture data on where clinicians vary from protocol; short and long-term clinical outcomes; cost; and patient satisfaction. Intermountain put a lot of resource into analyzing this data and learning from it.

Step 4: Tell clinicians that no protocol perfectly fits any patient, so they need to ensure they adjust the protocol based on patient need. The idea is to hold on to variation across patients and limit variation across clinicians.

Step 5: Build in a feedback loop to constantly improve the processes.

[10] Niazkhani, Zahra, et al. "The impact of computerized provider order entry systems on inpatient clinical workflow: a literature review." Journal of the American Medical Informatics Association 16.4 (2009): 539–549.

[11] Radley, D.C. et al. (2013) Reduction in medication errors in hospitals due to adoption of computerized provider order entry systems. J Am Med Inform Assoc 1;20(3): 470–6.

[12] Stone, William M., et al. "Impact of a computerized physician order-entry system." Journal of the American College of Surgeons 208.5 (2009): 960–967.

[13] Roshanov PS, Fernandes N, Wilczynski JM, et al. (2013) Features of effective computerised clinical decision support systems: meta-regression of 162 randomised trials. BMJ, 346 f657.

Engaged patients

> Engage patients at an early stage of their lives when they are well or may be at risk for a chronic condition and we can start helping them get into patterns of behavior that are going to put them on a path to minimize or delay the onset of chronic conditions in the future. That's where the huge savings are going to be in the long term. That's where the major productivity improvements will be as well.
>
> **— Richard Bakalar**
> KPMG in the US

Technology is rewriting the relationship between patients, their caregivers and the health system. Tools for patient empowerment, education and self-management are providing more meaningful opportunities for patients to manage their own health and care, with the potential to reduce transaction costs in the short term, and treatment in the longer term.

Patient portals and access to the clinical record

Many healthcare providers, particularly in the US, have created Patient Portals. These give patients access to their medical information such as discharge summaries, medications, immunizations and lab results. More advanced portals now enable patients to develop and track their personal care plans, request prescription renewals, schedule appointments, access their health education library and exchange secure messages with their provider.

While productivity savings have not yet been evidenced, the experience of movements like OpenNotes in the US has been positive so far. Patients with direct access to their providers' clinical notes report that they have a better understanding of their health, can better self-manage and adhere to treatment. Medical errors have been shown to be spotted earlier too.

In the UK, leading NHS general practice organization The Hurley Group implemented a 'WebGP' system for patients to access pharmacy advice, out-of-hours services, complete administrative transactions and have e-consultations with their doctor. Evaluation of their pilot showed 60 percent of the eConsults (which typically last less than 3 minutes) were resolved remotely. Nine months after implementation, consultations at one walk-in center dropped from 30,000 to 18,000, saving them £360,000 p/a and allowing them to close the facility.

Patient Health Networks

An increasingly important source of advice and information is online patient networks that leverage the insight and experience of patients themselves. PatientsLikeMe is perhaps the most well-known network, with over 350,000 members covering 2500 conditions. It allows patients to search for information and advice about their condition (provided by other patients), connect with peers and track their symptoms to discuss with their healthcare team. The data collected is proving a valuable tool for research, with over 60 published studies now generated from the network.

Wearables and apps

There has been a recent explosion in apps and health-sensing wearable technology. However, it is unclear what impact these will have on population health and the types of interactions people will have with healthcare providers. Devices such as FitBit smartwatch collects a huge amount of personal health data, and patient portals such as Patients Know Best (see page 20) are starting to allow this to be integrated in the EHR.

To date there has been a real focus on apps and devices to promote wellness such as step and calorie counters, sleep and heart rate trackers as well as those focused on a single disease, rather than tools for complex costly patients. One interviewee said developers shy away from those types of apps because "they're too complicated, too unappealing, the ROI is too unclear, the time to pay off is too long [and] they need to know too much about these patients in order to develop these applications." (David Blumenthal, Commonwealth Fund).

Given this market failure, there is a question about how far the healthcare sector should stimulate innovation to fill the gap. There is clearly a potential role for this data in health promotion, self-management and behavioral modification, but the current focus on devices or biosensors — rather than the information they produce — is a major barrier to meaningful applications.

There also remain security concerns around the use of mobile technology, particularly in unregulated markets. A 2015 systematic assessment of 79 apps certified as clinically safe and trustworthy by the UK NHS Health Apps Library found that 66 percent of apps sending identifying information over the internet did not use encryption.[14]

Specific lessons

Ensure patient-facing technology is easy to use: When designing patient portals or other patient tools it is essential to ensure they are both easy to use and appealing to patients — or risk low uptake.

For health apps and wearables, think carefully about how to turn the data into useful (and useable) information: Transferring data from patient devices into EHRs will only pay dividends with significant investments in analytical capability. Benefit is most likely when targeted at and designed for specific groups.

> It's fairly soon that it'll be absolutely feasible to monitor people almost at a critical care level within their own homes.
>
> **— Richard Ashby**
> Metro South, Australia

> One size does not fit all. The sooner we can accept this as truth, the better we will become at creating and rolling out meaningful programs that optimally engage patients in their own care.
>
> **— Aaron Berk**
> KPMG in Canada

Online consultations in Denmark

Since 2009 general practitioners in Denmark have been required to offer their patients consultations by email. In 2013, the number of email consultations was 4 million — equivalent to 11.2 percent of all primary care consultations in the country. Patients report benefits of being able to quickly access their GP, not being constrained by time of day and finding it easier to discuss embarrassing issues. GPs appreciate the benefits of being able to answer straightforward questions quicker, although some express concerns around loss of personal contact and misunderstandings that may come about through written communication.

