Health care: the cross-currents of convergence deliver participatory health

A second paper in the Health Reimagined series

EY
Building a better working world

The EY Health Reimagined Compendium

Health reimagined: a new participatory health paradigm

This paper explores a vision of the future of an expanding and participatory health ecosystem based around the individual as an engaged and active consumer. Health systems will reshape into a digital health ecosystem – one that is globally connected and locally relevant. Solutions to sustainability, growth and delivering health care to the rapidly growing population will be driven by three key shifts around digital technologies, social media 2.0 and a maturing health care consumerism.

> http://www.ey.com/au/en/industries/health/ey-health-reimagined-a-new-participatory-heath-paradigm

The future of health insurance
A participatory health solution

This paper discusses six trends disrupting health insurance. These trends are driven by two shifts: the need to tame runaway cost inflation, which is spawning new incentives and payment structures, and digital health, which is democratizing data and empowering consumers.

> http://www.ey.com/Publication/vwLUAssets/EY-the-future-of-health-insurance/$FILE/EY-the-future-of-health-insurance.pdf

The new innovation imperative
Reshaping biopharma business models

New technologies, customers and competition are forcing – and enabling – biopharmaceutical companies to find novel ways to create and capture value.

> http://www.ey.com/gl/en/industries/life-sciences/ey-vital-signs-reshaping-biopharmaceutical-business-models

How will we disrupt aging before aging disrupts economic growth?
Building an engaged aging strategy

Aging is a megatrend as big as digital disruption. EY Engaged Aging Summit, and associated thought leadership, explores how we – industries, governments, health consumers and non-governmental organization (NGO) – can seize the upside of aging.

> http://www.ey.com/gl/en/industries/health/ey-health-reimagined-how-will-we-disrupt-aging-before-aging-disrupts-economic-growth

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Foreword

This paper further extends our thinking on participatory health. We examine shifts in emphasis, direction and focus necessary to realize a new and disruptive paradigm. Based upon conversations with a broad group of health and wellness industry executives in the United States, Europe, Southeast Asia and Australia, desk research and a pulse survey of professional young adults globally, this paper outlines shifts that will move health care into an entirely new space — that of participatory health becoming embedded as business as usual in the health industry. How this might be financed will be addressed in the third paper in this series.

The innovation challenge to shift health care toward a participatory system is quite clear. Breakthrough technologies, new sciences and integrated design-based solutions will drive fundamental change in the delivery of health, wellness and care. The leading edge of the health industry is already moving at breathtaking speed toward anywhere, anytime care fashioning health care as continual and participatory in the home and community. But delivering participatory health care and well-being at scale is immensely complex, especially in an industry notoriously slow to change. In this paper, we propose a model of industry transformation where key elements of curation, navigation, data fusion and an eventual global platform-based ecosystem drive innovative solutions to some of the intractable problems in health care.

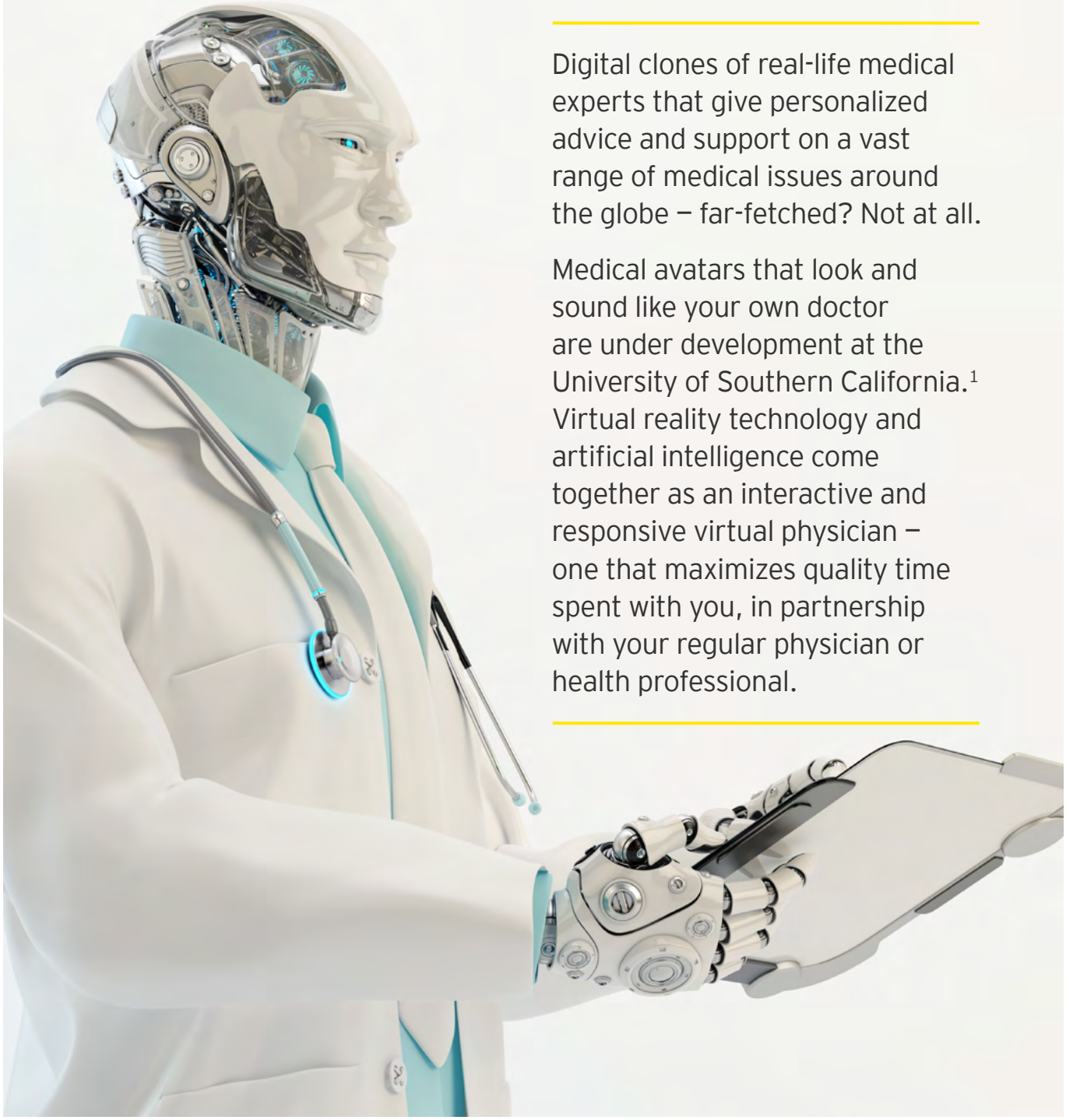
What realm of possibilities exist as health runs headlong into the space where industry, technology, science and social constructs converge? This convergence brings opportunity for those seeking to enter the health arena as well as to incumbents willing to reinvent core business, create non-traditional alliances or step into adjacent areas. Platforms that build networks that organize transactions and interactions, as well as draw upon the power of the crowd, will create new pathways by which to organize and deliver health care. Global alliances that blend the technical capabilities of one partner with the health care expertise of another could offer interesting opportunities if they were to get off the ground.

So who will lead and who will follow? Emerging and developing economies may well take the lead in this journey to participatory health. Advanced technologies enable these economies to leapfrog the more industrialized as they seek to build, rather than retrofit, health care markets. This will not be simple — or easy to put into practice — but may well deliver a decidedly disruptive change.

Participatory health is not the future of health care; it is, without doubt, the present.

David Roberts
EY Asia-Pacific Health Leader

Health care: the cross-currents of convergence deliver participatory health

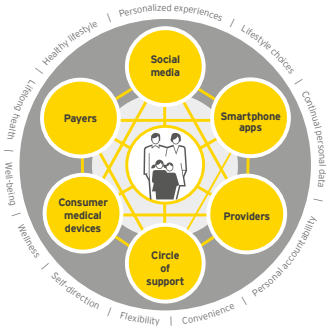


Digital clones of real-life medical experts that give personalized advice and support on a vast range of medical issues around the globe – far-fetched? Not at all.

Medical avatars that look and sound like your own doctor are under development at the University of Southern California.[1] Virtual reality technology and artificial intelligence come together as an interactive and responsive virtual physician – one that maximizes quality time spent with you, in partnership with your regular physician or health professional.

Now is not the time to be thinking about how health care might benefit from digital technologies – that time has long passed. In fact, the important conversation around the future of health care is not about shifting to digital at all. It is about people.

The real force for change in health care is patient mediated – the power of the patient or consumer to engage and participate. A new health care ecosystem is arising from convergence between traditional and non-traditional players that blends health care expertise with network and platform capabilities. New pathways of health and wellness arise at the interface between the consumer and the system that transform the industry into one that is online, networked and participatory.



Participatory health is reflective of a deep and profound shift in perspective toward well-being and wellness, greater convenience, flexibility, self-direction and personalized experiences. It is a transformation in the patient-provider relationship where individuals work with their health professional team as an equal and responsible partner. Individuals become empowered as they gain the knowledge, skills and confidence to engage persistently with the health system.

Participatory health – a radically different future

A significant catalyst for change is an engaged and participating patient or consumer who acts as an equal partner in their care. Market dynamics are shifting rapidly to the consumer as integrative platforms form ecosystems that disrupt both supply and demand with new ways of creating and consuming health care goods and services. Central to this is the deep and profound shift in the model of care toward participatory health.

Integrating participatory health as a pillar of the system, as part of the core business of health care, takes the industry into a radically different future. The digital revolution has changed what is possible in health care. Low-cost, fast mobile connectivity and smart devices redefine how consumers manage their health and engage with care systems. Sensor technologies and mobile solutions are reinventing how the health industry can connect and communicate with patients. In participatory health, it is the fusion of all these tools that builds an ecosystem and capabilities to deliver at scale.

The first paper in this Health reimagined series ***A new participatory health paradigm*** discusses how demand for health care can be reshaped by participation, strengthening an individual's capabilities to manage their health status and lifestyle choices, foster prevention and wellness, and support chronic conditions in vastly different ways. In this second paper, we suggest that convergence or points of intersection between traditional players (providers, payers, life sciences and devices) and non-traditional new entrants (retailers, telecommunications and technology companies, entrepreneurs and venture capital investors) create the tools and platforms by which participatory health can be delivered. Exponentially developing technologies through integrative platforms delivers a suite of new offerings around well-being, remote care, medical imaging at home and the internet of things (IoT). Participation is the underlying premise as the notion of health transitions from reactive to proactive care systems focused on wellness, chronic care and population health management.

