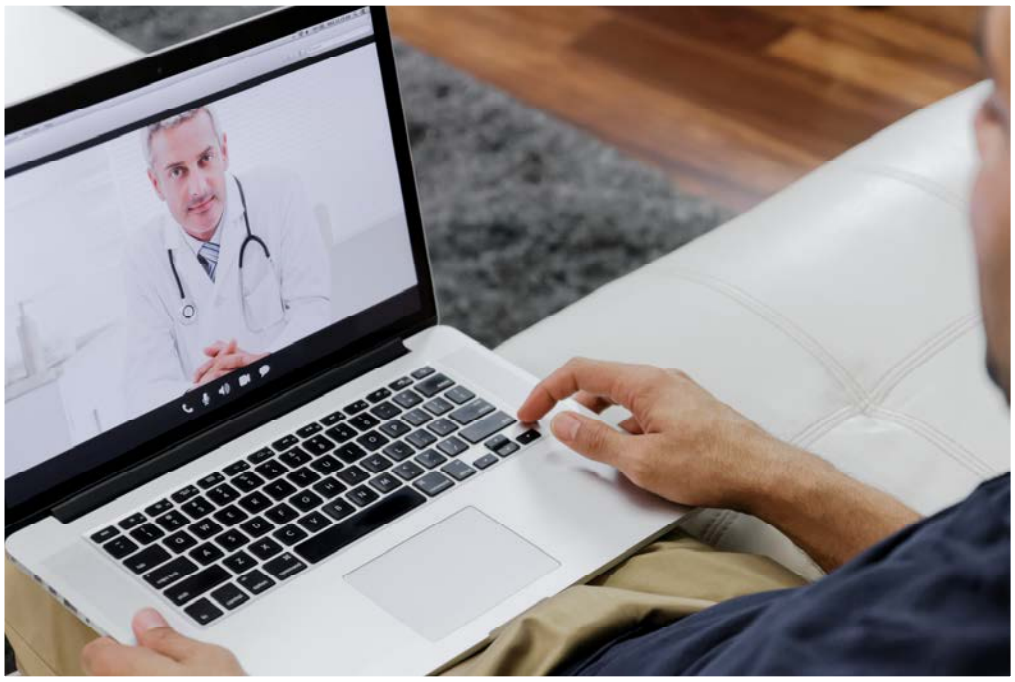
From Start-Up to Break-Through

Digital Health Adoption in US Healthcare

January 2018



pwc

START-UP NATION CENTRAL

Foreword

Supporting local digital innovators through our global healthcare network

The PwC team have been delighted to partner with Start-Up Nation Central on this insightful research that will have real impact on our market and the talented, local innovators looking to break through and demonstrate value in the US healthcare ecosystem.

Bringing evidence-based insight is fundamental to what we do. We have worked with our network's US-based healthcare specialists to capture the digital adoption challenges in the US ecosystem, disrupting trends and emerging opportunities. Many of these experts spend their careers advising American healthcare organizations and helping them take on their most strategic problems. Digital transformation is widely considered a growing key to demonstrating value to patients, and remaining competitive in this fast-evolving environment.

We were also pleased to further strengthen our relationships with the digital health start-up community in Israel. We worked together to define the community's priorities and understand what is most difficult about breaking through in the US market. This report collects some practical tools that respond to those priorities. Our aim is that local start-ups can use these in planning the next phases of their development and navigating more effectively towards successful adoption.

We wish continued success to all the innovative, local businesses looking to make a positive difference to US healthcare, and look forward to working together with you to reach that goal.

Rubi Suliman
CEO
PricewaterhouseCoopers Advisory Ltd.

Edouard Samakh
Head of Management Consulting
PricewaterhouseCoopers Advisory Ltd.

Providing digital health start-ups with tools to navigate in the US

The digital health industry is one of the most cutting-edge and innovative sectors within the tech world. Using the technical capabilities of today, an established industry is being radically and significantly altered both in terms of its external perception, and internal methodology. This offers health systems in the US and across the globe the potential to revolutionize how they operate, and make a substantial difference in how illnesses, disease and healthcare is approached from every angle.

While the possibilities are plentiful and broad-reaching, it is taking longer than previously predicted for the industry to move from the traditional structure established during the industrial revolution, to its potential of a digitalized, patient-centric system where consumers are empowered to manage their own medical issues on a more independent and actionable basis. The proposed, disruptive nature of various digital health solutions is in the pipeline, but has a way to go.

To this end, Start-Up Nation Central and PwC Israel are proud to present a comprehensive digital health toolbox to help start-ups approach and navigate the US healthcare system. Following extensive research conducted with digital health entrepreneurs investigating their needs, the toolbox was structured to cover everything a digital health start-up company could ever want or need in order to overcome barriers and fill in essential knowledge gaps.

The toolbox contains a broad variety of indispensable pieces of information, such as the digital priorities of healthcare organization executives, the essential components required for a successful digital health business model, tips on how to best prepare for the procurement cycle, the secrets to designing a successful pilot program and many others.

We are proud and honored to have collaborated with PwC Israel on what we believe constitutes a tangible set of practical tools that will resolve key questions, and further the Israeli digital health sector.

In keeping with the mission statement of Start-Up Nation Central, we are delighted to offer these free tools which we believe can serve you very well.

Sharon Shapira
Digital Health Sector Lead
Start-Up Nation Central

Eitan Elkin
Director of Marketing
Start-Up Nation Central

Contents

List of figures & features

1

US healthcare – why digital and why now?

Introduction to the forces at work in the US market

The US healthcare ecosystem

Virtually nothing in the US healthcare ecosystem is standing still. New disruptive technologies are breaking stories every day. Legislative efforts to repeal the Obama administration's 2010 Affordable Care Act (ACA) are triggering insurance market volatility. Healthcare providers – hospitals, clinics and imaging centers – are consolidating, patients are taking control of their own care, risk is shifting and financial incentives are reversing.

The New Health Economy is a digitally-enabled, consumer-focused environment that rewards healthcare providers who improve outcomes and reduce costs. But what role are digital health innovators playing in making this a reality? Is the market shifting in their favor or erecting more barriers? How can US-focused health start-ups position their emerging business models towards success? And what are providers and others really looking for around digital adoption?

These are some of the questions addressed in this report, in which we share tools, fresh analysis and real-world takeaways that can help new entrants navigate in the $5 trillion US healthcare ecosystem[1]. While the competition is fierce for technologies that demonstrate value, new opportunities are opening up at an unprecedented rate, and the rewards on the table are considerable – for patients, providers, employers, insurers, government and of course the next break-through start-ups.

Cost, quality and supply

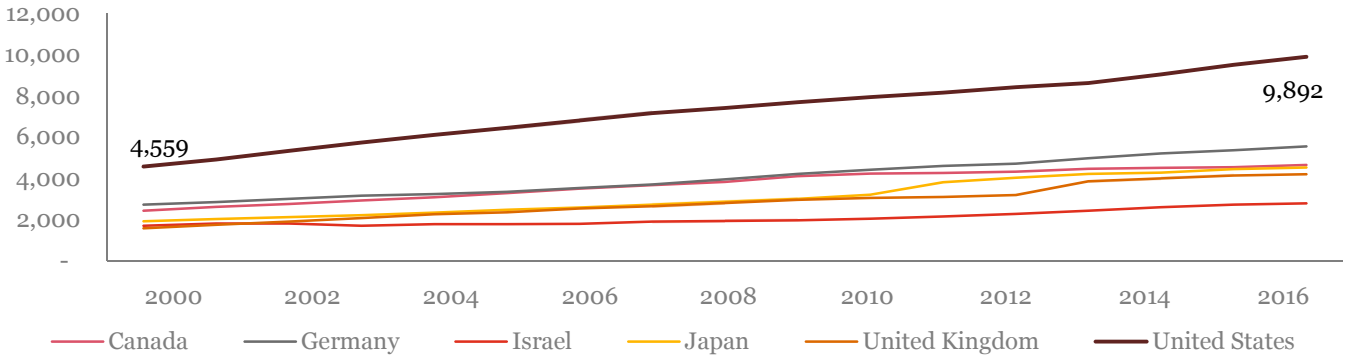
The US ecosystem's starting position is challenging, however, and central to this is the rocketing levels of spend. Healthcare spend as a percentage of GDP is 18% and rising – almost one in every five dollars spent is a 'healthcare dollar' – dwarfing spend levels by other developed economies[2]. Healthcare costs are borne largely by the nation's employers, meaning that wasteful care spending acts like an avoidable tax. *"Medical costs are the tapeworm of American economic competitiveness"*, argued Warren Buffet in May 2017[3].

The money is also being poorly spent. The US ranks last among a recent study of 11 developed economies on access, equity and outcomes measures, and second last in administrative efficiency. Mortality amenable to healthcare is nearly double that of France or Australia – 112 deaths per 100,000. Low access to primary care has lead to poor chronic disease management, delayed diagnoses, weak adherence, wasteful prescriptions, and poor care coordination[4]. The average price of a hip replacement in the US is $29,067 – almost double the cost of the same procedure in Switzerland or the UK[5].

There is a supply problem, too. Although the US leads the OECD in terms of doctors-per-population, by 2030, it will face a shortage of more than 100,000 physicians[6]. And new generations of clinicians, though digitally-savvy, join their older colleagues in concern about the administrative 'burn-out' that comes between doctors and their patients.

"Low costs don't necessarily equate with great outcomes or great quality. Instead, maybe what we really ought to be driving for is value for the health care dollar."
Toby Cosgrove, Cleveland Clinic, CEO

Figure 1: Health expenditure per capita ($)



Source: OECD data

Enter digital

In these conditions, the disruptive potential of digital transformation is captivating industry stakeholders.

What is 'digital' in health? Years ago, digital was another name for IT. But today, countless technology-based products are 'undergoing rigorous clinical validation that will have a direct impact on diagnosing, preventing, monitoring or treating a disease, condition or syndrome'[7].

For example, digital therapeutics solutions use behavioral inputs and sensor-generated data to guide care management for specific chronic diseases which affect 117 million Americans[8]. Machine-learning solutions spot misdiagnoses, prevent medical errors which make up the third leading cause of death in the US[9], and self-improve with data exposure. Virtual health telemetry tools open new revenue streams for providers, reduce costs by transitioning the site of care outside of hospitals, and help the rural 19% of the population reach specialists[10]. Genomics tests are becoming commercially affordable, and are building the capabilities for personalized medicine[11].

Other digital-enabled innovations are leading clinical and financial breakthroughs in predictive analytics, clinical workflow, remote monitoring, care coordination, cybersecurity, virtual reality, patient engagement and biometrics.

"Digital will underlie everything we do in health."
Adam Landman, Brigham and Woman's Hospital, Chief Information Officer

Demonstrating value

Digital is on the rise. Three quarters of hospital leaders now believe that digital innovation is essential to achieving their long term goals, key metrics and competitive advantage[12].

Year-to-date 2017 venture capital funding has smashed records. Healthcare and insurance companies are racing to appoint Chief Digital Officers. Retail and technology giants are expanding out of the lab and in to the market with ambitious acquisitions. The amount of stored patient data has increased more than 700% since 2010, and deal activity in health-focused Artificial Intelligence (AI) businesses has increased by a factor of seven since 2011[13].

Providers and payers are ready to look at whatever can demonstrate 'value' – better health outcomes, through greater patient access at reduced costs. It is time for the digital health innovation community to move from start-up to break-through.

Their success will depend on how well they navigate four key forces that are shaping the US economy and conditioning healthcare delivery in the US.

Demographics – America is ageing. 20% of the population is expected to be 65 or over by 2030 – up from 12% in 2000[14]. Three million more baby boomers will hit retirement age every year in the next 20 years[15], increasing the use and intensity of the services consumed under Medicare entitlement. The elderly make up 14% of the US population, but account for 34% of spending[16], so there will be continued upward cost pressure on the system.

Legislation – The Trump administration's efforts to repeal the 2010 ACA are affecting insurance premiums and coverage, impacting the ecosystem's size and money flow. As many as 20 million more Americans may be uninsured if repeal succeeds through Congress[17]. Even without repeal, subsidy cuts to cost-sharing reductions that help lower-income Americans afford insurance will shift health economics dramatically. There are also changes expected in the Food and Drug Administration's (FDA) regulatory oversight (see feature 4).

Lifestyles – Obesity, smoking, substance abuse, poor nutrition and physical inactivity intensify utilization of health services. Over 70% of Americans are considered overweight, and abuse of opioids such as heroin and prescription pain relievers is on the rise[18]. These growing health risks drive costs upward. However, more focus on wellness initiatives that target these risks before chronic conditions emerge are helping to stem the tide of increasing costs.

Technology – 77% of CEOs believe technology will transform their business over the next five years[19]. Growing affordability, increasing connectedness, and the explosion of data – 'the oil of the digital era'[20] – are finding application in health through robotics, virtual reality, blockchain, artificial intelligence and 3D printing. According to IDC Health Insights, 65% of consumer transactions by 2018 involving healthcare will include a mobile device[21].

2

Disruption in the US healthcare market

What is changing and for who?

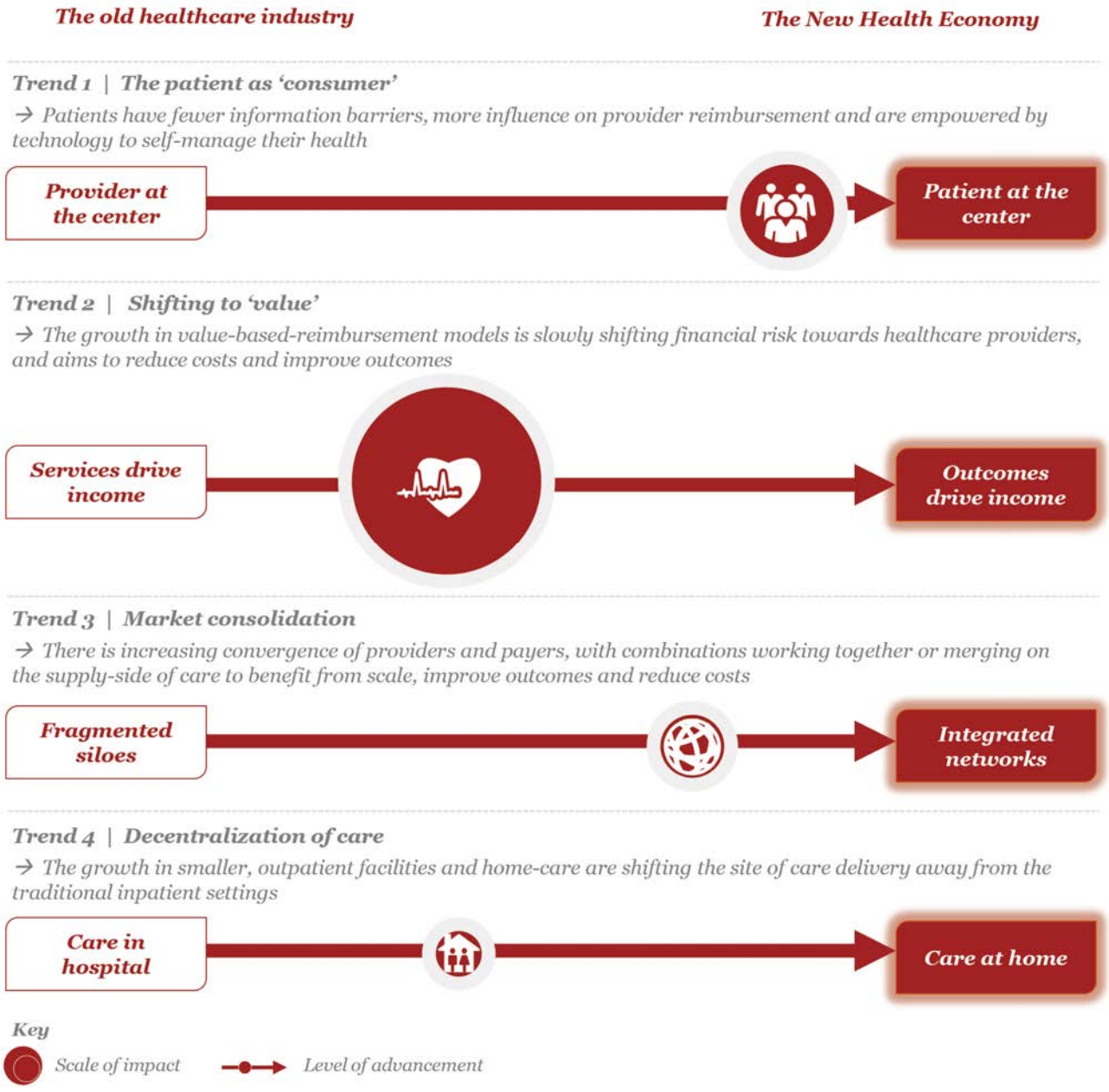
2.1 Trends shaping the US ecosystem

What is causing disruption?

Disruption in US healthcare is being felt through the changing role of the patient, the way health services are reimbursed, how the ecosystem is segmented and where care is being delivered.

In each case, the relationship between the ecosystem's key players is shifting and so is the flow of money between them. The four trends described in this section can be understood by scale of their expected impact, and their level of advancement.

Figure 2: Overview of trends in healthcare



Trend 1: The patient as 'consumer'

Consumers are taking more responsibility for their care, and are increasingly empowered by technologies including personal health apps and social media.

Consumers now access providers remotely, order genetic tests, track fitness levels, monitor symptoms and manage chronic illness — all from their smartphones. They typically share their experiences online, and in the process, influence health systems and drive change.

Patients look at other industries' levels of consumer-centricity, and increasingly expect the same experiences from healthcare providers, especially as financial risk has moved towards patients through employers' increasing use of high-deductible plans in recent years (see feature 2).

PwC's 2016 survey of US health consumers showed their readiness to embrace care through channels and from stakeholders that were unknown a generation ago:

- 45% are interested in using telemedicine services in exchange for lower insurance costs
- 28% say they would consider purchasing insurance from a major retailer
- 22% would consider buying insurance from a start-up

Patients-as-consumers are also owning more of their own health data – five million now use health monitoring tools – a jump of 63% in two years[22]. They are influencing the reimbursement of providers through the roll-out of quality measurement programs lead by the government's Centers for Medicare & Medicaid Services (CMS), which reimburses healthcare providers in part based on patient satisfaction measures (see section 3.1).

Takeaways for digital innovators

→ Attitudes are changing, and mostly in favor of mobile-lead, social and high-grade user interface products that start-up developers excel in. This special capability makes possible new ways of engaging with patients

→ But not all patient communities 'consume' the same way – chronic condition sufferers often have the most to gain from patient-centered digital tools, but are the least ready to use them. Can digital extend personalization?

→ Retailers are surfing the rise of consumerism, with established customer-bases and customer-centric models. Digital innovators will need to decide what their relationship with retailers should be – strategic partner, potential customer or target for acquisition?

***Trend in focus...* Oscar Health**

"The net promoter score of health insurers averages 4/100. Amazon is 74/100", remarked Oscar Health's cofounder Joshua Kushner[23].

Oscar Health – 'a new kind of individual health company' – sells health plans and targets consumer loyalty by focusing on individuals through price transparency, lifestyle incentives, and a retail-quality customer experience.

Founded in 2012, Oscar Health personalizes patients' online experience using dashboards summarizing claim records and patient journeys, app-based virtual doctor calls 24/7 and Amazon gift rewards in exchange for meeting step-counting goals.

Oscar represents the insurance industry's early attempts to treat the patient as a unique consumer, instead of another unit in a risk-sharing calculation.

The company was valued at $2.7 billion after the Fidelity mutual fund led a $400 million investment in 2016[24] and is now expanding geographically across the US, and through partnerships with provider networks like Cleveland Clinic.

Kushner noted, *"we wanted to fix the consumer experience in health insurance and make it more transparent and easy to understand."*

Trend 2: Shifting from 'volume' to 'value'

Healthcare providers used to see revenue rise directly in line with the number of surgeries, treatments, consultations, tests and procedures they performed (often called the 'volume' or 'fee-for-service' model). Providers' costs would therefore drive their reimbursement from insurance companies or employers.

In an expanding reversal, reimbursement levels are increasingly driving providers' costs. Recent legislative and policy changes have accelerated the adoption of value-based care, in which healthcare providers see their payments linked to the outcomes of the care they give patients (or the 'value' they demonstrate).

So for example, instead of getting revenue from running blood tests to identify a patient's cholesterol level, a physician would be rewarded by her success in maintaining that patient's healthy cholesterol level.

Providers, insurers, employers, government and pharmaceutical companies are increasingly measuring indicators like readmission rates and patient satisfaction, and experimenting with rewards and penalties in line with outcome goals (see section 3.1).

Government reimbursement through CMS is at stake, and more each year. 2016 saw CMS withhold approximately $528 million in provider reimbursement from low performers – 23% more than the year before[25]. On the upside, providers like Mercy Health who are ready to experiment with the value model can receive millions in shared savings rewards.

The 'shift to value' is incentivizing healthcare organizations to think twice before prescribing wasteful care, break down boundaries to cooperation, share clinical and administrative data, manage a patient's care transition more smoothly, optimize the value from Electronic Health Records (EHR) investments and extract efficiencies in daily operations.

Takeaways for digital innovators?

→ Physicians spend an average of 785 hours a year dealing with quality measure reporting[26], so there is a huge opportunity to find ways to reduce the administrative burden on clinicians as the shift to value escalates

→ Few healthcare organizations have the data reporting capabilities they need to produce the outcomes-related evidence that will drive their revenue under value-based contracts. Can digital health analytics play a role?

→ The early success stories around value-based care are coming from provider-insurer collaborations and Accountable Care Organizations (ACOs, see feature 5). Tools that help healthcare organizations share data and overcome technology, operational and commercial barriers will be strategically valuable

***Trend in focus...* Aetna**

Aetna could be considered a leading adopter of value-based care models.

Value-based payments are expected to account for two thirds of US healthcare spending by 2020 – it's around one third today[27].

Aetna contracted with Banner Health Network (BHN) in 2013 – a group of 5,000 physicians across 15 Phoenix-area hospitals – to implement outcomes-focused reimbursement programs, that resulted in a 9% fall in radiology services, 5% decline in overall medical costs, and a 4% increase in prescriptions of cheaper alternative drugs[28].

Quality outcomes also improved. Aetna members cared for by BHN had higher cancer-screening rates, better blood sugar management, and fewer avoidable hospital admissions.

To make this possible, Aetna developed a series of digital tools and data capabilities including population assessments, clinical analytics, and care coordination platforms that enabled BHN to avoid wasteful costs like repeated testing or expensive prescriptions, and also benefit from value-based contracting.

They also set up an innovation hub to explore how personalized and preventive care could help deliver better outcomes at lower costs.

Trend 3: The market is consolidating

Over 250,000 facilities and 1.6 million physicians make up the US healthcare ecosystem[29], but these hospitals, ACOs, ambulatory surgical centers, imaging centers, clinics and others are increasingly coming together to navigate the forces shaping the ecosystem.

Healthcare players are buying new assets to stay competitive, enjoy scale and remain solvent. Higher-risk payment models are being rolled out, expensive EHR implementations are draining capital expenditure, and younger physicians are looking for bigger employers in the industry's war for talent.

Growing through acquisition is a popular route. The first nine months of 2017 alone saw 705 deals, worth $76 billion, including UPMC's announced deal to acquire Pinnacle Health, in August[30]. In December 2017, a $69 billion deal was announced with CVS, a pharmacy chain, planning to acquire insurance giant Aetna.

But the growing financial risk for providers from changes to their reimbursement structure is also encouraging organizations of different types to come together in Integrated Delivery Networks (IDNs), where providers and sometimes insurers associate together.

IDNs like HCA Healthcare, Ascension, and Trinity Health share data to improve care transitions, and better manage population health, improving outcomes. They can help align incentives between those providing care and those paying for it and benefit from integrated IT systems, unified purchasing and distribution functions and group-wide reporting abilities. Most importantly, IDNs also enable smoother patient experiences, as health consumers face fewer hand-offs between separate suppliers of insurance, diagnostic and surgical services for example.

Takeaways for digital innovators?

→ Small, innovative new entrants to the US ecosystem will find a less fragmented industry than in the past. Collaborating with or selling to organizations that are part of wider networks will involve different stakeholders and procurement lifecycles (see section 4.1)

→ Insurers regard increasing collaboration with providers as their priority in The New Health Economy. Digital entrepreneurs who can play a role in connecting these organizations – for example developers of Application Programming Interfaces (APIs) that overcome technology boundaries – can become valuable stakeholders

***Trend in focus...* Hartford HealthCare**

Over 10 years, Connecticut-based Hartford HealthCare has grown through horizontal integration (with other provider facilities) to provide acute care through five hospitals and other non-acute facilities, serving two million Americans in the US region with the highest per capita health spending in the country (New England).

One challenge faced through integrating academic with community facilities was the unbalanced utilization and patient flow between network members.

In September 2016, Hartford established a Care Logistics Center to streamline and centralize logistics operations for patients across the network, anchored by Epic's patient transfer module, allowing live-time utilization tracking.

The digital overlay was developed through collaboration with GE Healthcare, who used 18 months of patient data to simulate patient flow and create a 'digital twin' of Hartford's key facility. This let them spot bottlenecks, and test virtual solutions before implementation.

Dr Rocco Orlando, the CMO, explained, *"The main driver [is] to improve care quality and patient safety. But our analyses show that improving patient movement is also economically advantageous*[31]*."*

Despite the challenges, Hartford HealthCare continues to collaborate with other healthcare organizations, including payers like insurer Blue Cross and Blue Shield and Anthem[32].

Trend 4: Decentralization of care

The site of care is moving. Hospital overheads associated with inpatient care and the required administrative processing inflate the real cost of procedures. So to face the cost reduction challenge, they are increasingly being performed elsewhere.

Health Economics professor Jamie Robinson explains, *"The single easiest way to reduce the cost of healthcare is moving care from the inpatient hospital to the outpatient hospital, to the ambulatory surgery center, to the physician's office, to the patient's home. Tech is driving that*[33]*."*

According to researchers at the University of California, Berkeley, cataract surgery and knee arthroscopy procedures performed at ambulatory surgery centers (ASCs) were $5,000 to $2,500 cheaper than when performed at hospitals, based on a study with California public employees[34].

The decentralization of care to facilities such as ASCs – 630 opened in the US in the first nine months of 2017 alone[35] – also improves patient access, and is accelerating along with the spread of virtual care, remote patient monitoring and increased use of clinician extenders.

The other site of care on the rise is the retail clinic. In 2006, fewer than 10% of consumers surveyed said they had ever been to one. By 2016, 42% of consumers said they had[36]. Often through partnerships between leading-brand retailers (like Target) and regional providers, they provide vaccinations, strep tests, sports physicals and minor injury treatments. They price transparently and are open during convenient hours.

Takeaways for digital innovators?

→ Many successful digital health innovators develop connected medical devices that enable consumers to send data to their clinicians from their homes, cars or places of leisure. Medtronic's Cardiocom sensors monitor patients with heart failure and save adopters like Centura Health thousands per patient by reducing hospital-site care[37]

→ Physicians and providers do not want to see 'numbers' from sensors and wearable devices operating outside the clinical setting – they want to have insights and decision support tools based on the data collected

→ Telehealth technology providers are also facilitators of the decentralization of care and can often build a compelling business case based around the cost reductions associated with reduced travel, greater productivity, and fewer hospital-acquired infections

***Trend in focus…* Kaiser Permanente**

Kaiser Permanente, the nation's largest vertically-integrated health system, and Target, the $70 billion retail chain began collaborating on in-store clinics in 2014.

They have eight existing West Coast retail clinics, and announced in September 2017 the opening of 31 more retail clinics[38].

"Southern Californians can expect to receive high-quality, patient-centered health care in convenient, trusted and familiar settings, wherever they live and work," said Ed Ellison, Executive Medical Director at Southern California Permanente Medical Group.

Kaiser Permanente nurses staff the clinics and connect to physicians via telemedicine consultations on pediatric care; women's health, chronic care management and other treatments.

2.2 How the New Health Economy breaks down

Industry players, old and new

Long-time industry stakeholders are not disappearing, but they are changing to survive the seismic change that the US ecosystem is undergoing.

Payers – insurers, employers and government – still hold the majority of financial risk under the 'volume' model, but increasingly need to build population health management capabilities or risk being disintermediated by health systems that take on risk through data sharing networks (see feature 5). *Providers* need to adapt, even if the current fee-for-service incentives do not incentivize them to proactively manage population health or tackle social determinants of disease.

New entrants with global brands but without healthcare credentials are establishing footholds in chronic care management and wellness, potentially leaving the providers with only the most expensive and advanced sufferers.

The dynamic relationships between these and other stakeholders are complex, but key to understand for those targeting digital adoption in the US.

The New Health Economy is a modular, inter-connected ecosystem. In dollar terms, the market is vast and growing and the spend levels can be grouped in to five sub-sectors, each with their own distinct value chains and players. This section looks at the key players and the relationships between them.