[14] Huckvale, K., Tomás Prieto, J., Tilney, M., Benghozi, P-J., and Car, J. (2015) Unaddressed privacy risks in accredited health and wellness apps: a cross-sectional systematic assessment. BMC Medicine 2015, 13:214

More proactive and targeted care

> Pretty soon instead of the patient seeking the hospital, it will be the hospital seeking the patient.
>
> **— Jagruti Bhatia**
> KPMG in India

There is enormous potential to reduce cost by early intervention through more proactive and targeted care. Powerful analytics can be used to spot early warning signs in patients in community and hospital settings and avoid significant number of deaths and admissions. Patient data can be used to predict clinical risk, enabling providers to target resources where they are needed most and target problems that would benefit from early intervention.

This is an area where the deployment of technology can rapidly deliver significant improvements in outcomes and savings. It should be a high priority for investment — particularly in a hospital setting. And as genomic information begins to become routinely captured as part of clinical examinations, the importance of analysis of this kind will only become greater.

Predictive analytics

Analysis of electronic datasets has the potential to more accurately predict healthcare demands in the future. Computer-based algorithms, drawing on patients' clinical and demographic data, can generate risk scores identifying those at higher risk of avoidable readmissions. Northern Arizona Healthcare in the US, for example, has found that sending risk scores to discharge planning nurses reduced emergency readmissions by 45 percent.

Use of analytics can extend beyond simple readmission prevention, however, and may have a role in predicting those in the community who are likely to use healthcare services in the near future. So-called 'case finding' tools are well-established but have been held back in the past by having to rely on limited, out of date and poor quality data. Systems of the future will draw not just on electronic clinical data (which is much cheaper to harvest) but data from home monitoring equipment and even — in some markets — personal data held by retailers or telecoms companies.

Monitoring of vital signs and early identification of those at risk

Remote monitoring technology offers significant potential for reducing avoidable

Predictive algorithms for readmission (Clalit, Israel)

Clalit is Israel's largest not-for-profit insurer and provider serving 3.8 million people. It has developed an algorithm for predicting patient readmission which is used for patients admitted to any of its 27 hospitals. In practice this means that clinicians have access to a list of all their patients that have been discharged from any hospital in the country on a daily basis, ranked according to their calculated risk of readmission. They are then able to undertake a process that is already hard-wired into the EHR — phoning the patient, asking them about risk factors and whether they have the drugs and support they need. A study found a 4 percent drop in a 30-day readmission for high-risk patients as a result.[15]

[15] Shadmi, E, Flaks-Manov, N, Hoshen,M., Goldman, O., Bitterman, H., Balicer, R. (2015) Predicting 30-Day Readmissions With Preadmission Electronic Health Record Data Med Care 2015;53: 283–289)

use of health resources and targeting staff time cost-effectively at those most in need. A number of proprietary systems have demonstrated promising results in homes and hospitals — for example, VitalPAC in the UK (see below).

In the US, Cerner have developed a system to identify the early symptoms of sepsis — a leading cause of avoidable harm that is often missed. By continuously monitoring key clinical indicators for potentially septic patterns, Cerner estimates its system could reduce in-hospital patient mortality by 24 percent and length of stay by 21 percent, saving US$5,882 per treated patient.

Specific lessons

Implement vital signs monitoring solutions at scale: A number of hospitals have tried to implement vital signs solutions in one or two wards rather than across the hospital as a whole. They found this led to duplication of work and an increased administrative burden in trying to marry separate paper and electronic systems. This suggests that to maximize the benefits of vital signs monitoring, it should be implemented across the whole hospital.

Think carefully about the data that should be used for predictive analytics: Analyses of predictive models for case finding have found that drawing on a higher number of detailed data sets improves accuracy.[16] Systems that use real-time clinical and population-based data sources are likely to be more medically useful for time sensitive interventions than those drawing from retrospective data sets.

Make the most of unstructured data: The vast majority of healthcare data is unstructured (such as doctors and nurses notes) and it will be essential to find ways to make best use of it. This may mean finding technological solutions to convert it into structured data, such as natural language processing and text mining.

> Since there is a large category of people who deteriorate over 2 or 3 days, with a pattern you can pick up… behaviors that are exacerbating the problem or symptoms. If you collect those in a systematic way… Then you can intervene.
>
> **— Adam Darkins**
> Medtronic

Vital signs monitoring in practice: VitalPAC, UK

VitalPAC is a technology solution for hospitals with a range of products allowing for electronic monitoring of patients, including VitalPAC Nurse which identifies patients at risk through early warning scores, VitalPAC Doctor which gives mobile access to real-time patient information to improve handovers and task prioritization, and and infection control tool, VitalPAC IPC.

Trialled in UK hospitals, VitalPAC has reported significant improvements in outcomes including: 15 percent reduction in mortality; 70 percent reduction in cardiac arrests; 50 percent reduction in unplanned transfers to ITU, 90 percent reduction in norovirus outbreaks and a reduced overall length of stay. The company claims the system has a return on investment of between four and six times. (http://thelearningclinic.co.uk/vitalpac/).

[16] Billings J, Georghiou T, Blunt I, et al. (2013) Choosing a model to predict hospital admission: an observational study of new variants of predictive models for case finding. BMJ Open; 3:e003352

Better coordinated care

A lot of patients are on multiple care pathways and yet they are not really receiving a personalized care pathway that's being delivered by a consistent care team. It's pockets of care.

— Neil Williams
Medicom Innovation Partner

A growing proportion of patients are in contact with a multiplicity of different professionals and agencies with no clearly defined person leading care. Without effective coordination there is a significant risk of duplication or neglect, and the experience of care will be poor. Across many industries digital technologies have been used to successfully streamline and better coordinate complex services — the same is increasingly true in healthcare.