This paper discusses a model of industry transformation and three conditions necessary to achieve scale:

- Consumer participation through curation and navigation technologies that are the interface between the consumer and the health care system
- Data-fusion platforms, which are the glue that hold the system together
- Global aggregators or "orchestrators"[2] that pull together a scalable ecosystem

We conclude with some thoughts around opportunities that emerge at the intersection of consumerism, technology and markets for those willing to explore beyond their traditional boundaries.

The challenge

The awkward truth is that, for the most part, the current reach of digital health technologies is restricted to pockets of activity globally, directed toward a specific condition, operational or administrative problem. In a fast-moving and early stage environment, adopting an incremental approach makes sense, picking the "battles to be won" by targeting outcomes that are amenable to action. Getting across the "last mile" to the hardest-to-reach consumers — whether they are in remote underserved areas or disinclined to engage in managing their health and wellness is a clear focus for disruptive innovators, health professionals, technologists and payers.

Emerging and developing economies may well take the lead, being less constrained by existing infrastructure and vested interests seeking to preserve the status quo. Delivering participatory health care and well-being at scale is immensely complex. What is not yet clear is how health care systems — either national, regional or local — will transition to incorporate or replace existing ways of doing business with participatory health. The case for change is being written today but, in an industry notoriously slow to change, this will be a deep-seated journey of transformation — for the system, for the professionals and for the consumer or patient.

Background

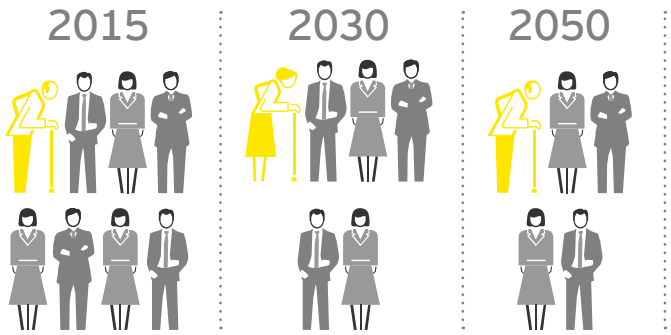
"More of the same" can't resolve 21st-century health care problems

Future adoption of advanced technologies built upon networks or platforms that organize transactions and interactions is important for all economies – whether they be emerging and developing or developed. Economic, epidemiologic and demographic shifts mean that legacy systems of providing health care or "more of the same" are failing to deal with the many difficult problems facing 21st-century health care.[3] Rising costs, consumer expectations, new technologies and increasing globalization place intense pressure on the health sector to align better with economic constraints. Long-established systems of primary, secondary and tertiary care are increasingly unsuited to deliver responses to challenges arising from aging populations and as the burden of disease shifts to chronic conditions such as diabetes, musculoskeletal disease and cardiovascular disease.[4] Chronic conditions and increasing longevity extend the end-of-life cost burden. Growing middle classes in emerging/developing economies will bring increased demand through rising health consumption expectations and health-related outcomes of lifestyle changes.[5, 6] Moreover, how care is organized and delivered is being reshaped by changes in the broader environment, including self-determination, social and crowd source networks, and a cultural shift toward sharing and participation.

Population aging and a rising middle class push health systems toward participatory health

By 2050, 1 in 5 people globally will be aged 60+ years. Rapid population aging places increasing demands on health care systems and expenditure.

Source: UN World Population Aging 2015.



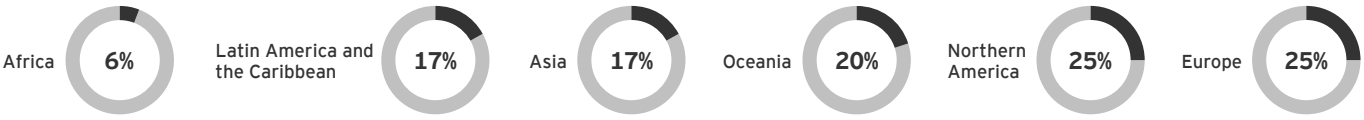
Disparities in investment in health

Global health expenditure per capita (2014)

- High-income countries US$5,251
- Middle-income countries US$292
- Low-income countries US$37

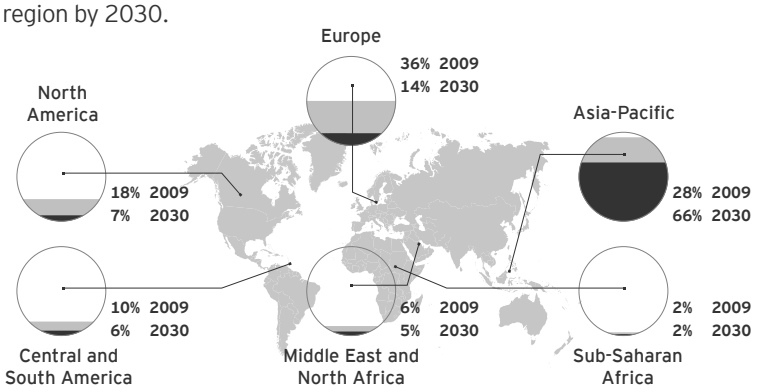
Source: World Bank 2014.

In some regions, around 25% of the population will be aged more than 60 years old by 2030. Improved longevity and larger numbers of the aging put pressure on health systems.



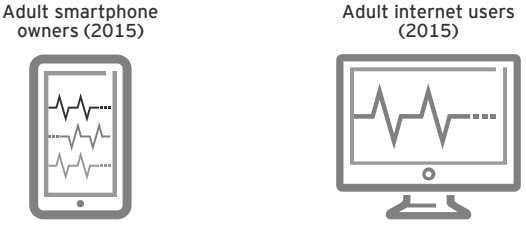
Showing proportion of population aged 60+ years, 2030. Source: UN World Population Ageing 2015.

Overall, the middle class will grow from 1.8 billion (2009) to 4.9 billion (2030), bringing rising consumption expectations. Growth will be in Asia-Pacific, with two in three of the growing middle class located in this region by 2030.



Source: Showing size of middle class, percentage of global share in 2009 and 2030. Kharas and Gertz 2010.

Mobility and rapid telecommunications underpin the shift to integrated, digital health care systems.



Source: Pew Research Center 2016.

The long run to transformation

A digital ecosystem is inevitable – emerging and developing economies may leapfrog ahead

The internet of everything (IoE)[7] is emerging as cyber and physical systems combine the physical, digital and biological worlds[8] in novel and powerful ways. This so-called Fourth Industrial Revolution[9] is profoundly altering our way of life as the speed and scope of breakthroughs propel a transition to a new set of social and economic systems.[10] Self-driving cars, for example, have moved from concept to real-time tests and are expected to be on the road by 2021.[11] Advancements such as gene-editing technologies, additive manufacturing (3D printing), robotics and artificial intelligence (AI) are rapidly changing health care.[12, 13] At the societal level, in anticipation of "technological unemployment"[14] as jobs disappear due to automation and AI, some countries such as Finland and the Netherlands are experimenting with paying citizens a guaranteed and unconditional universal basic income.[15]

For many in the health care industry, the journey to and adoption of digital is inevitable. Industry executives interviewed were confident that the future of health care includes a participatory and digital ecosystem. Many saw the need to move from running a supply-side agenda of imperfect resource allocation to tackling a demand-side agenda. Shaping the drivers of demand is a key lever in managing health care consumption — but the demand-side of the health care equation is customarily discounted. As the market moves toward the consumer, the tools of participation will empower consumers and create bottom-up levers for change.

Several executives surveyed emphasized the importance of mobile devices as the primary tool to get consumers to engage in their own care. Mobile devices are the route to "get the consumer into the digital space and take them on the journey." Especially so if tools could make that journey easier by freeing up communications and removing complexity and friction points to make health care simpler and navigable. In isolation, a mobile device is of limited benefit. The real value arises when connected to a suite of services through a platform.

Telehealth has been around for a long time without gaining traction. However, the concept is maturing and, as health care becomes fully digitized and consumers and health professionals embrace participatory health, technological and contextual conditions now exist that support delivering connected care at scale. The notion of telehealth has moved beyond that of care as usual, augmented by an internet connection to that of sensor-based teleconnected solutions embedded in lifelong health and wellness through the internet of health care things (IoHT) ecosystem. Developments in the burgeoning digital health landscape in China are an interesting example of a forming ecosystem moving toward scale. Shortages and maldistribution of health professionals, a rapidly aging population and hospital overcrowding are some of the many issues driving growth in China's digital health space. Digital giants from insurance, online search engines, social media and e-commerce are moving into the health care space and developing nationwide diagnostic, treatment and administrative platforms. And the numbers are vast (see below). Ping An Good Doctor, for example, claims to have 77 million registered users[16] — larger than the entire United Kingdom population, three times the population of Australia and one-fourth that of the United States. With industrialized countries facing similar drivers of demand and changing demographics as China, there is potential for a powerful impact from lessons learned across the health value chain, from service delivery through to structural reform and rising investment opportunities.

> "It's just a matter of time before the whole market shifts to 'got to know the patient, got to know the consumer, got to know the data, got to connect the stuff.'"
>
> **Deborah Kilpatrick, CEO Evidation Health**

Ping An Good Doctor

This is a Chinese online to offline (O2O) health care platform backed by the Ping An Insurance and Financial Services Group. It provides rovides 24/7 virtual health care consultations by phone, text or video online appointment booking, diagnostic services, health education, and online retail of pharmaceuticals and medical devices. In 2016, there were 77 million registered users and up to 250,000 consultations per day.

24/7
virtual health care consultations

77 million
registered users

250,000+
consultations per day

Source: PRNewswire *The Largest Unicorn to Date Emerges in the Online Health care Industry*, 2016.

Guahao.com

Meaning "take a number", Guaohao.com initially targeted resolving long wait times for hospital services in China, introducing an online appointment registration system. Recent intentions include expansion into a national digital health platform covering diagnostic and treatment services.

190,000
medical specialists

100 million
registered users

1,600
hospital locations

Source: SeekingAlpha, *Billion-Dollar Unicorns: GuaHao Targets China's Health care*, 2016.