Figure 3: The New Health Economy – market size

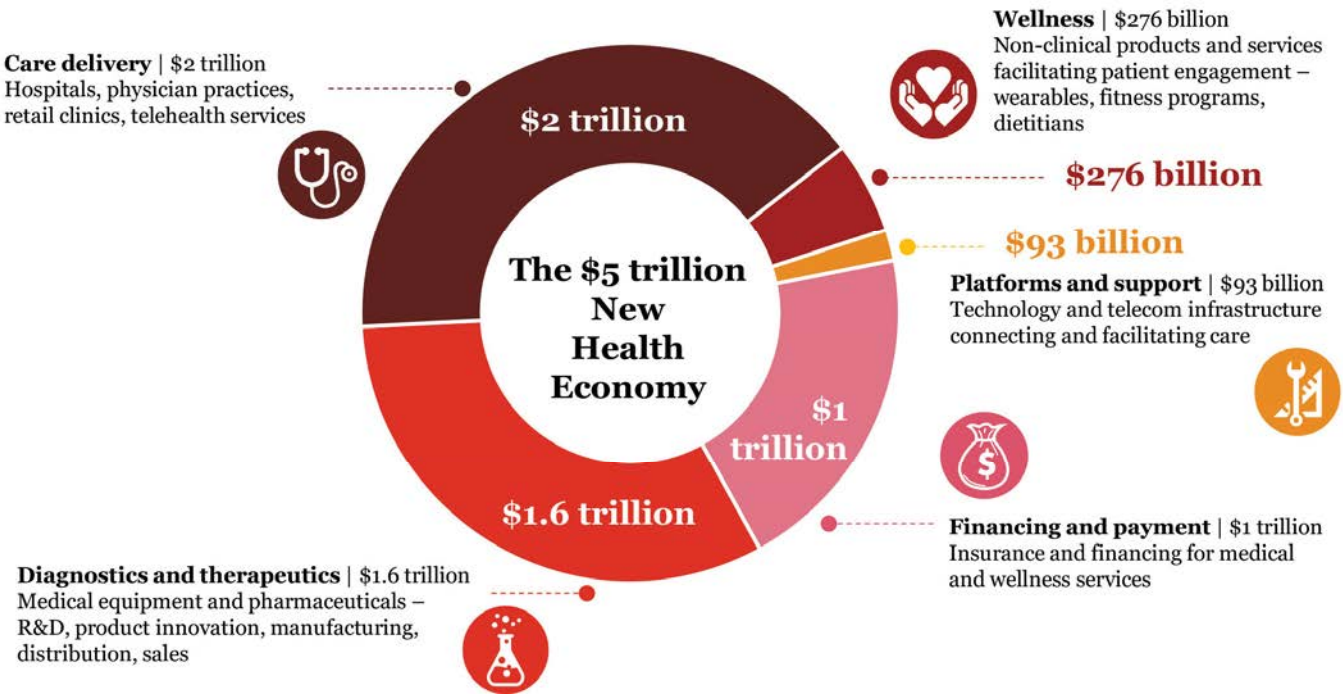
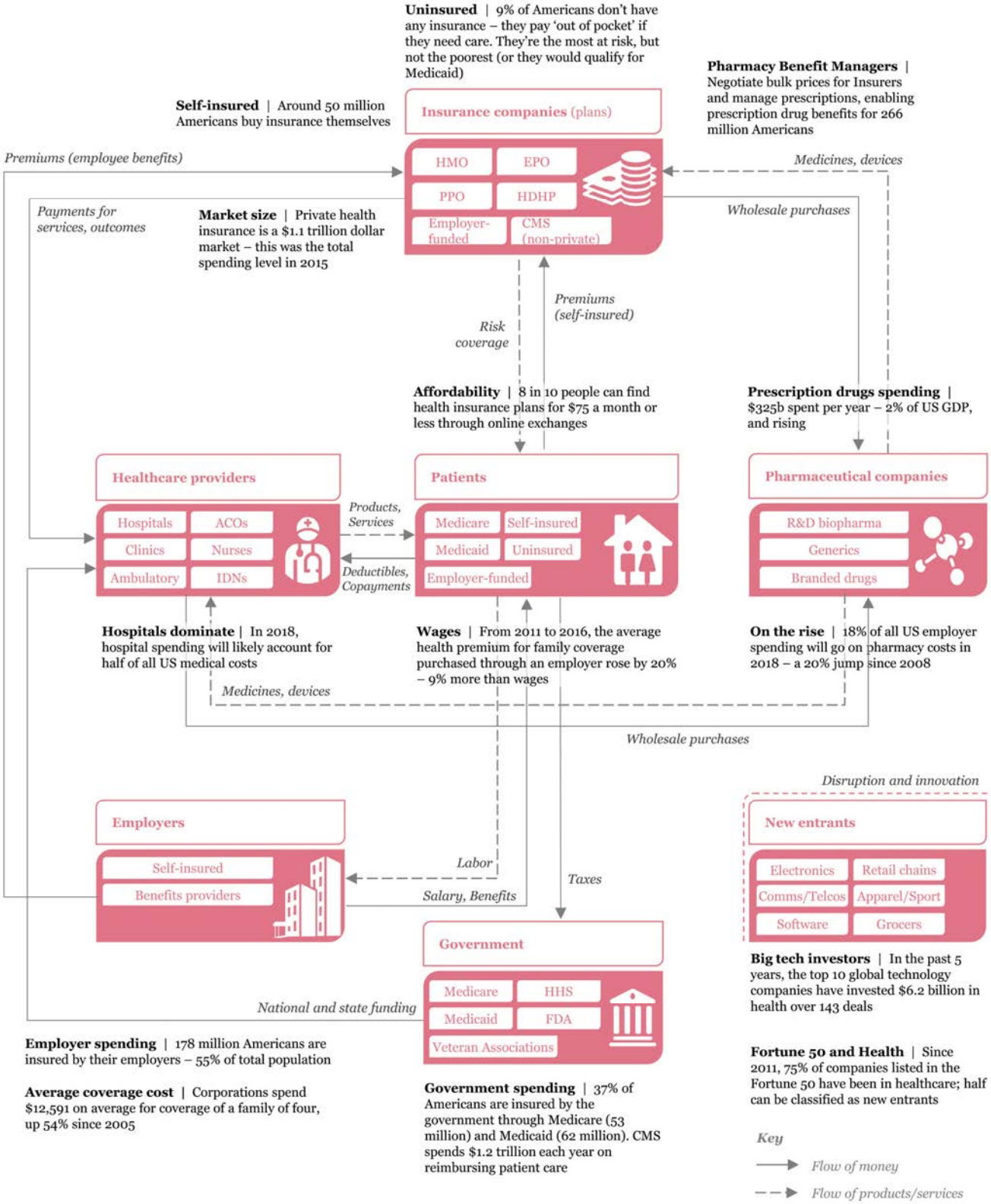


Figure 4: US healthcare market dynamics



***Note**: sources are described in 'Note on methodology'*

1. Healthcare providers

There are currently 5,564 registered hospitals in the US[39], in addition to other facilities such as ambulatory surgery centers, imaging centers, clinics and nursing homes. They are sometimes individual facilities but are increasingly grouping together in health systems.

US providers may be privately or publicly owned, treat acute conditions only or a wide range, be for-profit or non-profit, or serve mainly rural or urban populations.

Providers can be differentiated by the scale of the health system (driven by facility network and number of patients treated), and the complexity of the care they provide (the range and specialism of the services provided). Using this framework, providers can be categorized using the following profiles, and are sometimes 'hybrids' – Mayo Clinic for example can look for national product leadership in a specific technology, as well as deep local expertise serving rural communities.

- ***Access leaders*** focus on patient engagement to increase loyalty through low-touch, user-friendly programs (retail clinics for example), as well as virtual care solutions to enable patient self-management
- ***Scale leaders*** leverage national reach to maintain an end-to-end care continuum for patients across their network facilities, as well as analytics to predict and manage resources efficiently
- ***Risk managers*** also support a wide care continuum, but don't always have as large a reach, so often differentiate through specific initiatives, for example through retail collaborations
- ***Deep market leaders*** dominate their regions on quality and also support patients through a range of care episodes. Analytics and innovation are important to compete with national health systems
- ***Product leaders*** focus on innovation to maintain cutting-edge treatments and their center of excellence status. Patient experience is another priority, to stay competitive against niche, local providers

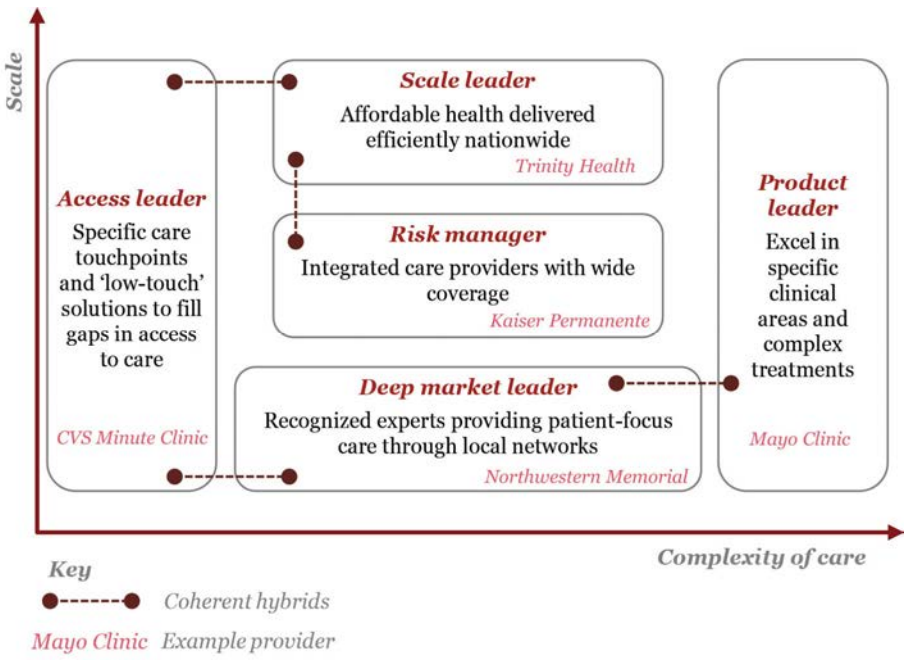
Provider strategic priorities

→ Cost-cutting solutions and efficiency programs enable providers to remain competitive and better navigate regulatory and legislative uncertainty

→ Regulatory and revenue uncertainty are driving providers to be more integrated and aligned across the care continuum. Smaller providers are experimenting cautiously with the right integrations, often through ACOs (see feature 5)

→ Though publicly supportive of the shift to value, many providers are privately unsure of how to make the fee-for-performance model work. Proactive population health management is widely seen as the starting point

Figure 5: Healthcare provider segmentation



FEATURE 1: LEADING US HOSPITALS AND THEIR INNOVATION CENTERS

For the past 28 years, the US News & World ranking of hospitals has been a key reference point for leading US hospitals. The 2017-2018 top 20 US hospitals, and their associated innovation centers are listed below.

	Hospital	*Innovation center*
1	Mayo Clinic, Rochester, Minnesota	*Mayo Clinic Center for Innovation*
2	Cleveland Clinic, Ohio	*Cleveland Clinic Innovations*
3	Johns Hopkins Hospital	*Johns Hopkins Medicine's Sibley Innovation Hub*
4	Massachusetts General Hospital	*John D. Stoeckle Center for Primary Care Innovation*
5	UCSF Medical Center, San Francisco	*UCSF's Center for Digital Health Innovation*
6	University of Michigan Hospitals and Health Centers	*Institute for Healthcare Policy and Innovation*
7	Ronald Reagan UCLA Medical Center	*University of California's Center for Health Quality and Innovation*
8	New York-Presbyterian Hospital	*NYP Innovation Center*
9	Stanford Health Care-Stanford Hospital	*Stanford Medicine Center for Digital Health*
10	Hospitals of the University of Pennsylvania-Penn Presbyterian	*Penn Medicine Center for Health Care Innovation*
11	Cedars-Sinai Medical Center, Los Angeles	*Cedars-Sinai Accelerator*
12	Barnes-Jewish Hospital, St. Louis	*Barnes-Jewish Hospital innovation nursing unit*
13	Northwestern Memorial Hospital, Chicago	*Program for Healthcare Quality and Safety Innovation*
14	UPMC Presbyterian Shadyside, Pittsburgh	*UPMC Wolff Center*
15	University of Colorado Hospital, Aurora	*UCHealth CARE Innovation Center*
16	Thomas Jefferson University Hospitals, Philadelphia	*Jefferson Innovation*
17	Duke University Hospital, Durham, North Carolina	*Duke Institute for Health Innovation*
18	Mount Sinai Hospital, New York	*Medical Innovation Center - Icahn School of Medicine*
19	NYU Langone Medical Center, New York	*Center for Healthcare Innovation and Delivery Science*
20	Mayo Clinic Phoenix, Arizona	*Multidisciplinary Simulation Center*

2. Insurance companies

The largest health insurer in the US is the nationally funded CMS, covering over 115 million Americans as of 2016[40]. But the private insurance market is also highly concentrated: as of 2014, the five largest insurers hold a 83% market share[41].

US insurers can be differentiated by their geographic scope (national vs regional), level of integration with providers (provider-owned vs independent) and plans offered (employer-sponsored vs individually purchased). But unlike insurers who traditionally focused on the employer-funded market, newer players like Oscar and Clover Health are marketing directly to individuals (see section 2.1).

The segmentation shown below contrasts insurers by their level of direct consumer engagement, and how well integrated they are with providers, for example through joining IDNs. Consequently, an insurer can be categorized as one of the following:

- ***Consumer advocates*** typically target consumers directly in a B2C model, and may invest in self-service portals and concierge services. Oscar is a prime example, focusing on the patient experience and partnering with larger insurers like Humana to help digitize its offering to employers
- ***Bridge connectors*** equally engage with patients and providers – through plans that support remote care tools like telehealth but also share data with providers to better understand population health trends
- ***Lean operators*** look to maximize administrative efficiency and lower costs, typically partnering with new entrants for consumer engagement and customized care delivery. These insures could be early investors in technologies like blockchain to secure, store and manage medical claims
- ***Analytic sensors*** share population health insights with providers using their nationwide networks and huge sets of patient data. These large insurers may incentivize patients to lead a healthier lifestyle or providers for keeping patients out of the hospital through proactive nutrition programs
- ***Care integrators*** typically offer care in addition to insurance, either through acquisitions, IDNs or in-house care capabilities. Half of US health systems are looking to market their own health plan, and the number of provider-sponsored health plans rose from 107 in 2014 to 270 as of May 2016[42]

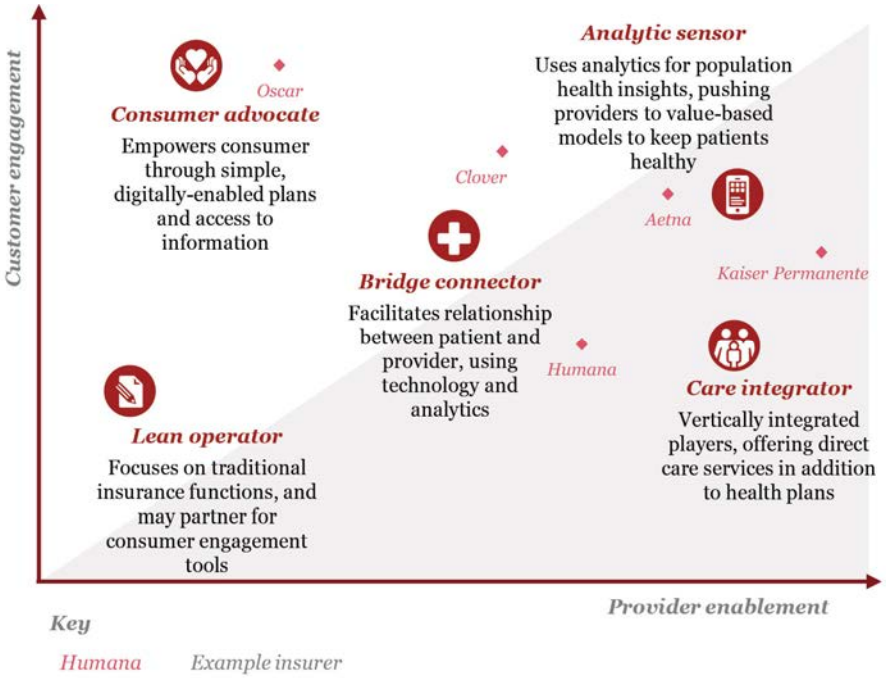
Insurer strategic priorities

→ Develop analytics capabilities to give care providers more accurate data-driven insights on population health

→ Extend vertical integration to manage costs through integrating care offerings

→ Facilitate the shift to value-based care by incentivizing patient wellness programs and linking premiums with behaviors

Figure 6: Healthcare insurer segmentation



FEATURE 2: UNDERSTANDING PRIVATE HEALTH INSURANCE PLANS

Over 216 million Americans have a private health insurance plan, the majority employer-financed. Plans vary based on the percentage of costs covered by the insurer, and the access to primary and specialized care. In recent years, costs have shifted from employers to patients and high-deductible, low-premium plans have been popular with patients needing less coverage and looking to save money – 28% of the market is now covered by these plans, up from 4% in 2006[43].

Figure 7: Insurance plan breakdown – cost sharing

Plan category	*Insurance pays*	*Patient pays*	*Premium amount*	*Deductible amount*	*Target audience*
Bronze	60%	40%			Users of low-cost plans for worst-case scenarios
Silver	70%	30%			Users of more frequent but routine care
Gold	80%	20%			Frequent users willing to pay more for more responsive care
Platinum	90%	10%			Very frequent users of care

Figure 8: Insurance plan breakdown – coverage

Plan	*Coverage of out-of-network care*	*Access to specialists*	*Target audience*
Health Maintenance Organization (HMO)	No, except in case of emergency	Within network, through primary care physician (PCP) referral	Patients who want to coordinate their care through their PCP
Exclusive Provider Organization (EPO)	No, except in case of emergency	Within network, without need for PCP referral	Patients preferring to stay within their network, but don't always want to coordinate through a PCP
Point of Service (POS)	Yes, at additional cost	Through PCP referral	Patients willing to pay more for extra flexibility
Preferred Provider Organization (PPO)	Yes, at additional cost	Without need for PCP referral	Patients who want maximum flexibility
High Deductible Health Plan (HDHP)	Cross-category plan (can be an HMO, PPO, EPO etc.) with high deductible and low premiums, often coupled with a Health Savings Account (HSA)		Patients who don't use extensive medical coverage looking to save money through low premiums

3. New entrants

New entrants from various industries are looking to leverage technological capabilities and consumer insight to penetrate the US health ecosystem. Attracted by the size of the potential market, many see the consumerization of healthcare as an opportunity to use their customer savviness to monetize patient experience improvements.

These companies – ranging from consumer electronics to clothing – have a number of advantages over traditional stakeholders, including their global reach, technological capabilities and brand equity. This group of new entrants can be differentiated by their core industry, and specific incentives for entering the healthcare ecosystem.

New entrants strategic priorities

→ Defining a health-focused value proposition and entry route. More likely to be acquirers of digital health solutions than customers in the short term

→ Disruption through knowledge of consumer behavior patterns, marketing know-how and platform-extensions to existing customers outside of healthcare

"There is a new world order coming and… it will be a new healthcare service offering, heavily technology-enabled, dead simple to engage with."
Marcus Osborne, Vice President of Health and Wellness Payer Relations, Walmart

Figure 9: New entrants to healthcare

Consumer electronics *Samsung Health* *Sony* *Canon* *Apple*	Using technological capabilities to build wearables and applications to enable patient tracking and health management, using a 'Do-It-Yourself' approach	***Grocery stores*** *Safeway* *Wegmans* *HEB* *Whole Foods Market*	Improving the social determinants of health associated with nutrition guidance and healthy-living plans
Social media *Facebook* *Twitter* *Yelp* *LinkedIn*	Social networks make information accessible, help rate and compare providers, and support caregivers in their patient engagement initiatives	***Retail chains*** *Walmart* *Sam's Club* *Costco* *Target*	Leading brands partnering to bring in-store healthcare services to consumer locations with transparent and affordable pricing
Communication & telecom *Qualcomm Life* *Verizon* *Spectrum* *AT&T*	Already providing the infrastructure to make the home the fastest growing care setting, notably through virtual care platforms	***Drugstores & pharmacies*** *CVS* *Walgreens* *Rite Aid*	Diversified health offerings, medication adherence and health information portals to increase convenience for patients
Software *Microsoft Azure* *Amazon Web Services* *IBM Watson* *Oracle*	Cloud-based data storage, analytics and advanced AI capabilities creating the networked software backbone for digital health	***Apparel & footwear*** *Under Armour* *Athleta* *Adidas* *Nike*	Combine healthcare and lifestyle through fitness apparel, accessories and mobile apps

Figure 10: Innovative collaborations in the New Health Economy

Under Armour + ***IBM Watson***	• Under Armour acquired three fitness platforms for $710 million between 2013 and 2015 • They partnered with IBM Watson to create Healthbox – a trio of fitness wristband, digital scale and heart monitor • Under Armour apps have reportedly now been downloaded by 215 million people	***Walgreens*** + ***WebMD***	• Your Digital Health Advisor, a virtual wellness coaching program powered by WebMD, is available on Walgreens.com • Participants living a healthy lifestyle earn points they can use for Walgreens purchases
Sam's Club + ***Aetna***	• Sam's Club, a Walmart-owned chain of membership-only discount retail warehouses, partners with Aetna to offer health insurance coverage to their business members' employees and families (mostly young companies familiar with the wholesaler)	***Kaiser Permanente*** + ***Target***	• 31 additional Kaiser Permanente-staffed retail clinics will open in Target stores across Southern California (4 were already launched in 2014) • Kaiser Permanente provides care to its members and Target customers at the in-store clinics, branded 'Target Clinic, care provided by Kaiser Permanente.'
Yelp + ***California Health Care Foundation***	• Maternity care ratings for 250 California hospitals will be displayed on Yelp to help pregnant women choose the right facility	***Google*** + ***Harvard Medical School*** + ***Mayo Clinic***	• Partnership between Google and two leading academic medical centers to improve search queries related to medical symptoms (1% of total Google queries worldwide)

FEATURE 3: AMAZON'S FOOTPRINT IN HEALTHCARE

Amazon, 'earth's most customer-centric company', is disrupting yet another industry – healthcare. And it is doing so in multiple ways.

Initiatives	*How is Amazon making an impact?*
Pharmacy moves	Amazon has acquired wholesale pharmacy licenses in 12 states, signaling a potentially disruptive entry into the business of selling prescription drugs. CVS Health's proposed $69 billion mega-deal to acquire Aetna is seen by some as a reaction to Amazon's entry. This would be the first tie-up of a retailer, an insurer and a pharmacy benefit manager.
Alexa	Amazon's AI-powered device can tell Fitbit users about their activity, inform parents about their kids' health, in partnership with Boston's Children's Hospital, and offer medical advice in partnership with Mayo Clinic. The potential list of similar applications for Alexa is growing.
Amazon Web Services	Genomics companies, health providers and payers, pharmaceutical companies and biotech innovators are using AWS for storing and sharing population data, collaborating online on clinical research and aggregating HIPAA-secure patient information.
Nutrition and wellness	Amazon's 2017 acquisition of Whole Foods Market signals a clear entry into the nutrition and health-food space. Prices are already reportedly dropping for organic fruits and vegetables and Amazon may also plan to sell its technology products directly in grocery stores.
'1492'	Recently launched, this 'secret' team is dedicated to exploring new, innovative healthcare initiatives. Reportedly, the team will develop various applications and use-cases for Amazon's hardware such as Alexa for Echo, including offering medical data services to doctors and patients.

"Size and scale-wise, they can disrupt anywhere they want to disrupt."
Chip Davis, CEO, Association of Accessible Medicines

4. Employers

As the largest payers for healthcare in the US, employers are the central stakeholders in healthcare financing and, increasingly, population health. 178 million Americans were insured by their employers as of 2016[44].

Some employers are self-insured, meaning they directly contract with providers for medical goods and services provided to their employees.

However many large companies offer insurance policies to their workers through commercial insurers as part of their employee benefits programs.

Employers therefore have some influence on the kind of medical products and services that insurers agree to reimburse, including digital.

The most significant examples so far have been with solutions focusing on proactively managing health – for example combating work-related stress, and helping working parents with diagnostics around child developmental issues.

Digital entrepreneurs focusing on women's health have also found adoption with employers, including start-ups like Wildflower and Bellabeat.

5. Government

As a heavily regulated industry with state-subsidized care for older and poorer Americans, the government plays a key role in legislating, regulating and paying for healthcare through its different institutions.

The US government acts as a healthcare provider through its 212 federal government hospitals[45], including Veterans' Administration facilities, and 983 state and local government community hospitals[46], which are often also academic institutions.

It is also a payer of healthcare through Medicare and Medicaid, as well as the State Children's Health Insurance Program, Veterans' Administration, Indian Health Service, and other programs.

The government regulates through the FDA, run by the Department of Health & Human Services (HHS). Other regulatory institutions include the Federal Trade Commission (FTC) and the Office of the National Coordinator for Health Information Technology (ONC).

Finally, as a legislator, the government develops policy, sets funding to CMS and works with Congress to prepare legislative changes.

6. Pharmaceutical companies

US pharmaceutical companies – reportedly a $446 billion market[47] – vary by the medical conditions they address, the patient segments they target and their main activity (branded drugs, generics or research & development).

Large pharmaceutical companies like Pfizer or Johnson & Johnson are highly engaged in clinical innovation and digital health initiatives, either in-house, through VC investment arms or through experimental partnerships.

Specific to the US market, pharmacy benefits managers (PBMs) operate as wholesale intermediaries between the insurers or employers paying for drugs and pharmaceutical manufacturers.

PBMs negotiate rebates from drug manufacturers and discounts from drugstores on behalf of patients, plans or employers.

PBMs can be standalone companies like Express Scripts, or operate within integrated healthcare organizations (e.g. Kaiser Permanente), as part of retail pharmacy chains (e.g. CVS) or as part of insurance companies (e.g. Aetna).

"The comprehensive reforms of the Affordable Care Act of 2010, the expansion of Medicaid, and the continuing growth in the Medicare-eligible population means that the federal government is taking on a bigger role as a payer, a setter of rules, and a shaper of markets."
Strategy+business, 'Staking Your Claim in the Healthcare Gold Rush'

FEATURE 4: THE FDA AND DIGITAL HEALTH

What is changing at the FDA?

The US Food and Drug Administration (FDA) is the US federal agency responsible for protecting public health through regulating the safety of drugs, medical devices and other products. It has to balance the needs of regulation with enabling digital health innovation that can improve patient outcomes, and is currently in a transition period where, under its new commissioner Scott Gottlieb, it is laying out its vision for regulating digital health solutions. Some key developments include:

- ***Legislative background.*** 2016's 21st Century Cures Act was designed to help accelerate new innovations in reaching patients and clinicians who need them. It changed the definition of 'medical device' in the Food, Drug and Cosmetic Act to exclude some software functions from regulation such as claims processing and billing
- ***Digital health innovation plan.*** As a result of the Cures Act, the FDA developed its Digital Health Innovation Action Plan, which lays out its new digital health classifications and guidance for regulating specific technologies such as mobile medical apps or image storage devices. For example, the FDA has recently released long-awaited guidance on the regulation of clinical decision support software[48], and is expected to communicate about other changes to which technologies require clearance and relevant procedures
- ***Pre-certification for software pilot.*** As part of its innovation plan, the FDA launched a pilot program to develop its approach to digital health technology regulation and help produce a 'regulatory framework that accommodates the distinctive nature of digital health technology[49]'. The originality of the program is its novel focus on the 'manufacturer' over the 'device' when making decisions about their public safety. Pilot participants include Apple, Fitbit, Johnson & Johnson, Pear Therapeutics, Roche and Samsung
- ***New digital health unit.*** Reflecting changing skill requirements, the FDA is hiring a team of engineers with experience in software development and its application to medical devices. Directed by Bakul Patel, this team will work with reviewers, compliance officers, and other FDA stakeholders to improve the quality and predictability of decision-making on individual products and their developers

First steps for start-ups: Q&A

Q: What if my solution touches protected health information (PHI)?
A: Under HIPAA data security guidelines, companies usually run detailed, routine security audits and sign Business Associate Agreements with their clients. Business Associates manage PHI on behalf of HIPAA-covered entities like hospitals or insurance companies, and are therefore subject to specific security and privacy rules to protect PHI.

Q: How can I know if my product is considered a medical device by the FDA?
A: Products that provide a diagnosis, cure, mitigation, treatment or prevention of a disease, are usually considered 'medical devices'. Developers submit a premarket approval form called '510(k)' to demonstrate that the product is safe and effective. The FDA then classifies medical devices into three categories depending on their risk level[50].

Q: When am I exempt from FDA regulation?
A: 'Minimal risk' devices are not regulated by the FDA. These could be, for example, tools that help providers streamline billing without impacting patients[51]. Also, many apps are not considered 'medical devices' and are therefore not regulated by the FDA, for example, medical e-textbooks or geolocation tools for finding the closest doctor[52].

Q: How does the FDA regulate mobile apps?
A: Some apps are considered 'medical devices' and will be regulated – including apps using smartphone features like a microphone, camera or lighting as medical devices, or apps that connect sensors for medical purposes (like a phone-connected ECG, electrode or a glucometer)[53].

"Momentum toward a digital future in healthcare is advancing. Not all of these tools are subject to FDA regulation. For the devices we are asked to evaluate, we know that our policies must continue to empower consumers and facilitate innovation."
Scott Gotlieb, FDA Commissioner

3

Why disruption matters for digital health innovators

Impact on incentives and business models

3.1 Shifting incentives with the move to 'value'

The incentive paradox

The 'volume' of care still mostly drives provider reimbursement, but this is changing, and opportunities are rich for digital innovators.

The US healthcare system cannot sustain the projected rise in spending levels, and is falling behind other developed countries on care quality. Part of the problem is a historic 'incentive paradox', that the poorer the health of the population, the greater the providers' reward, through national or commercial insurance schemes reimbursing a rising *volume* of services performed. Historically, a clinic is paid for administering dialysis when a patient's kidney condition becomes worse, not better. In simple terms, the more ill-health, the more services provided, the more fees for providers.

Landmark US legislation with bipartisan support in 2015 is now being rolled out, in an attempt to address this gap through the government's CMS – the federal agency responsible for regulation and the largest insurer in the US. It is designed to stimulate innovation in *value*-based care through realigning financial incentives for providers – some positive, several negative – to break the paradox and create 'a future in which hospital systems are paid more when their patients are healthy, not sick'[54].

But how does this work in reality? Who wins and who loses? And what will be the role of digital?

Value-based reimbursement

The 2015 Medicare Access and CHIP Reauthorization Act (MACRA) tries to control costs and promote 'value' by phasing out fee-for-service payments in Medicare, which covers non-hospital care for 58 million older Americans[55]. In its place, two value-based payment models will emerge. They have a number of more condition-specific associated programs, reimbursing based on joint-replacements or oncology outcomes, for example.

The first is the Advanced Alternative Payment Model (AAPM) which rewards physicians with up to a 5% bonus for taking on more financial risk by linking revenue to outcomes; second is the Merit-Based Incentive Payment Systems (MIPS) which grades clinicians like doctors and nurses on quality, cost, and improvement metrics and link payment to those, with upsides and downsides of up to 9%[56].

CMS operates a number of other value-based programs, including its hospital star-rating system which compares hospitals on performance metrics to help patients make informed decisions. They are aiming for 90% of healthcare dollars they reimburse to providers to be linked with quality programs in the near term[57].

CMS is therefore laying the groundwork for the new incentives that will drive the shift to value. How are providers and payers responding?

Key initiatives

Providers are cautious, because their revenue models are becoming less predictable, the evidence for the shift's impact is too scant, and the government is still experimenting (some CMS metrics have been introduced then scrapped). However industry stakeholders are taking their first steps, including the following initiatives:

1. ***Accountable Care Organizations (ACOs)*** – CMS rewards providers that voluntarily collaborate – called ACOs – by giving them a share of the savings they make through better coordination of care (e.g. sharing data to facilitate patient transitions) and reduced costs (e.g. through technology investments to improve clinical workflow). There are positive and negative incentives at work here – ACO models save Medicare hundreds of millions of dollars a year through removing wasteful treatments. Amongst the 400+ providers now participating, top performers win performance bonuses – Mercy Health recently received $11m through CMS' 'shared savings' ACO program[58].

2. ***Patient Centered Medical Homes (PCMH)*** – not a physical site of care, but a government-incentivized and accredited model where a primary care physician is accountable and rewarded for the full coordination of care needs for a given patient. Patients with primary care physicians have 33% lower health care costs than those who only visit specialists[59]. The move to value means rewarding them for positive outcomes, instead of for each disconnected, individual service.