Shared health and social care records can be linked to give a 360-degree view of patients and their situation. This shared perspective can support multi-disciplinary teams working together and improve their clinical decision making. This may be particularly important in cases where lifestyle and environmental factors play a significant role in a patient's overall health status.

If all healthcare professionals have access to all patient information in real time there is significant potential to expedite necessary care and to reduce waste in the system, such as the duplication of tests.

Supporting integrated care for patients with diabetes: Western Diabetes Institute and ClickMedix, US

The Western Diabetes Institute is an "integrated practice unit" in California which co-locates multiple services needed by patients with diabetes. Partnering with ClickMedix, they are using a range of cross-specialty services including patient engagement tools and self-assessments, tele-consultation with a network of specialists, and real-time outcome monitoring. By sharing reports and care plans between the patient and multiple providers they have significantly improved glycaemic control levels, as well making treatment planning quicker and more cost-effective.

ClickMedix suggest that physicians are able to consult with 4–10 times more patients with their system, while at the same time there has been a 50–90 percent reduction in hospital visits for patients with multiple chronic diseases.

In the UK, Nervecentre allows inpatient teams to seek specialist advice from other specialties by sending an instant message to the relevant specialist, who then receives the referral details along with all the patient information, their up-to-date observations and results and location in the hospital. Referred patients are automatically added to the list of the receiving team (allowing easy integration into their ward rounds) and the referring team is able to see the status and outcome of the referral.

One radical way of ensuring all relevant professionals have immediate access to integrated clinical data is by putting the entire record in the hands of the patient. This approach has been adopted by Patients Know Best (see below), which functions as a 'patient portal' allowing patients to own, store and control access to their clinical notes.

> We are currently seeing a lot of technology to standardize and improve care at the hospital level. The next stage is to see that same thinking applied to the system level, where chronic diseases are necessitating a totally new way of working in the community.
>
> **— Alberto De Negri**
> KPMG in Italy

Patients Know Best (PKB)

Originally designed for patients with complex, rare or multiple conditions, PKB allows patients and their caregivers to create an account to which all their clinical information from multiple providers (e.g. laboratory results, GP notes, outpatient clinic letters) can be uploaded. Available in 14 languages, the system allows any healthcare professional authorized by the patient to log in and see the complete record. In addition, PKB has a library of self-help material including videos and links which can further aid in self-management, as well as providing instant messaging services for patients to interact directly with their clinical team and the option for online consultations via videoconferencing.

As CEO Dr Mohammad Al-Ubaydli says, "the best way to achieve integration is to give power to the patient. After all, they're the only ones involved in every appointment and interaction".

Specific lessons

Don't crowd out informal exchanges between clinicians: Automated systems that share clinical results or opinions digitally can discourage the informal human exchange of views and advice across healthcare teams, which often enrich and improve clinical decision making in complex cases. Health professionals need to create physical or virtual opportunities for provider-to-provider collaboration.

Improved access to specialist expertise

> In many hospitals 60 percent of the real estate and at least as much of the car parking requirement is for outpatient visits. Why put the patient, the carer, the payer and the planet to so much trouble?
>
> **— Malcolm Lowe-Lauri**
> KPMG in Australia

Telemedicine services remove geographical barriers between underserved patients and their medical specialist, improving quality, access and, potentially, reducing cost of care. Patients can now connect to clinicians via mobile devices, secure email or via web portal platforms. While some systems have created supply-induced demand, others have shown a reduction in the medical specialists' workload through the effective use of email to reduce the number of unnecessary face-to-face consultations and clinical tests.[17]

Some centers have introduced 'hotlines' or email addresses for GPs to seek specialist advice. Using 'hunt group' technology means a single gateway can direct the GP to multiple specialists, locating one that is available with the right expertise. Video conferencing, sharing of the patient record or using pre-defined, bookable appointments might improve interactions further. Such approaches have the potential to reduce referrals, and in the long term educate GPs to improve their care.

More radically, in the US, a range of developers are attempting to disrupt traditional geographical patterns of healthcare delivery. Services such as Spruce, HealthTap and Doctor on Demand offer instant, 24-hour access to remote appointments through smartphones, while apps like MedZed and Heal are enabling house calls to be requested via mobile devices.

Telehealth applications can be particularly helpful in large sparsely populated areas by enabling a small number of clinicians to cover a large geography. In the future, it might even allow teams of healthcare professionals to act internationally on a larger scale, although patient safety, legal protection and information confidentiality present significant regulatory barriers to this expansion.

e-ICU

e-ICUs or tele-ICUs are intensive care units that receive clinical support from a remote critical care team through patient surveillance and monitoring, as well as remote video collaboration. Tele-ICUs are generally associated with a number of benefits including reduced mortality and ICU length of stay and reduced staff turnover (a 56 percent reduction in one center, saving over US$1 million per year).[18, 19, 20]

Onsite clinical staff reluctance to engage with the remote e-ICU consultants is likely to have a significant negative impact on clinical benefit and cost-effectiveness, however. One study found that hospital costs increased with an e-ICU.[21] This may be because healthcare professionals find the remote team threatening, or do not feel they need additional clinical input.