Shifting the mindset — easier with a clean slate

In the long run, many of the interviewees expect improvements in quality, cost and consumer experience through participatory health. Technologies open the doors to radically different approaches to care and will transform how we deal with ill health and disease; capture, manage and share health data; and how consumers engage with care systems. Opinions as to how this might likely happen varied greatly. Uptake was thought to be perhaps more likely in single payer, large integrated or centrally organized health care systems. Many executives thought that emerging and developing economies could bypass setting up traditional primary care structures in favor of a participatory health model that can support low-cost models of care across larger populations. System transformation is highly dependent upon "crossing the chasm"[17] of adoption, or the propensity to act early or wait and see. Of course, there may be little choice but to act if, as Christensen's disruptive innovation theory[18] suggests, fast-moving challengers disrupt the market using technologies to offer cheaper and better products, forcing incumbents to rethink legacy systems. Some interviewees also weighed the possibility of a "big-bang" large-scale and fast-paced disruption completely upending health care.[19]

> "... if you're building a health care system from scratch, you would not mimic or replicate what we have and so I think you might see people who have more of a, you know, clean slate. They're actually able to be much more progressive and get to that end state in a far quicker time."
>
> **Venture Investor Executive**

Facing the "double burden of disease" (the overlap between communicable diseases and a growing prevalence of chronic health conditions), many emerging and developing economies are looking to deliver services via low-cost mobile solutions and analytic insights from digital devices data. AI has the potential to lower the cost of care, mobile device ownership fosters communications and application program interfaces (APIs) bridges the gaps between solutions.

Emerging economies – leading the way?

Innovations designed around mobile devices, telecommunictions networks and AI will enable emerging economies to bypass establishing traditional health systems and move directly toward a virtual system. Initial steps may focus on discrete components of the health system, such as supply chains, frontline services, workforce and public health measures, rather than whole of system development:

- For developing health systems, health navigation will provide an alternative to the costly establishment of the current model of primary care and avoid the substantial overcapitalization of Western health systems in favor of virtual. Navigation supports a participatory health model that is better equipped to provide low-cost models of care for larger populations and underpinned by emerging supply chain advances.
- Solutions will be shaped to achieve best fit by factors such as demand for basic health care and preventive services, work–arounds of the limitations of existing infrastructure, national budget constraints, the degree to which solutions can be integrated rather than act in a stand-alone capacity, affordability and opportunities for partnerships to develop a sustainable ecosystem. Barriers include rising anti-globalization sentiment, evidence gaps regarding the effectiveness of some solutions and impact on health system objectives, and protection of intellectual property.
- An interesting question arises of who leads and who follows. Will established economies take on lessons learned from the experiences of virtual health systems implemented in the emerging economies or not? Will governments force the changes due to fiscal constraint or will a consumer revolution be driven by a commercial explosion of alternatives?

Mobile phone-based systems are used in emerging and developing economies in many ways for system enhancement (such as registries that replace paper-based systems), quality improvement, delivering frontline care, health worker supervision, training and further education and establishing communications and networks between health workers.

- **RapidSMS** (www.rapidsms.org), an open-source framework for building customized mobile services with web-based dashboards, is the basis of a range of registry, performance improvement and outreach programs:
  - **The EGPAF** performance-based financing program is in Mozambique. Health workers are incentivized to complete mobile-based quality surveys, resulting in improved quality of health services:

    > www.rapidsms.org/projects/episurveyor-for-pbf-verification

  - **The Liga Inan (Mobile Moms) Project** uses mobile phones to connect expectant mothers and health providers in Timor-Leste. Maternal health and post-delivery care are delivered via SMS, and midwives create local support networks that communicate by SMS:

    > www.rapidsms.org/projects/liga-inan-mobile-moms

- **mSakhi** is an open-source Android application developed specifically for frontline health workers in India. Health workers access up-to-date information, training and supervision through their smartphone, and it also functions as an electronic medical record system, replacing multiple paper-based tools. Workers can track and report outbreaks or rising health issues in their communities:

  > www.intrahealth.org/msakhi-award-winning-mobile-phone-app-frontline-health-care

- **Switchboard** builds software to register health workers' mobile numbers and connects them to colleagues and the larger health system through messaging platforms and free calling networks. These services, along with nationwide phone directories of health workers, allow practitioners to receive information, guidance and advice, while also supporting government efforts to track diseases and manage potential epidemics, and are in action in Ghana, Liberia and Tanzania:L

  > www.switchboard.org

Revisit, redesign and reset health care: a new default setting

Shifting health care from reactive to proactive

A vision of the future emerged over the course of our conversations with industry leaders. As Andrew Thompson, CEO and co-founder of Proteus Digital Health observed, the health care system will be built: "Using the best technologies that we now have in the 21st century, not to replace sick care but to extend it, magnify it and make it better … you have to shift from sick care into health care, and the current and future generations of mobile devices in every consumer's pocket will become the most significant platform for health care service delivery the world has ever seen." Technologies vital to sustained engagement are embedded in everyday items, pervasive, always connected and discreetly in action behind the scenes. These draw upon economic, behavioral and cognitive insights to shape an individual's behavior and decisions. Payers may well be influential in pushing general adoption of monitoring devices through incentive-based health and wellness improvement programs.

> "I would go one step further than patient centric and say it is patient mediated. Patient centric means just designing around the patient or consumer – 30% of the way there. Patient mediated means patients are actively controlling and influencing the process … patients have access to a data set they've never had access to before – access to their data."
>
> **Deborah Kilpatrick, CEO Evidation Health**

Digital is a defining trend

Digital is considered by our interviewees to be a central pillar that shapes an intelligent health care system. Technology, in all its various forms, will ultimately embed as a common platform in all aspects of health care. This will be as an interconnected environment around an individual, across the continuum of care and the lifespan. Most of those interviewed considered that uptake would vary. Some early adopters are in this space already, to be closely followed by the "early majority"[17] in the next three to five years. Most in the industry will wait and see and, as the network effect kicks in, move when comfortable with technology. This is thought likely to occur in the short to medium term in advanced economies. The executives' views on the adoption cycle of digital health technologies were based upon three qualifications:

- The early stage maturity levels of emerging technologies
- The profound cultural shift within health care (of consumers, health professionals, administrators, policy-makers and governments) necessary to achieve this vision
- A recognition that it is early days and many iterations are required to learn the lessons to deliver the evidence and attractiveness to persuade others (including fundamental shifts around payments, transparency of costs, and system incentives away from the prevailing transactional and institutional focus)[20]

Several interviewees stressed that digital solutions coming to market need to be very clear about the problem to be solved, be of demonstrable efficacy and clinically relevant, and avoid creating inequities.

Wearables and monitoring devices: a clear consumer appetite

The global market for connected wearable medical devices and remote patient monitoring systems is expected grow from US$123 billion in 2015 to US$612 billion by 2024, driven by the adoption of mHealth devices, wearable technologies and the IoT. In 2016, around 259,000 mHealth apps were available through major app stores, and worldwide shipments of wearable devices such as watches, wristbands and clothing are expected to grow by a compound annual growth rate (CAGR) of around 20% by 2020. The industry is beginning to consolidate, and emerging players are focusing upon improved accuracy and lower costs for consumer-focused medical devices. Some devices are targeting achieving clinical-grade quality. Universal adoption becomes possible as sensors and monitoring systems become embedded in everyday objects and industries (telcos, life sciences, manufacturers and health care players) converge.

Mack, Heather, Report: Global market for connected wearables, health devices expected to reach $612B by 2024 Mobihealthnews, August 11, 2016, http://www.mobihealthnews.com/content/report-global-market-connected-wearables-health-devices-expected-reach-612b-2024.

Grand View Research, Connected Health And Wellness Devices Market Report, 2024 August 2016 http://www.grandviewresearch.com/industry-analysis/connected-health-wellness-devices-market.

Research2guidance, mHealth App Developer Economics 2016, October, 6th edition. https://research2guidance.com/product/mhealth-app-developer-economics-2016/.

IDC IDC Forecasts Wearables Shipments to Reach 213.6 Million Units Worldwide in 2020 with Watches and Wristbands Driving Volume While Clothing and Eyewear Gain Traction http://www.idc.com/getdoc.jsp?containerId=prUS41530816.

As industry, technology, science and social converge

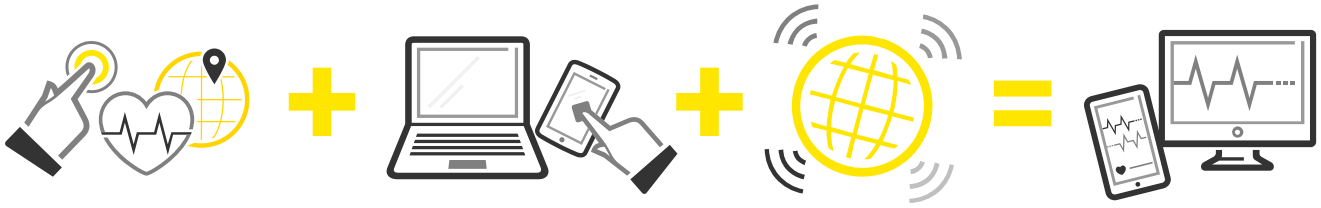
As digital uptake within the health care system moves from where it is today to digitization of transactions, tasks and processes (translational) and then to more fully integrated and personalized solutions (transformative), expectations are also changing around what can be delivered by technology.

We seek to know more from the digital space and to do a lot more with the information. Strong capabilities exist to capture, analyze and predict from data arising from the"digital crumbs"[21] of an individual's life. Intelligent machines and devices that sense, recognize and learn from signals in the environment enable disparate data about drugs, biophysical attributes, mood and behaviors to be combined. We want to understand, at a deep level, who does what, who responds and, importantly, how can we learn from the data to deliver better care and to engage individuals.

Health is running headlong into the industry, technology, science and social convergence space. The resulting new technologies demystify health care and simplify wellness by solving translational and transformative problems, and open the door to a raft of commercial opportunities previously considered the exclusive preserve of the health care industry.

In the early stages of disruption, the system is chaotic. There is a lot of noise, and a vast range of innovations are emerging and under trial. Not all will add value, remove pain points or give better utility to health professionals and consumers. These will be ultimately abandoned or rethought as learnings emerge. What is new, innovative and demonstrably impactful will eventually become incorporated into the core business of health care.