3. ***Disease specific initiatives*** – designed to financially reward improved quality in treatment, CMS' End Stage Renal Disease (ESRD) program was the first to link a portion of Medicare payments directly to facilities' outcome measures around this condition. The program reduces payments to ESRD facilities that do not meet or exceed certain performance standards. This incentive principle has since been replicated for numerous other conditions, including the Comprehensive Care for Joint Replacement Model started in April 2016[60].

These and other value-based care initiatives will emerge slowly, as a decades-old ecosystem responds in incremental steps to new incentives and revenue structures.

"The recognition that alternative payment models at first struggle to match fee-for-service reimbursement is one reason why many have been slow to fully embrace ACOs, bundled payments, capitation and other risk-based arrangements."
PwC Health Research Institute, 'Healthcare's alternative payment landscape'

FEATURE 5: WHAT ROLE ARE ACOs PLAYING IN THE SHIFT TO 'VALUE'?

What are ACOs?

A group of doctors, hospitals, and other healthcare providers, who come together voluntarily to give coordinated care to the Medicare patients they serve. They are incentivized to reduce wasteful treatments and share data more effectively to support patient recoveries with less, rather than more treatment. Patients will likely have fewer repeated medical tests and a more 'joined-up' experience. There are more than 1,400 ACOs now in the US, covering 24 million Americans[61].

How do they work?

CMS' shared savings programs incentivize providers to collaborate to improve care for specific patient populations, still under a fee-for-service payment model. On the upside, they award a percentage of any net savings to the provider, assuming the outcomes improve as a result of collaboration. After three years of phasing in the model, downside penalties begin applying to participating providers for poor outcomes.

ACOs usually emerge around narrow specialties, as more specialist providers participating can be more confident about likely outcomes within their single domain of expertise.

Emerging payment models

If outcomes are increasingly driving payment levels, what does that mean for how healthcare reimbursement works? A number of models have emerged, with varying levels of risk to providers. Some providers work with a number of these models in parallel. At one end, is the fee-for-service model which still dominates the majority of healthcare payments. The fee-for-performance model takes a step towards 'value' by linking a minority stake of revenue to outcome metrics – a logical first step with health systems experimenting with value based contracts.

Bundled payments are commonly used by ACOs who agree to accept a payment for an 'episode of care' instead of for the individual services provided during a patient's episode (say a hip replacement). At the end of the spectrum are capitated payments, which are higher-risk, but can be higher reward. CalPERS, the retirement program for California state employees, reduced spending by $5.5 million over two years after 'capping' hip and knee procedure payments at $30,000, reducing their costs by 19%[62].

Figure 11: Emerging payment models

	Fee-for-service	Fee-for-performance	Bundled payments	Capitation
How it works?	• Healthcare providers are reimbursed by payers (insurers or employers) per individual service provided to a patient, even in cases of readmissions	• Still 'fee-for-volume', but with a % of revenue dependent on care outcomes. Providers paid per service, but rewarded more if care quality is maintained or improved while costs reduced	• Payments will be made to providers per 'episode of care', regardless of which procedures or how many are required within that episode	• Providers receive a fixed payment per patient for all expected treatment over a defined period
Example?	• A radiology clinic paid per MRI scan administered, regardless of patient prognosis	• Hip replacement surgery will be reimbursed per procedure, but 5% of revenue is awarded in line with patient satisfaction ratings	• A health system treating a patient diagnosed with coronary heart disease may receive one lump payment for scans, bypass graft surgery, and post-acute care, across all sites of care	• A diabetes patient will require treatments, lifestyle advice, drug courses and check-ups – the provider will get a 'capped' payment for the year for all treatment
Risk position	• Most risk is held by payers, as providers decide when and what care is required for a patient without consideration of costs or margins	• Majority of risk still held by payers, as payment-linked reimbursement will still form a minority of the reimbursement	• With a fixed revenue 'bundle' per episode, providers now take on financial risk for the cost of treatment, as well as preventable complications that could arise	• The providers' risk is significant – the payers' liabilities will not increase if recurring or increased episodes of care are required in the period
Incentives created	• Hospitals, clinics and physicians are rewarded by providing as many services to patients as possible • The poorer the patient community's health, the greater the provider's reward – an incentive paradox	• Volume of procedures still driving provider reimbursement, but financial incentive introduced for 'right first time' care and professional patient coordination	• Providers will want to minimize unnecessary visits, and give high quality treatment, to achieve the patient's positive outcome efficiently, and thereby improve their margin on the bundle paid for the episode • However, still no real incentive for preventative health – future episodes still drive more revenue	• Providers have a real incentive to proactively manage a patient's care, in order to reduce costs incurred by multiple procedures, and to obtain the maximum reimbursement driven by outcomes measured • Real incentive for preventative health measures

'Volume' ⟶ 'Value'

'Lower provider risk' ⟶ 'Higher provider risk'

'More common' ⟶ 'Emerging'

Example patient roadmap

The following example patient roadmap tells the story of Joe, a fully insured office worker who suffers a sports injury, has unsuccessful orthopedic treatment, and later develops a risk profile for diabetes. Imagining and comparing Joe's experience before the shift to 'value' (let's say in 2005), and afterwards (2025), we can see how the incentives change and opportunities for digital health innovators emerge.

Figure 12: Joe's patient roadmap – 2005

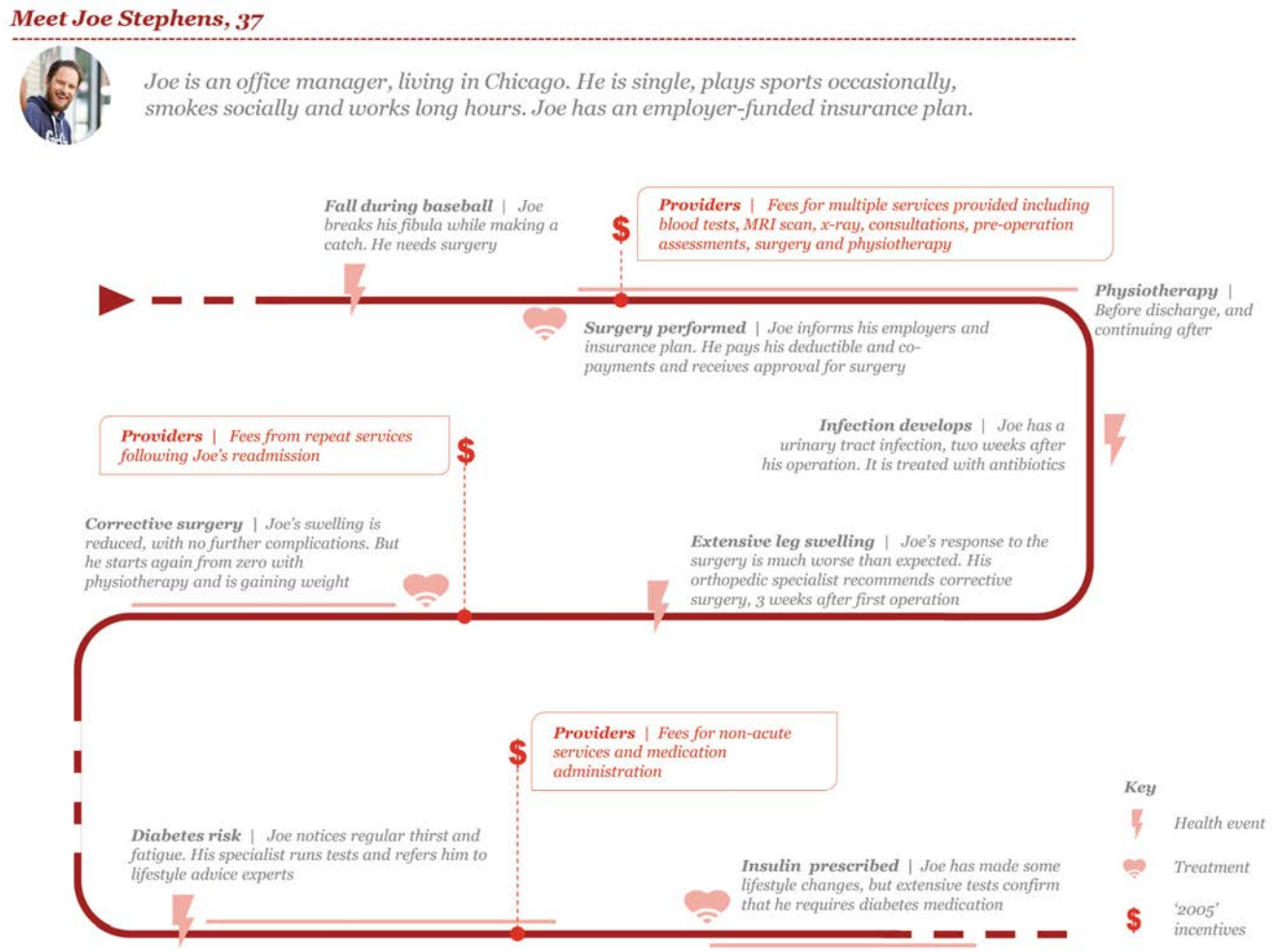
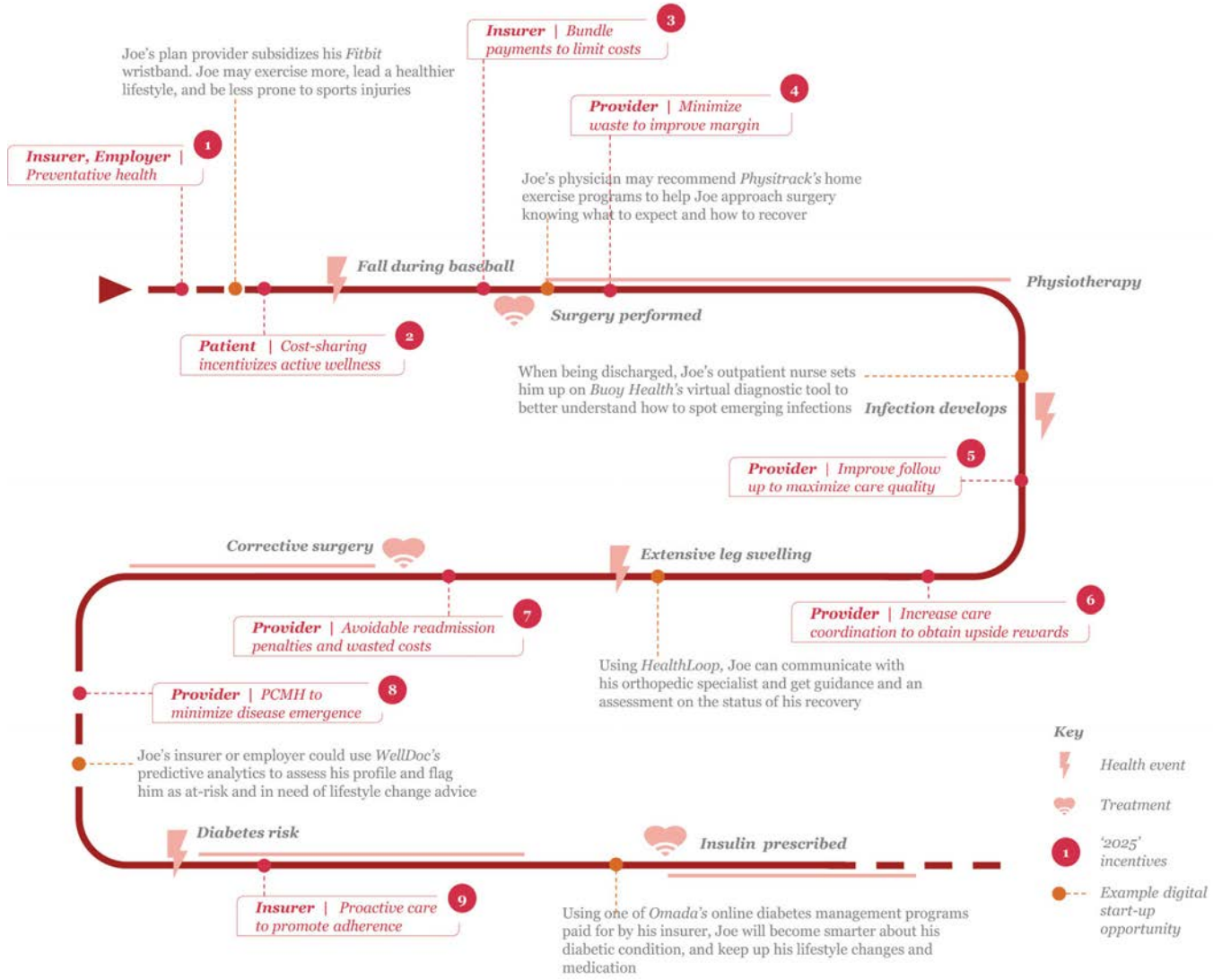


Figure 13: Joe's patient roadmap – 2025



How do these new incentives work?

1. *Incentive to equip Joe with fitness-tracking wearables or to subsidize sports activities. Can help promote lifestyle focus and pre-empt illness, meaning fewer care episodes that payers will have to reimburse*
2. *Joe is on a higher-deductible plan than in the past, and will want to use tools that improve his general health because he will want to think twice before triggering demand for healthcare services*
3. *Insurer will make a single bundled payment triggered by Joe's need for orthopedic care, to cover all related treatments. Insurer will then avoid uncertainty of unforeseen costs*
4. *Provider will promote patient experience (it partly drives CMS reimbursement), coordinate departments on care transition (to maximize patient outcomes) and skip wasteful scans (to improve profitability of the bundled payment)*
5. *Reimbursement will be withheld from Joe's hospital by the payer when patient experience is worsened by preventable hospital-acquired conditions. Joe's hospital is therefore incentivized to follow up more actively*
6. *Providers will have an interest in patient engagement, post-acute-care. Very low readmission rates helped along by strong follow up could realize upside rewards from the payer, and raise the provider's CMS star rating, attracting more patients*
7. *Joe's hospital's margin is reduced by funding the readmission from the single bundled payment already received. Additional CMS penalties possible due to Joe's readmission within 30 days of the first procedure*
8. *Joe's orthopedic complications and weight gain could be 'joined up' by an accountable primary care clinician to help spot risk factors and minimize chronic conditions. PCMHs also reduce providers' costs and increase satisfaction ratings*
9. *The capitated insurance payments driven by Joe's risk profile mean that his insurer and provider will want to proactively support Joe's adherence with lifestyle advice, and later, with medication. This way, his condition may not develop and his costs of care will be contained*

FEATURE 6: CAN EVERYONE WIN WITH VALUE-BASED PAYMENT MODELS?

Everyone agrees that health spending is higher than it needs to be. But does everyone agree to make the shift to value? The concept of linking provider reward with patient outcomes has been around for decades. However evidence supporting its success is limited by the small scale of the experiments tried and the long timescales in collecting the evidence base.

Providers may seem to lose from the move to value, since the risk moves away from fee-paying insurers to the providers who now have their margins at stake. But supporters suggest that providers can win by excelling at outcomes, and thereby gaining market share at their competitors' expense.

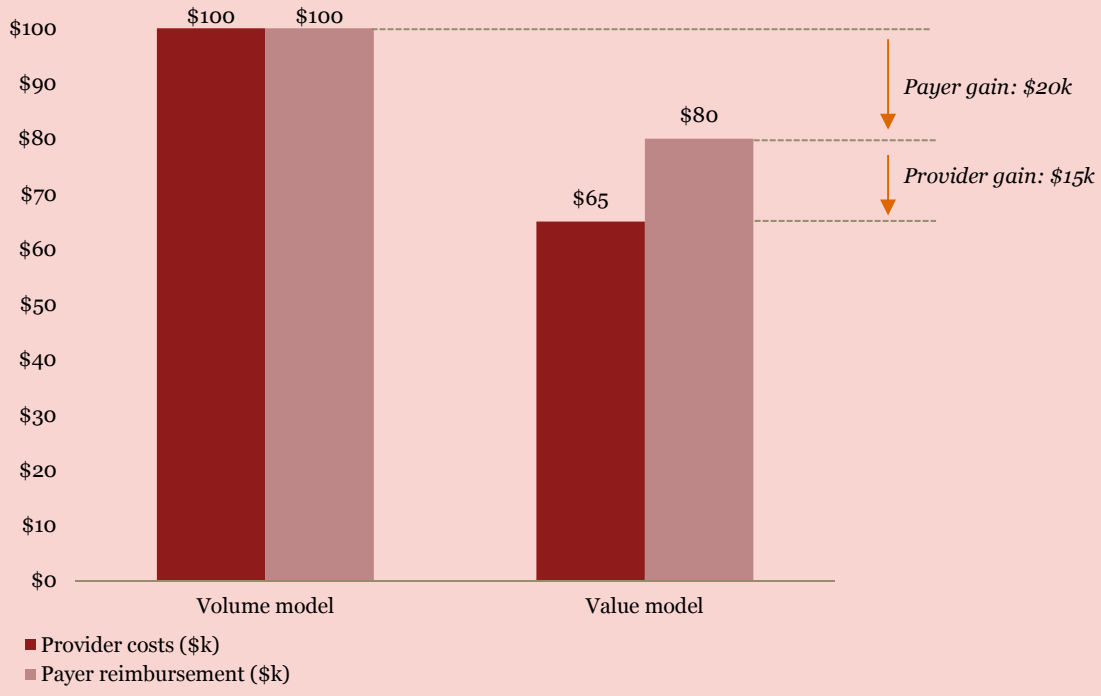
They also gain from the immediate financial incentives. In April 2016, CMS began a bundled payment model for knee and hip replacements. In the first year alone, about 50% of the almost 800 participating providers saved money through beating outcome targets, averaging $1,134 in savings per bundled procedure[63]. *"It was so eye-opening to go through and find all the inefficiencies and to see how we have moved the bar from both a clinical and financial perspective in a way I would never have imagined,"* commented Jon Fohrer, Network Vice President for orthopedics and neuroscience at participating Community Health Network, Indianapolis.

A key explanation is the huge wastefulness in US healthcare. Studies suggest that about 30% of US healthcare spending is wasted or unnecessary[64] – most prescription drugs work for less than 60% of patients who take them for example[65]. Failed care execution, avoidable readmissions, overtreatment, and administrative complexity all contribute.

Let's look at Joe's orthopedic care episode as an example, and assume that his two operations and associated scans, post-surgery care and physiotherapy cost a total of $100k. In '2005', Joe's provider recovers this in full from Joe's insurance company.

Under the bundled payment model in '2025', Joe's fall will trigger reimbursement to his provider based on a pre-calculated cost of that orthopedic treatment episode – say $80k. Joe's hospital, now incentivized to avoid Joe's second operation, reduces costs to $65k through internal efficiencies, PCMH coordination and an avoided readmission.

Everybody wins in theory – Joe's provider increases their profit margin on his care, his insurer has reduced costs of Joe's treatment and Joe avoids a second surgery.



Implications

Healthcare's transformation in the US has economic implications – both good and bad – for the different segments in the ecosystem:

- ***Consumers*** — patients stand to gain from the transition, as the ecosystem re-orientates around delivering value by the consumer's own definition
- ***Hospitals*** may lose some patients to ambulatory care centers and retail clinics as care moves out of the hospital setting to reduce costs. Some will respond by narrowing their range of services or exploring new health services and products like virtual care and disease prevention. But excelling at outcomes will increase their market share
- ***Payers*** will want to invest in preventative treatments and wellness to reduce hospitalization rates. They may trial emerging genomic-based treatments, and will need to build patient satisfaction metrics in to their reimbursement models. Most urgently, they will want to leverage their data assets to help patients access the right care
- ***Government*** must balance evolving regulation with enabling innovation and new applications of fast-changing technologies. State and federal institutions can also direct funding and facilitate data sharing through CMS to help improve population health
- ***Digital health innovators*** can exploit the emerging opportunities from the shifting incentives by building innovative business models that find a new way of increasing patient access, raising quality and reducing costs. The next section explores the building blocks they need to consider

"Digital enables the ability to shift the model from volume to value. It will take a decade to make this shift the industry norm."
Andrew Thompson, President and CEO, Proteus Digital Health

3.2 Business models and 'where to play'

Building blocks of digital health

New entrants bring capabilities from outside the ecosystem and new ideas about demonstrating value. Successful ones ride the wave of lightning-quick disruption to profitability – telehealth solutions are a great example. Already more than 50% of Kaiser Permanente visits are virtual, a staggering rate of adoption over a short period[66].

The demand-side challenges facing these start-ups are significant – navigating systems interoperability, demonstrating the clinical evidence, building a compelling business case (see feature 13). But many start-ups fail before going to market by designing incomplete business models, and therefore failing to achieve adoption by conveying a value proposition that doesn't convince the buyer or doesn't have the answers it needs. Digital start-ups Hello, maker of a sleep tracker, and HomeHero, connecting home-carers with patients both closed in 2017 after having raised a combined $64 million from investors[67].

Failures occasionally happen because technologists with a great source code look for an application in health but don't fully understand the commercial incentives, competitive environment or strategic objectives of the potential health adopters. They build a business model without market validation and due diligence.

The following framework and example case studies can be used to identify some of the building blocks that B2B digital health start-ups need to put in place. There are many right answers to the questions addressed and several unique paths that lead to profitable demonstrations of value.

All the businesses mentioned in the section are examples of US-based digital health start-ups seeing successful adoption. The case study library at the end of this report includes more detail on each.

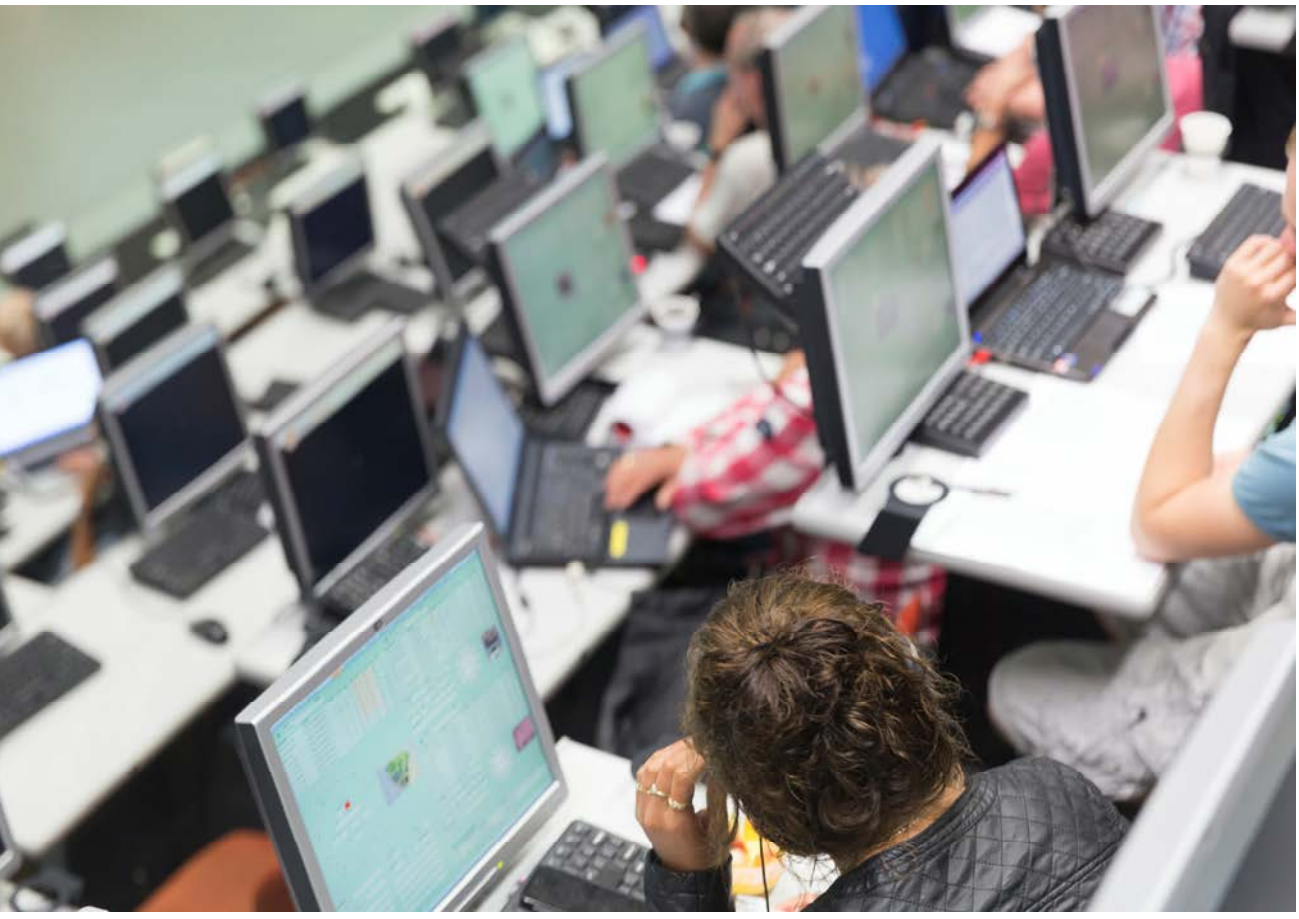


Figure 14: Building blocks for digital health business models

Parameter	*Options*
OBJECTIVES	➔ ***Why can you demonstrate value?***
1. Benefit category	*Which of your buyer's strategic objectives will you support?*
	Access · Quality · Cost
2. Adopter group	*Where are you looking to achieve adoption in the ecosystem?*
	Provider · Insurer · Retailer · Employer · Patient
3. 'End-game'	*What is your business' long-term goal?*
	Sell Services · Sell Products · Monetize Data · Ecosystem Infrastructure
COMMERCIALS	➔ ***How will you be profitable?***
4. Revenue structure	*How will you price your product or service?*
	Licenses · Transactions · Patients · Users · Outcomes · Devices
5. Reimbursement	*What will be the original source of your revenue?*
	Medicare · Medicaid · Employers · Providers · Payers
6. Technology platform	*How is your product or service used?*
	Point-of-care Device · App · Software / Hardware · Sensor · Plug-in Accessory
CLINICAL CONSIDERATIONS	➔ ***Where will you intervene?***
7. Site of care	*At what locations will your product/service be used?*
	ER · OR · Inpatients · Outpatients · Clinic · Physician's Office · Patient's Home
8. Stage of care	*Where in the care continuum are you focusing?*
	Prevention · Diagnosis · Adherence · Point-of-care · Pre/Post Care · Palliative
TARGETTING	➔ ***Who will you help?***
9. User group	*Which medical stakeholders will use your product/service?*
	Patients · Physicians · Nurses · Administrators · Other
10. Demographic	*Which populations will your product/service most impact?*
	Urban · Rural · Higher Income · Lower Income · Younger · Older

"Objectives" ➔ Why can you demonstrate value?

1. Benefit category – Which of your buyer's strategic objectives will you support?

Access | Quality | Costs

Healthcare organization leaders take the Institute for Healthcare Improvement's 'triple aim' as the starting point for defining value – improving the health of populations (access), improving patient experience (quality), and reducing the per capita cost of healthcare (cost).

Access is promoted by businesses focusing on bridging the gap between patient and clinician. Telemetry solutions like those developed by Doctor On Demand are a good example, where patients in remote areas, patients with mobility constraints or those from socially disadvantaged communities can access care more conveniently.

Quality is achieved through improved patient coordination, satisfaction from clinician interactions, and positive health outcomes such as safety and readmission avoidance. Quality-focused businesses also help physicians do their job more effectively and improve health outcomes – examples include 'Instagram-for-doctors' Figure 1, or the VR headset producer for surgeons, Medical Realities.

Cost-focused innovations include workflow optimizers like PatientSafe, asset utilization efficiency promoters and waste reduction technologies.

Start-ups may expect to target more than one of these – for example, telemedicine solutions increase access to hard-to-reach patients, make care cheaper by moving it outside the hospital setting, and increase convenience and therefore satisfaction.

The chosen benefit category will determine the buyer-side stakeholders that a start-up will need to convince. Quality-focused innovations for example will often impact the point of care, and therefore require clinical validation and regulatory approval. Administrative efficiency tools may not.

2. Adopter group – Where are you looking to achieve adoption in the ecosystem?

Provider | Insurer | Retailer | Employer | Patient

Providers are increasingly experienced in buying digital, with many operating in-house innovation hubs (see section 4.1). Numerous entrepreneurs target clinical requirements, such as developers of imaging software that connects to MRI machines (Arterys), diagnostic assistants (Bright.md) or chronic disease management apps (Glooko).

Insurer-focused digital solutions help leverage the valuable medical data that these health plan companies hold (order fulfil) or support their members in leading healthier lifestyles (Omada Health).

Retailers are expanding aggressively, if mostly through acquisition. But many like Target and Wallgreens are focused on tools that help them emerge as a site of care – telehealth consoles, inventory management of in-stock pharmaceuticals, and online medical order fulfilment tools. Examples include Walgreens partnering with MDLIVE to expand its telehealth platform.

As the source of funding of medical insurance for nearly 180 million Americans[68], *employers* are primarily focused on tools that can prevent illness, monitor recovering patients and promote adherence to prescribed treatments. For example, some employers are offering Cognoa's video-based child-development analysis tool to employees with children, while AbleTo connects top behavioral health providers with company employees.

The *patient*-focused B2C market is particularly competitive – only 15% of digital health start-up business models are end-consumer-focused[69]. Patients benefit from vitals-tracking wearables (Spry Health), online second opinion consolidators (Grand Rounds), medication adherence solutions (Cohero Health), and mobile EHR portals to facilitate access to personal data (drchrono).

3. ***End-game*** – *What is your business' long-term goal?*

Sell services | Sell products | Monetize data | Ecosystem infrastructure

Some of the simplest start-ups take a retail approach to scale, by aiming to sell as many units of their *products* as possible to maximize revenue. Many are very successful in this approach – Fitbit's tripled their sales in two years to 2016. Even the world's biggest retailer follows this transactional approach – Amazon's Alexa is primarily a unit-priced digital assistant product (with health applications[70]).

The same approach is taken by some digital *service* companies, including success stories like genomics-focused 23andMe or Evidation Health which helps healthcare organizations quantify the real value of digital health solutions. These are technologies that perform innovative, information-focused services for customers, even though no products are exchanged.

Others build business models that target longer-term goals. Claims data aggregator tools can help payers match plans to customers through anonymized patient data analysis. Predictive analytics companies like LeanTaaS, may initially sell patient scheduling optimization software to cancer clinics, but may aim at accumulating enough *data* in live engagements to diversify into risk profiling of cancer patients – another application of predictive analytics[71].

Some entrepreneurs see their end-game as helping other innovations integrate smoothly. Software integrators like iNTERFACEWARE aim to become components of the ecosystem's *infrastructure* by making digital adoption easier, for other stakeholders.

"What component of your product is going to affect outcomes? If you can't give an answer, that's a problem. And if you can't give an answer, there are a lot of people in line."
Dr. Scott Young, Executive Director and Senior Medical Director, Kaiser Permanente's Care Management Institute

"Commercials" ➔ How will you be profitable?