[17] Caffery L J, Smith A C. (2010) A literature review of email-based telemedicine. Stud Health Technol Inform. 2010;161:20–34

[18] Goran, S., (2010) A Second Set of Eyes: An Introduction to Tele-ICU Crit Care Nurse August 2010 vol. 30 no. 4 46–55

[19] Kumar et al., (2013) Tele-ICU: Efficacy and Cost-effectiveness approach of remotely managing the critical care. The Open Medical Informatics Journal, 6, 24–29

[20] Lilly CM, Cody S, Zhao H, Landry K, Baker SP, McIlwaine J, Chandler MW, Irwin RS (2011) Hospital mortality, length of stay, and preventable complications among critically ill patients before and after tele-ICU reengineering of critical care processes. JAMA. 2011 Jun 1;305(21): 2175–83

[21] Morrison JL, et al. (2010) Clinical and economic outcomes of the electronic intensive care unit: results from two community hospitals Crit Care Med. 2010; 38(1):2–8

Specific lessons

Patient-to-professional telehealth can cost more than it saves: There is mixed evidence on the cost-effectiveness of patient-to-professional telehealth.[22, 23] To realize the value of these systems, close attention should be paid to patient selection, duplication of services and referral procedures, staff engagement and training, and reassuring patients about safety and appropriate use.

Identify appropriate cases for professional-to-professional telehealth: One study found "failed teleconsults", whereby a face-to-face consultation is required despite the teleconsultation, could increase costs by US$709 million nationally across the US, although this was offset when email and real-time interactions were both used.[24] This means it is important for generalists to try to identify cases for professional-to-professional telehealth, which are likely to be resolved without specialist follow up.

Kaiser Permanente Telemedicine, US

Kaiser Permanente (KP), the largest not-for-profit health provider in the US, have developed a number of different telehealth systems for remote consultations. These include integrated video appointments and CDU-to-CDU telemedicine across different hospitals to spread demand during busy periods.

In 2012, nearly 50 percent of contacts between KP's patients and primary care providers took place over the phone or secure email, and they estimate that as many as 30 percent of full consultations could soon happen digitally. Certain programs have seen rapid quality improvements, such as their telestroke service, which through rapid assessment of patients via video conference has increased the proportion of people receiving thrombolysis from 14 percent to 84 percent, and those given it within 60 minutes from 16 percent to 52 percent.[26]

Abiye Safe Motherhood Project, Nigeria

In Ondo state in Nigeria, mobile phones are used to remotely monitor pregnant women and link them to specialist advice. Community health workers (CHWs) were appointed to act as intermediaries between pregnant women and Abiye maternity health centers. To facilitate quick and effective communication between the women and CHWs, mobile phones were distributed free of charge to pregnant women across the state for them to call for advice if needed. The project showed a 47 percent reduction in maternal mortality and 26 percent reduction in child mortality, and is subsequently being scaled up.

[22] Torre-Díez I, et al (2014) Cost-Utility and Cost-Effectiveness Studies of Telemedicine, Electronic, and Mobile Health Systems in the Literature: A Systematic Review. Telemed J E Health 21(2):81–5

[23] Mistry, H (2012) Systematic review of studies of the cost-effectiveness of telemedicine and telecare: changes in the economic evidence over twenty years. Journal of Telemedicine and Telecare 2012; 18 (1): 1–6

[24] Cusack, C.M., Pan, E., Hook, J.M., et al., (2007) The Value of Provider-to-Provider Telehealth Technologies. Charlestown: Centre for Information Technology Leadership

[25] Cruickshank J and Paxman, J (2013) 2020 Health Yorkshire & the Humber Telehealth Hub project evaluation. London: 2020 Health

[26] Zhou YY, Kanter MH, Wang JJ and Garrido T (2013) 'Improved quality at Kaiser Permanente through e-mail between physicians and patients', Health Affairs 29(7), 1370–5.

Improved resource management

> We should be tracking all materials… tracking the time of our procedures and automating our scheduling… The more analysis we have on that… the more clinicians can make efficient decisions which will then improve their productivity.
>
> **— Joel Haspel**
> GE Healthcare Finnamore

There are significant opportunities to improve productivity by bringing to bear the tools widely used in other sectors for improved resource management to plan staff rosters, patient flow, and match capacity to demand.

E-rostering and mobile working

Tracking and management of staff time through e-rostering solutions can be used to ensure that the workforce is employed where it is needed most, enabling quality and efficiency improvements. Well implemented systems can avoid under- or over-staffing, reduce the reliance on locum or agency staff, and provide less stressful working patterns.

E-rostering solutions should be used to match skills in the workforce with patient need, and deploy resources flexibly. This means that they should not simply constitute electronic versions of paper rosters, but should be used as a tool to redesign workforce deployment. When linked to clinical record systems, e-rostering can incorporate task management and allocate clinical tasks to staff in real time.

Active support for mobile working can also reap significant productivity gains. Remote access to records, via tablets and other mobile devices, can transform the way that staff in the community can deliver care. Instead of having to travel to a base twice a day to pick up and return heavy notes, a case list can be downloaded at home. Apps can include CDSS and in-built protocols, facilitating efficient care which is compliant with best practice; as well as working in both online and offline mode to facilitate mobile working.

MIA Maternity (Isosec and Imperial College Healthcare NHS Trust, UK)

MIA Maternity is an app designed for community midwifes, introduced by Imperial College Healthcare NHS Trust (ICHT) in 2015. It enables midwifes to enter all data directly into an iPad, which automatically syncs with the hospital database. Instead of having to travel to the hospital at the start of each day, the midwife can download a case-list from home and the app will suggest an order of cases based on geographical location. The app works in offline and online mode; when online it will push and pull data from the central hospital server, ensuring all patient information is up-to-date and available to other members of the maternity team.