The digital uptake equation

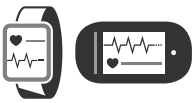


Capture, analyze and understand
- Sensory
- Locational
- Perceptual

Tools of connection
- Mobile
- Social
- Devices
- Sensors

Connectivity
- Enhanced 4G
- IoT and IoE
- 5G
- E-home

Digital uptake

 **Mobile devices**	Increasingly sophisticated capabilities to capture and understand sensory, perceptual and locational information. Even entry-level phones and tablets will soon have biometric technologies, such as ultrasonic fingerprint authentication capabilities,[22] that strengthen personal data security and facilitate a vast range of actions from service delivery through to payment.
 **Medical-grade wearables**	Wearables such as Bioflux ECG monitor[23] and the Phillips biosensor[24] that require approval as medical devices[25, 26] are emerging. Once approved they will be able to provide clinically relevant and reliable data.
 **Cognitive technologies**	Cognitive technologies such as machine learning on mobile devices, even when offline,[27] suggest untold possibilities for cognitive behavioral therapies that target psychosocial issues.[28-30]
 **Connectivity**	Enhanced 4G and forthcoming 5G networks[31] will enable universality and responsiveness of applications with faster mobility, lower latency and better connectivity. These will support IoT/IoE and health programs that draw upon complex functions such as virtual reality, gamification, robotics, video coaching and the e-Home.

Could health care be "Uberized"?

The question on everyone's lips is, "could health care be 'Uberized' or 'AirBNB'd'"? Some say yes, and are pursuing their ambitions seeking to develop platforms around transaction and interaction-based networks.[2] Others believe not, that diverse parts of the world, health systems and industry segments, payers and providers will advance quite differently. The disconnected and highly fragmented nature of the health industry points to opportunities to incorporate the power of platform-based transactional and interactive networks and drive industry transformation. Lack of price transparency in health care is an issue that distinguishes it from other industries in which a massive shift has occurred. Tackling this may well open the doors to change, setting up conditions for an information-driven disruptor to emerge unexpectedly and upend health care.

Discontinuity with the past: a curation-navigation-fusion model

Capacity to scale will be the turning point

Enabling technologies form a data-driven foundation for the health industry. The capacity to scale up new care models and settings through integrated pathways will deliver the quantum leap necessary to break with the past. In this section, we discuss a model comprised of several building blocks that structure the ecosystem and may deliver a clear route to achieve scale (Figure 1). We then address three key elements that we consider important in the transition toward an ecosystem.

We envisage an integrated system of interconnected attributes, all needed to operate and exist within an environment as a complex sum of its parts. Participatory health becomes possible through:

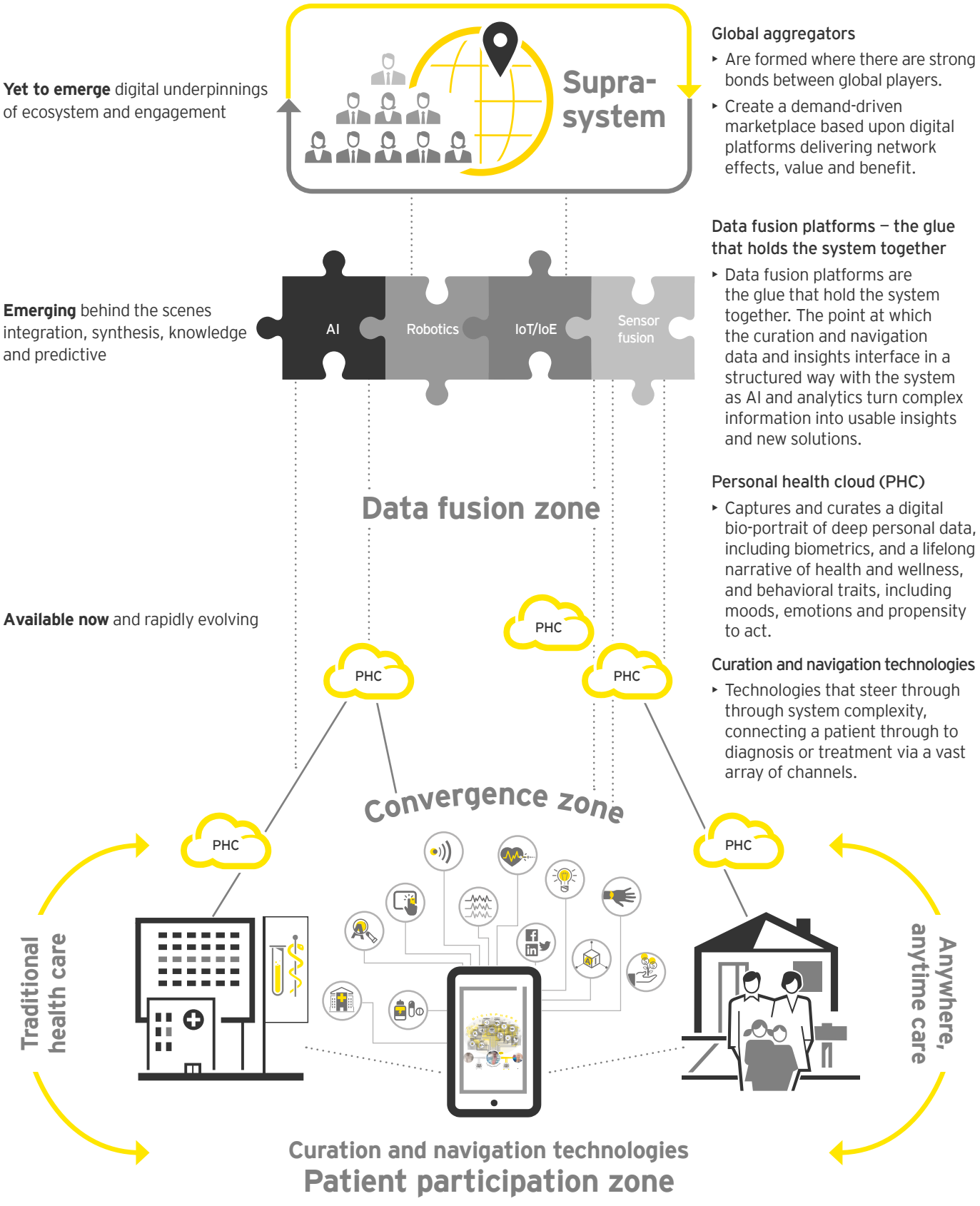
Unstructured and structured data feeds

- From personal devices as well as industry-generated information (such as clinical records and payer data) interfacing with curation and navigation technologies

Overall systematization behind the scenes

- Order is imposed on chaotic data through:
  - Cloud-based services, natural language processing, APIs, deep learning intelligence and data aggregation platforms
  - Integration of social determinants of health and behavioral, environmental and social network data
  - Insights based upon meaningful patterns for individuals and populations

Figure 1: Building blocks of a participatory health care ecosystem



At the health system-level, building blocks are those of:

- **Curation and navigation** connecting and steering a patient through the delivery system (real and virtual) from diagnosis through to treatment and lifelong learning
- **Data fusion platforms** are the glue that hold the system together. This is where the curation and navigation of data and insights interface in a structured way with the system as AI and analytics turn complex information into usable insights and new solutions
- **Supra-system** or ecosystem that is made up of strong bonds emerging between global players, with potential for alliances and benefits that trickle down through the system

Building blocks

For individuals, the base is a **personal health and wellness cloud**. Highly sophisticated, this:

- Captures and curates a digital bio-portrait of deep personal data, including biometrics, a lifelong narrative of health and wellness, and behavioral traits, including moods, emotions and the propensity to act
- Inputs flow from environmental and social sources, including unstructured data feeds from wearables, IoT/IoE, remote monitoring, environmental sensors and structured data from clinical information systems and payer portals
- Utilises multiple channels including mobile devices (phones and tablets), social media and wearables that link the individual to their PHC and to the broader health system

Curation and navigation: the interface between the consumer and the health care system

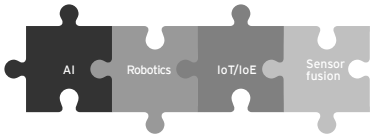
Functions as a care navigator or broker with tools that connect and capture, direct and deliver to assist consumers to make choices regarding the services they need and the experiences they prefer. A vital part of the participatory care team, curation and navigation technologies follow clear pathways and coordinated resources to help people make the right decisions regarding their care and to answer the burning questions of "where do I go for help?" and "what do I do next?"

These interfaces can automate many routine tasks and enhance the work of health professionals, freeing them to focus on more complex tasks and interpersonal relationships. Navigation is critical to improved communication and coordination of high-risk patients who typically have multiple chronic conditions and multiple health care providers in a number of settings.

Examples of curation and navigation models include:

- Solera Health (www.soleranetwork.com), which connects fragmented disease management programs into an integrated network to better coordinate care for chronic conditions and manage costs
- CommunityRx, a population health improvement program that combines ePrescribing and community engagement, and links patients with local resources and community-based services in a high-poverty urban area in Chicago for health and wellness management[32]
- Next IT Health care (www.nextithealthcare.com), which uses cognitive-based digital health coaching technologies to support behavior change

Data fusion platforms: the glue that holds the system together



The integration of vast flows of data fused with AI form the backbone of the system where curation/navigation materials meet the health delivery system. Data fusion aggregates volumes of patient data from multiple sources (clinical, financial, social, environmental and operational) delivering insights into care management, risk stratification, performance and care gaps with respect to populations.

Through data mining, learning and predictions from captured data,[33] "simple AI" delivers an ability to organize, monitor and support a user, generate risk alerts from the data and deliver services. For example:

- Sentrian (www.sentrian.com) is a remote patient intelligence big data predictive analytics platform. It captures and analyzes a patient's physiological data from a raft of sensors to build personalized disease deterioration models that detect subtle changes or warning signs in an individual's condition and support clinical decision-making, especially for those at risk for hospital admission.
- HealthReveal (www.healthreveal.com) analyzes incoming data from medical records, claims, wearables/implantables, and directly from patients, to monitor continually high-risk clinical signals and sends diagnostic/treatment information directly to the patient and care team via mobile alerts.
- Babylon Health (www.babylonhealth.com), a subscription remote care provider, is tackling the issue of misdiagnosis in the face of accelerating volumes of health information, testing an app that employs AI speech recognition to check symptoms against a database of diseases and provide advice to physicians.