4. ***Revenue structure*** – *How will you price your product or service?*

Licenses | Transactions | Patients | Users | Outcomes | Devices

Health entrepreneurs need to decide how and what to price for. Breakthrough start-ups often show extraordinary flexibility on pricing as they scale up. Kit Check manage and analyze inventory levels for hospital pharmacies. They switched from charging for stock scanning hardware to giving scanners away for free and pricing inventory tags instead, as this immediately removed a buyer-side procurement barrier.

Many virtual health tool developers charge *per user per month fees* to their users, in addition to upfront implementation costs – examples include Teladoc[72] or ExplORer Surgical[73], who charge monthly based on the number of surgeons using the solution or the number of procedures performed.

Software and analytics companies typically charge for individual user *licenses*, much like other Software-as-a-Service and cloud solution providers. Biometric sensors like Medtronic's Cardiocom and wearables devices like Fitbit all include charges *per device sold*.

Outcomes-focused pricing is used to link the seller's reward with value created for the buyer. One form of this is known as 'gainsharing', where the seller's revenue is usually a percentage of the cost reductions created. Omada Health charges for its programs based on performance – a revenue structure that appeals to buyers, but requires a high degree of seller-side confidence in the product's value. Outcome-based pricing is more common in transactional scenarios (like prescription management), and less common in care contexts like oncology where outcomes are harder to predict.

5. ***Reimbursement source*** – *What is the first source of your revenue?*

Medicare | Medicaid | Employers | Providers | Payers

Although many entrepreneurs target health systems, it will likely be the national or commercial *payers* that will ultimately provide reimbursement. WellDoc for example developed a range of diabetes-management applications which providers prescribe, and payers agree to pay for as a way of promoting population health and disease prevention.

However with the move to value-based care, there is growing interest in technologies that improve the administrative efficiency of clinical operations. *Provider* facilities are looking to become leaner to maximize their margin from capped payments (see section 3.1). So solutions that optimize operating room utilization rates, like ExplORer Surgical, may source reimbursement from providers directly.

Products that address conditions prevalent amongst poorer Americans (say, adherence-assisting apps for inner-city diabetes sufferers) or older adults (say, ambient sensors tracking heart disease metrics) have more chance of qualifying for CMS reimbursement through *Medicaid* and *Medicare* respectively, and are more likely to have approved Current Procedural Terminology (CPT) codes that payers recognize in the billing cycle.

6. ***Technology platform*** – *How is your product or service used?*

Point-of-care device | App | Software/Harsware | Sensor | Plug-in-accessory

Digital health innovators often combine *hardware* and *software* components in different ways. Cohero's care coordination application is software delivered through user smartphones, and Amazon's digital assistant Alexa for Echo is a hardware/software hybrid.

Hardware products invite buyer-side considerations including the depreciation, logistics and maintenance of physical assets. The business case for adoption for technologies including hardware components will therefore need to reflect specific balance sheet considerations, even if the start-up's pricing model does not require investment outlays for the hardware.

Alternatively, business models built around sophisticated algorithms create their own questions for adopters:

- Machine-learning tools like Conversa Health's conversation automator may require time and real-world data to self-optimize, impacting the payback period for the buyer
- The contracting phase before adoption can get stuck on questions around where the data will be hosted, and what happens to the source code if the pilot is not successful
- Interoperability requires smooth 'docking' with an existing IT landscape, and even software with high-grade interfaces will require user training before adoption benefits are felt

"Clinical considerations" ➔ Where will you intervene?

7. ***Site of care*** – *At what location will your product/service be used?*

ER | OR | Inpatients | Outpatients | Clinic | Physician's office | Patient's home

The decentralization of care means that to reduce healthcare costs, services are being delivered less in the hospital and more in retail clinics and patients' homes. Technology is driving this transition.

Start-ups therefore need to understand the practicalities of the location in which their solution can be used. Experienced *physicians* from a range of sites and points of care must feed in to the development phase. Virtual or Augmented Reality (VR/AR) products (like those developed by Medical Realities) for *operating room* contexts will require different levels of responsiveness, accessibility, and data-capture techniques than those required by patients *at home* (e.g. AliveCor's smartphone-connected ECG device), even if the development platform is otherwise similar.

Developers must also realize that the likely user group of many technologies will soon change as specific care scenarios transition across sites and clinical extenders are

becoming more prevalent. Retail staff at Target stores already support care involving vaccinations, strep throat treatments and minor injuries, where more experienced nursing staff would have in the past[74].

8. *Stage of care – Where in the care continuum are you focusing?*

Prevention | Diagnosis | Adherence | Point-of-care | Pre/post-care | Palliative

patientMpower, an app for kidney transplant patients, *"started with an original idea around medication adherence"*, according to CEO Eamon Costello. *"But when we started to unpack what was going on in the patient's life, medication adherence is kind of a very siloed approach to a treatment plan. [It's] a very important component, but you really have to understand the entire patient journey. It's important to offer a much more rounded solution*[75]."

The care continuum is fluid, therefore, but business models for start-ups usually require an entry point on the care continuum. A predictive analytics company like Truven for example will quickly realize that the data profiles produced by patients in *end-of-life* care stages are different in character as well as richness to those produced by younger populations more for whom *prevention* is higher priority.

The stage of care is also related to whether a start-up is focusing on a specific condition or not, and this can drive their future growth strategy. patientMpower, who are in pilot stage at Brigham and Women's Hospital in Boston focus on patients often suffering from chronic kidney disease, but their digitization technology may be customizable for application in other chronic conditions, or non-chronic acute stages of care.

"We may have a million people looking at trackers and walking, but how do we blend that with data about diabetics? What about those with hypertension? I can look at what prescription they are filling and see with a pretty good degree of accuracy what condition they have."
Michael Taitel, Senior Director of Health Analytics, Walgreens

"Targeting" ➔ Who will you help?

9. *User group – Which medical professionals will use your product/service?*

Patients | Physicians | Nurses | Administrators | Other

Successful digital health start-ups are clear about the difference between the payer, user, and beneficiary of their solutions, as each stakeholder requires their own incentive for adoption.

For example, a health system may wish to use smart catheters (a related device is being developed by Spinal Singularity) which could help flag and prevent hospital-acquired infections that reduce care quality, as we saw with Joe's story (see section 3.1). Under the current fee-for-service payment models, insurance companies would be incentivized to pay for this equipment to help preempt expensive, avoidable readmissions. The user would be the *nurse*, the beneficiary would be the *patient*.

Prospective buyers are looking for two things when considering the user: fit with clinical workflow and administrative effort required. Business models must specify the correct user – if a start-up positions their product to be used in a clinical environment when a front-office administrator could be the user, it signals a lack of real-world validation, a poor fit and greater clinician burn-out.

Many start-ups develop their base codes first, and look for an applications for their technologies later. The temptation is to find a clinical setting in which to add value, but this should not be automatic – administrators have as much to gain from digital.

10. ***Demographic*** – *Which populations will your product/service most impact?*

Urban | Rural | Higher income | Lower income | Younger | Older

Good business models finds innovative, profitable ways to connect a requirement with a solution. In healthcare, many of the most urgent and costly requirements are determined by social drivers like transportation, education and nutrition. Therefore, health entrepreneurs building solutions should target a buyer serving a demographic where their solution's value will be clearest.

For example, technologies that overcome distances and increase utilization (e.g. American Well) will be valuable for *urban* providers for example, but critical for *rural* ones.

Equally, aiming at adoption of a diabetes medication adherence solution like WellDoc at an inner city health system where the patient demographic means that the number one priority is managing an opioid epidemic will not give the best chances of success.

Entrepreneurs should also be sensitive to market projections when building their business model. Demographic trends indicate huge growth in the Medicare market, and private insurance add-on's such as Medicare Advantage (MA). Over 32% of Medicare members in 2016 — some 19 million Americans — are enrolled in MA plans[76]. Analysts expect this to be a $500 billion market by 2025 – a fertile market for technologies that can help *older* Americans[77].

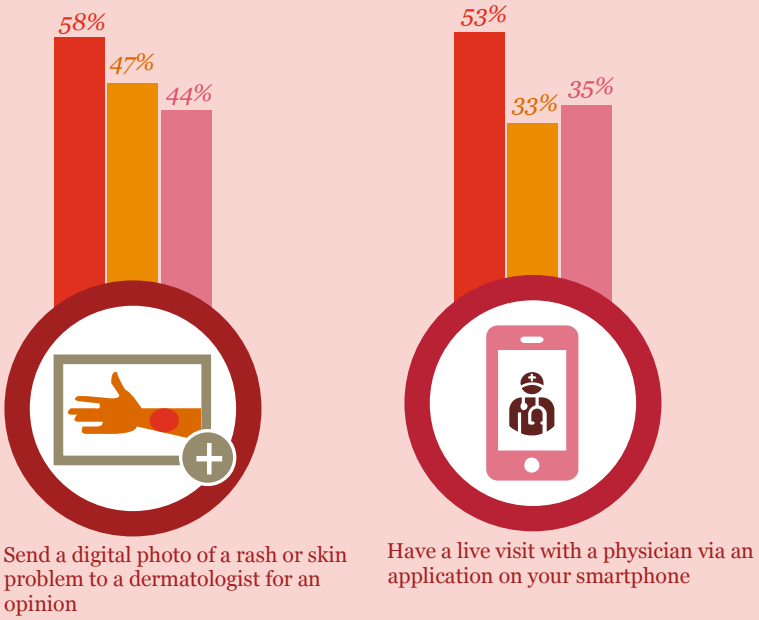
Providers must start tracking the clinical and social needs of their communities proactively and move to address them locally — or be ready to tackle them in your emergency room."
Navigating the Choppy Waters of Healthcare Reform, Strategy+business

FEATURE 7: DIGITAL'S OPPORTUNITY WITH DEMOGRAPHICS

US healthcare consumers with chronic conditions – about 150 million Americans – are among the most likely to benefit from digitally-enabled care, but the least interested in using it. Investing in this population segment has huge potential for all health stakeholders, including digital innovators who often excel at engaging groups through high-grade user interfaces (for example, Catalia Health's AI-based robot, *Mabu*, that engages with elderly patients).

Figure 15: Survey data – patients' readiness for innovation

How likely would you be to use the following medical innovation?



Source: PwC Health Research Institute consumer survey, 2016; PwC Health Research Institute report, Primary care in the New Health Economy: Time for a makeover, 2015

Real-world takeaways

Case study 1: Carrum Health
"Patient access extender"

Carrum Health offer fixed-fee planned surgeries to self-insured employers, made available through an online comparison-tool to help their employees select the right care provider. The business has scaled from its first contract with a West Coast employer in 2014 to 400 employers across three regional geographies.

Carrum negotiate standard prices through bundled payments for common surgeries like knee replacements and weight loss operations, with regional providers, on behalf of large employers.

They then offer these prices to employees of those self-insured employers, through a transparent, price-and-quality comparison aggregator, which consolidates their care options and ranks the available providers, like an Amazon shopping platform.

The employers save up to 40% in treatment costs (today, nearly $1 trillion per year in the US) through their employees gaining access to Carrum's standard, rated procedures, reducing exposure to fluctuating market prices.

The employees' usual out-of-pocket expenses are absorbed by their employer, because they are more than offset by the savings made. So employees are incentivized to select treatment provided by a Carrum-contracting provider and Carrum then cross-charge the surgery cost to the employer, adding a percentage-based transaction fee.

The providers gain market share as the employers' demand streams divert towards them.

Business model takeaways?

→ Carrum Health's business connects with the ecosystem's move towards alternative payment models, by aligning financial incentives around the prices of bundled payments. They reach multiple objectives: reducing costs, incentivizing the selection of higher quality care, and increasing patient access by breaking down barriers of information

→ Their transaction-based pricing model means buyer-side adoption requires less one-off investment, and improves their ability to forecast demand, because surgery numbers are relatively predictable

→ Carrum Health's model also has many options for future scaling – new care episodes, new geographies, more employers, or add-on patient services like performance or workflow analytics (see section 5.4)

Parameter	*Options*					
OBJECTIVES	➔ *Why can you demonstrate value?*					
1. Benefit category	**Access**	Quality	**Cost**			
2. Adopter group	Provider	Insurer	Retailer	**Employer**	Patient	
3. 'End-game'	**Sell Services**	Sell Products	Monetize Data	**Ecosystem Infrastructure**		
COMMERCIALS	➔ *How will you be profitable?*					
4. Revenue structure	Licenses	**Transactions**	Patients	Users	Outcomes	Devices
5. Reimbursement	Medicare	Medicaid	**Employers**	Providers	Payers	
6. Technology platform	Point-of-care Device	App	**Software/ Hardware**	Sensor	Plug-in Accessory	
CLINICAL CONSIDERATIONS	➔ *Where will you intervene?*					
7. Site of care	ER	OR	Inpatients	Outpatients	Clinic	Physician's Office	**Patient's Home**
8. Stage of care	Prevention	Diagnosis	Adherence	Point-of-care	**Pre/Post Care**	Palliative
TARGETTING	➔ *Who will you help?*					
9. User group	**Patients**	Physicians	Nurses	Administrators	**Other**	
10. Demographic	**Urban**	Rural	**Higher Income**	**Lower Income**	**Younger**	Older

Case study 2: WellDoc
"Adherence champion"

WellDoc's BlueStar applications analyze patient diabetes data in order to spot patterns and make recommendations on managing their condition – their target market includes 21 million type 2 diabetics in the US[78].

WellDoc markets a variant of its app with an insulin calculator requiring prescription (BlueStarRx) to self-insuring companies like Ford, and another without the calculator, for which no prescription is needed (BlueStar). A third version, developed with Samsung, is sold directly to diabetic patients to provide lifestyle support (BlueStarC).

Patients need an access code from their employer, health plan or health care provider to use BlueStar, and can upgrade to BlueStarRx with a prescription. These two FDA-approved versions of the app (BlueStar and BlueStarRx) are incorporated into employee health plans and are paid for by employers and insurance companies with a per patient, per month fee. BlueStarC is available directly through the Samsung Health app.

While the Baltimore-based company sells mobile-accessed software, its journey is more similar to that of a biopharmaceutical company: it started off by conducting randomized clinical trials, testing its app on 150 patients across 26 primary care practices. BlueStar beat the control group for reducing blood sugar levels by 1.2%[79].

The results of these early trials enabled WellDoc to set a precedent as the first digital health company to obtain FDA clearance, medical prescription for its app and reimbursement approval from payers[80].

WellDoc has partnered with Johnson & Johnson company LifeScan since 2016 to integrate their Bluetooth glucose monitoring system to BlueStar. It has also partnered with the American Association of Diabetes Educators to incorporate educational content into its apps, and with Human API, an open platform for real-time patient data.

Business model takeaways?

→ The company invested upfront on clinical validation and FDA submission, building a credible evidence-base that enabled differentiating accreditations

→ Developing several versions of their core application opened up parallel adoption opportunities with patients, payers and providers, maximizing scale-up options open to them

Parameter	*Options*					
OBJECTIVES	➔ *Why can you demonstrate value?*					
1. Benefit category	**Access**	**Quality**	**Cost**			
2. Adopter group	**Provider**	Insurer	Retailer	**Employer**	**Patient**	
3. 'End-game'	Sell Services	**Sell Products**	Monetize Data	Ecosystem Infrastructure		
COMMERCIALS	➔ *How will you be profitable?*					
4. Revenue structure	Licenses	Transactions	**Patients**	**Users**	Outcomes	Devices
5. Reimbursement	Medicare	Medicaid	**Employers**	Providers	**Payers**	
6. Technology platform	Point-of-care Device	**App**	Software/ Hardware	Sensor	Plug-in Accessory	
CLINICAL CONSIDERATIONS	➔ *Where will you intervene?*					
7. Site of care	ER	OR	Inpatients	Outpatients	Clinic	**Physician's Office**	**Patient's Home**
8. Stage of care	Prevention	Diagnosis	**Adherence**	Point-of-care	Pre/Post Care	Palliative
TARGETTING	➔ *Who will you help?*					
9. User group	**Patients**	**Physicians**	Nurses	Administrators	Other	
10. Demographic	**Urban**	**Rural**	**Higher Income**	**Lower Income**	Younger	**Older**

Case study 3: Kit Check
"Efficiency driver"

Kit Check help hospitals track and manage medication inventory in their internal pharmacies and operating rooms (OR) through three components: Radio-frequency identification (RFID) tags, a scanning machine and software for pharmacy and OR staff.

Used medication kits are scanned, which then triggers automated restocking and inventory checks on soon-expiring drugs. After the restocked kits are assembled, the scanner verifies the kit's contents are correct.

The Washington-DC-based company also provides a cloud-hosted dashboard for hospital pharmacy managers to monitor data on medication usage, par level for each medication, and in-network inventory levels. Kit Check claim users dramatically reduce time spent on restocking medication kits while reducing stocking errors.

Kit Check's initial revenue structure was to sell the scanning machine to hospitals, an investment requiring approvals and budgets from buyer-side procurement, IT, and Heads of Pharmacy. But the company quickly shifted approach, giving the scanning machine away for free and only charging for the RFID tags, which required fewer approvals.

This shift helped enable Kit Check to scale from seven hospitals to almost 200 in less than three years. Numbers of medications tracked grew from 400,000 in 2013 to over 13 million in 2016. Kit Check sells its tags to hospitals either directly or through local distributors, Group Purchasing Organizations (GPOs), Government Purchasing Options and other partnerships.

Business model takeaways?

→ The company quickly understood that to achieve traction, it needed to show flexibility and switch its pricing approach. The loss when absorbing the costs of the scanning machines was more than offset by the variable revenue through accelerated adoption

→ Kit Check also demonstrated sensitivity to the buyer-side users and decision-makers – they repositioned pricing to fast-track procurement, and distinguished between the users and beneficiaries of their solution

Parameter	*Options*					
OBJECTIVES	➔ *Why can you demonstrate value?*					
1. Benefit category	Access	Quality	**Cost**			
2. Adopter group	**Provider**	Insurer	Retailer	Employer	Patient	
3. 'End-game'	Sell Services	**Sell Products**	Monetize Data	Ecosystem Infrastructure		
COMMERCIALS	➔ *How will you be profitable?*					
4. Revenue structure	Licenses	Transactions	Patients	Users	Outcomes	**Devices**
5. Reimbursement	Medicare	Medicaid	Employers	**Providers**	Payers	
6. Technology platform	**Point-of-care Device**	App	**Software/ Hardware**	Sensor	Plug-in Accessory	
CLINICAL CONSIDERATIONS	➔ *Where will you intervene?*					
7. Site of care	ER	**OR**	**Inpatients**	Outpatients	Clinic	Physician's Office	Patient's Home
8. Stage of care	Prevention	Diagnosis	Adherence	**Point-of-care**	Pre/Post Care	Palliative
TARGETTING	➔ *Who will you help?*					
9. User group	Patients	Physicians	**Nurses**	**Administrators**	**Other**	
10. Demographic	**Urban**	**Rural**	**Higher Income**	**Lower Income**	**Younger**	**Older**

Case study 4: Omada Health
"Digital therapeutics leader"

Omada's flagship program, Prevent, is a 16-week online weight reduction program delivered through a mobile platform to patients at risk for chronic diseases. Using population health analytics, patients are matched into a social network with similar demographics, paired with a certified 'coach' and receive daily guidance and lifestyle recommendations.

Patients submit data (for example through smartphone connected digital scales) to allow coaches to remotely track their progress during the program and offer guidance after it. Prevent was founded on the success of the Centers for Disease Control and Prevention's (CDC) landmark program.

The San-Francisco-based company invests heavily in peer-reviewed research to showcase the clinical validity of its programs and sharpen it's success metrics – weight loss percentage and 5-year risk levels for diabetes or heart disease.

Though patients can sign up and pay for the program individually, the program is mainly offered through health plans offered by insurance companies or through employers. Leading insurers like Humana or Cigna pay for their customers' access to Omada's programs as a 'fully covered preventive benefit'. For other health plans, the cost of the program may vary depending on the employer or the insurer.

In March 2016, CMS announced that Medicare will begin reimbursing CDC-recognized partners like Omada Health, which is today the largest federally recognized provider of diabetes prevention programs in the US[81].

Business model takeaways?

→ Prevent is priced solely based on performance. If the program fails to deliver quantifiable outcomes for the patient, Omada does not get paid – this reduces adopters' risk, and communicates confidence in the program's value

→ The company's program is patient-facing, it is sold to employers and insurance companies, incorporated into health plans offered to patients, and reimbursed by CMS – the different stakeholder communities are clear

→ Omada's success reflects its software capabilities, but also operational achievements related to the hardware side of the business – mailing patients with medical equipment, fulfilment and warehousing, and coach-scheduling

Parameter	*Options*					
OBJECTIVES	➔ *Why can you demonstrate value?*					
1. Benefit category	**Access**	**Quality**	**Cost**			
2. Adopter group	Provider	**Insurer**	Retailer	**Employer**	Patient	
3. 'End-game'	Sell Services	**Sell Products**	Monetize Data	Ecosystem Infrastructure		
COMMERCIALS	➔ *How will you be profitable?*					
4. Revenue structure	Licenses	Transactions	Patients	Users	**Outcomes**	Devices
5. Reimbursement	**Medicare**	Medicaid	**Employers**	Providers	**Payers**	
6. Technology platform	Point-of-care Device	**App**	**Software/ Hardware**	Sensor	**Plug-in Accessory**	
CLINICAL CONSIDERATIONS	➔ *Where will you intervene?*					
7. Site of care	ER	OR	Inpatients	Outpatients	Clinic	Physician's Office	**Patient's Home**
8. Stage of care	**Prevention**	Diagnosis	**Adherence**	Point-of-care	Pre/Post Care	Palliative
TARGETTING	➔ *Who will you help?*					
9. User group	**Patients**	Physicians	Nurses	Administrators	Other	
10. Demographic	Urban	Rural	Higher Income	**Lower Income**	Younger	**Older**

Case study 5: CirrusMD
"Virtual care facilitator"

Using CirrusMD's virtual care mobile platform, patients can text with physicians in live time who then recommend an at-home treatment, join a video-chat or schedule a referral.

The Denver-based company currently serves two million people in 44 states across the care continuum. Its virtual acute care treatment protocols reportedly yield a 40% decrease in avoidable emergency room visits. It also has a post-acute program that aims to reduce readmissions and provide guidance on managing chronic diseases from the patient's home[82].

Since the majority of CirrusMD patient-physician interactions only use messaging, they claim to enable physicians to dramatically increase the productivity of their patient consultations, and offer patients convenience.

While patients can independently subscribe and pay for the solution, CirrusMD mainly sells to health systems, insurers and employers. Subscriptions are purchased either on a per-patient, per-month basis, or through a shared-risk plan where the provider pays CirrusMD a percentage of the savings generated from avoided hospitals visits.

Business model takeaways?

→ CirrusMD can position as a key resource to avoid readmissions, and reduce hospital-acquired infections – two of the key quality metrics being rolled out. They reduce costs through raised productivity and out-of-hospital consultations, and they increase access by reaching patients through cell phones – all the benefit categories are involved

→ The company offers options around payment methods, which shows flexibility to potential adopters

→ CirrusMD is well-placed as a potential supplier to integrated networks of payers and providers, carers of rural patient communities and younger patients with its text-based care

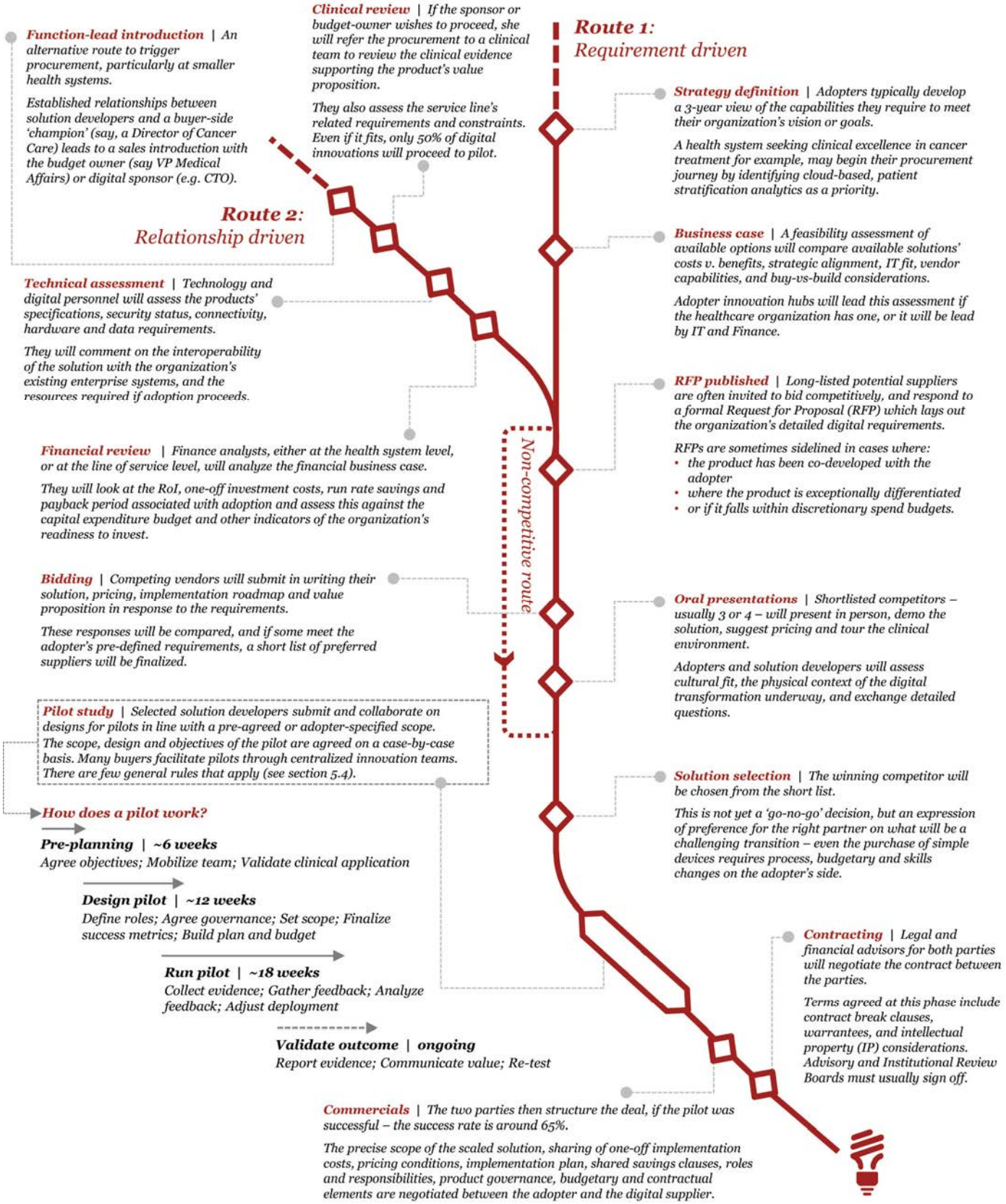
Parameter	*Options*					
OBJECTIVES	➔ *Why can you demonstrate value?*					
1. Benefit category	**Access**	**Quality**	**Cost**			
2. Adopter group	**Provider**	**Insurer**	Retailer	Employer	**Patient**	
3. 'End-game'	**Sell Services**	Sell Products	Monetize Data	Ecosystem Infrastructure		
COMMERCIALS	➔ *How will you be profitable?*					
4. Revenue structure	Licenses	Transactions	**Patients**	Users	**Outcomes**	Devices
5. Reimbursement	Medicare	Medicaid	Employers	**Providers**	**Payers**	
6. Technology platform	Point-of-care Device	**App**	Software/ Hardware	Sensor	Plug-in Accessory	
CLINICAL CONSIDERATIONS	➔ *Where will you intervene?*					
7. Site of care	ER	OR	Inpatients	Outpatients	Clinic	**Physician's Office**	**Patient's Home**
8. Stage of care	**Prevention**	**Diagnosis**	Adherence	**Point-of-care**	**Pre/Post Care**	Palliative
TARGETTING	➔ *Who will you help?*					
9. User group	**Patients**	**Physicians**	Nurses	Administrators	Other	
10. Demographic	**Urban**	**Rural**	**Higher Income**	**Lower Income**	**Younger**	Older

4

How organizations buy digital

The 'mechanics' of digital health technology procurement

4.1 The digital health procurement roadmap



The digital procurement roadmap indicates the major milestones entrepreneurs should expect when approaching potential buyers. Only 45% of hospital leaders have a standard process to assess whether to pilot a digital solution, and since the health insurers differ in size and focus, their adoption process will also vary[83]. The following suggests what start-ups can expect as standard across potential buyers, and what can vary.

What is standard between adopters?

- ***Return on investment requirement***. Most obviously, this involves calculating the attractiveness of the investment the adopter must make (see section 5.2). Start-ups should expect to provide the detailed rationale behind the one-off investment costs anticipated, the expected return in dollars over time, and the 'levers' that they and the adopter have in influencing the costs and returns, if and when they come to structure the sale

- ***Medical, Finance and Technology***. Clinical, commercial and technical stakeholders will want to understand the benefit and impact on their respective functions of adopting the solution. They will also expect to hear what options there are around implementation – for example, how will they control who the roll-out affects? There may be other functional approvals required, such as Head of Legal or Regulatory

- ***Demonstration of value***. Any buyer-side stakeholder expected to recommend that their own enterprise proceeds with the procurement journey, will need a customized and evidence-based connection between the product's capabilities, and that institution's specific value objectives. If they are a health insurer aiming to increase sales of their plans to a younger demographic, or a safety-net health system aiming to maximize CMS reimbursement, then start-ups must self-assess the impact of their product's adoption against these goals

What varies between adopters?

- ***Pilot pre-certification requirements***. Buyer-side policies vary greatly. Larger, integrated networks of buyers are most likely to have standardized prerequisites before a start-up's solution is even considered. For example, results of randomized clinical trials, documentation of HIPAA-secure status or implementation credentials at other institutions. Smaller, or particularly progressive hospitals may be more open to pilot-based experimentation during procurement, with lower thresholds.

- ***RFP and competitive bidding***. Issuing an RFP is standard practice at larger health systems, and at all institutions where the solution is commoditized or in a relatively mature digital sub-sector like telehealth. More than 80 RFPs per month were issued by US providers for technology software and services in 2016. Procurement teams use these to help negotiate better pricing for adopters, and reduce their number of suppliers to achieve bulk value contracts. But for some institutions, particularly those open to relationship-triggered procurement, the RFP stage may be skipped altogether

- ***Central approvals***. Some health technology suppliers, including EHR vendors, have succeeded in selling directly to specific lines of service inside a health system. A cardiology department may for example allocate part of its capital budget in a given year to purchase ambient sensors to remotely collect patient generated health data. In other institutions, digital health procurement decisions require central approval by 'category' as well as budgetary owners

Accelerators of digital impact

What gives digital health developers and their hospital buyers the best chance of successful adoption? And what should a health start-up look for to be confident in their adoption partner? According to a 2017 study by the American Hospital Association (AHA) and Avia Health, four factors significantly accelerate digital innovation within hospitals[84].