MIA Maternity has improved patient care, with quicker data entry leading to more time spent on patient contact, improved continuity and handover as all team members have up-to-date notes readily available and compliance with best-practice guidelines aided by prompts and in-built protocols. In addition to improved staff satisfaction the app also has direct cost-savings: saving 5 hours per midwife per week, equivalent to £500,000 across a department of 50 midwives — an ROI of around 6 months.

United Hospital, US

Centralized patient-flow systems have saved United Hospital US$5 million annually through reduced expenditure and fewer income penalties arising from the A&E department being on divert. The initiative centralized the management of patient flow within the hospital with the support of an electronic flow system and integrated with the main hospital electronic record system. The combined system enables staff throughout the hospital to see and update real-time patient status information and location.

By having a comprehensive, real-time view of the location, need and treatment of every patient in the hospital, not one from hours earlier, staff can more rapidly and effectively resolve blockages or care needs. At the back end of the system data-mining capabilities enable workflow and capacity usage to be improved over time, driving further savings.

> We've found [wearable person-to-person communicators] to be particularly beneficial. In ward situations the average time for a nurse to find another nurse has gone from 3 minutes to 20 seconds, and that's saved huge amounts of time multiplied out across the wards where it's been implemented.
>
> **— Richard Ashby**
> Metro South, Australia

Managing patient flow

In the US, patient tracking systems are being used to track not just the status of rooms, equipment, patients and waiting times but the location of all the people managing care via a "command center". This approach was advocated by a number of those we interviewed. Ultimately, they argued, this line of sight should go across the system and include GPs, ambulance and community services.

Involving end-users in developing patient flow software is essential to ensure it meets clinical and administrative needs and is easy to use.[27] Some providers have encountered significant resistance to what can be perceived as 'big brother healthcare', but by being flexible to staff input about how systems work, concerns have been overcome in some providers.

Specific lessons

"Bring your own device": A number of organizations have found that giving ward nurses a mobile device such as a tablet or mobile phone and allowing them to take it home, customize it and use it for personal tasks has ensured higher uptake of the technology. Not only this, but they found that nurses were checking their rounds on the way to work and familiarizing themselves with the handover notes.

Capacity to work offline: In moving to mobile working, benefits can be gained from applications that can work offline, enabling mobile workers to carry out tasks where Wi-Fi is not available — and to upload their notes to the clinical system once a signal is restored.

[27] Poulos CJ, Gazibarich BM, Eagar K. (2007) Supporting work practices, improving patient flow and monitoring performance using a clinical information management system. Aust Health Rev. Apr;31 Suppl 1: S79–85

Continuous cycles of learning and improvement

> Once you are starting to use data in a systematic way, there are numerous ways in which this supports your on-going benchmarking and performance improvement. You can't improve what you don't measure.
>
> **— Ran Balicer**
> Clalit Research Institute
> Israel

Feeding the learning from clinical and non-clinical data back into existing processes is essential to fully realizing the benefits of digital technology. We have already highlighted numerous examples of how this continuous cycle of improvement and learning can take place throughout the report: using patient flow technology to identify where patients wait in the system and re-designing services; collecting data to understand where variation in care occurs and why, and using data to predict and target at-risk groups.

Intermountain, US

A core part of Intermountain's digital strategy is system learning and improvement from the data they collect. Leaders at Intermountain choose the data they collect carefully, keeping in mind the estimate that each data item collected costs a dollar per patient.

Data analysts are fundamental to this process. Intermountain's Institute for Health Care Delivery Research employs 17 statisticians at Masters level or higher to analyze registry data and produce routine reports on care delivery performance. The intention is to make performance transparent to the clinical teams at an individual patient level and at a process level. According to Brent James, Intermountain has carried out three formal evaluations to understand if these data analysts could be replaced by a business intelligence system. However, they have always found that analysts are the preferable option given that they offer considerably more flexibility than a technological solution. Intermountain embed their analysts in clinical teams and believe they represent very good value for money, often costing less than a nurse but offering insight that could save their salary many times over.

Intermountain have already taken out 10 percent of their costs in the last 3 years. They believe that these systems will enable them to reduce the cost of care by 50 percent — both through reductions in waste and non-value adding activity and improvements in clinical outcomes. [Source: BJ Interview]

The use of data can also help drive improved care pathways and ensure that patients receive optimal care. For example, Advocate Healthcare in Chicago estimate that they are saving US$200 million a year from an algorithm that offers recommendations to physicians and patients about what level of care someone should be discharged to (e.g. nursing home, their own home with nursing support, or a hospice).

We are also starting to see significant investment in artificial intelligence, with the best known example being Watson. This is some distance from mainstream adoption but signals a direction of travel.

IBM Watson

Watson is a supercomputer built by IBM, which is able to process and understand data in a novel way to answer complex questions put to it by the user. It is able to extract meaning from free text enabling it to store data from any written source. It has a wide range of applications across multiple industries, including healthcare.

Watson is being trained by oncology experts at Memorial Sloane Kettering (MSK) so that it might be able to inform decision making in cancer care. The idea is that Watson will be able to analyze the patient's medical record to identify key characteristics that might influence outcomes. It can then identify potential evidence-based treatment options, rank treatment options and present these to the user with supporting evidence from a wide range of sources. This can allow clinicians to match individual patient characteristics to the vast and complex research and knowledge base and provide tailored and evidence-based treatments.