Currently at a very early stage of development, "complex AI" is taking steps toward building intelligent systems that transform massive data sets into action. Personal data, real-world evidence and growing capabilities in perception, sensing, object recognition and language learning through iterative, dynamic modeling are hoped to deliver personalized solutions for individuals and populations eventually. Accuracy will improve over time as systems self-learn, validate and fine-tune. For example:

- Saffron (www.saffrontech.com) is a hybrid of machine learning, AI and advanced analytics. Associative memory technology mimics the way a human brain makes connections and associations. Through organizing structured and unstructured data, Saffron learns, recalls and finds meaningful patterns in the connections between people, places and things.[34]

Supra-system: strong bonds between global players

Digital technologies are borderless. As the inflection point is reached and the reduction of fragmentation becomes possible, an overarching supra-system or ecosystem will likely appear. The catalyst to shift to scale will be rising interest from players who see opportunity in a global ecosystem of peer value creation, such as large retailers, venture investors, large integrated networks and global technology companies. Network orchestrators, or "digital platform organizations that leverage a growing and virtual network of suppliers and customers," will seek to build and manage global networked platforms.[35] A supra-system will draw together dynamic groups of players (traditional and non-traditional) into communities that evolve and change over time, and new models of collaboration and competition will ultimately create value. For example, consider the potential for the "Fab Five"[35] trusted brands of consumer, tech and electronics companies with a global audience to build upon existing platform know-how and forge partnerships with leading health industry players. Partnerships are likely to emerge that blend the technical capabilities of one partner with the service and health care expertise of another. In so doing, global alliances could offer interesting opportunities if they were to get off the ground. New business models will prompt a rethink of talent, culture and organizational forms. To illustrate:

- Finnish multinational communications and information technology company Nokia (www.nokia.com) acquired Withings digital health start-up in 2016. From this base, it intends to build out beyond consumer wearables and devices to advanced sensors, AI and insights arising from large-scale data.[36]
- Qualcomm, a multinational semiconductor and telecommunications equipment company through Qualcomm Life (www.qualcommlife.com) medical-grade connectivity network in partnership with Phillips HealthSuite, aims to develop a scalable ecosystem.[37]

It is early days

The curation/navigation marketplace is beginning to emerge through start-ups and new organizations that are driving change. Governments, particularly in the United States through the Office of the National Coordinator for Health Information Technology (ONC), the United Kingdom through the National Health Service (NHS) and Australia through the Digital Health Agency, are setting ambitious digital Health Information Technology (HIT) and consumer-empowerment agendas. Improving access to quality health care is a priority in emerging health care markets and in economies facing extreme pressures through population aging and rising chronic health problems. Some countries are moving to digital platforms as a model for affordable, universal and patient-centric care. For example, when Estonia transitioned to a digital economy after leaving the Soviet bloc,[38] a national e-health system was launched in 2008 that covers electronic health systems, patient portals and e-prescriptions. Telemedicine is under trial in remote areas of South Korea[39] and nationally in Indonesia.[40] Finland is positioning as a leader in digital and personalized health, actively promoting a start-up and venture investment culture with the Vertical Accelerator[41] and exporting health technology through the Digital Hospital program.[42] Japan is pursuing a portable personal health information system via cloud computing,[43, 44] and Portugal is implementing a nationwide telemedicine and telemonitoring program across the national health system.[45]

"Creating a connected health ecosystem will establish structure, priorities and collaboration to truly advance the market, leading to a more cohesive and successful endeavor, eliminating the 'noise' and focusing on winning ideas and services."

Joseph Kvedar, MD Vice President, Connected Health, Partners Health care

The courage to lead: Mercy Virtual, a virtual care center first

The US$54 million Mercy Virtual Care Center, the world's first virtual care center, opened in October 2015 in Chesterfield, MO. With no beds and no on-site patients, it's a virtual facility connecting patients to the care they need 24/7, 365 days a year. A team of medical and health professionals, along with leading-edge telemedicine technologies, is housed in the four-story, 125,000m^2 building. Dr. Randy Moore, president of Mercy Virtual, spoke with EY about the innovative and forward-leaning medical care.

The facility is bed-free and technology-rich, with clinicians treating patients remotely, monitoring vital signs and health status and providing expert advice to patients and health professionals alike. Currently keeping an eye on care to patients at 34 hospitals in six states, Mercy Virtual supports and cares for people in their local communities. While virtual care reduces travel costs and inconveniences for patients, Mercy Virtual is focused on identifying a person's medical needs earlier, reducing hospitalizations and keeping people healthier.

Mercy Virtual is improving quality of life and delivering a better care experience for the patient, which is paramount. As Moore notes, "We're treating the sickest patients with the highest needs. They're engaged, they're getting care and their quality of life is much better."

And the concept is working. For Mercy Virtual's Engagement @Home patients, it has meant a 50% reduction in hospital admissions and emergency room use. Besides a 98% satisfaction by patients, staff too have experienced lower stress levels. Clinical teams have accurate data and the right decision-support tools at their fingertips. "We are reaching more patients in more places, providing care when and where they need it most," said Dr. Moore. "In the past year alone, Mercy Virtual has served more than half a million people."

"We have shown the transformative power of virtual care."

Randy Moore, MD, MBA

The result of 10 years of hard work and a US$300 million investment is paying off with reduced costs and healthier patients. Insights gained inform future care and financial models to develop and extend the reach of the virtual care platform. Mercy Virtual is keen to partner with others, sharing what they know with a firm belief that transforming the entire health care process lies at the core of their strategy to optimize health seamlessly.

> **Mercy Virtual Care Centre can be found at https://www.mercyvirtual.net/.**

Getting to business as usual – system transformation

Breaking out of old models requires a new way of thinking

To change course, many things need to be in place, and where the stimulus for health system transformation will arise – whether through consumers, government, private sector or public-private partnerships – is not yet evident. Moore (2014),[17] discussing new technology adoption in mainstream markets, suggests that the key to system transformation is leadership commitment and intention as a matter of political and economic will. As Andrew Thompson from Proteus Digital Health explained, "Someone has to decide it's a priority and it's what they're going to get done. At some point, they decide we're going to enable consumers to access health care using mobile devices and … to create legal and regulatory and other policy structures to make that happen. The Japanese Government (for example), has said they're going to build a secure foundation and they want the entire industry to run off it. It appears that there is going to be an emerging set of policy, regulatory and economic factors in that country that mean they coalesce around digital services and health care reasonably quickly."

The health industry is often noted as slow to adopt technological change.[46] Consumers are more agile, and many already take advantage of changes in information flows as the internet and social networks become trusted sources of information and personal support. Conditions exist to benefit from the best of what technology can offer – a mass market enabled by mobility, enhanced 4G/forthcoming 5G telecommunications and cloud storage underpinned by integrative platforms.

Emerging technologies will not necessarily arise from within health care: blockchain

Initially developed as a way of validating and relaying financial transactions, blockchain offers considerable potential for use in health care.

Blockchain is a distributed framework that could support the integration of health care information at scale, across organizations and across time. Pseudonymous accounts would allow individuals to control their own data and privacy settings while providing de-identified rich standardized data sets for research and population health. Analytical tools and AI capabilities could deliver solutions for personal health management, patient engagement programs and virtual health systems beyond organizational boundaries.

While not a perfect solution and not a substitute for an enterprise system, blockchain may offer promising solutions to address medical records interoperability, identity verification, data standardization, protection and scalability.

Sources: EY, Blockchain Technology as a Platform for Digitization, http://www.ey.com/Publication/vwLUAssets/EY-blockchain-technology-as-a-platform-for-digitization/$FILE/EY-blockchain-technology-as-a-platform-for-digitization.pdf.

Vian, Voto and Haynes-Sanstead, A Blockchain Profile for Medicaid Applicants and Recipients, 2016.

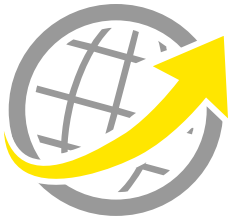
ONC, Use of Blockchain in Health IT and Health-related Research Challenge, https://www.cccinnovationcenter.com/challenges/blockchain-challenge/.

Three key elements that we consider important to system transition are:

1 Capitalizing on the advantages of technologies

2 Empowering platforms that combine technologies, people and processes

3 Cultural shifts that enable the system to transition toward an ecosystem



Shift 1: Putting technology to work

The right infrastructure

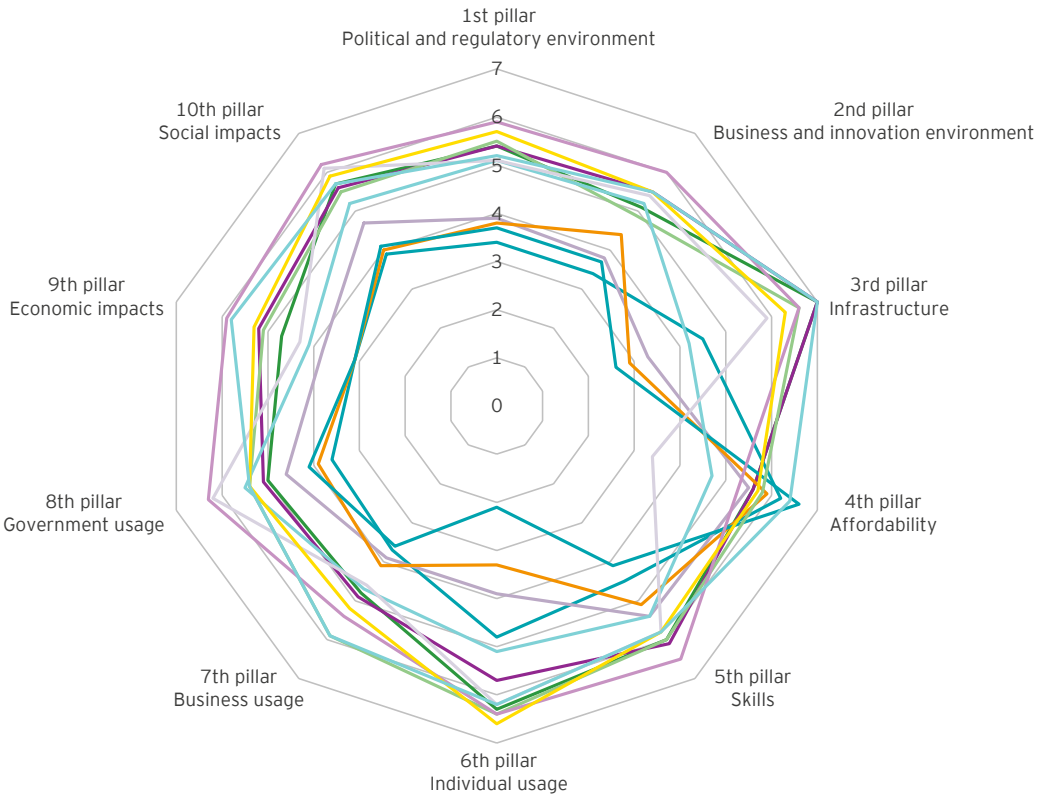
Core infrastructure needs include:

- Access (broadband, cloud service technologies and security)
- Affordability, mobility and connectivity (device ownership and subscriptions; 4G/5G connectivity)
- Consumer skills and readiness
- Enabling regulatory and innovation environments

Global locations will have some various combinations of these, and several indices track the overlay between infrastructure and health system readiness[10, 47-49] (Figure 2). For example, the United Kingdom intends to be paperless by 2020 and to develop local area digital health road maps that improve digital technology strategy.[50] In the United States, the Connect2health[51] project maps broadband connectivity, deployment and subscribership to metrics of health status, physician access and prevalence of chronic conditions in urban and rural areas.