1. *Sufficient IT skills, people and assets*
2. *A flexible budget cycle*
3. *Dedicated digital funding*
4. *Decentralizing digital budgets*

→ *All four factors together help execute innovation projects 52% faster, leading to impact 12 months sooner*

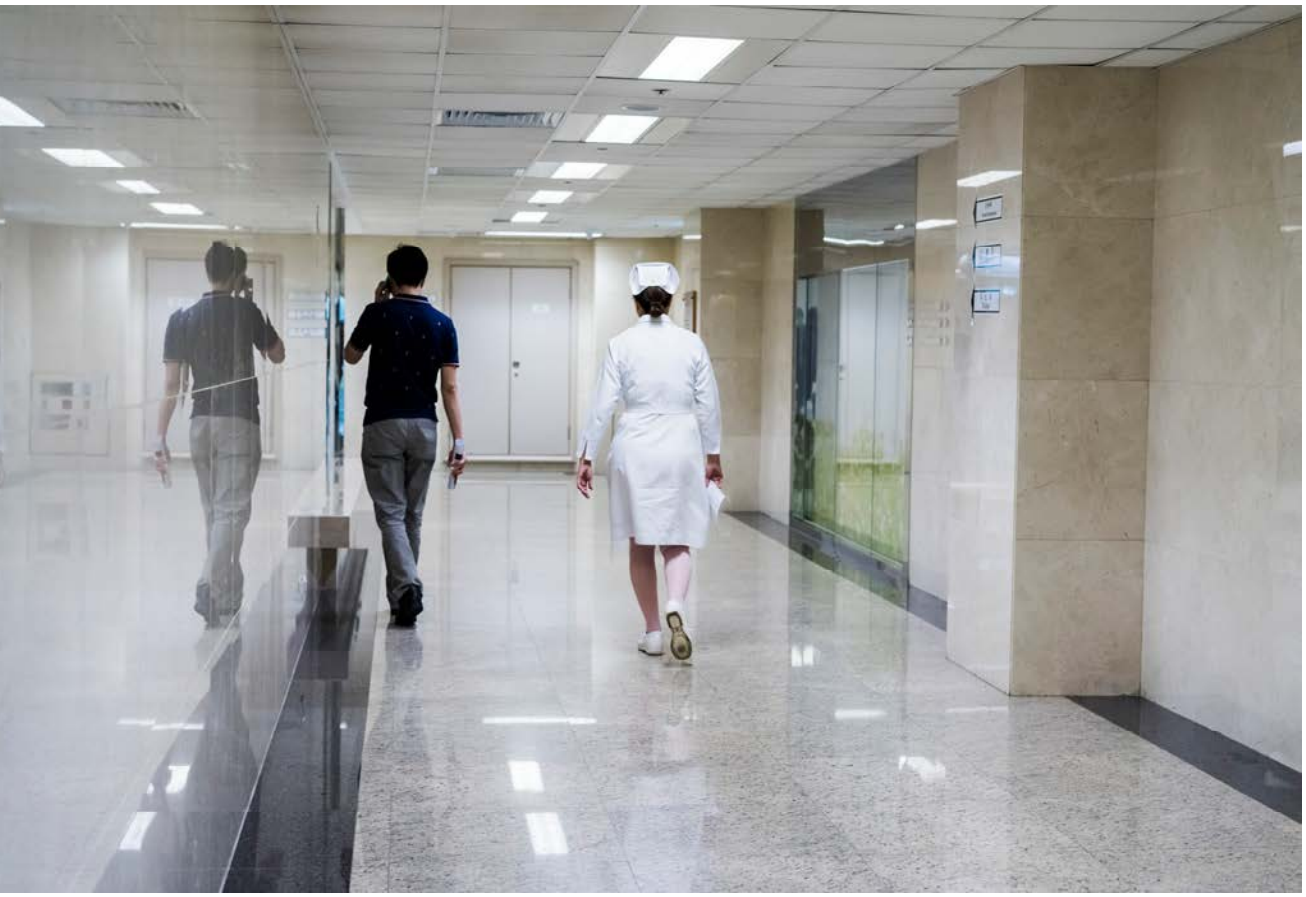
1. ***Accelerator 1: Sufficient IT skills, people and assets.*** 70% of hospital leaders do not believe that their IT department have sufficient resources to effectively support digital innovation[85]. The ideal digital health adopter has well-staffed teams, with IT personnel distributed in the business where they are needed. They have the right mix of digital, architecture, data management, engineering and application skills to dramatically accelerate innovation.

2. ***Accelerator 2: A flexible budget cycle.*** Organizations able to respond to digital opportunities

by making exceptional capital expenditure when certain pre-agreed conditions are met are quicker to see innovation benefits (see section 5.2).

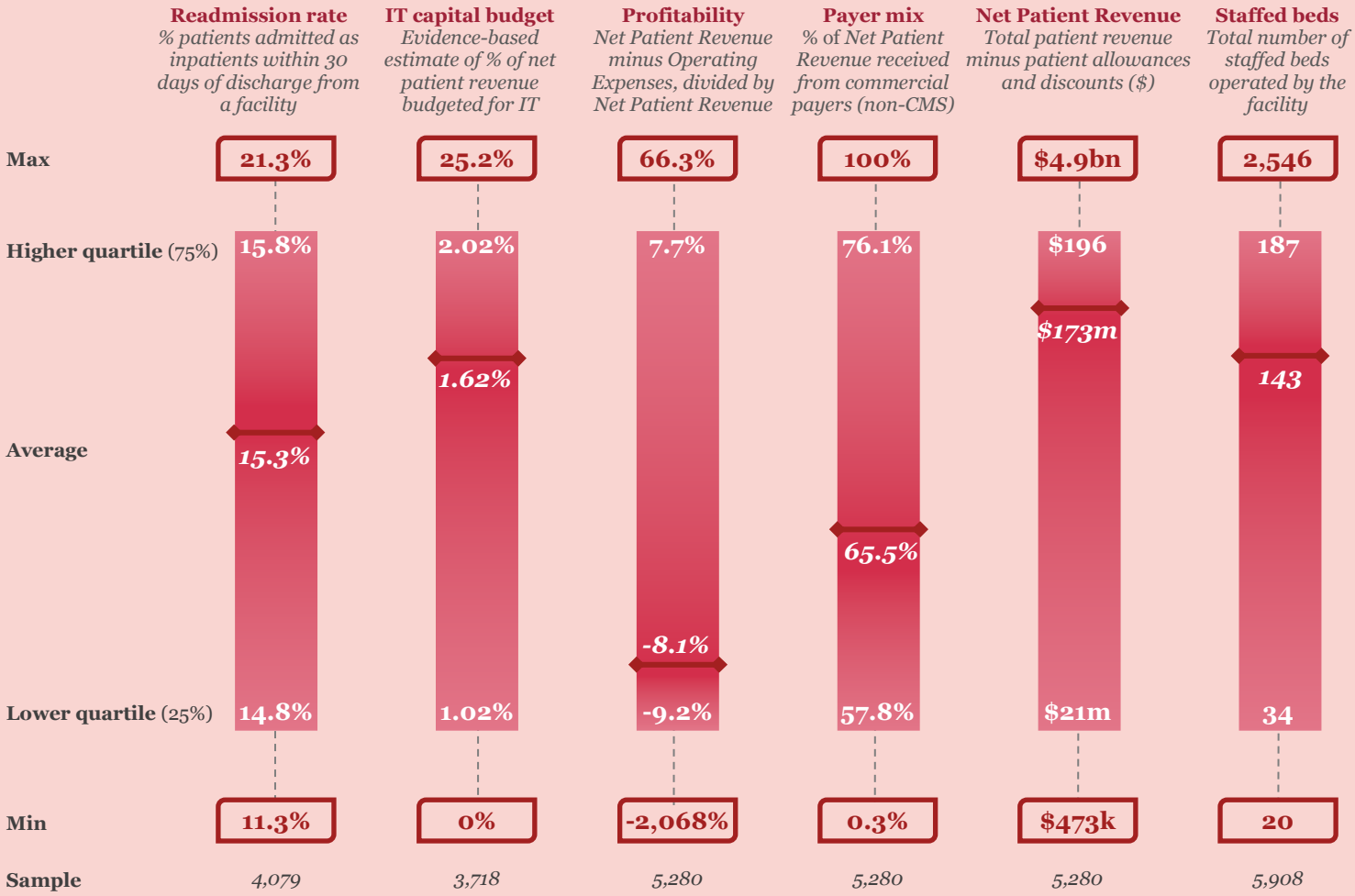
3. ***Accelerator 3: Dedicated digital funding.*** Providers who allocate digital their own budget (distinct from IT) are better positioned for agile innovation. Hospitals are doing this increasingly, as indicated by the sudden increase since 2015 in recruitment of Chief Digital Officers, with their own budgetary responsibilities.

4. ***Accelerator 4: Decentralized digital budgets.*** Allocating a percentage of each hospital service line's budget for digital innovation is another way to boost responsiveness to digital procurement opportunities. This does not preclude distributing the costs of innovation to the service lines benefitting most, but does allow easier financing for back and middle office innovations which support clinical outcomes, and promote the digital agenda in the organization



FEATURE 8: BENCHMARKS – TARGETING THE RIGHT HOSPITAL BUYER

There are several thousand registered hospitals in the US, but some will be better potential targets than others for start-ups. Entrepreneurs will maximize their adoption prospects by understanding how a given hospital compares to the nationwide average on key industry indicators. The following analysis of US hospitals clarifies some examples and suggests takeaways for digital health entrepreneurs that can help narrow down their 'ideal' buyer profile.



Note: PwC analysis. For more information on sources see 'Note on methodology'

How can start-ups use these benchmarks?

Hospitals with higher-than-average **readmission rates** will be losing money on CMS penalties associated with outcomes measurement. These will likely be the right targets for solutions which combat misdiagnoses, prescription errors, and poor care follow up.

IT capital budget is approximately $3 million per year for an average individual hospital, some of which will go to digital investments. But the analysis reveals this is unevenly distributed amongst the potential buyers in ecosystem – a small number of outliers have higher IT capital budgets than the average 1.62% of net patient revenue.

Net operating profit levels indicate the financial health of the targeted buyer. Digital health products focused on cost reduction will feel much more urgent for lower quartile hospitals than products which offer other clinical benefits at significant cost.

Payer mix reveals the source of reimbursement and therefore offers clues about likely payment models at work

at a given hospital. Hospitals with very low commercial reimbursement rates (lower quartile) may be better targets for solutions built around value-based pricing methods, and poorer targets for technologies that facilitate specialist care for niche conditions that are privately reimbursed.

Net Patient Revenue is the key financial indicator of the size of the hospital. Technologies like clinical workflow optimizers are expensive to implement, and pay off at scale, so their developers may choose to avoid targeting lower quartile hospitals in the tens of millions of dollars.

Number of **staffed beds** is a key operational indicator of a hospital's size. Start-ups with a unit-based, point-of-care product which is lucrative at high volume, like a smart catheter, will want to target a facility with more than average numbers of beds (over 250).

"Start-ups [are] pitching to so many other organizations instead of focusing on a few and hitting it out of the park. Start-ups can better focus on deeper engagements with potential partners than spreading themselves thin."
Laika Kayani, Director of Health Innovation Product Strategy, Blue Shield of California

Buyer-side drivers of digital procurement

There are eight key buyer-side considerations for entrepreneurs targeting adoption in the procurement cycle.

1. Level of innovation

Some hospitals, like Boston Children's Hospital, have embedded innovation into how they operate by establishing in-house digital accelerators, independent of IT. According to a 2017 survey of hospital leaders, 29% were planning to or have already built innovation centers. These are influential, but small facilities, often running on a budget of $1-2 million per year, employing between five and eight full time personnel. They are particularly prevalent amongst academic medical centers like Mayo Clinic (50%), some insurers like Providence in the form of investment arms and larger health systems with over 400 beds (72%)[86].

Others, like Brigham and Women's Hospital, have a digital innovation hub run by their IT function. But regardless of the governance model, these innovation hubs all aim to fund and support emerging innovations, develop enterprise-level solutions and embed a culture of innovation. They also serve as testing grounds for hospitals to see what value can be harnessed from their own medical data.

These innovation hubs are helpful for start-ups because they offer buyer-side resources, a clear roadmap to scaling, and higher conversion rates post-pilot. But they will likely include more experienced buyers who can benchmark different start-ups against each other and ask penetrative questions about the seller's readiness to scale.

2. Policy and governance

Hospitals with embedded innovation functions often have formal governance procedures around digital health adoption. For example, Brigham and Women's iHub accelerator has a Digital Innovation Guide to help pass emerging technologies through the appropriate approvals towards a pilot, and then scale it beyond if successful.

While this increases the need for entrepreneurs to meet prerequisites and follow a controlled process, it creates a well-trodden path for innovators to follow through the procurement cycle and sets realistic expectations for both sides. Brigham's CIO recognizes that, *"it's impossible for the entrepreneur to understand everything that is required at the hospital system to vet the potential solutions."* At Boston's Children's Hospital, they *"don't expect that a start-up is going to be able to know all the steps and have that full roadmap laid out."* Yet they recently partnered with one smart notification start-up – Herald Health – through to implementation[87].

Progressive hospitals with formal processes around adopting digital may also be challenging buyers because in exchange for offering support, they demand a stake in the company. Cedars-Sinai Medical Center in Los Angeles runs an accelerator program that invests $20,000 in start-ups along with an optional $100,000 grant, in exchange for 6% in equity[88].

Conversely, hospitals with less experience in digital adoption are less likely to have established hubs for innovation. External entrepreneurs may consider these hospitals as unsuitable sales targets, but equally, their digital procurement cycle may be more flexible and involve fewer approvals.

"We know healthcare is a very difficult industry to break into as a startup, and we want to break down those barriers to bring exciting ideas and approaches to those we are privileged to serve."
Chris Young, Vice President of Innovation, Ascension

3. Appetite to co-develop

Health systems see the growing venture capital investments in digital health as an opportunity to leverage innovation without the costs of in-house development. In many cases, they would rather 'buy' than 'build'. In a 2017 study, 76% of American health system leaders said digital innovation includes partnering with other organizations – only a minority want to home-develop. A smaller, though very significant 42% of leaders think that innovation specifically includes testing and scaling digital products developed by small or medium sized, external innovators like start-ups[89].

In-house development takes place when hospitals have the IT skillsets, untapped data assets and specific clinical expertise that mean they don't urgently need external entrepreneurs. For example, Boston's Children's Hospital have:

- developed a Cerner EHR optimization tool that will support precision medicine in genetic disorders suffered by children

- built and then divested Circulation, an in-house start-up focused on patient logistics
- supported POPP, another start-up which predicts patient placement and likelihood of admission for patients through machine learning

Across these examples, the hospital's accelerator offered funding, engineering support, business strategy, and project management skills.

Co-developing is often a favored approach because it enables the highest level of customization to the needs of the buyer's workflow, and better achieves buy-in amongst stakeholders involved. As one Chief Innovation Officer put it, *"we like those kind of relationships. They're not just pure vendor relationships, they're real opportunities for collaboration*[90]*."*

4. Stakeholder mix

At Boston Children's Hospital, the procurement cycle begins with ideas being tested in the Innovation Hub. Proposals to be taken forward go through a 360 degree review of the business case and IT feasibility. An independent advisory board made up of investors and advisors challenge the business case and IT requirements that triggered the procurement cycle.

Other stakeholders will have a say too. Some faith-based health systems like Catholic Health may have non-medical community members on their Board whose innovation priorities may be different and influential. A huge upturn in appointments of Chief Digital Officers has been observed since 2015, and the new role of Chief Medical Informatics Officer is also on the rise, looking for ways to make the most out of patient data assets.

"I think we will get used to using 40-50 predictive models from vendors that bolt on to the data in our EHRs, and then internally develop four or five. We'll need to be comfortable with being known for those four or five predictive models, and they have to be solid."
Robert K. Eardley, Senior Vice President and Chief Information Officer, Houston Methodist

FEATURE 9: PROCUREMENT CHECKLIST

Before initiating procurement through entering a competitive process or presenting a value proposition, digital health start-ups need a positive and compelling answer to the following ten questions.

- ✓ **Value priorities** – Are you clear about how your product or service demonstrates value for the specific buyer? Does it talk to their strategic goals?
- ✓ **Business case** – Have you developed a clear, flexible tool for explaining the costs and benefits of adoption?
- ✓ **Negotiation parameters** – Have you decided on your commercial thresholds for the pilot? Do you know your zone of possible agreement?
- ✓ **Clinical evidence** – Are the benefits of your product or service backed up by clinical and real-world evidence?
- ✓ **Regulatory approval** – Can you demonstrate compliance with laws and regulations that apply?
- ✓ **Security credentials** – Is your solution HIPAA-secure? Do you have the documentation to show how?
- ✓ **Understanding of workflow** – Have you simulated your product or service at the buyer's environment? Are you sure you know the right end user?
- ✓ **Customization plan** – Do you know the adaptations required in order to configure your product or service to the buyer's IT landscape and data structure?
- ✓ **Implementation roadmap** – Can you defend your roadmap's timescales, launch plans, team sizing, and change management milestones?
- ✓ **Success metrics** – Have you defined what adoption 'success' means and how to measure it?

5. Security and risk attitudes

Decisions to purchase will depend on the seller's pricing and capabilities, but also the potential adopter's increased risk. Additional regulatory, privacy, malpractice liability, and security concerns may apply from working with outside suppliers that touch or host sensitive patient data.

Procurement can proceed more smoothly if the start-up presents a 'menu' of options to choose from. For example, Avizia's Carena offers buyers its core technology – an online virtual health platform – as well as optional supporting capabilities like a visit scheduling interface. Buyers can then choose the options that fit their security and risk requirements more flexibly.

6. Group Purchasing Organizations

GPOs are third party organizations that aggregate demand from a number of hospitals to improve purchasing power when negotiating terms with suppliers for capital equipment, support services and medical supplies. GPOs are growing, because the savings they realize are significant (estimated at between 10 – 18%[91]). Three of the largest GPOs are MedAssets, Novation and Premier, each of which holds tens of billions of dollars in contract value.

Today, 8 out of 10 health systems affiliate with one or more GPOs and 72% of hospital purchasing now flows through them[92]. Some GPOs have developed advanced analytics capabilities and even run parts of health systems' procurement departments.

Although GPOs are not yet acting as a gatekeeper for digital purchasers, demand for digital products could soon start to be aggregated for some solution categories, meaning a growing distance between potential sellers and buyers of digital health solutions.

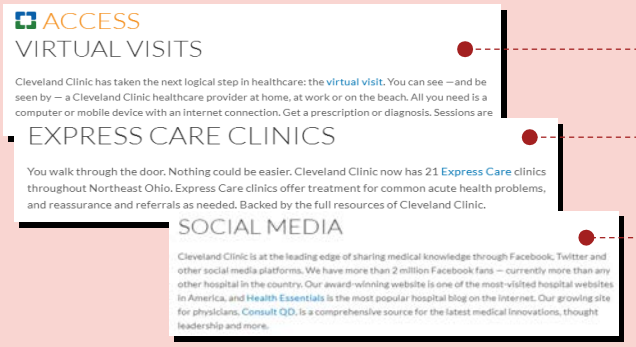
FEATURE 10: RESEARCHING YOUR BUYER

There is a lot of public information that start-ups can use to customize their value proposition to the priorities of a potential buyer, including annual reports, investor presentations, and conference papers – some examples are shown here.

Successful digital providers manage to find a connection between their value and the buyer's objectives.

Volumetrics | Kaiser' Permanente's online care platforms include prescription refill, requests for appointments, video visits and lab tests. Entrepreneurs can use these volumetrics to simulate benefits of adoption

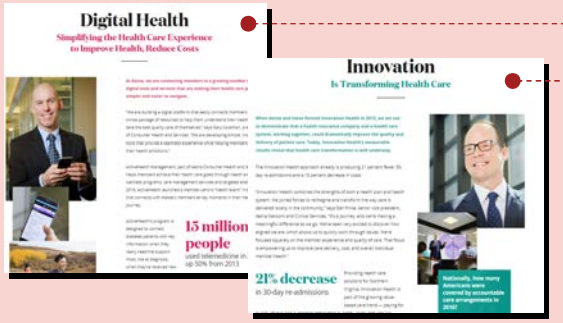
Capital budgets | 900 new IT jobs suggests big investments in new capabilities. This organization is likely to be developing digital strategy around new facilities mentioned, and they also indicate their capital budget



Priorities | Virtual care is viewed by Cleveland Clinic as "the next logical step in healthcare" – a statement of intent that invites related digital health innovators

Regional focus | Regional distribution of facilities narrows the patient demographic and can help sharpen a seller's value proposition

Differentiators | Understanding how a buyer defines their distinctive strengths helps seller's maintain relevance – in this case, the focus on social health and patient-physician communication



Conditions | Insurers often indicate which exact conditions they most want to manage through digital capabilities. This can be very valuable for condition-specific solutions to target appropriately

Innovation | Aetna for example views innovation as critical to lower patient readmissions and reduce costs – two key elements of the shift to value-based care

7. Budget cycles

The annual budget setting period for many health systems revolves around August to October. This means that there can be a rush by adopters to contract with external partners on IT capital expenditure and pilot projects towards the end of the calendar year, to avoid lost budgets. Equally, adoption journeys that start earlier in the year and overspend can be frozen until additional budgetary funding is released later in the year. This can be a show-stopper for smaller start-ups who are not yet profitable.

There is relatively little that digital health start-ups can do to influence the budgetary cycle, but it is important that they seek information from their potential buyer. It is worth noting that larger providers and payers like United Healthcare or Anthem Health Insurance, who may budget as much as $2 billion per year on IT spend, may have discretionary technology spend of hundreds of millions of dollars per year, so for these, budget cycles are unlikely to be a procurement deal-breaker.

8. Level of network integration

As noted already in section 2.1, health facilities are increasingly forming networks in the form of IDNs to manage the full continuum of care, improve care coordination, and benefit from scale.

These networks vary in the degree and type of their integration. Horizontally integrated networks like HCA Healthcare are made up of a number of hospitals, often with similar lines of service. Others are vertically integrated, like Tenet Healthcare, where the members extend across a larger range of care services, from obstetrics through to palliative care. The most advanced level of strategic integration however, as with Dignity Health or Ascension Health, involves a high level of cross-network systems standardization, policy alignment and unified procurement. Many IDNs are shareholders of a GPO, and provide both insurance plans and care services.

Start-ups targeting mature IDNs may find it harder to make sales introductions and may be constrained by procurement decision made centrally. But on the positive side, IDNs are typically more transparent about their strategic priorities and their value priorities – start-ups must find a way during the procurement cycle of connecting their proposition to the IDN's specific goals.

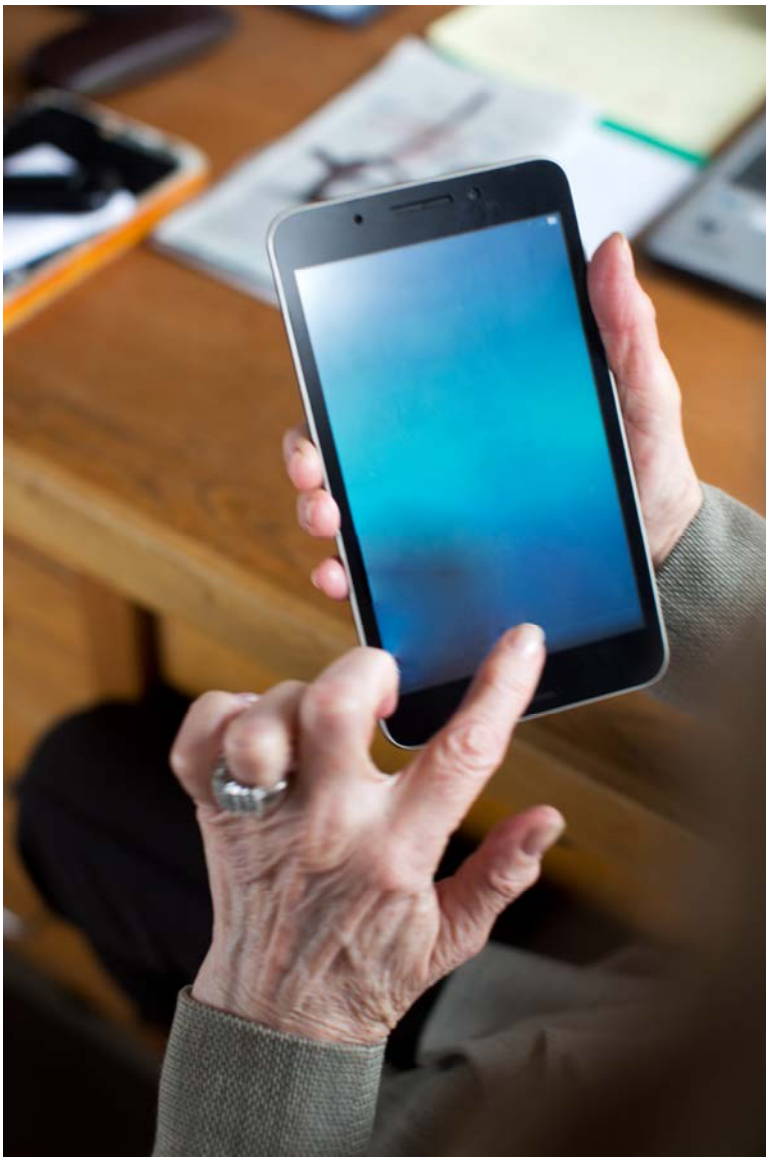


Figure 16: Pricing options and commercial considerations when structuring your sale

	Option	Description	Benefit to buyer	Benefit to seller	Seller-side risk
1.	**Discounting**	Seller will offer a % discount on their product or service (e.g. 5% off standard fee per user per month), or a subset of them (e.g. 25% discount on each new license after 100 licenses sold)	• Cash savings • Procurement team show value	• Manageable loss in margin may lead to a breakthrough contract • Often offered to 'first adopters'	Low
2.	**Split resourcing**	Seller agrees to resource key implementation, technical support, customization or delivery roles at the buyer's site	• Reduces pressure on steady-state IT workload	• Greater control of customization	
3.	**Equity stake**	Seller offers an ownership % of the company to the buyer in exchange for sales contracts (e.g. Northwell Health and Conversa)	• Asset value potential can offset capital expenditure if start-up breaks through	• More ownership and resource investment likely from buyer	
4.	**Independent repository**	Seller agrees to store product's source code with a third party under an escrow arrangement during the implementation	• Provides security in case seller's business is small or unestablished	• Can facilitate sale without complicated financial negotiation	
5.	**Royalties**	Seller agrees to be remunerated based on buyer-side applications of the solution, not rate of utilization. More likely to be used in combination	• Buyer has higher control on variable costs of applying the solution and the timescale for scaling	• Can facilitate sales by reducing pressure on the buyer to commit to minimum spend amounts	Medium
6.	**Stepped pricing**	Seller and buyer agree a combination of pricing methods which apply at different levels of use (e.g. price per unit for first 100 units, and 50/50 on savings made after)	• Limits risk and variable costs above a certain threshold	• Guarantees short-term income, while deferring more complex pricing mechanisms	
7.	**Intellectual Property sharing**	Seller may agree to share rights to IP ownership for heavily customized solutions produced in the course of implementation	• Provides platform for scaled innovation in other areas • Leverages external capabilities	• Can be a non-financial source of leverage if negotiations get stuck on price	
8.	**Shared savings**	Seller keeps a % of the savings their product or service achieves. Complicated to use from start of adoption, but attractive as a 'kick-in' mechanism after a time period or number of units sold	• Limits financial risk and aligns incentives • Links seller payment to savings realized	• Potential for much greater reward if product is effective • Demonstrates confidence in solution	High
9.	**Outcome-based pricing**	Seller reimburses payer in proportion to pre-defined outcomes being achieved, instead of usage of solution. (e.g. Omada)	• Reduced risk • Links seller payment to positive outcomes realized	• Adoption easier to approve amongst buyer-side stakeholders	

4.2 Buyers' different priorities

Front, middle and back-office

Depending on the strategic goals of the buyer, 'digital' can impact healthcare organizations' front-office, middle-office or back-office. It is important for start-ups to understand what role their target buyer wants digital health technologies to play in their organization.

Front-office digital transformations are patient-directed, and use powerful user interfaces and convenience tools to increase consumer satisfaction through greater personalization. 'Front-office' buyers want to engage consumers – to streamline their patient touch points by building more seamless ways to interact. Online portals that guide patients through their treatment milestones, text reminders to take medication, and behavior-lead personalizations that support treatment adherence are all popular examples. This 'front-office' motivation is both clinical and marketing-related, and is intended to increase patient retention and market share.

Middle-office solutions aim to digitize core processes around clinical delivery. Caring for patients through telehealth solutions increases quality outcomes and shifts physicians to a new workflow altogether hosted by different platforms[93]. Voice-enabled assistants change the amount of time clinicians dedicate to patients in physical consultations. Diagnosis error robots create a digital safety net to challenge or guide decisions about care. The beneficiary group may be the patient, but is certainly the clinician too.

Back-office solutions benefit management teams and administrators as well and are usually often efficiency-focused. These adopters want to automate pharmaceutical inventory renewals, track delayed billing values in real-time or increase utilization patterns of assets like emergency rooms.

"I don't think any physician today should be practicing without artificial intelligence assisting in their practice. It's just impossible [otherwise] to pick up on patterns, to pick up on trends, to really monitor care."
Bernard J. Tyson, CEO, Kaiser Permanente

Across the front, middle and back-office, the suite of products and services making up the digital health market is diverse and always changing. Where do adopters' current priorities lie, and what are the digital categories at the frontier?