Definitive outcomes for its use in cancer care are awaited as Watson is still undergoing training and testing at MSK. However, results presented at the 2014 American Society of Clinical Oncology meeting demonstrate that Watson is able to choose the preferred treatment option with 89–100 percent precision, depending on cancer type.[28]

> The skills required to enable digital healthcare — big data, user experience, cybersecurity — are in limited supply and have not historically been core to healthcare. But accessing these capabilities — whether in-house or externally — will be the ultimate arbiter of progress.
>
> **— Liam Walsh**
> KPMG in the US

Specific lessons

Gain patient consent for use of data beyond direct care: England's scaled-back care.data program has highlighted the sensitivities around using patient data for reasons beyond direct care without adequate engagement and consultation. Organizations need to be entirely transparent about how they will use patient data and think carefully about how they will gain informed consent for data analysis, articulating clearly intended benefits of using data in this way.

[28] Epstein AS, Zauderer MG, Gucalp A, Seidman AD, Caroline A, Fu J, et al. (2014) Next steps for IBM Watson Oncology: Scalability to additional malignancies. Journal of Clinical Oncology.

The way ahead for technology in healthcare

Seeing evidence of triumph and disaster, many will ask of health IT investment 'are the gains worth the risk?'. The answer is unmistakable: staying with the status quo is more risky and hazardous still. Technology is already transforming healthcare delivery models, and this will only accelerate over the next 10 years. So the choice is simple: embrace it, or be left behind.

— Wah Yeow Tan
KPMG in Singapore

We started this work with a question — what are the opportunities to use technology to improve the productivity of the health system and the workforce in particular. We found all the complexities that might be expected and a huge scope for investment in this area to destroy value as well as create it.

A second question is why is it that the health sector has failed to gain the productivity improvements found in other industries. There are undoubtedly opportunities to streamline the work of clinicians and to use technology to lift the burden of administrative and low value tasks. However, doing this in a way that liberates productive time is difficult. The really big benefits come from more fundamental redesign of the way the system delivers care, how clinicians think and how far patients can participate. There are grounds for optimism but many reports in this area fail to confront the difficulties or the scale of change that will be required.

The next 5 years

There are several sources of productivity improvement that will form part of plans for the next 5–10 years and digital tools can help with all of these in different ways. There are three main areas for change with progressively higher levels of risk, cultural change and potential disruption of current operating and business models.

Operational improvement. Although there is a lot of interest in new models of care, the most significant improvements in productivity over the next few years are likely to come from the combined impact of large numbers of small changes.

The areas where digital tools are most likely to help are:

- Reducing duplication and rework
- Removing unjustified variation from standards and increasing reliability
- Tools for identifying deteriorating patients, those at risk of infection or predicting the probability of an extended stay or readmission
- Improving communication and hand-offs between professionals
- Removing administrative tasks from clinical staff
- Scheduling and improving flow
- Inventory and procurement
- Rostering, mobile working and staff deployment
- Patient self-service for administrative tasks such as booking, etc.

Redesign of the whole pathway. Doing the current work more efficiently, with fewer errors and in ways that are easier and more convenient for staff would get many organizations a long way. Additional opportunities come from the redesign of complete pathways within organizations and beyond their traditional boundaries. Reduced variation, the ability to ensure the most appropriate level of care is provided and appropriate staffing mix to demand offer the potential for very substantial savings and improvements in the effectiveness of the workforce. There are also opportunities for patient involvement with some tasks being transferred to patients and benefits from improved self-care.

Population health management. The third shift is a move from pathways to populations and a change of focus from the effective management of the patient through the pathway to maintaining the health of populations over time. This requires a mind-set shift in providers and a focus on early intervention and targeting, enabling patient self-management, shared decision making and measuring outcomes and value rather than counting activities. To do this systems will need to become more adept at using digital tools to:

— Link care episodes

— Build better data and analytics including using predictive models which take into account behavioral factors as well as med history

— Create systems to provide feedback, learning and improvement

— Drawing on personal data from outside of the health sector, such as that currently held by retailers, telecoms companies and app developers.

This is likely to be most disruptive, requiring significant shifts in models of care, and the management of three key risks:

1. The non-linear return on investment — there is a risk that the tipping point is not reached where there is a critical mass of investment in technology, changed care processes, analytics and new workforce models.
2. The more disruptive models require extensive data sharing and secondary use, as well as adaptions to staff roles.
3. The tendency to focus on the technology and not the problem it is intended to solve. The more the improvements in efficiency and productivity are driven by a shift to value and population-based models of care the bigger the challenge in terms of changing the mind-set and practice.

What does this mean?

So what might technology mean for the way we deliver services in 10–20 years time? You could interpret what we have written as describing a future in which healthcare will transform from the messy, inefficient world it is today, with much that is clinically uncertain and variable, to a glorious nirvana of streamlined efficiency, clinical certainty and consistency and patients who are so effective at managing their own health and care they barely need to trouble the doctor. The sceptics may see a much bleaker world where clinicians are tied to computers trying to interpret a sea of data while patients are overburdened with self-management tasks and anxiety about health generated by obsessional monitoring and difficult to interpret probabilistic predictions about their genetic risk factors.

As with all disruptive forces, the outcome of health IT on healthcare is inherently uncertain. Given that health warning, our best assessment of what the future may hold, is as follows.

> Technology alone rarely makes recognizable change. Replacing an old system with an identical digital process only creates more work for users.
>
> **— Jin Yong Jeon**
> KPMG in Korea

Firstly, information and communications technology will be omnipresent but much less visible. No more carts with PCs on the ward. Medical technology will become more and more intelligent. Data will be held remotely in the cloud allowing professionals to use hand-held devices that give them access to everything they need. Some have described the smartphone as the new stethoscope, the difference being that the patient has one too.

Technology is driving a fundamentally different relationship between patient and professional. This requires new skills for both. Professionals will develop new coaching skills in order to "activate" and engage people in their care, adaptable to the wide range of patient capabilities that will persist.