Figure 2. State of readiness: 12 countries' capabilities to benefit from information technology

Information technology state of readiness: selected countries



* = High-income group
^ = Upper-middle income group
\+ = Lower-middle income group

Source: Baller, S., Doutta, S., and Lanvin, B. (eds), The Global Information Technology Report 2016, World Economic Forum.

Showing an economy's performance on the 10 pillars of the Networked Readiness Index – 53 indicators assessing capabilities to benefit from information communication technologies (ICTs). Score from 1 to 7 scale, with 7 being best possible outcome.

The right environment

Participatory health of the future may well occur across national boundaries and clinical interest areas. Safeguards arise from regulatory, financial and policy environments that define and set the future course of creating a technologically rich environment. Regulations can and do change, particularly when driven by public benefit and consumer demand — Uber, for example, has rewritten the transport industry regulatory handbook.

Scaling and sustaining participatory health models that deliver optimal health and health care for individuals and communities will require attention to:

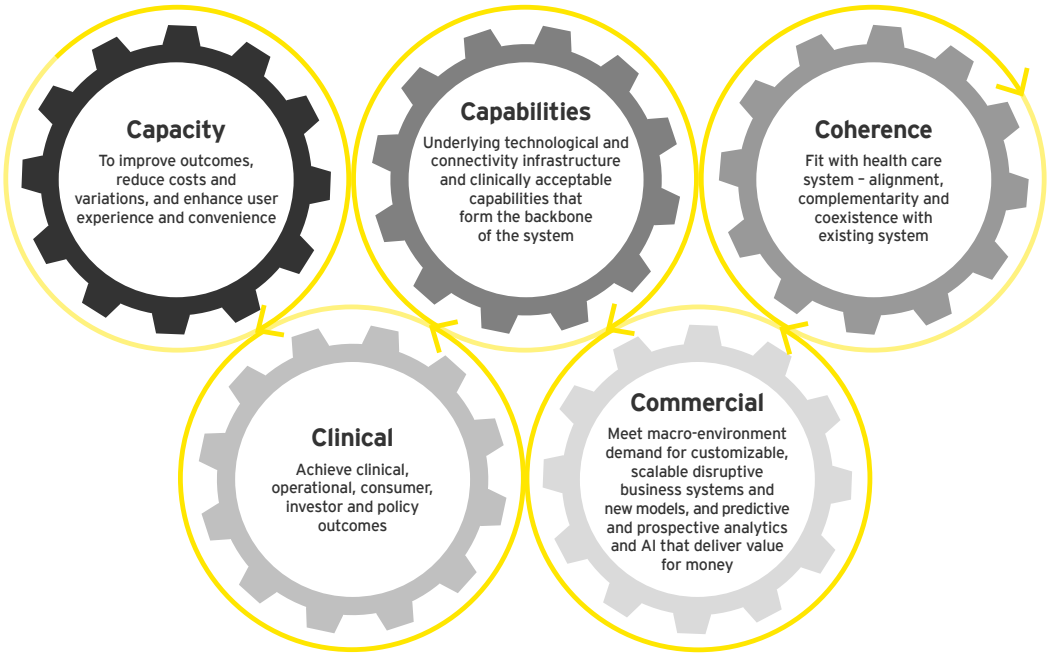
- User-centered design
- Supporting mission-critical activities, including safe/secure capture and sense-making of unstructured patient-generated data and structured system data (providers, payers) for shared decision-making, clinician use and patient information
- Integration of other data, including the social determinants of health, environmental and social networks
- Enterprise systems that alter the supply-side cost structure through automation, virtual systems, disintermediation and predictive accuracy

Regulations can and do change, particularly when driven by public benefit and consumer demand — Uber, for example, has rewritten the transport industry regulatory handbook.

The right information

Mobile devices are key tools with capabilities to capture data, interface and connect via platforms, are cloud based and require no specialized knowledge or skills. They represent a key first step in personal sensors that sit alongside everyday life. They become the invisible hand guiding an individual, removing complexity from participation and self-management, and bring functions to capture and understand sensory, perceptual and locational information. Health literacy, or the ability to understand health and medical information sufficiently well enough to make informed decisions, is foundational to engaging individuals. Evidence suggests that better understanding health and medical information leads to improved outcomes as individuals gain skills and confidence in managing their health and care.[52] Solutions include health-literate organizations that support people to navigate, understand and use information and services,[53] improved accessibility and platform design,[54, 55] and early intervention. Vivo (www.vivoclass.com.au), for example, has embraced this through creating a learning platform, targeting children at school. It has built the fundamentals of health knowledge and learning into the digital future for wellness in youth. Incentives are used to influence and reward behavior shifts.

The five Cs of information are:



Shift 2: Platforms: the architecture of transformation

Platforms create new pathways by which to organize and deliver health care. The idea of a platform is a familiar one – something that can capture, organize, scale and automate. A platform is a layer of infrastructure upon which other applications and technologies can be built. As a vehicle that brings parties together for exchange through sharing, collaboration and competition, platforms can fulfil functions where exchange becomes the basis of value to the participants: whether that be trade of goods and services (such as online marketplaces), exchange of information and interactions (such as crowdsourcing solutions to complex diagnostic problems) or resources brokerage (such as accommodation rentals).

Network effects

One of the strengths of platforms lies in generating a network effect or demand-side economies of scale – the more people who join and use them, the greater the benefit. This is a shift from a linear arrangement of inputs and outputs to an ecosystem that creates value exchange between members. This is evident in peer-to-peer systems such as social networking sites and in shared resources networks for patients such as PatientsLikeMe (www.patientslikeme.com) and SmartPatients (www.smartpatients.com) and Patientory (www.patientory.com), an app that store and manage personal medical information and, through a platform, connects individuals who have shared interests and enables care teams to manage a patient's care across multiple locations. Consumers can actively source comparative information, support and navigation. Aggregation platforms or comparison sites such as Why Not The Best (www.whynotthebest.com) and Castlight Health (www.castlighthealth.com) enable consumers to compare prices, products and performance of insurers and hospitals. Health& (www.healthand.com.au) consolidates an individual's health records in the one place, providing evidence-based clinical information and a personalized risk-driven dashboard.

Platforms

Systematize and organize

Other strengths of platforms lie in the capacity to systematize and organize around (or to create) an ecosystem. In addition to platform technologies, success to reach scale depends upon key attributes of:

- Good governance
- Valued partnerships
- Codes of conduct
- A facilitatory regulatory landscape

Disruptions become possible due to reduced barriers to entry for new entrants and low investment costs as those entering build upon what has gone before. New business opportunities arise through the capture and monetization of vast amounts of data. Health care organizations and entrepreneurs recognize value in consolidating and controlling ensuing data sets and in deep analytics that optimize information sharing and system-wide coordination, and help deliver cost benefits.

Validic (www.validic.com), for example, provides a "one-to-many" connection between patient-recorded data from health applications, clinical and remote-monitoring devices, fitness equipment, sensors and wearables to key health care companies. The consolidated data supports better patient engagement, population health management and efficient care coordination. And Fitbit (www.fitbit.com), the consumer fitness device maker, has signaled its ambition to become a digital health platform across the health system.[56]

For many, competitive advantage will arise in developing innovative solutions and services, as well as growing consumer relationships, preferences and brand loyalty. As health care platforms continue to evolve and mature, they deliver the foundations to re-envision entirely how health care is delivered. Issues around privacy, enterprise risk, cybersecurity, regulatory challenges, resolving resistance to data sharing and achieving coordination across platforms will all impact the evolution of platforms.

Shift 3: The transformation journey

Pressure from patients or consumers who want a "voice" and "choice" will likely drive industry change toward a participatory health system. This comes about as people expect in health care what they have in other areas of their lives – autonomy, connectivity, immediacy and tools for self-direction. Consumerism trumps culture. It will be a critical lever of change in an industry resistant to technological transformation.

New entrants emerge as the industry transitions to an environment that is online, networked, participatory and integrative. But this shift also breathes life into incumbents willing to redevelop their core business or move into adjacent areas. Critical to the move toward care in the home and community (such as health care homes) will be the degree to which stakeholders (professionals, consumers, policy-makers, payers and the public) and organizations embrace a participatory health system. This will require a deep understanding of the benefits that participatory health brings along with shifts in the economic, behavioral and motivational factors that determine and shape how performance is recognized and rewarded. Highly fragmented and with many vested interests,[57, 56] the industry needs to quicken its pace to keep abreast with the changes occurring outside of traditional legacy structures as what was once disruptive becomes the norm.

Reaching an adoption threshold capable of achieving and sustaining a growing segment is vital. Sensors such as accelerometers are a good case in point. The technology is increasingly sophisticated and cheaper. Consumer adoption of wearables is rising (although recent studies suggest abandonment rates of around 30%)[58] and some health professionals incorporate them into treatment plans. But the shift to scale to effect positive behavior change, and health and wellness management options at the population level, remains elusive. Broad adoption is only likely when these products transition into cheap and readily available tools that are integrated into daily life. As Associate Professor Alain Labrique, founding Director of the Johns Hopkins University Global mHealth Initiative, told us, the need for improvements in functionality and accuracy, along with a lower price point, will be necessary to shift the market to mass adoption.

This shift challenges long-held assumptions and routines requiring changes across organizational and professional boundaries. To achieve scale means:

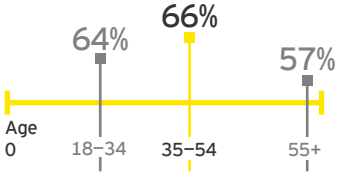
- Meeting consumer expectations for technologically enabled care that is mobile and connected and as new generations of clinicians turn to mobile devices, decision support, cognitive assistants and diagnostic support (see below and see young professional pulse survey results)
- Dealing with service design, payment and performance management issues that encourage and support the delivery of participatory health care
- Attending to clinical, regulatory, safety, risk and privacy concerns, and organizational and cultural transformation
- Understanding and addressing the dynamics of complex change and innovation adoption (for example, persuading health professionals to change the long-held ways of interacting with consumers, and the ownership and sharing of information and expert knowledge)[57, 59, 60]
- User-centered design should form the basis for creation of integrated service models based on consumer engagement to drive an individual's health

Health care open to change

62%

of United States consumers interested in virtual care as alternative to in office doctor visit for non-urgent care.