Figure 17: How digital procurement priorities are changing

Pioneers
Emerging digital solutions enabled by EHRs, improved download speeds, exploding smart phone penetration and the growth of the cloud

Priorities
The most popular five digital health solution groups that healthcare organizations are actively looking to implement now

Projected
Frontier technologies undergoing clinical validation and becoming commercially viable

2000 2018 2025

Examples

- Employee benefit analytics
- Primary care utilization software
- Virtual health and telemedicine

Around one in three hospitals have implemented a 'pioneer' solution. Software-based efficiency optimizers and telemedicine facilitators are established, competitive segments of the digital health market

Examples

- Patient-generated data trackers
- Network utilization optimization software
- Referral management automators
- Community support platforms
- Access convenience tools

The most in-demand solutions track and analyze patient generated data. These are used by providers to proactively manage patient populations like condition-specific groups, to promote adherence and reduce wasteful spending. These tools complement and enable the industry's move to value-based care

Examples

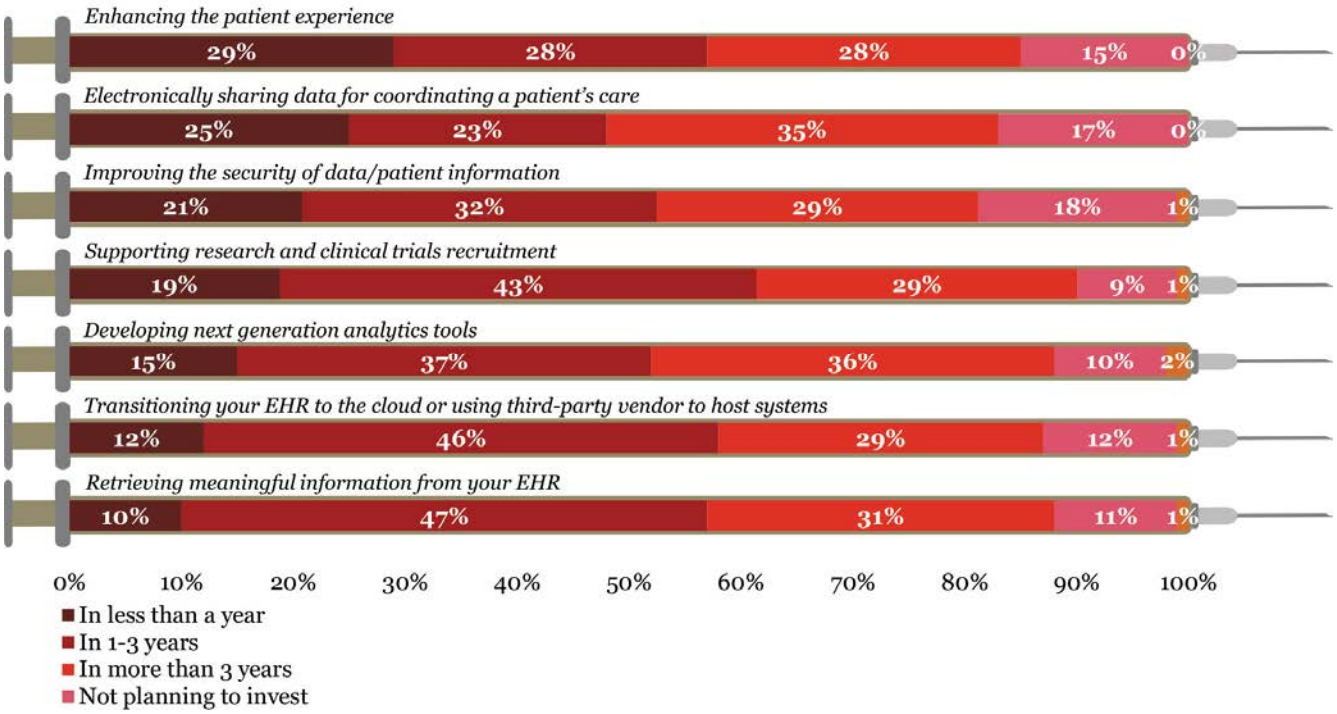
- Genomic diagnosis tools
- Biometric identification products
- Personalized medicine

Genomics sequencing costs have dropped by 90% in five years[94]. These and other projected technologies are finding clinical applications, undergoing rigorous validation and are projected to evolve in to multi-billion dollar markets

Where are buyers investing?

Figure 18: Survey data – providers' investment priorities

When are you planning to invest in technology for any of the following purposes?



Source: PwC Health Research Institute Provider Executive Survey, 2017

Takeaways

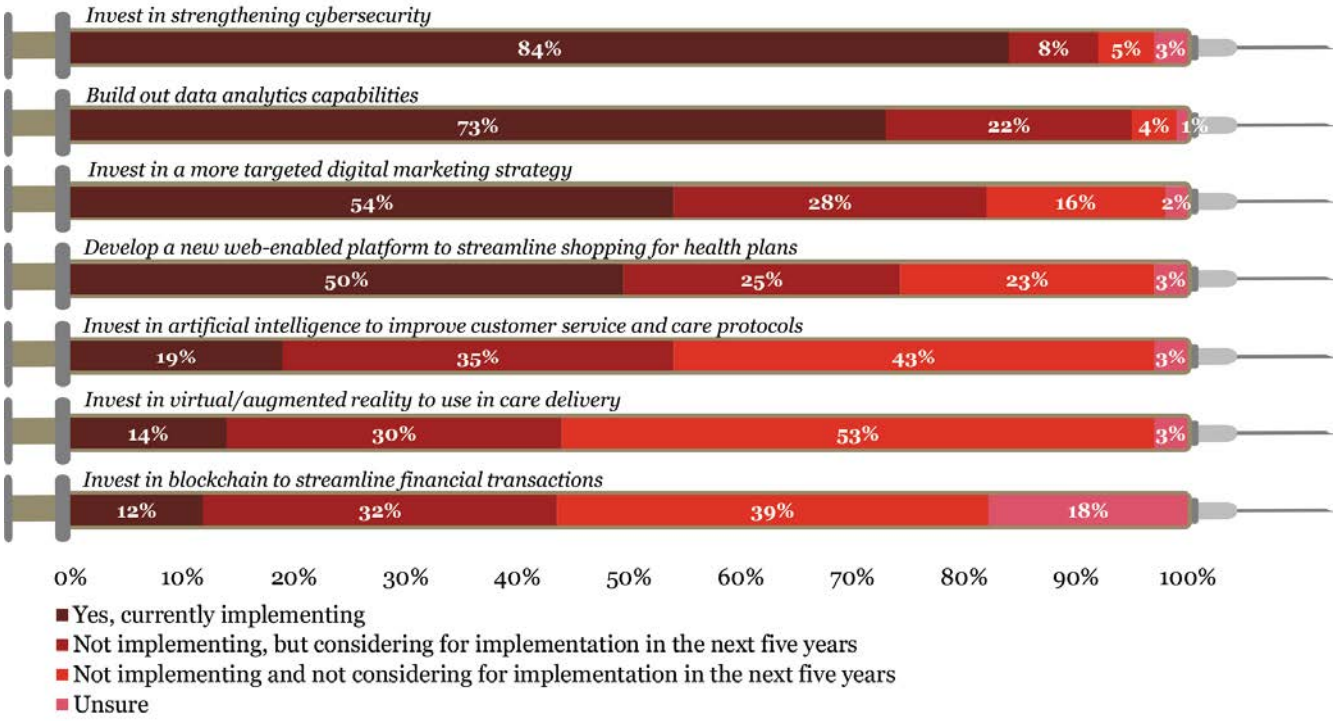
→ Providers are more urgently focused on investments that improve patient experience than investments that extend clinical capabilities – more than 25% of providers plan related investments in the next 12 months

→ These results also indicate the relatively long timescales at work in health systems' technology investment planning – for even the most urgent investment areas, 40% or more of providers have no plans within 3 years

→ The security and accessibility of provider-owned data is a consistent theme in this survey, including the priority of optimizing EHR insights and increasing PHI security

Figure 19: Survey data – insurers' investment priorities

Which solutions are you planning to implement over the next five years?



Source: PwC C Health Research Institute health insurer executive survey, 2016-2017

Takeaways

→ Health insurers' main priority is cybersecurity – 84% are already implementing measures to safeguard the sensitive health data they own on patient behaviors, treatment adherence, and costs

→ An overwhelming 95% of insurers are either implementing, or planning to implement data analytics capabilities. Start-ups in this market will therefore need a differentiator to stand out from existing suppliers

→ Customer-facing, front-office tools are the next highest priority, and include digital marketing initiatives and convenient online shopping platforms

→ Around a third of respondents want to explore other innovations in the coming five years – AI-based tools to enhance customer service, VR for care delivery, or blockchain to secure financial transactions

5

Achieving successful adoption

Adoption challenges and success factors

The CMO, CFO, CTO – Attitudes to digital

A great digital solution is a pre-requisite, not a guarantor of adoption. In a competitive digital environment with increasingly mature buyers, start-ups cannot rely on novel technology alone for success.

Break-through adoption at a buyer means carefully navigating a number of barriers to digital health transitions. Innovative entrepreneurs who have succeeded don't ignore these – they build value propositions that actively recognize the challenges facing their buyers, and come prepared to discuss how their solution can be implemented with minimum risk (see section 3.2).

Risk for healthcare organizations can be understood from clinical, financial and technological viewpoints. The central stakeholders responsible for these three perspectives will be the Chief Medical Officer (CMO), Chief Financial Officer (CFO) and the Chief Technology Officer (CTO). This section looks at the priorities facing the healthcare CMO, CFO and CTO in 2018, why digital adoption is a challenge, and how start-ups can break through these barriers and achieve scale and success.

Figure 20: CMO, CFO, CTO priorities in 2018

CMO's priorities in 2018:

- *Reducing clinician burn-out*
- *Building population health management capabilities*
- *Aligning performance metrics with MACRA*

CFO's priorities in 2018:

- *Maximizing revenue though value-based reimbursement*
- *Identifying strategic consolidation opportunities (e.g. M&A targets)*
- *Managing budget compliance*
- *Tracking CapEx benefits (e.g. EHR roll-out)*

CTO's priorities in 2018:

- *Attracting and retaining talent*
- *Extracting full value from EHRs*
- *Minimizing risk of data security incidents*
- *Balancing innovation with compliance*

5.1 The CMO – Creating value

Barriers to adoption

1. Clinician burn-out

Stress levels amongst clinicians are high and rising – a recent Mayo Clinic study shows a majority of physicians are now showing signs of burnout[95]. Hours spent reporting, compiling information for billing, and updating EHRs are significant, and the digitization of patient information has added, not reduced workloads (see feature 11). Additional digital applications, online patient management software and more dashboards may have clinical benefit, but will be negatively offset by the administrative burden they add to clinicians.

2. Resistance to change

Doctors are open to many digital developments, like mobile access to patient health information (PHI) and telemedicine. But digital transitions involve a cultural shift in ways of working and clinicians show some reticence to change, especially following challenging EHR roll-outs. They may be skeptical of digital results, concerned about malpractice lawsuits, and too busy to invest time to close the training gap required for full value to be realized. Digital solutions based on physicians as users will have to overcome this barrier.

3. Meeting the evidence threshold

Adoption has low prospects without clinical evidence demonstrating a product's value. This has traditionally been produced through double-blind, randomized clinical trials, in which a specific intervention is tested cleanly for cause-effect relationships between treatment and outcome[96]. Credible evidence of this grade is increasingly seen as prerequisite for FDA approval, payer reimbursement approval, and buyer-side adoption, and this costs time and money that are precious to entrepreneurs.

4. Uncertainty around MACRA's impact

The phasing-in of value-based payment models since 2015, especially MACRA for treatments falling under Medicare part B, is directly influencing the take-home reward of individual clinicians. Finding that patient experience sometimes worsened as a result of the demand to use EHRs, doctors will be cautious of additional technologies that could mean less rather than more direct interaction with patients.

Success factors for digital adoption

1. Staffing clinicians

Pairing seller-side doctors with buyer-side doctors during implementation and delivery can better guarantee success. Even talented and well-prepared technologists, administrators and commercial leaders will fail to fully grasp all the clinical complexities associated with the point of care. The more specialized these doctor-representatives are in the specific condition or environment targeted by the solution, the better the chances of success.

2. Reducing administrative effort

Products and services which demonstrably reduce clinical workload will be compelling during the sales cycle, and easier to embrace during implementation. Technologies which potentially reduce multiple portal sign-on's, like Sansoro's Emissary, through Application Programming Interfaces (APIs), or speed up documentation, will mitigate a key CMO concern around the administration that comes between doctor and patient.

3. Targeting demographics

CMOs are particularly sensitive to their patient demographic, and share responsibility for moving their institutions towards their stated clinical goals. Developers of solutions which target specific chronic conditions must match their product with a health system or niche plan which aims to be known as a center of excellence for that condition. Solutions will appear more relevant when they can be applied to specific population stratifications or social determinants of health, because these are the clinical goals that CMOs orientate around.

4. Using real-world evidence

Clinical evidence is a minimum requirement for adoption, but real-world evidence can be a differentiator for start-ups. The clinical community is increasingly interested in evidencing value through combining messy data sets like insurance claims data, prescription fulfilments, and patient behaviors with the clinically controlled results of tests. Innovators which go some way to integrate these sources to demonstrate benefits will have greater credibility through validation in the unstructured real-world care setting.

FEATURE 11: DIGITAL HEALTH'S RELATIONSHIP WITH EHRs

Electronic Health Records (EHRs) were envisaged to have such an impact on health outcomes through streamlining patient data that the US government put a price on it – $36 billion in federal incentives for their 'meaningful use', following 2009's Health Information Technology for Economic and Clinical Health (HITECH) Act.

Provider adoption rocketed, but at extraordinary cost – Mayo Clinic's Epic implementation is reportedly costing $1.5 billion, and will require retraining 51,000 employees[97].

But recent data shows that EHRs have not prepared providers well for the ecosystem shifts described in section 2.1. Only a quarter of provider executives feel strongly that EHRs have helped them meet consumer preferences, compete with new entrants or manage value-based care.

Can digital fill the gaps?

Financial vs clinical benefits. EHRs are used predominately for billing and payment, with vendors focusing workflow on this angle, at the expense of clinical enablement. *"'Let's just put it in a comments field' doesn't help when we are trying to compare physicians and look at variations in practice,"* explains health IT expert Jessica Cornelius. Digital innovations neatly overlay workflow to address these gaps.

Limited impact on population health. Only 50% of providers are using their EHRs for population health management, and just 13% strongly believe that EHRs have met their expectations here. More mature data techniques are needed to integrate financial or supply chain data to segment patients and manage their specific risks. Analytics-focused digital capabilities are already targeting these EHR blind-spots.

EHRs aren't shared. *"The EHR by itself is insufficient for population health analytics because patients cross systems,"* explains Dr. David Chin from Johns Hopkins School of Medicine. Some providers are taking early steps towards health information exchanges (HIE) that allow sharing of patient histories to reduce needless care and improve coordination – CVS Health and Cleveland Clinic for example[98]. Digital can help connect the dots across community, customer, insurance, clinical, financial, and marketing data.

EHRs have largely gone untapped for research. EHRs are not helping providers support practice-based research, because most aren't designed for predictive modeling, a key research capability. 42% of providers plan to focus on non-EHR technologies for research and clinical trials over the next three to five years. This is a huge opportunity for digital providers to fill the functionality gap.

Percentage of providers investing in non-EHR technologies for...

Core support – *Integrate clinical data from sources outside the health system, connect clinical and financial data*

E.g. Clinical documentation, revenue cycle management, workflow tools

Population health – *Finance/supply data integration, stratification analytics, MACRA reporting*

E.g. Clinical decision support, data manipulation and warehousing

Patient engagement – *Medication reminders, care follow-up alerts, patient segmentation and personalization*

E.g. Care coordination, provider-to-patient communication tools

Research – *Data science capabilities for predictive modelling, regression analysis, clinical research protocols*

E.g. Clinical trials support, recruitment profiles

Source: PwC Health Research Institute provider executive survey, 2017

"When it comes to a person's health and well-being, all the data in a provider's EHR only account for one-third of what is needed."
Jonathan Weiner, Center for Population Health IT, Johns Hopkins University

5.2 The CFO – Demonstrating the business case

Healthcare organization CFOs have to balance the requirements of efficient accounting, statutory compliance and management information activities. But many CFOs are already juggling a number of technology questions together with their Chief Technology Officer (CTO) colleagues. Investing in digital is only one of these – others focus areas include:

- **Cost transparency** – A 30-hospital East Coast health system recently designed their own cost tracking methodology to combine EHR data with the general ledger to drive insights. Their IT function has its own CFO, who has worked with Finance, using tools like Apptio, to track IT costs against the true cost of operations
- **Making buy-vs-build decisions** – CFOs want to optimize IT procurement by negotiating with fewer suppliers for better rates, or alternatively developing a solution in-house. However, they struggle to get lines of service to comply – cloud solution vendors have in some cases been purchased by lines of business directly, bypassing Finance and IT
- **Investment tracking –** Hospital CFOs are 'collection points' for management reporting to the CEO and Board level on returns on investment and capital management. One New York state academic medical center has an ongoing investment with Amazon to transform their supply chain – the CFO and CTO work together to track benefits

CFOs are natural stakeholders in the journey to adopt digital processes, and will challenge start-ups on return on investment. According to a recent survey of hospital leaders, 60% say that they have not seen a large enough RoI (Return on Investment) from previous digital solution investments, and only a quarter believe they saw the full value of previously adopted solutions[99].

"CFOs are deeply skeptical that it can work, especially since the process means budgeting for losses over a period of time. You just have to say, we're going to get there eventually."
Timothy Ferris, Senior Vice President of Population Health Management, Partners HealthCare

Barriers to adoption

1. Measuring digital RoI

The investment costs associated with digital technologies can be significant. Analytics investments, for example, may require cloud licenses, employee training, new compliance policies, and data security audits.

Equally challenging is measuring the returns of digital. Defining RoI narrowly – as the percentage of net profit over the total cost of investment – will not convey to the CFO and her colleagues the full impact on the organization. The CFO will want to assess digital solutions against other factors – reduction in adverse clinical events, improvements in patient experience and clinician workload – but is often unable to (see feature 12).

2. Revenue uncertainty

The adoption of MACRA (see section 3.1) and outcomes-linked reimbursement mean that providers' revenues are now less predictable – varying between -17% to +35% with new CMS penalties and bonuses, according to one analysis[100]. Provider CFOs need to manage the financial impact of healthcare reform, but only 14% feel very prepared with their current financial planning tools[101].

CFOs of health insurers are facing parallel uncertainty, with the Trump administration's intended reduction of funding for cost sharing subsidies the government currently pays insurers to reduce expenses for low-income Americans.

This makes profitability less certain, and CFOs more conservative on capital expenditure, including digital transformations. Even the largest health systems, with annual discretionary spend levels in the millions of dollars, will need to manage this uncertainty.

3. Network consolidation

CFOs are key stakeholders in ensuring hospitals remain competitive, including through integration or acquisition (see section 2.1). In these cases, the constraints on digital procurement may rise as planning for the post-merger IT integrations accelerates. Well-integrated networks may already have adopted solutions like those being considered by an acquisition target, and will certainly want to have a say in the assessment of technology capital spend, potentially limiting the adoption potential.

Success factors for digital adoption

1. Enabling value-based contracts

Digital technologies have emerged in parallel with the industry's move to 'value' (see section 3.1). Digital solutions that enable healthcare organizations to make the transition with less risk are well positioned.

Some will do so through improving reporting functions – for example, software that automates the changing, admin-heavy CMS reporting procedures for lower-value procedures[102]. Others will do so by creating comparison aggregators that facilitate choosing care through bundled payments (see section 3.2). Many focus entirely on the front-office context, improving patient experience and usability, which partly drives reimbursement.

2. Reduced costs and new revenue streams

"Anybody that can help make healthcare cheaper has got a good business going," argues Jamie Robinson, Professor of Health Economics at Berkeley. His claim is that so great is the risk facing providers with the changes to reimbursements, that unless a digital technology has 'revolutionary' clinical benefits, it will not succeed with adoption ahead of solutions which will save hospitals money. AI tools to improve diagnoses accuracy for example, may be at risk.

Equally, solutions which create new revenue streams for healthcare organizations are more likely to succeed. In the fee-for-service environment which still dominates, virtual health solutions for example can open new markets of more remote patients, particularly for specialist facilities.

3. Low-risk pricing

There are many prerequisites for adoption – waterproof clinical evidence, a compelling value proposition, a connection with the buyer's specific goals. But many proposals fail at the contracting stage, because the risk is too great for cautious buyers. Creative commercial mechanisms can reduce this barrier and help clinch a contract (see figure 16).

FEATURE 12: HOW TO MEASURE ROI IN DIGITAL HEALTH INVESTMENTS

Measuring RoI as a % of a dollar value does not capture the full impact of a potential investment. Both monetary and non-monetary metrics should comprise a wider view RoI. The following framework suggests some practical metrics that can be built in to a more complete definition of RoI for digital health investments[103].

Benefit	*Dimensions*	*ROI metrics*
Monetary	*Patient engagement*	• Increased patient footfall • Increased patient interaction with organization (e.g. measured by social media behavior, usage of apps) • Increased patient satisfaction • Improved quality of life (e.g. quality-adjusted life year)
	Organization workflow	• Reduced/improved service time in the following areas: → *Patient wait times* → *Average length of stay* • Increased active patients to clinical staff ratio • Improved staff utilization rates
	Patient safety	• Reduced data entry and transmission errors • Reduced near-miss and adverse events • Lowered medication error and prescription error rates • Lowered cybersecurity threat events
Non-monetary	*Clinical outcomes and quality of care*	• Reduced complication rates • Improved surgical success rates • Lowered readmission rates • Lowered morbidity and mortality rates • Reduced hospital-acquired infections (HAIs)
	Social and organizational benefits	• Improved quality of working environment • Enhanced trust • Increased flexibility

FEATURE 13: WHAT MAKES A GOOD BUSINESS CASE?

All digital entrepreneurs know they need one – but what are the components of a compelling business case?

	Component	*Description*
1	***Strategic alignment***	An evidence-based statement connecting a seller's product to the buyer's organizational goals or requirements (access, quality, cost)
2	***Adoption scope***	Clear assumptions about what will and will not be included with the solution (e.g. expected users, sites of adoption, implementation support, customization limits)
3	***Investment analysis***	Projection of financial costs and benefits over time. Includes one-off investment costs, and direct/indirect variable costs
4	***Project approach***	A proposal for the adoption timescales, including high-level milestones and the sequence of expected activities
5	***Resource requirements***	Quantified estimates of buyer-side staff required, customization hours, data hosting specifications and others
6	***Results***	Key financial indicators like net present value of investment, run rate savings compared to non-adoption, weighted return on investment and payback period
7	***Sensitivity analysis***	Variables that the buyer can change to simulate different results. May include scope of users, pricing optionality, timescales of adoption
8	***Options and constraints***	Transparent list of the feasible operational and financial options available to the buyer, as well as limitations on implementation

5.3 The CTO – Navigating interoperability

Healthcare CTOs manage a series of balancing acts – for example, between furthering innovation and extending security or between extracting value from existing assets and exploring new ones. Some CTOs act as data strategists, and are looking for their next frontier to demonstrate value, whether through applying robotics in healthcare delivery or monetizing anonymized health data. Others are more focused on security controls or EHR optimization.

They are typically short of skilled resources, particularly digital and data science capabilities, and have to compete for these skillsets with new entrants like Amazon and Google.

Provider CTOs are under pressure from hospital administrators to source, develop and provide returns on enterprise infrastructure that will help drive revenue and improve billing. Equally, their colleagues from the clinical side routinely express frustration with the EHR systems which have increased workloads at the expense of patient experience (see feature 11).

Some expect CTOs to lead the adoption of digital in their organizations, and many do, but there are a number of powerful barriers – and success factors – that start-ups will need to navigate.

Barriers to adoption

1. EHR optimization still dominates agenda

CTOs are still overwhelmingly focused on drawing the full value out of their investments in EHRs. Although they agree there is value in standalone digital integrations, they are often viewed as a competing use of IT budget capital, time and management attention.

Many providers are still yet to establish EHR basics like automated, online patient scheduling. Others have experienced EHR implementation failures that mean even basic data is still not available from systems. Others still are trying to reduce their suite of applications – one leading East Coast health system uses more than 1,100 across their enterprise. So the option to integrate additional portals, applications or data flows runs against their priorities.

2. Navigating interoperability

59% of respondents in PwC's 2016 Digital IQ survey, reported that lack of integration of new and existing technologies and data was a barrier to achieving their expected results from digital investments.

The complexity of integrating digital solutions – mapping the structured and unstructured data they collect and aligning it with the existing workflow – raises the risk that adoption will eliminate clinical inefficiencies but create technological ones. Even if the integration roadmap is clear, the time and cost involved in upgrading infrastructure or reconfiguring workflow can reduce the RoI significantly.

3. Data and security

Stolen health records and ransomware threats are a leading priority for healthcare CTOs. Approximately 112 million medical records were stolen in 2015, and large breaches have been reported, such as Anthem Health Insurance's loss of 80 million records[104]. To the extent that digital health solutions potentially increase adopters' risk exposure through adding more connected devices to the organization's networked landscape, the CTO will be cautious. 81% of healthcare CIOs are focused on strengthening data security – the health technology community's primary business goal[105].

Compliance requirements to protect PHI can drive demand for digital start-ups that specifically aim to improve the convenience of security, for example, through single-sign-in for physicians. But for the majority of emerging solutions, the prospect of patient data traveling through unsecured, consumer-grade wireless networks raises confidentiality risks and greater potential liability for hospitals and physicians.

4. The skills gap

The lack of properly skilled teams is considered the number one barrier to achieving expected results from digital technology investments – 63% of a recent PwC survey's respondents identified it as an existing or emerging barrier[106]. A September 2017 PwC roundtable of leading CFOs and CTOs at a number of IDNs confirmed the same concern – winning the 'war for talent' was spontaneously mentioned as a key priority.

Digital health entrepreneurs should not expect large, digital-savvy teams on the buyer's side. Those technology personnel who understand digital transformation will be few and probably new to the organization, or even to healthcare altogether. At Blue Shield of California, a San Francisco-based health plan, Todd Walthall, Senior Vice President of customer experience, says his role is to, *"stir the pot containing both the people who understand healthcare and who have the mind-set to change and embrace what digital has to offer[107]"*.

Success factors for digital adoption

1. Demonstrating maximum compliance

Start-ups, even those developing products which don't touch PHI directly, maximize their chances with full HIPAA-secure status. It takes an immeasurable risk off the table on the buyer-side and creates a differentiator the buyer can use to select better-secured competing solutions. Demonstrating that the full suite of security, privacy and policy controls are in place on the seller side is achievable through scheduling third party security audits from companies like Coalfire, who can provide annual HITRUST Common Security Framework (CSF) Certifications. This is not a legal requirement, but it is a valuable adoption accelerator, and increasingly, a prerequisite for a buyer to even consider procurement, particularly for those looking for reimbursement from insurance companies.

2. Influencing the skills mix

Just as adoptions fail through missing skill sets, they can succeed through imaginative approaches to staffing the scale-up journey. Offering solutions in combination with supporting personnel will give the seller greater influence over the implementation and a richer learning experience of the clinical or administrative site of adoption, which will enable more effective customizations. It will also reduce the burden on the buyer to provide all of the engineering, project management, change management, training, and technical support personnel, which are already stretched by existing, non-digital projects.

3. Building integration in to the solution

Designing the integration route for connecting a digital product with the buyer's data structures and workflow steps is challenging but possible. The CTO of CareMerge, a successful Chicago-based start-up focused on senior patients, notes that, *"major health systems offer out-of-the-box APIs and interfaces that make the integration process quick to build and test*[108]*."* For example, Boston Children's Hospital and Harvard Medical School have an interoperability project allowing 'medical applications to be written once and run unmodified across different healthcare IT systems'[109]. Independent, health-focused vendors of integrator tools like Interfaceware that can help start-ups sidestep, or at least minimize a key adoption challenge facing their buyers.

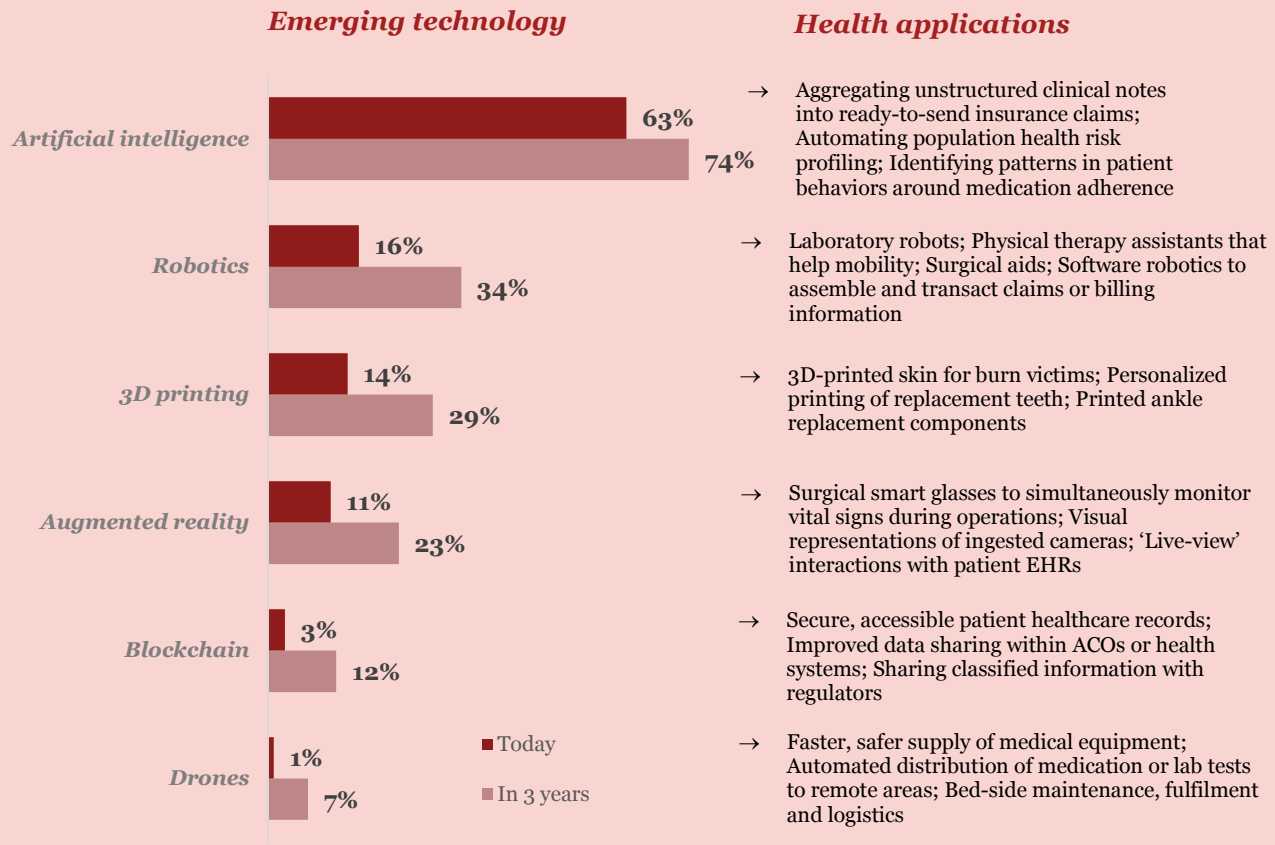
"Bringing me a piece of technology is becoming less and less interesting… Bringing me a solution that I can describe to my colleagues is becoming far more important, and bringing me a solution that is meaningful to patients and consumers is of the highest value to me."
Martin Harris, CIO, Cleveland Clinic

FEATURE 14: BUYERS' INVESTMENTS IN EMERGING TECHNOLOGIES

PwC surveyed 237 global health executives as part of a 2016 survey – from IT and other functions – on which emerging technology categories they were investing in. Takeaways included:

- AI dominates the agenda – 63% of organization are already investing, and more plan to in the next three years
- Robotics, 3D printing and AR are also finding application in health – between a quarter and third of healthcare organizations will be investing within three years
- Blockchain technology and drones are seeing minor investment now but are expected to be the fastest growers – investments will increase fourfold in the next 3 years for blockchain

Figure 21: Which technologies are healthcare organizations investing in?