Technology is also driving a very different relationship between professionals. It supports medicine as a team rather than individual pursuit. This too will require new ways of working. As the traditional barriers between primary, secondary, community, social and mental health care are broken down so will some of the traditional roles and services. For example, the current hospital outpatient model looks increasingly anachronistic in a world where consultants can offer advice to professionals and patients remotely. Multi-skilled staff with a range of core therapeutic skills are likely to become an increasingly core part of the workforce.

The management of the potential sea of data presents the healthcare and its workforce with its greatest opportunity and challenge. All staff will need to develop and extend their skills with patient, performance and population health data, while new professional roles in the area of clinical and medical informatics are likely to emerge. Many have talked about how this new access to clinical decision tools will enable all staff to work to the top of their license. This may well be true, but it may also present opportunities to work beyond the scope set by current professional boundaries.

Managerial staff will also require new analytical skills in order to maximize the benefits from the newfound intelligence about their organization and how it is operating. They will also require sophisticated organization development competencies in order to take staff on the transformation journey that technology can facilitate.

More prosaic and often neglected in this sort of analysis is the ability of these systems to just make people's lives easier by automating administrative tasks, improving communication and helping them do their work more effectively and efficiently. In addition to disrupting, transforming and getting the benefits of big data, wearables and all the other exciting new developments we should still aim for less duplication, searching for missing information and fewer of the multiple causes of waste that get in the way of patients, clinicians and other staff and try to make their working lives better than when we started.

The path to a successful health IT transformation: How KPMG can help

The journey to digital transformation in healthcare is a challenging one, with numerous moving parts. Each of these parts must transition in a purposeful, coordinated way to new clinical delivery models, all while ensuring that the services continue to function during the transition.

Services we provide to clients to help with these challenges include:

Organizational alignment: This can be related to business objectives, strategy and planning, and internal education/change management. The latter is particularly important, as getting project leaders to align on financial ROIs and clinical outcomes is critical to long-term success.

Governance and regulatory guidance: It is imperative to have strategic planning and operational support which include patient-centered governance protocols and policies in place across care settings. Virtual care projects should be coupled with an analysis of regulatory and reimbursement compliance issues, both as they stand in the present and with an eye to further developments in the near- and longer-term.

Maturity assessment and re-design: Our process comprises an organizational assessment of the current state, determination of business objectives, and establishment of a future-state strategy, target operating model and transition roadmap. It is essential that the systems that are implemented with change management in mind and are standardized with scalable and aligned infrastructures, data flows and workflow.

Integrated system platform selection and configuration: Choosing and configuring health IT platforms, and ensuring network security and patient privacy/confidentiality (HIPAA) compliance, represent some of the most challenging tasks reported by clients. These are critical decisions as they impact the success and efficiency of clinical documentation and administration, eVisit video collaboration, patient engagement, and performance management reporting functions.

Performance management and reporting: Measurement, tracking, analysis and reporting on quality, productivity and efficiency are indispensable when sustaining and growing a modern health system. Financial, clinical and operational key performance indicators must be validated, maintained and integrated into an ongoing enterprise continuous improvement program.

Data and analytics: KPMG's data and analytic (D&A) capability is seen as a means to enhance proficiency and quality in healthcare. Many healthcare organizations are exposed to an array of new risks pertaining to compliance regulations, fraud, inefficiency, ineffectiveness and errors resulting in financial loss and reputational damage. Our expertise in data and analytics improves client's ability to identify essential anomalies when reviewing business processes and allows a detailed understanding of an organization's operational and financial standing.

> KPMG is a trusted advisor to payers, providers, governments in their journey to digital transformation

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Alberto is a project leader and business developer of advisory services in healthcare and the public sector. His experience includes being a project leader in many advisory projects for regional health authorities, local health authorities, hospitals, including project leader of the national project "the bricks of the National Health Service", for the development of shared methodologies and classifications across the Italian NHS and project leader for the design of the Italian national health information system. Alberto has developed regional plans to redesign the network of services and cut costs.

Malcom Lowe-Lauri, KPMG in Australia

Malcolm has been at the forefront of the NHS's modernization efforts, having helped several UK healthcare authorities deliver change and improve performance, successfully working with multiple stakeholder groups. In a 30-year career with the NHS, Malcolm's early successes include rationalizing laboratory services, consolidating clinical and support services and meeting ambitious national waiting list targets at a number of London hospital authorities. A prominent national and international figure, he has chaired the UK CEO's Research Forum and was a member of the NHS Future Forum, advising the UK government on health legislation. Malcolm has a BA from Oxford University, an MsC from the University of London and is an Honorary Fellow of King's College London.

Frank O'Donnell, KPMG in Ireland

Frank is the sector lead for Health and Public Sector at KPMG in Ireland. He is currently leading a series of engagements across the area of health reform with a significant focus on Health IT, Health Data, Electronic Health Records and Health Identifiers. He is an experienced consultant across the health and public sector area with a focus on technology-enabled change and innovation and he has worked in health, education, economic development and local government.

Paul Tan, KPMG in Singapore

Paul is currently a Director with KPMG Management Consulting for the health sector. He has 18 years of Healthcare Industry Solutions experience, working with major healthcare providers and public health agencies in the region. In his last role, his focus was on solutions including cloud, mobility, telehealth, care coordination, analytics and cognitive computing to address the healthcare industry's business requirements and transformation.

He has worked with various solutions areas including Clinic Management System, Business Process Outsourcing, Managed Care &TPA Claims Management, HIS/ERP, EMR, EHR, Care Coordination, Digital Hospital, Telehealth, Analytics and Public Health Solution. Paul has extensive experience in healthcare IT strategy and solutions, vendor selection and developing business case in heath IT adoption.