>74% greater convenience



Source: Salesforce State of the Connected Patient. 2016.

72% of health professionals surveyed believe that health apps will encourage patients to take more responsibility for their health.

59% of health professionals surveyed use smartphone technology to access medical research.

46% of health care professionals surveyed say that they will introduce mobile apps to their practice in the next five years.

Source: Research Now. 2015.

46%

of consumers who search online for health information act directly upon the information they find.

Source: Rock Health Digital Health Consumer Adoption. 2015.

20%

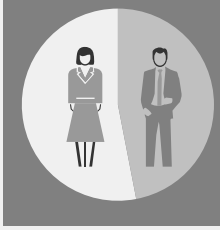
of consumers would switch to a Primary Care Provider (PCP) who offered video visits.

Source: American Well Telehealth Index: 2017 Consumer Survey.

Participatory health: taking the pulse of young professionals' survey

Engaged, empowered and digitally active

Young professionals clearly see for themselves an active role in managing their own health and wellness in partnership with their health professional. Engagement, self-management and accepting personal responsibility for their own health is important to them.



In early 2017, EY took a snapshot of young professionals' views of participatory health and the future of health care. A convenience sample of 267 respondents in nine countries, respondents were male (47%) and female (53%) and aged between 21 and 35 years. More information about the survey can be found in the "Methodology" section later in this report.

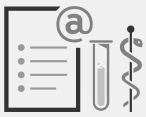
Inevitably online

Use of virtual resources is high. In the past year:

73%

turned online for general research and information on health issues.

49%



sought information for diagnostic purposes for themselves or another.

24%

used internet research to develop questions to ask during their most recent appointment with a health professional.

Digital tools and technologies would help an individual better manage and coordinate their health care. The most helpful tools are (all data reflects ratings of extremely helpful or helpful)

81%

Access to test results in understandable formats

77%

Digital tools (e.g., reminders and self-management programs)

73%

Secure phone apps to store personal records and data

Changing models of health care

Open to non-traditional care models, young professionals are highly receptive to non-urgent care in alternative locations, such as pharmacies or department stores, and by health professionals other than physicians. However, for urgent and emergency care, preferences are evenly divided between new emerging care models and preference for physician-provided care.

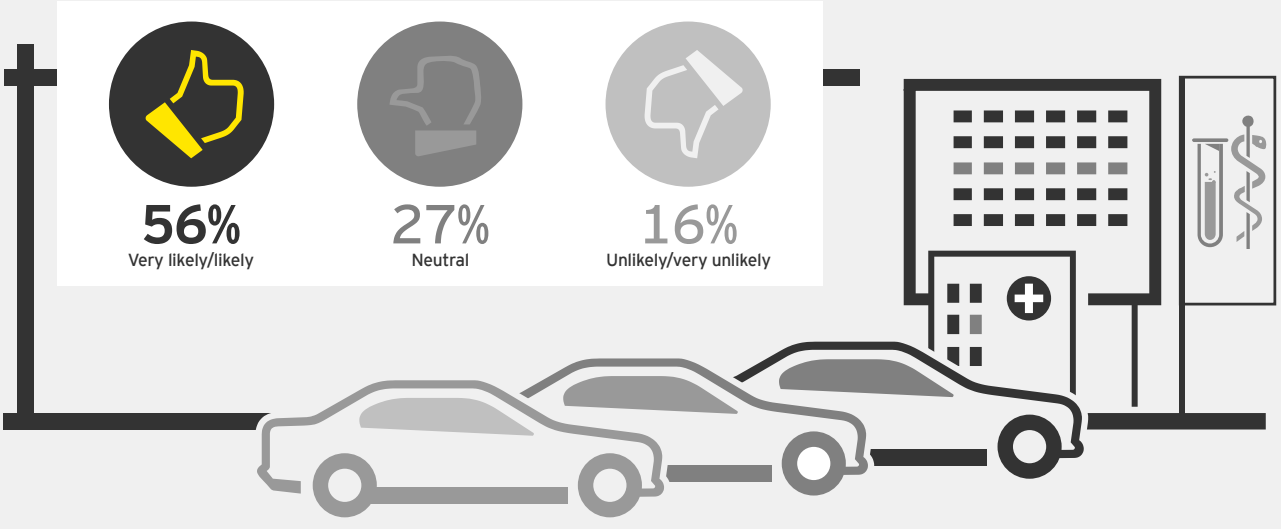
Strongly agree/ agree	To what extent do the following statements accurately reflect your views? (Five-point rating scale) I am willing to ...	Disagree/ strongly disagree
81%	Be treated by a health professional (e.g., registered nurse, physician assistant or pharmacist) instead of a doctor for minor/non-urgent health problems, vaccinations and basic health screenings (e.g., blood pressure, blood sugar or weight)	5%
72%	Have non-urgent treatment, vaccinations and health screenings (blood pressure, blood sugar or weight) by a health professional (e.g., registered nurse or pharmacist) at a retail pharmacy or in a facility located in a department store	7%
39%	Be treated by a health professional (e.g., registered nurse, physician assistant or ambulance officer) instead of a doctor at an emergency department in a hospital	**34%**
38%	Be treated by a health professional (e.g., registered nurse, physician assistant or pharmacist) instead of a doctor for urgent or complex health problems or screening procedures	**39%**

The next five years will bring big changes. The future of the health industry lies in digital and mobile solutions, consumer influence and engagement, and non-traditional players and locations. Health broadens to wellness, as well as dealing with chronic conditions and population health.

Very likely/likely	Unlikely/very unlikely	To what extent do you believe the following will likely occur in the health industry in your country in the next five years? (Five-point rating scale)
71%	5%	Digital, mobile and social solutions give patients the knowledge, skills and confidence to engage persistently with the health system.
68%	10%	Individuals will use apps and social media for health-related information and support in preference to the formal health care system.
64%	9%	The location of care will shift beyond the four walls of the clinic to care anywhere and anytime in the home and community.
64%	6%	Non-traditional players – entrepreneurs, retailers, telecommunications and technology companies – will develop consumer-orientated services that compete with existing systems.
62%	13%	The concept of health will transition from sick care systems to wellness, chronic care and population health management.
62%	11%	Consumer opinion through crowd-sharing of experiences, ratings and reviews will become an important influence on improving system performance.
59%	14%	Connected health will become the norm as clinical telemedicine and consumer-oriented personal health technologies combine and create new ways to deliver care.
58%	17%	Individuals will manage their own PHC of personal data feeds, e.g., from wearables, IoT or remote monitoring.
57%	14%	Primary care as we know it will change fundamentally as integrated care teams form around a patient-centered medical home supporting chronic and complex health conditions.
51%	12%	Consumer demands for a "voice' and 'choice" will ultimately force the health system to refocus around consumers.

Could health care be "Uberized"?

More than half consider health care in their country likely to shift to on-demand



Primary care transitions to chronic care and population health

The primary care model is transitioning toward chronic disease and population health management, drawing upon curation, navigation and integration technologies and team-based care.[61-65] Personal data fusion in the individual's cloud will supplant electronic health records that have failed to deliver utility.

Two possible scenarios emerge:

- "Cradle to grave" care[66] within an integrated system with the generalist physician[67, 68] as navigator, guiding patients through understanding complex information and deciding upon a course of action
- Availability of multiple service options as determined by the market, with integration occurring behind the scenes through personal data fusion in the cloud

Navigation will help primary care providers manage larger populations with lower-cost models of care centered on the home. This will drive more cost-effective solutions for treating low-acuity illness, support patients to participate actively in their own health management, aid early identification of major illness and navigate the patient to the right care provider. Providers will routinely have access to a vast array of relevant information, including research, environmental, social and personal, to tailor individual care but also to focus upon broader issues of population health. Payers will draw upon population data to support and encourage cost-effective self-management solutions, as well as early identification of disease and connections with the right care provider.

Advanced communications and virtual care models support care at a distance and reduce the need for in-person visits. Population health and value-based care models are supported with AI and data analytics that predict risk and support highly personalized care. Analytics platforms that can continually examine and analyze multimillions of items of sensor data and clinical and medical history information will underpin remote patient monitoring and, ultimately, population health.

- **Forward** is a primary care service membership model (US$149 per month) based in San Francisco that provides members with access to physicians, data-driven technology, AI, wearable sensors and 24/7 mobile access via an app. Initial in-person baseline is captured through a body scanner, blood tests and genetic testing, which are used to develop a blueprint for future health and wellness. AI analytics of baseline data and real-time data from phone and devices sensors is used by the medical care team to reach out to the individual via the mobile app with alerts or monitoring progress.

> www.goforward.com

- **Medalogix** assists home health clinicians by analyzing home health and clinical data with predictive analytics to identify patient risk, predict and resolve issues that may lead to unnecessary hospitalizations, and provide value-based care. Three main types of predictive services target patients at high risk of readmission; provide prospective identification of patients who will likely benefit from hospice care and assists clinicians with managing home health care; and finally, predict which patients will need post-discharge care and assistance and customized care management plans, including monitoring tools, calling prompts and schedule.

> www.medalogix.com

- The IoHT is changing the face of primary care through such things as home monitoring (for example, the Withings wireless blood pressure monitor), medication management (for example, the AdhereTech wireless pill bottle) and early intervention (for example, Omada Health chronic diseases programs).

> www.withings.com

> www.adheretech.com

> www.omadahealth.com

Creating a cadence for change

> "What is the burning platform event where people will say, 'OMG, we have to change health care?'"
>
> **Joseph Kvedar, MD Vice President, Connected Health, Partners Health care**

The digital revolution in health care described by Eric Topol[69, 70] offers untold opportunities to deliver care and connect with consumers in unique ways. In this paper, we have sought to understand the changes necessary to embed a participatory ecosystem within the core business of health care – something that we believe is inevitable as technologies mature, disruptive solutions succeed and health systems become participatory.

This paper has canvassed an early stage transformation. The pathway to a participatory health system is under construction as we move past the digitization of everyday practices and tasks toward a future of health care that is personalized, predictive and better value for money. Solutions are emerging that address the many governance, regulatory, social and ethical questions that arise. Gaining public and clinician trust, particularly around the safety, validity and integrity of devices, AI and continual and unobtrusive monitoring is of the utmost importance. Also critical is gaining and sustaining consumer engagement. As one executive noted, "Most people don't actually want to think about their health care on a routine basis, and that's one of the fundamental barriers to truly engaging the consumers". With information comes power and responsibility – for consumers, a transition to a participatory health system will bring both.