Source: PwC 2017 Global Digital IQ Survey

5.4 Designing successful pilots and scaling up

Despite common concerns around 'death by pilot' – in which emerging innovators fail to build a steady revenue position after several, small-scale experiments – up to 70% of pilots do successfully convert to fully paying engagements, according to one study[110]. The trend seems to be towards fewer pilots, more demanding vetting on solutions, but then higher success rates.

Pilots in digital health are 'provisional agreements to test the technical capabilities and value proposition of a product in a controlled manner'[111], with the goals of validating the value proposition and progressing to commercialization. Although reaching the pilot stage is demanding, both sides – prospective buyer and digital entrepreneur – have an interest in success. As Boston Children's Hospital's John Brownstein, Chief Innovation Officer notes, *"We're careful about who we bring in. A pilot is obviously the fastest way to get something started, but the ultimate goal is always a paid engagement."*

The following analysis groups observations from the US market under four categories – Governance, Commercials, Planning and Stakeholders – and draws conclusions about how to structure a successful pilot.

"There's a disconnect between digital interventions' performance in pilots/clinical trials and in the real world because clinical trials artificially increase engagement, and engagement is so important to a digital health intervention's success."
Joseph C. Kvedar, MD, Center for Connected Health, Partners HealthCare System

Figure 22: Designing pilots – observations from the market

Observation	*Rationale and example*
Governance	
1. Set goals that are organization-specific	Pilots should not feel like a commodity to the adopting party – they should be customized and point to specific priorities or challenges of the host organization and aim to show value that is very specific to those. ***Example:*** *Joe's insurance company (see section 3.1) may serve a population in the Chicago area with an above-average pre-diabetic profile in the over 50s age category. A pilot may seek to show how lifestyle changes can be facilitated with better success rates in this specific condition and age group.*
2. Agree on decision-makers in advance	It is best to manage a pilot like a slick project. Agree in advance who is accountable for tracking benefits, defining milestones, communicating risks, engaging stakeholders, making decisions and managing the plan. ***Example:*** *A pilot to test the clinical benefits of installing ambient sensors in the homes of asthma sufferers may have a key dependency on a specific buyer-side analytics team to process the incoming data. If that team's workload rises unexpectedly, a designated decision-maker will be authorized to override their priorities.*
3. Be very specific on the pilot's scope	A pilot's scope should be limited to control variable conditions and better evidence success. Ways of limiting scope include setting a maximum on the number of patients, number of facilities, participating departments, geographical locations, periods of time, relevant conditions or number of clinicians. ***Example:*** *An inner-city safety net hospital wanting to reduce unnecessary admissions to the emergency room may pilot a patient triage solution for a single emergency care facility, between the hours of 12am and 6am, for three months, for all patients admitted under the age of 30.*
Commercials	
4. Price your pilot	Even early-stage companies looking for a first, credible pilot should share costs with adopters during pilots. A pilot-for-free approach reduces a start-up's perceived value at the buyer, and makes it harder to stay solvent during inevitable future setbacks. ***Example:*** *A health network piloting AI-enabled diagnosis support software that analyzes mammograms will agree to pay a small transaction fee per correct diagnosis during the pilot, while the technology developer absorbs the costs of hardware, user training and workflow configuration.*
5. Exchange discounts for longer-term plans	Both sides aim for pilots to become scaled, commercial deployments. Some pilot contracts can automatically convert to commercial engagements, unless certain break clauses are triggered by specific success metrics not being met. This opt-out option orientates expectations for longer-term collaboration. ***Example:*** *A large employer trialing step-tracking wearables for a specific employee segment may agree additional segment roll-outs with the seller before the pilot, unless specific population health results are not demonstrated within the first group.*
6. Define your metrics before you start	Defining from the start what a successful intervention would look like for all parties will avoid the need for retrospective assessment, and will avoid misunderstanding during the pilot. Unambiguous criteria and specified acceptance levels are necessary. ***Example:*** *A 'regional blue' health plan wants to experiment with descriptive analytics software to better stratify their customers. They define success as a 5% increase in customer plan renewals within three months following more targeted marketing enabled by the analytics.*

Planning	
7. Agree marketing upfront	Pilots are start-ups' key route to credentials. A successful pilot should be recognized as such by a current buyer's stakeholders, and by others in the healthcare community. Agreeing confidentiality and data sharing terms when designing the pilot is essential. ***Example:*** *A solution being trialed at a health system which has payer reimbursement approval may also attract interest from competing payers from another IDN. The start-up will want to agree rights to share the pilot's outcomes before beginning.*
8. Timing is key for pilots	Pitching pilots too early can mean a start-up's minimum viable product is not yet a scalable reality for the adopter. The results may then fall short of buyer expectations, and most digital health innovators will not get a second chance to approach an innovation hub, accelerator, or clinical sponsor. ***Example:*** *A health system trials a clinician messaging and alerts application. The functionality is complete, but the user experience design is still in testing. The nurses and doctors participating in the pilot don't have time for detailed training, and the interface was not intuitive enough to use comfortably.*
9. Simulate full adoption benefits	The pilot will often be the first opportunity to access rich data sets containing the adopter's PHI and care volumetrics. Leveraging pilot data to run simulations about the value and RoI of organization-wide, scaled adoption is a powerful option. It will sharpen the business case and clarify available benefits of scaling up. ***Example:*** *A start-up piloting its medical adherence application at a hospital for a subset of patients uses a predictive analytics tool (like PwC's Bodylogical[112]) to model a synthetic population. This helps project the adherence improvements and related savings if the hospital extends adoption across a wider patient population.*
10. Tie up your documentation	Start-ups majorly focus on the technology side of their development before pilots. But building HIPAA controls documentation, preparing Institutional Review Board (IRB) submissions, filing for provisional patents, preparing NDAs, submitting FDA applications, and signing Business Associate Agreements are critical. ***Example:*** *A digital solution that creates home blood-testing kits builds a compelling business case, and begins piloting at a regional IDN. But FDA documentation was unclear on the approval status of the vials used to collect and ship the blood for testing across states, and the company's internal quality procedure was incomplete.*
Stakeholders	
11. Find your sponsor	If a pilot is not the result of a functional introduction through a clinical sponsor, start-ups will often choose to approach facilities with dedicated innovation centers, and find a clinical 'champion' through co-development. If a potential buyer expects results without a buyer-side sponsor committed to support, it's a sign to stop. ***Example:*** *A hospital sponsor may be a Head of Orthopedic Care who wants to trial an AR display that overlays relevant health indicators during surgery. They will advocate for the solution, explain utilization rates at different operating rooms, navigate the hospital's IRB approvals, identify the hospital's stakeholders, and advocate for adoption amongst clinician groups.*
12. Work with the right people	If pilots are successful, adoption usually means some change in roles, behaviors and processes. The people judging the pilot's success on the buyer side should not be the same people as those whose roles stand to change the most. ***Example:*** *An imaging center running a pilot trialing software that aims to increase efficiency of x-ray machines will work closely with laboratory technicians and administrators, including the personnel who previously made manual decisions about optimal x-ray use. But the success factors should be assessed by other stakeholders.*

Scaling up – Options for 'breaking through'

After running successful pilots and raising capital, digital health innovators continue development and sales activity, but with enhanced credibility and experience. Growth and commercial success means rolling out to new customers, new geographies and with new functionalities. When it comes to designing a start-up's business model, a good indicator of success is the built-in potential to extend the business through scaling in more than one way. Some of the common routes to scaling up are as follows.

New customers Innovative companies with effective, differentiated capabilities may simply grow through raising their profile, collecting successful credentials and rolling out the same solution but at new adoption sites. Kit Check scaled to 200 hospitals in three years without significant changes to their solution (see section 3.2).

New partnerships It is possible to take giant strides in adoption through aligned interests with a strategic partner. By partnering with EHR provider Allscripts, Conversa gained access to a customer base of over 2,500 hospitals, where it can integrate its automated healthcare conversation platform (chatbot) with Allscripts' enterprise software[113].

New product variants Offering different versions of the same product to different stakeholders can open up new markets. Initially, AliveCor made a smartphone-connected ECG device sold directly to patients. Realizing the need for a more advanced version for cardiologists, the company launched a dashboard accessible only to doctors, providing only relevant information about patients' ECGs. WellDoc's BlueStar application range is another example.

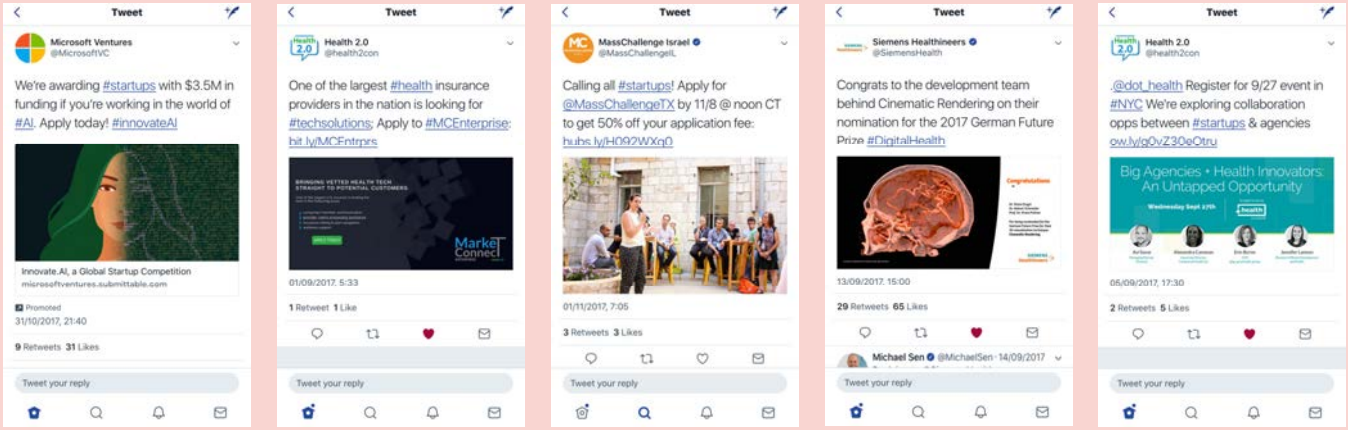
New conditions Some solutions (say, adherence-promoting apps) can scale up by finding parallel applications across chronic conditions (diabetes, obesity). Carrum Health recently expanded its solution to bariatric surgeries, in addition to orthopedics, spine and cardiac surgeries as another example (see section 3.2).

New services As start-ups grow, they can develop new opportunities in their customer interactions to develop bolt-on or diversified services. Initially combining remote patient monitoring with AI-driven analytics for providers, Ginger.io, for example, used its growing data assets and nationwide clinical network to develop a chat solution pairing patients with certified coaches[114].

New geographies Start-ups finding success in a specific region or state, can replicate the success in other geographies. Again the example of Carrum Health is illustrative – as a West Coast business contracting with self-insured employers, their fixed-price surgeries model could be replicated elsewhere as a route to growth.

FEATURE 15: RESOURCES FOR US-FOCUSED DIGITAL HEALTH INNOVATORS

Partnership facilitators	In recent years, several organizations have run initiatives to introduce Israeli digital health innovators to their local market. Examples: • *Northwell Health, New York State's largest provider, has partnered with the Israel Innovation Authority to validate medical technologies and collaborate on R&D projects* • *BioSTL, a St-Louis organization promoting bioscience and health innovation ran an introduction program between Israeli start-ups and potential US adopters*
Accelerator programs	Large healthcare organizations give entrepreneurs access to their innovation leaders, providing both resources and mentoring. Examples: • *athenahealth's More Disruption Please (MDP) program connects digital innovators to the company's network of innovation teams and senior executives* • *From spring 2018, the Plug and Play Cleveland HealthTech Accelerator, co-funded by Cleveland Clinic, will run two programs annualy, selecting start-ups to participate in an accelerator focused on biotech and health innovation*
Matchmaking events	Events where potential buyers network, 'pitch' their clinical challenges and invite proposals for digital solutions. Examples: • *The annual HIMSS conference is a flagship event bringing together over 45,000 health information and technology leaders around a variety of digital health topics* • *Digital Health Marketplace, supported by City of New York, connects buyers and sellers of health technology twice a year. It also runs the Digital Health Breakthrough Network, for earlier-stage start-ups looking for product design guidance and early piloting*
Innovation communities	Local hubs facilitate interaction between digital health innovators, providing office and event space as well as early-stage funding: Examples: • *Cambia Grove, located in Seattle, serves as a hub for digital innovators and health organizations to collaborate through pilots, workshops, community meetings and networking events* • *Launchpad Digital Health, in addition to being a seed investor in start-ups, also provides workshops and mentoring programs to early-stage digital health innovators*
Start-up associations	Where interests align, start-ups sometimes choose to cooperate. Example: • *A grouping of companies recently formed the Digital Therapeutics Taskforce at Boston's Connected Health Conference in October 2017* • *The association will work together to study real-world evidence, design pilot programs, build industry standards, and develop shared data repositories*



6

Takeaways for start-ups

Application for Israeli digital health innovators

1 *Define your role in navigating the ecosystem's shifting incentives*

Break-through start-ups are able to explain why their solution takes their buyer closer to its own unique goals. Leading digital health entrepreneurs can demonstrate value by quantifying how they extend access to patients, move the needle on quality outcome metrics, and do so at lower net costs. Start-ups must demonstrate to potential buyers that with their capabilities embedded, they are better positioned to navigate changing payment models, increase asset utilization, reach and retain more patients, help clinicians or reduce readmissions.

2 *Build flexibility into your solution at every stage*

Start-ups limit their chances when they present an all-or-nothing solution. Even at early stages of the procurement cycle, leading start-ups give potential buyers 'levers' to control the variables around adoption and the associated benefits to be realised. Solutions step closer to adoption break-through when buyers are presented with a menu of options – pilot pricing alternatives, implementation scope flexibility, data hosting optionality, resourcing possibilities, and customization choices.

3 *Develop a complete and coherent business model*

Digital buyers are looking for sustainable models that will justify the investment on their side. Winning business models point to specific value-objectives, identify their adopter's future reimbursement source, price flexibly, intervene at specific sites and stages of care, and focus on the right end user through familiarity with the workflow. There are countless success stories to learn from and many possible 'right answers', but start-ups should be ready to defend every component of their business model as well as its overall coherence.

4 *Narrow down the profile of your target buyer*

Innovative, new entrants to the US ecosystem must prioritize who to target. The provider and insurer segments are varied and vast, and their digital priorities will differ. Smart start-ups will settle on a very precise profile of their ideal buyer, for whom their solution will add the most value, and find the likeliest prospects of adoption. Buyer-side variables such as size, profitability, patient demographic, level of integration and digital maturity can help filter down the potential targets, allowing the start-up to do deep due diligence and customize a compelling value proposition.

5 *Communicate 'value' to the CMO, CFO and CTO*

Digital health adoption is a clinical, commercial and technological opportunity. Successful entrepreneurs develop around the respective priorities of buyer-side stakeholders from clinical settings, the Finance team, and IT leaders, and articulate the value for each. Understanding their different agendas and taking them on proactively when communicating the value proposition is essential. Instead of ignoring the many barriers to adoption, break-through start-ups lower them – through real-world evidence, broadly-defined RoI metrics, built-in integration functionality and secure data controls.

Appendix

7

Case study library

Note on methodology

Glossary

Case study library

			Primary healthcare focus		
	Company	***Funding***	***Access***	***Quality***	***Cost***
1	Glooko	$71m	•		•
2	AliveCor	$44m	•	•	
3	LeanTaas	$39m			•
4	AbleTo	$37m	•		•
5	Evidation Health	$31m	•	•	•
6	Ginger.io	$28m	•		•
7	Figure 1	$23m			•
8	HealthLoop	$22m	•		•
9	drchrono	$19m	•		•
10	Cohero Health	$15m	•		•
11	Bright.md	$13m	•		•
12	Cognoa	$12m	•	•	
13	Conversa Health	$11m	•		•
14	Vericred	$10m			•
15	Buoy Health	$9m	•		•
16	Catalia Health	$8m	•		
17	Sansoro Health	$6m			•
18	Spry Health	$6m	•		•
19	ExplORer Surgical	$4m			•
20	AdhereTech	$2m	•		•

Glooko

Total funding: *$71m*

Access
Cost

The company develops a diabetes management app, which synchronizes with over 80 types of compatible glucometers and insulin pumps used by diabetics to track blood glucose and insulin data[115]. The app aggregates and analyzes patient glucose levels next to diet-related data (e.g. food daily intake) to optimize and monitor care plans and send medication reminders. Information is shared with providers and payers, who ultimately get insight on diabetic population health and patient risk levels.

Even though the company has always operated within the diabetes management space, its technology has evolved over time: it initially made adapter cords to connect glucometers to smartphones, then evolved into predictive data analytics and artificial intelligence.

The company has strategic partnerships with Samsung, Medtronic, Mayo Clinic and insulin pump maker Insulet. Reportedly, the company has helped more than a million patients served by over 6,000 caregivers[116].

According to company CEO, Rick Altinger, Glooko aims to *"increase medication adherence, provide personalized insights and prompts that drive behavior change for people with diabetes, and deliver clinical decision support to thousands of clinicians and coaches."*

AliveCor

Total funding: *$44m*

Access
Quality

The company develops a smartphone-connected ECG device, where data is recorded and automatically analyzed for heart irregularities. Users of the app collect an average of 20 ECGs monthly, compared to the standard of two or three per year[117].

Initially, the company sold the ECG device directly to patients for $99, coupled with two types of subscriptions – a free basic version and a paid version with additional heart activity analysis features[118].

Realizing the need for a customized solution for doctors, the company recently launched a more advanced version of the app for cardiologists, giving them only the relevant information about their patient's ECG results.

The solution has been FDA-cleared and clinically validated through several studies, notably with Cleveland Clinic and Mayo Clinic. Physicians using the solution can receive reimbursement from Medicare using a specific CPT code[119].

LeanTaaS

Total funding: *$39m*

Cost

Paradoxically, healthcare organizations' resources are often overbooked and under-utilized. A 2013 study showed that surgery rooms have a 53% utilization rate, while patients will often book a surgical appointment months in advance[120].

LeanTaaS has developed a suite of apps for hospital administrators, nurses, physicians and surgeons to optimize the utilization of hospital resources and match it to real patient needs. Operating rooms and infusion labs can be used at their full capacity, leading to shorter waiting times for patients and optimal use of hospital staff time. This helps hospitals reduce 'staff burnout' by identifying staff members who need more time and those who have more time than they need.

The company's solution has been used by over 40 leading US care providers, showing significant financial and clinical benefits: a 55% decrease in wait time at New-York Presbytarian, a $400,000 yearly revenue increase per OR at UCHealth, and a 74% decrease in hours of extended operation at Wake Forest Baptist Health[121].

The company addresses one key issue for many US providers – staff burnout. According to Jamie Bachman, Executive Director of Oncology Services at UCHealth, *"Before we implemented iQueue for Infusion Centers, our nurses were burnt out. They rarely had time for breaks – let alone lunch – and were concerned about patient safety in the daily chaos. Now, nurses not only get their well-deserved breaks, but feel more comfortable and confident in an environment that lacks the 'feast or famine' conditions to which they had become accustomed."*

AbleTo

Total funding: *$37m*

Access
Cost

According to company information, more than 34 million Americans have both a mental health and a medical condition, driving $300 billion in avoidable healthcare costs and lost productivity per year, according to a 2008 study[122].

AbleTo's online platform (app and website) is used by large health insurers, connecting patients with a nationwide network of behavioral health providers. Sessions with therapists and behavioral coaches are typically held by phone or video chat. The company has developed evidence-based, structured treatment protocols, as well as counseling programs which help reduce depression, anxiety and stress by 50%[123].

AbleTo has been partnering with Aetna since 2011 – a joint-study demonstrated a 31% decrease in total hospitalizations and a 48% reduction in hospital days over a six-month follow-up[124].

The company is able to combine clinically validated treatment guidelines with strong analytics capabilities, as mentioned by one investor:

"By integrating evidence-based treatment, structured data capture, and predictive analytics, AbleTo has developed a robust platform that enables insurers and employers to address an important, unmet need."

Evidation Health

Total funding: *$31m*

Access
Quality
Cost

The company, launched in 2016 by GE Ventures and Stanford Healthcare, has developed an advanced research methodology to evaluate and quantify the impact of a digital health solution. Evidation runs studies through a proprietary AI-based tool, analyzing data from sensors and devices used by real-world patients and running virtualized, randomized trials. The platform conducts this type of research very quickly, at scale, and through hundreds of channels of data.

The objective is to give Evidation's customers – providers, payers, pharma companies, digital health innovators – a sense of risk and benefit in population health and the real, quantifiable value of a specific digital health program or product.

The company conducts this type of research in partnership with key players across the healthcare spectrum – it has recently signed a three-year partnership with Sanofi, and partnerships with Stanford, Ochsner Health, and Brigham and Women's Hospital's innovation arm[125].

Ginger.io

Total funding: *$28m*

Access
Quality

The company develops a HIPAA-secure mental health mobile app, which combines 'passive' data collected from patient smartphones (information on their movement throughout the day, call and texting patterns, how they are feeling) with live chat and video appointments with certified psychiatrists and licensed therapists.

Starting with a free trial plan, patients will then choose between a basic membership including access to a coach and self-management tools, and a premium membership which also includes two 50-minute video sessions with a licensed therapist each month. Plans start at $129/month and are usually paid for by employers[126].

While the company initially operated solely as analytics company that sold its technology to hospitals, it has now become a care provider in its own right, working directly with payers – employers, patients, health insurers – and offering full mental and behavioral health services[127].

Figure 1

Total funding: *$23m*

Access
Quality

The company develops a free social-network app where medical professionals can share photos of their patient's medical issues, view rare conditions uploaded by other doctors, learn about new treatments and share knowledge on specific medical cases.

Every uploaded case is checked by the company's medical officers and a team of moderators, and any details on the specific patient are removed (face, tattoos, etc.). While anyone can view cases, only users identified as medical professionals can post and comment, and also have access to additional features. Since cases do not have details about specific patients, they are not subject to HIPAA requirements or other data-privacy regulations.

The company has recently started monetizing the app through 'peer-to-peer sponsored content', where brands sponsor programs for doctors to share knowledge on rare conditions or new medical applications. The app is also monetized through polls where doctors vote on specific medical issues. The company has notably worked with Shire, Novartis and the Center for Disease Control and Prevention Foundation[128].

According to company information, the app currently has over two million registered users and hundreds of thousands of monthly active users (doctors, nurses, nursing and medical students), two-thirds of which are in the US[129].

HealthLoop

Total funding: *$22m*

Access
Cost

The company develops a SaaS-based platform for providers to monitor and communicate with their patients between visits – before admission and after discharge. Care providers invite their patients to use an app version of the platform, which then provides health guidance, tracks recovery progress and answers questions through secure messaging[130].

The platform allows providers to reduce patient readmissions and collect valuable, real-time patient-reported data, as stated by company CEO Jordan Shlain:

"As well intentioned as our interventions are with patients, when we throw them back into the world there are a whole series of contextual influences that will pull on them in ways that are incredibly hard to predict… But if we build a relationship with them, we can be there throughout the process to support them."

The company has deployed its solution at leading providers in the US, including Cleveland Clinic, Kaiser Permanente-Southern California and Memorial Sloan Kettering Cancer Center.

drchrono

Total funding: *$19m*

Access
Cost

The company has developed one of the first app-based EHR solutions, available to providers on tablets or mobile. In 2013, the company opened its API so that digital health developers could build applications intended for providers and patients from the company's EHR. For example, it has recently partnered with Physitrack, an app for physical exercise at home which will be used by drchrono's provider customers with their patients through EHRs.

drchrono also develops other features such as cloud-based scheduling, clinical documentation, a patient portal and a medical billing software for providers. The app is currently used by over 93,000 physicians, and has EHRs of over six million patients[131]. drchrono has also recently launched a version of its app on the Apple Watch[132].

Even though the current EHR market is made up of well-established players like Epic or Cerner, drchrono hopes to leverage the emergence of mobile-based technologies and the fact that physicians do not always appreciate traditional EHR solutions. According to company COO Daniel Kivatinos:

"If you look at the incumbent EHRs, many of them are practically unusable…We are developing a healthcare platform that allows physicians to focus on their patients, also enabling a better patient journey. Technology should help doctors to provide patient focused care."

Cohero Health

Total funding: *$15m*

Access
Quality

As of 2014, 50 million Americans have respiratory disease, costing the health system a reported $80 billion every year, half of which is due to lack of medication adherence[133].

Cohero Health develops a FDA-cleared, smartphone-connected, spirometer which tracks inhaler use, measures lung function and offers medication reminders. Patients share information with their doctor and family members.

Cohero Health's solution is deployed for different patient categories by hospitals, payers, pharmaceutical companies and pharmacy benefit managers, representing over a million patients. Initial pilots (notably at Mt Sinai in 2014-2015) yielded a x2.5 increase in medication adherence[134].

Cohero is partnering with Samsung and Omron (leading manufacturer of health monitoring and wellness products) to enhance product development and commercialization for health organizations[135].

One of the company's strengths is its ability to combine software development and manufacturing capabilities, as mentioned by one investor:

"Cohero Health provides both connected hardware and software as an integrated platform, with a high attention to usability – this is no easy feat. We are especially impressed with how the team developed their range of mobile spirometers, which required significant work around manufacturing, clinical efficacy and regulatory approval."

Bright.md

Total funding: *$13m*

Access
Cost

The company develops an AI-based, remote diagnosis platform for non-acute care through its SmartExam app and website. Patients remotely connect to their primary care physician, and are 'interviewed' by software which analyzes their condition based on their responses. Following the interview, the software can provide the patient a treatment plan within an hour, customized drug prescriptions as well as different payment models.

According to the company, collecting information about a specific patient and cross-referencing it with evidence-based criteria from other cases, allows physicians to achieve as much in a two-minute virtual patient visit as the 20 minutes usually required for a normal visit. The cost of a health care visit is reportedly reduced on average by 80%[136]. According to one investor,

"SmartExam is being widely used by leading health systems across the United States to address primary care conditions, route higher acuity cases to the appropriate setting and provide surge capacity for urgent care centers – supporting physicians, instead of trying to replace them. Bright.md offers a unique solution to address the large and growing shortage of PCPs, while driving down cost."

Cognoa

Total funding: *$12m*

Access
Quality

The American Academy of Pediatrics suggests children go through several screenings to check if they are at risk for developmental issues such as autism, but a recent CDC report shows fewer than half of children actually go through these screenings at the appropriate time.

Cognoa's app analyzes parent-provided videos of a child's behavior, using machine learning to assess whether the child is developing at the right pace, and to then evaluate their behavioral health.

The solution was originally developed through five years of research at Harvard and Stanford medical schools, and further validated at other leading institutions. It has since been used by 300,000 families[137].

Initially designed directly for parents to take the evaluation provided by the app to the pediatrician, Cognoa has recently launched Cognoa for Employers, which fits into health plans provided by employers to working parents.

It has been working to get FDA clearance and expand commercialization with employers, payers and clinicians.

Conversa Health

Total funding: *$11m*

Access
Cost

83% of patients do not adhere to their care plans, costing the US health system a reported $125 billion annually on unnecessary office visits[138].

Conversa develops an automated healthcare conversation app (chatbot), where personalized messages are sent to patients based on many sources of data using machine learning algorithms. The data is shared with providers who can see whether patients are following their prescribed care plan.

According to company information, the increase in patient engagement can result in up to a 20% reduction in post-acute care, with over $3,400 average savings per patient over 90 days[139].

While the company was able to develop its offering through technological partnerships, notably through its partnership with EHR vendor Allscripts, Conversa Health's CEO emphasizes the importance of strategically collaborating with a leading care provider at post-seed stage, in this case Northwell Health:

"They live and breathe the issues that the business needs to address. It's hard for a lot of strategics to play at the seed level, particularly because you need some independence at the outset, when you're creating your vision, doing some of your early prototyping. Customers can take you down pathways that may or may not be appropriate for what the founding team's vision is."

Vericred

Total funding: *$10m*

Cost

Healthcare insurance data is highly fragmented, unstructured and changes rapidly. Health plan types change annually and their pricing can change quarterly (see feature 2).

Vericred has built a complex online database of health insurance data, where it aggregates unstructured data from thousands of sources, normalizes and standardizes the data, and then creates a structured dataset delivered through an API.

This data can then be used by developers of digital solutions who need this type of structured data but don't have the time or resources to build a database themselves – for example, companies helping patients find the right health insurance plan for their needs, or book an appointment with the right doctor.

The added-value of the database is that it delivers health-related data that, *"all industry innovators need, but which doesn't make sense for each to build on their own,"* according to company CEO Michael Levin.

Buoy Health

Total funding: *$9m*

Access
Cost

The company develops a machine learning-based app which analyzes diagnoses from over 18,000 medical cases and five million patients to help users understand and treat their symptoms[140]. According to the company's CEO, *"the unfortunate thing about trying to use Google [for symptoms] is the information you find is either accurate or convincing, but never both."*

The company's algorithm attempts to 'think like a doctor' in a complex, nuanced way, asking the patient the most statistically significant questions in order to understand the symptom, present a maximum of three possible diagnoses and several treatment options.

Rolled out for the first time in March 2017, the company's app has 8,000 daily users and has experienced 38% week-on-week growth. The company also performed a 500-person trial where the app was able to match the diagnosis of urgent care patients to their doctor's 91% of the time[141].

The company is currently generating revenue by white-labeling its product on provider and payer websites and portals.

Catalia Health

Total funding: *$8m*

Access

Upon receiving the company's AI-enabled robot, Mabu, at their home, patients can ask questions about their health and get information on medication adherence, chronic disease management, or simply advice on how to lead a healthier life.

The underlying rationale for using a robot as a 'health companion' is that direct, conversational communication ultimately yields better outcomes than getting information from a tablet or a smartphone. While the robot is connected to a patient's smartphone, the objective is for the patient to develop a 'conversational relationship' with Mabu, allowing the robot to gradually learn more about a patient's needs and provide customized information and guidance.

While patient-to-robot interaction is the flagship feature of the company's solution, information summaries are regularly sent to care providers or pharmacists, who are paying for Mabu and offering it to patients as a supplementary care solution. Pricing is on a per-patient, per-month basis[142].

Sansoro health

Total funding: *$6m*

Cost

The company develops a plug-and-play solution called Emissary that allows digital health applications to exchange data with provider-based EHR systems.