Wah Yeow Tan, KPMG in Singapore

Wah Yeow is the Deputy Managing Partner of KPMG in Singapore, and leads the firm's National Markets sector (Singapore government departments, government agencies and government-linked companies). He also heads KPMG's Asia Pacific Healthcare practice. Wah Yeow has been with KPMG since 1984 and was admitted into the partnership in 1995. Wah Yeow has more than 20 years of experience in auditing and advisory work for private, public and government-owned companies. He has held various leadership positions with KPMG in Singapore and at Asia Pacific region including Head of Management Consulting and Head of Infrastructure, Government & Healthcare. He has also been involved in advisory work, including running strategy workshops, costing of services, and policy reviews, with several of the ministries and government organizations.

Liam Walsh, KPMG in the US

Liam is a Principal and the US Healthcare and Life Sciences Advisory Industry Leader. He has extensive experience in solution areas such as Strategy and Governance, Strategic Sourcing, Global Process Re-engineering, Merger Integration, Business Unit Divestitures, and New Company Launch. His technology experience includes ERP, CRM, SFA, Business Intelligence, Collaboration and Knowledge Management solutions. Liam focuses on leveraging emerging technologies and best business practices to develop pragmatic strategies focused on generating business value.

Jenny Yao, KPMG in China

Jenny Yao has over 20 years of international management experience in healthcare industry. Her areas of expertise include hospital management, quality improvement, project management, risk management, service transformation, training programs, system redesign and market-entry strategy.

Before joining KPMG, Jenny was an Associate Director of Operations at Brighton and Sussex University Hospitals NHS Trust, UK. Jenny was involved in setting up a new hospital in Shandong Province, China before doing her MBA at Imperial College London.

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Methodology

Evidence to support this study was gathered through an extensive search of the existing literature on health technology's impact on productivity and quality of care. This was supplemented by 36 interviews with leaders of healthcare organizations who have been actively pursuing a digital strategy over many years, as well leading technology suppliers. These covered the US, India, Australia, Israel, Botswana, Nigeria, South Africa and the UK (see Interviewees). The literature and interviews were used to identify major opportunities for technology to improve healthcare, in addition to lessons for its successful deployment collected by KPMG's healthcare leaders from their own extensive experience of health IT implementations.

The Nuffield Trust

The Nuffield Trust is an authoritative and independent source of evidence-based research and policy analysis for improving healthcare in the UK. Our vision is to help provide the objective research and analysis that boosts the quality of health policy and practice, and ultimately improves the health and healthcare of people in the UK.

We aim to help provide the evidence base for better healthcare through:

— conducting cutting edge research and influential analysis

— informing and generating debate

— supporting leaders

— examining international best practice.

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Interviewees

Name	Title	Organization	Country
Adam Darkins	Vice President for Medical Affairs and Enterprise Technology Development	Medtronic Inc	US
Alok Khare	Vice President	JIL Information Technology Ltd	India
Amanda Basset	Director of Workforce Insight	Allocate Software	UK
Amy Garcia	Chief Nursing Officer for Nursing Workforce Solutions	Cerner	US
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Brian Clay	Chief Medical Information Officer	University of California San Diego (UCSD)	US
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David Blumenthal	President	The Commonwealth Fund	UK
David Furniss	Vice President, Propositions and Frameworks, Global Government and Health	BT Global Services	UK
Efrat Shadmi	Lecturer	University of Haifa	Israel
Elaine O'Brien	Clinical Strategist	Cerner	US
Eric Alper	Chief Medical Information Officer	Lifespan	US
Eric Poon	Chief Medical Information Officer	Duke University	US
Gareth Thomas	Clinical Director for Innovation	Salford Royal NHS Trust	UK
Girish Kulkarni	Chief Medical Informatics Officer	Cytecare Hospitals	India
Harpreet Sood	Senior Fellow to the Chair and Chief Executive's Office	NHS England	UK
Jai P. Dwivedi	Chief Information Officer	Rajiv Gandhi Cancer Institute	India
Joel Haspel	Partner	GE Healthcare, Healthcare Finnamore	UK
John Deverill	Managing Partner	GE Healthcare, Healthcare Finnamore	UK
Jonathan Lewis	Chief Executive Officer	Bromley Healthcare	UK
Jonathan P. Weiner	Professof of Health Policy and Management and Health Informatics	John Hopkins University	US
Kagiso Ndlovu	Health Informatics Program Manager	Botswana-UPenn Partnership	Botswana
Kelly Limonte	Healthcare Industry Manager	Microsoft UK	UK
Ladi Awosika	Chief Executive Officer	Total Health Trust	Nigeria
Martyn Partridge	Professor of Respiratory Medicine and Patient Centred Care	Imperial College, London	UK
Neil Williams	Head of Connected Health	Medicom Innovation Partner	UK
Mandie Sunderland	Chief Nurse	Nottingham University Hospitals NHS Trust	UK
Owen Heckrath	Technical Advisor	Health Information Systems Program	South Africa
Ran Balicer	Director	Clalit Research Institute	Israel
Richard Ashby	Chief Executive Officer	Metro South Health	Australia
Robert Pearl	Chief Executive Officer	The Permanente Medical Group	US
Robert Wachter	Professor and Interim Chair of the Department of Medicine	University of California San Francisco (UCSF)	US
Simon Wallace	Clinical Consultant	Total Mobile	UK
Theresa Cullen	Chief Medical Information Officer	Veterans Health Administration	US
Will Cavendish	Director General of Innovation, Growth and Technology	NHS England	UK
Anonymous interviewee	Anonymous	Technology company	UK
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