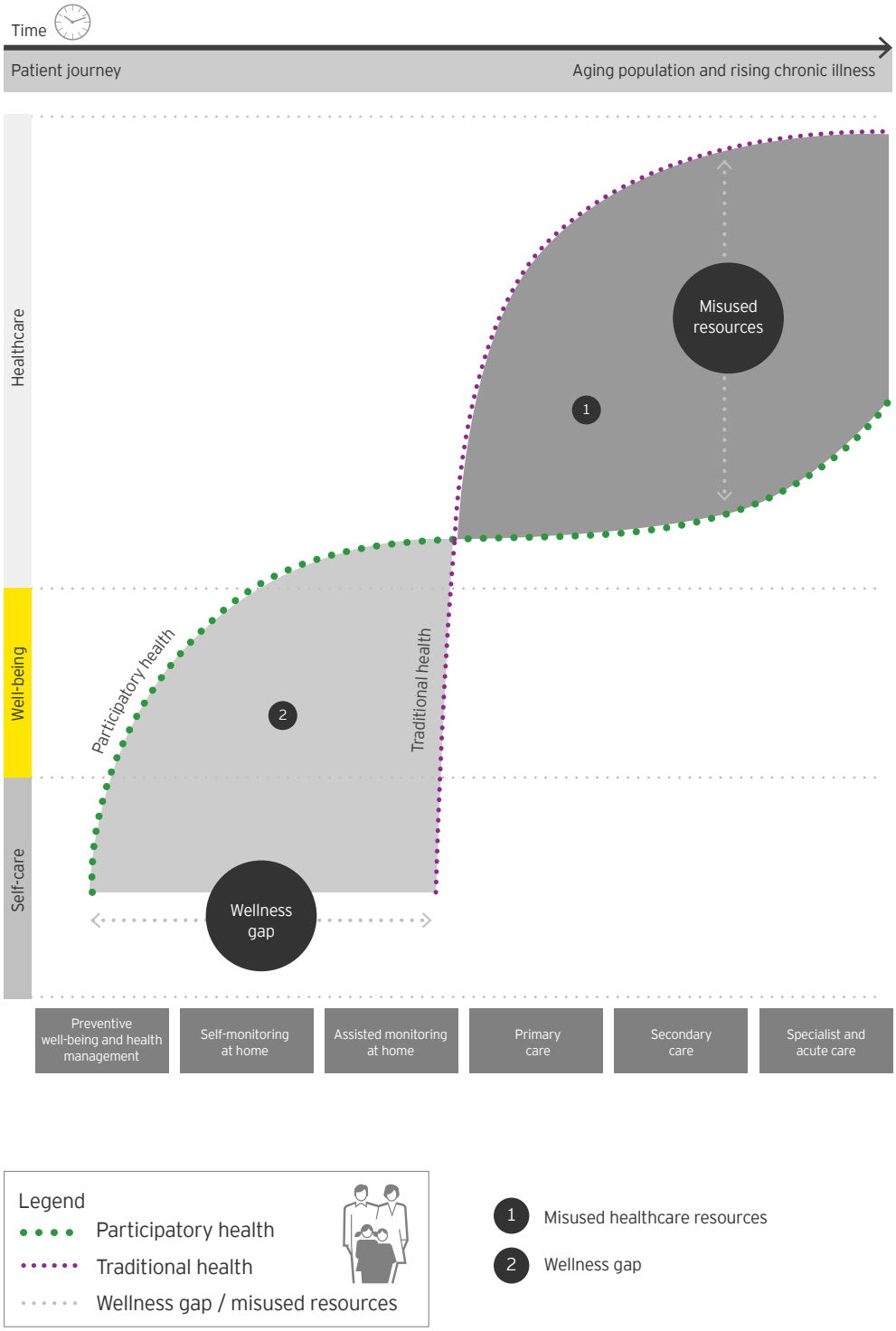
Listening to the leading industry executives speak about the future of the health care industry has been illuminating. Industry transformation will be built upon innovations that truly make health care simpler and seamless - especially innovations developed around the devices of daily life and mobile phones. Disruptive technology-based responses that drive patient engagement through participation and curation of their health and wellness experience, deliver population health outcomes and deal with the burning issue of costs are paramount.

Concerns around purpose and payment were voiced, especially how to benefit from the opportunities afforded by participatory care and, at the same time, avoid increasing health inequities. Data fusion ecosystems that capture and make sense of massive data flows and platforms that glue the multipiece jigsaw that is a health care system together are vital. As are shifts in industry culture and in how we conceive and think about health and wellness in a globalizing and interconnected environment. Geopolitical differences and the absence of expensive infrastructure may well see emerging and developing economies take advantage of advanced technologies and promising platforms to leapfrog into a participatory health care model.

In our first paper, we concluded that opportunities emerge at the intersection of consumerism, technology and markets for those willing to explore beyond their traditional boundaries. Our views have not changed – the convergence dynamic continues apace. Health care will need to reconfigure to reach its digital potential. (Figure 3) There will be growing pains, and the big issue will be that of the "last mile" – persuading consumers, health professionals and those charged with governance and stewardship to adjust business, clinical, and regulatory processes around the new technologies and participatory care models. How a shift to participatory health might be financed will be addressed in the third paper in this series.

To avoid being on the wrong side of an emerging and disruptive trend, health industry players need to recognize that preserving the status quo is no longer an option. It is timely to be bold. Even highly conservative estimates suggest that considerable health expenditures may be wasted and potentially available for redirection. We ask: what if even a small proportion of this money was directed toward creating a participatory health care system?

Figure 3. The patient journey in different health care ecosystems: opportunities exist to address the wellness gap and resources deployment



Our view

Some will lead and others follow but, in a forward-leaning world, three things to consider are:

1 Consumerism and technological change are the twin dynamics of disruption in health care

Maturing health care consumerism and changing technologies are a powerful combination. Leveraging the power of the crowd through technology (such as crowdsourcing and social networks) will likely be an effective force for change. Changes in consumer expectations and new patterns in consumer behavior will arise from and be shaped by such networks and platforms, and will ultimately be a key lever pushing the health system to adapt. This will require a clear appreciation of the market and where disruption is most likely – whether this is upcoming generations caring for aging family members, baby boomers vigorously redefining their future or a newly formed health care system in an emerging/developing economy.

2 Convergence between science, social, technology and industry demands a rethink of business models

Convergence opens the doors to new opportunities. A shift in mindset requires core capabilities in partnering to operate and thrive in the new environment of partnerships, alliances, new locations and consumerist orientation, and identifying innovative ways to capture value. A new ecosystem brings a new set of players with opportunity to leverage expertise in adjacent spaces such as financial services, manufacturing and insurance.

3 When system-ready, health care will deliver affordable, accessible total health

Future success depends on the system-readiness of the health industry. In the future state, individuals will access care regardless of geography through teleconnected services, and the core business of health care will be anchored around virtual delivery, consumer engagement, and an integrative and long-term orientation. Platforms are key to new pathways by which organizing and delivering health care and a broad ecosystem of many players becomes possible, including virtual care centers, smart homes, smart hospitals, smart technologies on and in-person the person and smart insurers. Payment models, performance incentives, industry structure and staffing systems require redesign to account for new models of care and changing roles and responsibilities. New approaches in future services demand different talents, including data scientists, creative designers and behavioral economists.

Methodology

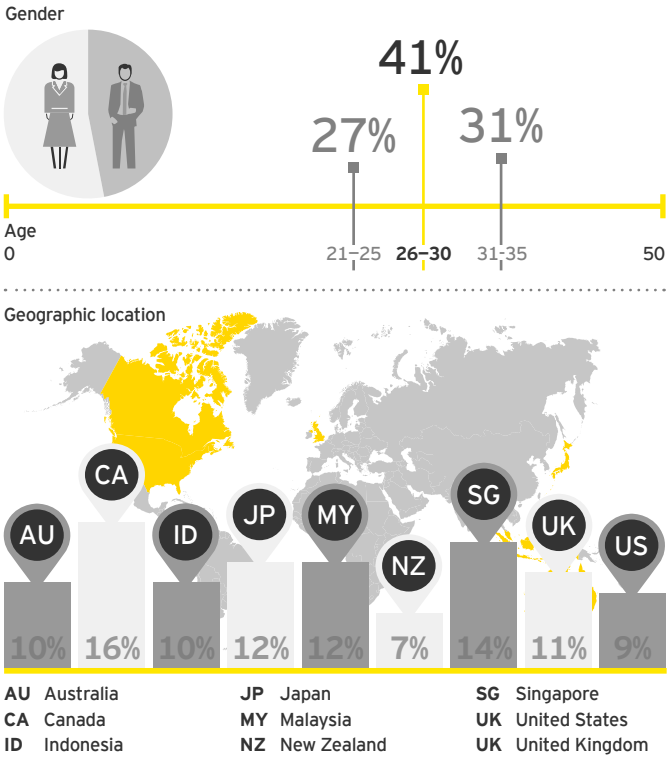
This paper draws upon conversations held with health industry leaders in the United States, Europe, Southeast Asia and Australia.

Executives from government and regulatory bodies, academic institutions, providers, payers, entrepreneurs and consumer groups were interviewed between September 2016 and January 2017. Views around participatory health and the shift to a digital health care system were discussed, including likely time horizons and anticipated impact upon the health care industry. We also spoke with our global health care industry professionals, and reviewed relevant academic and industry literature, and conducted an exploratory survey that took the pulse of professional young adults views on virtual health.

Participatory health: taking the pulse of young professionals' survey

An online pulse survey was conducted in February 2017 of a convenience sample of young professionals located in nine countries. The 267 respondents were aged between 21 to 25 (27%), 26 to 30 (41%) and 31 to 35 (31%) years. Respondents were male (47%) and female (53%). Countries of residence included Australia (10%), Canada (16%), Indonesia (10%), Japan (12%), Malaysia (12%), New Zealand (7%), Singapore (14%), the United Kingdom (11%) and the United States (9%). The majority of respondents report that they are in excellent or good health. Around half use the health care system on an occasional basis for minor illnesses such as colds/flu, 17% are regular users of the health care system for a chronic condition or long-term injury and illness and 24% say they have no real need to use the health care system at this stage in their life.

Ten questions were asked exploring respondents' views on participatory health, use of online digital tools for health care purposes for themselves or another, views on privacy and security of personal information, interest in new service delivery models and views about the future of health care in their country.



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