Emissary is a set of standard APIs providing digital health companies real-time, read-and-write access to EHR data. Developers code their application only once to the Emissary APIs and they are then ready to connect to any supported EHR. The platform is currently deployed at 20 healthcare organizations[143], and has a strong reputation for its efficient implementation, as stated by one investor:

"Sansoro Health solves the #1 problem for most hospital CIOs, who often have a 2-3 year backlog of systems to integrate… Unlike other vendors that rely on limiting data formats, Sansoro offers robust integration that can cut implementation from months to days."

Spry Health

Total funding: *$6m*

Access
Cost

Since its foundation in 2014, the company has heavily invested in clinical validation of its *Loop* system. The device was evaluated on more than 250 participants for blood pressure, heart rate, oxygen saturation and respiration. It is currently expecting FDA clearance on its solution[144].

The target audience for the solution is often insurance companies looking for deeper insight into population health risk and chronic disease management solutions. As stated by one investor, capturing and understanding real-time patient data is what makes Spry Health a key player in the New Health Economy:

"The Loop is healthcare's Holy Grail, enabling a continuous medical presence on patients' wrists to monitor the breadth of vital sign information."

ExplORer Surgical

Total funding: *$4m*

Cost

The company develops a mobile app to improve collaboration and performance for surgical teams in operating rooms. Surgeons can identify the necessary tools and instruments for the procedure and review its anticipated stages. Nurses can know exactly when and where they are needed in operating rooms. Hospital administrators can track progress of surgery and send for nurses if necessary.

The Chicago-based company, which started developing its solution in partnership with the University of Chicago, sells its solution directly to health systems (about half of its customers are currently based in the US Midwest[145]).

Users of the app will typically pay an upfront fee for implementing the solution, followed by a monthly fee depending on the number of surgeons using the platform, the number of procedures, and the level of customization.

The company recently raised $3 million, $500,000 of which from the University of Chicago's Startup Investment Program[146].

AdhereTech

Total funding: *$2m*

Access
Cost

Working mostly with pharmaceutical companies and specialty pharmacies, AdhereTech develops patented smart pill bottles that track and improve medication adherence in real-time. Pill bottles use built-in sensors and chips to send real-time data which is analyzed by AdhereTech's secure system.

Whenever doses are missed by patients, automatic reminders are sent to them: phone calls, text messages, on-bottle lights and alerts to caregivers. The average user is about 70 years old and one third don't own cellphones[147].

The company also works with payers, which, according to company CEO Josh Stein, "*have been a little bit slower to invest time and resources in medication adherence technologies. The one area we've seen adoption with payers is in the Hepatitis C space. Some Hep C medications are incredibly expensive. It requires a lot of upfront payment to pay for this medication, but if the patient doesn't take the medication that leads to even more in treatment costs. That's where we've seen adoption.*"

Note on methodology

The evidence used in this report has been extensively referenced in the endnotes section. Readers are invited to use these links to learn more. Analysis and surveys performed by PwC have also been used extensively, with sources clearly identified where required.

1. Sources for 'Figure 4: US healthcare market dynamics' include Census.gov; PwC Health Research Institute reports; CMS data; The New York Times, "Forget Taxes, Warren Buffett Says. The Real Problem Is Health Care.", May 8 2017; CB Insights, "Where Big Tech Is Placing Bets In Healthcare", May 22, 2017; Pharmaceutical Care Management Association, "Pharmacy Benefit Managers (PBMs): Generating Savings for Plan Sponsors and Consumers", February 2016; Milliman Medical Index for 2008; and PwC Health Research Institute projections of 2018 medical spending based on the 2017 Milliman Medical Index.

2. Sources for 'The digital procurement roadmap' in section 4.1 include Rock Health, "Streamlining Enterprise Sales in Digital Health"; AHA & AVIA Digital Innovation Survey, September 2017.

3. The PwC analysis for 'Feature 8: Benchmarks – targeting the right hospital buyer' was conducted using data sourced from Definitive Healthcare's database of US hospitals, extracted in November 2017.

   The sample includes all US hospitals, excluding those with fewer than 20 beds, and excluding those which had data reporting anomalies.

   The sample count is based on individual hospitals, not health systems or IDNs.

   This database estimates hospitals' IT capital budgets using a proprietary Definitive Healthcare algorithm based on capital expenditures, hospital size, type of facility and other data points.

   Net Patient Revenue is defined as total patient revenue minus patient allowances and discounts. Allowances and discounts may include provision for bad debts, contractual adjustments and charity discounts.

   Profitability is defined as Net Patient Revenue minus operating expenses, divided by Net Patient Revenue. Operating expenses include salaries and variable running costs. The values used to calculate profitability are reported by the hospital directly to the Medicare Cost Reports, and aggregated by Definitive Health.

   The sample counts vary between metrics only where some hospitals did not report specific metrics.

4. The 'Case study library' in this appendix includes funding amounts for the US-based start-ups profiled. The source for these values was Crunchbase, accessed in December 2017.

Glossary

21st Century Cures Act	Bipartisan legislation to encourage medical innovation and enhance FDA's digital health regulatory approach
AAPM	Advanced Alternative Payment Model. Value-based reimbursement model for physicians
ACA	Affordable Care Act. Comprehensive reform signed by the Obama administration, aimed to expand health coverage and improve care delivery
ACO	Accountable Care Organization
AHA	American Hospital Association
API	Application Programming Interface. A set of routines, protocols, and tools for building software applications, critical for building digital health solutions
ASC	Ambulatory Surgery Centers. A non-hospital, outpatient-based site of care
CDC	Centers for Disease Control and Prevention
CHIP	Children's Health Insurance Program
CMS	Centers for Medicare & Medicaid Services
Copayments	Fixed amount paid by patient for health care after paying their deductible. Usually, plans with lower premiums have higher copayments.
CPT	Current Procedural Terminology. Code used to define medical services and procedures, also serving for CMS reimbursement in the medical billing process
Deductible	Amount paid by patient for healthcare before their health insurance contributing to costs
EHR	Electronic Health Record
EPO	Exclusive Provider Organization
ER	Emergency Room
ESRD	End Stage Renal Disease. Medicare has a national health insurance program for value-based reimbursement for clinicians treating patients with ESRD
FDA	Food and Drug Administration
FTC	Federal Trade Commission
GPO	Group Purchasing Organizations. Third party organizations aggregating demand from several hospitals to improve their collective purchasing power
HDHP	High Deductible Health Plan
HHS	US Department of Health and Human Services
HIPAA	Health Insurance Portability and Accountability Act (1996). Notably includes industry-wide standards for healthcare data and requirements for the protection and confidentiality of patient information
HIPAA Business Associate	Entity managing protected health information on behalf of HIPAA-covered entities such as hospitals or payers
HITECH	Health Information Technology for Economic and Clinical Health Act (2009). Introduced federal incentives for providers for the 'meaningful use' of EHRs

HITRUST	Health Information Trust Alliance. Collaboration between healthcare and technology organizations, defining a non-mandatory Common Security Framework (CSF) for companies looking at HIPAA compliance
HMO	Health Maintenance Organization
IDN	Integrated Delivery Networks. Network of health organizations working together to enjoy scale and improve outcomes. Often includes different types of provider organizations and can include health plans
IRB	Institutional Review Board. Body made up of clinicians, staff and community representatives which reviews, monitors and approves medical research involving people
MACRA	Medicare Access and CHIP Reauthorization Act (2015). Legislation aiming to control costs and promote 'value' by phasing out fee-for-service payments in Medicare
Medicaid	National health insurance program, jointly-funded by Federal and State governments, primarily covering eligible, low-income people
Medicare	Federal health insurance program, primarily covering people who are 65 or older
MIPS	Merit-Based Incentive Payment Systems. Value-based reimbursement model for clinicians
MSSP	Medicare Shared Savings Program. CMS program incentivizing providers to form ACOs and improve patient outcomes
ONC	Office of the National Coordinator for Health Information Technology
OR	Operating Room
Out-of-pocket expenses	Medical expenses not covered by health insurer – includes deductibles and copayments
PBM	Pharmacy Benefit Managers. Wholesale intermediaries between the insurers or employers paying for drugs and pharmaceutical manufacturers
PCMH	Patient Centered Medical Homes. Outcome-based reimbursement model for primary care physicians who are rewarded for end-to-end coordination of a patient's care
PHI	Protected Health Information. Individually identifiable health information, subject to HIPAA regulation
PPO	Preferred Provider Organization
Premium	Monthly amount paid by a patient or her employer for health insurance plan coverage
RFP	Request For Proposal
ROI	Return On Investment

Acknowledgments

PwC US and Strategy&

Ashwin Badrinarayan, Director

Igor Belokrinitsky, Partner

Mike Cohen, Partner

Keith Fengler, Partner

Serena Foong, Director

Jamie Gunsior, Partner

Gil Irwin, Partner

Vaughn Kauffman, Principal

Deepak Tilani, Director

Brian Williams, Director

PwC Health Research Institute

Sarah Haflett, Director

Alexander Gaffney, Senior Manager

PwC Israel

Rubi Suliman, Partner

Edouard Samakh, Partner

Rafael Maman, Partner

Rafael Broch, Senior Manager

Gabriel Levy, Senior Associate

Others contributors

Brent Nicholson, Chief Operating Officer, Carrum Health

Dr Benny Zeevi, Managing General Partner, Tel Aviv Venture Partners

Dr Nick Mourmouris, UK General Practitioner, National Health Service

Endnotes

1. PwC Health Research Institute, "Surviving seismic change: Winning a piece of the $5 trillion US health ecosystem", September 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-health-industry-changes.pdf
2. The Commonwealth Fund, "Mirror, Mirror 2017: International Comparison Reflects Flaws and Opportunities for Better U.S. Health Care", July 2017, http://www.commonwealthfund.org/interactives/2017/july/mirror-mirror/
3. The New York Times, "Forget Taxes, Warren Buffett Says. The Real Problem Is Health Care.", May 8 2017, https://www.nytimes.com/2017/05/08/business/dealbook/09dealbook-sorkin-warren-buffett.html
4. The Commonwealth Fund, "Mirror, Mirror 2017: International Comparison Reflects Flaws and Opportunities for Better U.S. Health Care", July 2017, http://www.commonwealthfund.org/interactives/2017/july/mirror-mirror/
5. International Federation of Health Plans, 2015 Comparative Price Report, Variation in Medical and Hospital Prices by Country, 2015, http://static1.squarespace.com/static/518a3cfee4b0a77d03a62c98/t/578d34649de4bb15e7a9f2e2/1468871781348/2015+Comparative+Price+Report_Final+071516.pdf
6. Henry Ford Innovations, "Henry Ford Health System – Artificial Intelligence in Healthcare Challenge", 2014, http://henryfordinnovation.com/Challenge/
7. Nature Biotechnology, Volume 33, Number 9, "Building a business model in digital medicine", September 2015, https://www.WellDoc.com/images/uploads/Nature_Article_on_Digital_Health_Business_Model.pdf
8. Hub, Johns Hopkins University, "Johns Hopkins study suggests medical errors are third-leading cause of death in U.S.", May 4 2016, https://hub.jhu.edu/2016/05/03/medical-errors-third-leading-cause-of-death/
9. *Ibid.*
10. US Census Bureau, "New Census Data Show Differences Between Urban and Rural Populations", December 8 2016, https://www.census.gov/newsroom/press-releases/2016/cb16-210.html
11. PwC Health Research Institute, "New Health: A vision for sustainability", July 2017, https://www.pwc.com/gx/en/healthcare/pdf/pwc-new-health-a-vision-for-sustainability.pdf
12. AHA & AVIA Digital Innovation Survey, September 2017, http://connect.healthforum.com/rs/734-ZTO-041/images/AVIA_AHA_Report_vF.pdf
13. PwC, "Enabling better healthcare with artificial intelligence", August 28 2017, http://usblogs.pwc.com/emerging-technology/ai-in-healthcare/
14. Pew Research Center, "Global Population Estimates by Age, 1950-2050", January 30 2014, http://www.pewglobal.org/2014/01/30/global-population/
15. H&HN, "Baby Boomers Will Transform Health Care as They Age", January 14 2014, https://www.hhnmag.com/articles/5298-Boomers-Will-Transform-Health-Care-as-They-Age
16. Centers for Medicare and Medicaid Services, "National Health Expenditure Fact Sheet, 2015", https://www.cms.gov/research-statistics-data-and-systems/statistics-trends-and-reports/nationalhealthexpenddata/nhe-fact-sheet.html
17. Quartz, "What happens to US health care and the federal deficit if Obamacare is repealed completely?", July 18 2017, https://qz.com/1032063/what-happens-to-us-health-care-if-obamacare-is-repealed-completely/
18. Centers for Disease Control and Prevention, National Center for Health Statistics, https://www.cdc.gov/nchs/fastats/obesity-overweight.htm
19. PwC, "Tech breakthroughs megatrend", https://www.pwc.com/gx/en/issues/technology/tech-breakthroughs-megatrend.html
20. The Economist, "The world's most valuable resource is no longer oil, but data", May 6 2017, https://www.economist.com/news/leaders/21721656-data-economy-demands-new-approach-antitrust-rules-worlds-most-valuable-resource?fsrc=scn/tw/te/rfd/pe
21. Strategy+business, "Staking Your Claim in the Healthcare Gold Rush", July 20 2015, https://www.strategy-business.com/article/00353?gko=0d6fe
22. PwC Health Research Institute, "Beyond the device: From producer to problem solver", August 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-medtech-spotlight.pdf
23. Rock Health, "38 lessons from digital health CEOs", September 2 2014, https://rockhealth.com/top-quotes-lessons-digital-health-ceo/
24. Forbes, "Oscar Health Gets $400 Million And A $2.7 Billion Valuation from Fidelity", February 22 2016, https://www.forbes.com/forbes/welcome/?toURL=https://www.forbes.com/sites/stevenbertoni/2016/02/22/oscar-health-gets-400-million-and-a-2-7-billion-valuation-from-fidelity/&refURL=&referrer=#35c352855321
25. Kaiser Family Foundation, "Aiming for Fewer Hospital U-turns: The Medicare Hospital Readmission Reduction Program", March 10 2017, https://www.kff.org/medicare/issue-brief/aiming-for-fewer-hospital-u-turns-the-medicare-hospital-readmission-reduction-program/
26. Physicians Foundation, "US Physician Practices Spend More Than $15.4 Billion Annually To Report Quality Measures", March 2016, http://www.physiciansfoundation.org/uploads/default/US_Physician_Practices_Spend_More_Than_15.4_Billion_Annually_To_Report_Quality_Measures.pdf
27. Strategy+business, "Aetna's Frugal Healthcare Strategy", September 15 2015, https://www.strategy-business.com/blog/Aetna-Frugal-Healthcare-Strategy?gko=432ba
28. Aetna, "Infographic: Quality of care versus quantity of service", October 2 2017, https://news.aetna.com/2014/01/quality-quantity-core-value-based-care/
29. Definitive Healthcare, "Selling to Hospitals and Other Healthcare Facilities", Webinar, September 27 2017, https://www.definitivehc.com/webinars
30. PwC, "US Health Services Deals Insights Q3 2017", 2017, https://www.pwc.com/us/en/health-industries/publications/pdf/pwc-health-services-deals-insights-q3-2017.pdf
31. DOTmed, "The right care at the right time and in the right place", November 15 2017, https://www.dotmed.com/news/story/39697?utm_campaign=MagLink&utm_source=DMBusiness&utm_medium=print
32. Wtnh.com, "Hartford Healthcare reaches multi-year deal with Anthem", November 18 2017, http://wtnh.com/2017/11/18/hartford-healthcare-reaches-mutli-year-deal-with-anthem/
33. Rock Health, "From Obamacare to Trumpcare: Questions for digital health", January 2 2017, https://rockhealth.com/from-obamacare-to-trumpcare-questions-for-digital-health/
34. Fox Business, "Warding Off Decline, Hospitals Invest in Outpatient Clinics", September 25 2017, http://www.foxbusiness.com/features/2017/09/25/warding-off-decline-hospitals-invest-in-outpatient-clinics.html
35. Definitive Healthcare, "Selling to Hospitals and Other Healthcare Facilities", Webinar, September 27 2017, https://www.definitivehc.com/webinars
36. PwC Health Research Institute, "Surviving seismic change: Winning a piece of the $5 trillion US health ecosystem", September 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-health-industry-changes.pdf

37. Strategy+business, "How Teamwork Will Transform Healthcare", August 21 2017, https://www.strategy-business.com/article/How-Teamwork-Will-Transform-Healthcare?gko=efca5
38. Kaiser Permanente, "Kaiser Permanente and Target to Open 31 More Retail Clinics in Southern California", September 14 2017, https://share.kaiserpermanente.org/article/kaiser-permanente-target-open-31-retail-clinics-southern-california/
39. American Hospital Association, "Fast Facts on US Hospitals", January 2017, http://www.aha.org/research/rc/stat-studies/fast-facts.shtml
40. US Census Bureau, "Health Insurance Coverage in the United States: 2016", https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-260.pdf
41. The Commonwealth Fund, "Evaluating the Impact of Health Insurance Industry Consolidation: Learning from Experience", November 20 2015. http://www.commonwealthfund.org/publications/issue-briefs/2015/nov/evaluating-insurance-industry-consolidation
42. PwC Health Research Institute, "Vital signs: What to consider before launching a provider-sponsored health plan in the New Health Economy", May 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-provider-sponsored-health-plans.pdf
43. Kaiser Family Foundation, "2017 Employer Health Benefits Survey", 2016, http://files.kff.org/attachment/Report-Employer-Health-Benefits-Annual-Survey-2017
44. US Census Bureau, "Health Insurance Coverage in the United States: 2016", https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-260.pdf
45. American Hospital Association, "Fast Facts on US Hospitals", January 2017, http://www.aha.org/research/rc/stat-studies/fast-facts.shtml
46. *Ibid.*
47. Statista, U.S. Pharmaceutical Industry - Statistics & Facts, https://www.statista.com/topics/1719/pharmaceutical-industry/
48. U.S. Food & Drugs Administration, Statement from FDA Commissioner Scott Gottlieb, M.D., on advancing new digital health policies to encourage innovation, bring efficiency and modernization to regulation https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm587890.htm
49. U.S. Food & Drugs Administration, "FDA Announces New Steps to Empower Consumers and Advance Digital Healthcare", July 27 2017, https://blogs.fda.gov/fdavoice/index.php/2017/07/fda-announces-new-steps-to-empower-consumers-and-advance-digital-healthcare/
50. U.S. Food & Drugs Administration, Premarket Approval (PMA), https://www.fda.gov/medicaldevices/deviceregulationandguidance/howtomarketyourdevice/premarketsubmissions/premarketapprovalpma/
51. U.S. Food & Drugs Administration, IRB Waiver or Alteration of Informed Consent for Clinical Investigations Involving No More Than Minimal Risk to Human Subjects, Guidance for Sponsors, Investigators, and Institutional Review Boards, July 2017, https://www.fda.gov/downloads/RegulatoryInformation/Guidances/UCM566948.pdf
52. U.S. Food & Drugs Administration, Examples of MMAs That Are NOT Medical Devices, https://www.fda.gov/MedicalDevices/DigitalHealth/MobileMedicalApplications/ucm388746.htm
53. U.S. Food & Drugs Administration, Examples of MMAs the FDA Regulates, https://www.fda.gov/MedicalDevices/DigitalHealth/MobileMedicalApplications/ucm368743.htm
54. Politico, "A hospital without patients", November 8 2017, https://www.politico.com/agenda/story/2017/11/08/virtual-hospital-mercy-st-louis-000573
55. Strategy+business, "How to Succeed in the Booming Business of Medicare Advantage", September 14 2017, https://www.strategy-business.com/article/How-to-Succeed-in-the-Booming-Business-of-Medicare-Advantage?gko=5aaf7
56. Strategy+business, "Improving Healthcare Affordability in a Volatile Time", October 2 2017, https://www.strategy-business.com/blog/Improving-Healthcare-Affordability-in-a-Volatile-Time?gko=e8bec
57. PwC Health Research Institute, "Surviving seismic change: Winning a piece of the $5 trillion US health ecosystem", September 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-health-industry-changes.pdf
58. PwC Health Research Institute, "EHRs in the New Health Economy: Essential but insufficient", October 2017, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-ehrs-in-the-new-health-economy.pdf
59. Catherine Chuter, athenahealth, "Patient-Centered Medical Home: Navigating through Recognition and Rewards", https://www.slideshare.net/athenahealth/patientcentered-medical-home-navigating-through-recognition-and-rewards
60. Centers for Medicare and Medicaid Services, "Comprehensive Care for Joint Replacement Model", https://innovation.cms.gov/initiatives/cjr
61. Health Affairs, "Growth And Dispersion Of Accountable Care Organizations In 2015", March 31 2015, https://www.healthaffairs.org/do/10.1377/hblog20150331.045829/full/
62. Kaiser Health News, "Reimbursement Caps Mean Some Calif. Hospitals Reduce Surgery Prices", June 24 2013, https://khn.org/morning-breakout/hospitals-cut-surgery-cost-after-caps/
63. Modern Healthcare, "Hospitals warm up to CMS bundled payments as agency cools off on them", October 26 2017, http://www.modernhealthcare.com/article/20171026/NEWS/171029904
64. Health Affairs, "Reducing Waste in Health Care", December 13 2012, http://www.healthaffairs.org/do/10.1377/hpb20121213.959735/full/
65. Mara G. Aspinall, Richard G. Hamermesh, Harvard Business Review, "Realizing the Promise of Personalized Medicine", October 2007, https://hbr.org/2007/10/realizing-the-promise-of-personalized-medicine
66. PwC Health Research Institute, "New Health: A vision for sustainability", July 2017, https://www.pwc.com/gx/en/healthcare/pdf/pwc-new-health-a-vision-for-sustainability.pdf
67. TechCrunch, "10 of the most-funded startups to fail in 2017", September 2 2017, https://techcrunch.com/gallery/10-of-the-most-funded-startups-to-fail-in-2017/slide/8/
68. US Census Bureau, "Health Insurance Coverage in the United States: 2016", https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-260.pdf
69. Rock Health, "Streamlining Enterprise Sales in Digital Health", https://rockhealth.com/reports/streamlining-enterprise-sales-in-digital-health/
70. USA Today, "Dr. Alexa? What Amazon might do in health care", October 28 2017, https://www.usatoday.com/story/tech/2017/10/28/dr-alexa-what-amazon-might-do-health-care/806945001/
71. MedCity News, "Applying predictive analytics to optimize patient scheduling for chemo units", October 20 2015, https://medcitynews.com/2015/10/applying-predictive-analytics-to-optimize-patient-scheduling-for-chemo-units/?rf=1
72. VSee, Online Doctor Consultation Services, https://vsee.com/online-doctor-consultation/
73. Chicago Tribune, "Explorer Surgical lands $3 million more for operating room software", August 29 2017, http://www.chicagotribune.com/bluesky/originals/ct-bsi-explorer-surgical-series-a-funding-20170829-story.html

74. Kaiser Permanente, "Kaiser Permanente and Target to Open 31 More Retail Clinics in Southern California", September 14 2017, https://share.kaiserpermanente.org/article/kaiser-permanente-target-open-31-retail-clinics-southern-california/
75. MobiHealthNews, "Brigham and Women's taps patientMpower for kidney transplant patient app", October 31 2017, http://www.mobihealthnews.com/content/brigham-and-womens-taps-patientmpower-kidney-transplant-patient-app
76. Medicare Enrollment Dashboard, https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Dashboard/Medicare-Enrollment/Enrollment%20Dashboard.html
77. Strategy+business, "How to Succeed in the Booming Business of Medicare Advantage", September 14 2017, https://www.strategy-business.com/article/How-to-Succeed-in-the-Booming-Business-of-Medicare-Advantage?gko=5aaf7
78. FierceBiotech, "J&J partners with, invests in WellDoc for real-time Type 2 diabetes management", March 1 2016, http://www.fiercebiotech.com/medical-devices/j-j-partners-invests-WellDoc-for-real-time-type-2-diabetes-management
79. *Ibid.*
80. WellDoc, https://www.WellDoc.com/product/bluestar
81. Omada Health, "Medicare Will Cover Diabetes Prevention Program for At-Risk Seniors", March 23 2016, https://www.omadahealth.com/press/medicare-will-cover-diabetes-prevention-program-for-at-risk-seniors
82. Cirrus MD, https://www.cirrusmd.com/programs/
83. AHA & AVIA Digital Innovation Survey, September 2017, http://connect.healthforum.com/rs/734-ZTO-041/images/AVIA_AHA_Report_vF.pdf
84. *Ibid.*
85. *Ibid.*
86. *Ibid.*
87. MedCity News, "How Boston has transformed itself into a powerful digital health ecosystem", August 3 2017, https://medcitynews.com/2017/08/boston-transformed-powerful-digital-health-ecosystem/
88. MobiHealthNews, "Cedars-Sinai's accelerator teaches startups what healthcare's really like", July 20 2017, http://www.mobihealthnews.com/content/cedars-sinais-accelerator-teaches-startups-what-healthcares-really
89. AHA & AVIA Digital Innovation Survey, September 2017, http://connect.healthforum.com/rs/734-ZTO-041/images/AVIA_AHA_Report_vF.pdf
90. Rock Health, Podcast: Provider Adoption of Digital Health, September 25 2017, https://rockhealth.com/podcast-provider-adoption-of-digital-health/
91. Managed Healthcare Executive, " Five things to know about the role of GPOs in the healthcare supply chain", September 14 2017, http://managedhealthcareexecutive.modernmedicine.com/managed-healthcare-executive/news/five-things-know-about-role-gpos-healthcare-supply-chain
92. Definitive Healthcare, "The Pivotal Role of Healthcare IDNs in Purchasing and Population Health", September 19 2017, https://www.definitivehc.com/news/healthcare-idns-population-health
93. For example, Mercy Health opened a $54 million facility in 2015 with more than 330 clinical staff, but no patients
94. PwC Health Research Institute, "Surviving seismic change: Winning a piece of the $5 trillion US health ecosystem", September 2016, https://www.pwc.com/us/en/health-industries/health-research-institute/publications/pdf/pwc-hri-health-industry-changes.pdf
95. Mayo Clinic Proceedings, "Changes in Burnout and Satisfaction With Work-Life Balance in Physicians and the General US Working Population Between 2011 and 2014", December 2015, http://www.mayoclinicproceedings.org/article/S0025-6196(15)00716-8/abstract
96. BMJ, "Understanding controlled trials: Why are randomised controlled trials important?", 1998, http://www.bmj.com/content/316/7126/201
97. Healthcare informatics, "Mayo Clinic Kicks Off $1.5B Epic EHR Rollout", July 17 2017, https://www.healthcare-informatics.com/news-item/ehr/mayo-clinic-kicks-15b-epic-ehr-rollout
98. Healthcare IT News, "CVS Health, Cleveland Clinic expand clinical affiliation, expand EHR communication", July 25 2017, http://www.healthcareitnews.com/news/cvs-health-cleveland-clinic-expand-clinical-affiliation-expand-ehr-communication
99. AHA & AVIA Digital Innovation Survey, September 2017, http://connect.healthforum.com/rs/734-ZTO-041/images/AVIA_AHA_Report_vF.pdf
100. Definitive Healthcare, "The Changing Role of Healthcare CFOs", September 12 2017, https://www.definitivehc.com/news/top-healthcare-cfos
101. 2017 CFO Outlook: Performance Management Trends and Priorities in Healthcare, 2016, https://www.kaufmanhall.com/resources/2017-cfo-outlook-performance-management-trends-and-priorities-healthcare
102. KaufmanHall, "2017 CFO OUTLOOK - Performance Management Trends and Priorities in Healthcare", 2016, https://www.kaufmanhall.com/sites/default/files/2017-cfo-outlook-healthcare.PDF
103. PwC, National University of Singapore, "Digital health: Challenges and solutions to measuring Return on Investment (ROI)", October 2017, https://www.pwc.com/sg/en/publications/assets/digital-health-roi-2017.pdf
104. CSO, "Black market medical record prices drop to under $10, criminals switch to ransomware", December 22 2016, https://www.csoonline.com/article/3152787/data-breach/black-market-medical-record-prices-drop-to-under-10-criminals-switch-to-ransomware.html
105. Spok, "The Healthcare CIO Perspective on Supporting Clinical Workflows", 2017, http://www.spok.com/resources/spok-skim-articles/cio-perspective
106. PwC, 2017 Global Digital IQ® Survey Healthcare, pharmaceutical & life sciences, 2017, https://www.pwc.com/us/en/advisory-services/digital-iq/assets/pwc-digital-iq-healthcare-pls-findings.pdf
107. Strategy+business, "The New Class of Digital Leaders", June 21 2017, https://www.strategy-business.com/article/The-New-Class-of-Digital-Leaders?gko=a250f
108. Forbes, "Why Digital Health Startups Have Yet To Reach Unicorn Status", May 5 2017, https://www.forbes.com/sites/forbestechcouncil/2017/05/05/why-digital-health-startups-have-yet-to-reach-unicorn-status/2/#1e8755d774ce
109. Journal of the American Medical Informatics Association, "SMART on FHIR: a standards-based, interoperable apps platform for electronic health records", 17 February 2016, https://academic.oup.com/jamia/article-lookup/doi/10.1093/jamia/ocv189
110. Rock Health, "Streamlining Enterprise Sales in Digital Health", https://rockhealth.com/reports/streamlining-enterprise-sales-in-digital-health/
111. KQED, "A Caution for Would-be Digital Health Entrepreneurs", May 19 2015, https://ww2.kqed.org/futureofyou/2015/05/19/a-caution-for-would-be-digital-health-entrepreneurs/
112. PwC, "Bodylogical™ gives more power to consumers to do more with their health", 2016, https://www.pwc.com/us/en/health-industries/DoubleJump/bodylogical-precision.html
113. Conversa Health, "Conversa and Allscripts® Forge Strategic Partnership To Transform Doctor - Patient Communications", July 25 2017, https://conversahealth.com/conversa-and-allscripts-forge-strategic-partnership-to-transform-doctor-patient-communications/

114. Fast Company, "Can Artificial Intelligence Help The Mentally Ill?", 21 July 2016, https://www.fastcompany.com/3059995/can-artificial-intelligence-help-the-mentally-ill
115. Glooko, Category: Products, https://www.glooko.com/category/glooko-products/
116. TechCrunch, "Diabetes management platform Glooko raises $35 million", June 28 2017, https://techcrunch.com/2017/06/28/diabetes-management-platform-glooko-raises-35-million/
117. MobiHealthNews, "With $30M in new funding from Omron, Mayo Clinic, AliveCor launches new AI-powered provider dashboard", March 16 2017, http://www.mobihealthnews.com/content/30m-new-funding-omron-mayo-clinic-alivecor-launches-new-ai-powered-provider-dashboard
118. AliveCor, Clinician FAQ, https://www.alivecor.com/clinicians/faq/
119. *Ibid.*
120. MGMA, "MGMA Cost Survey for Anesthesia and Pain Management Practices: 2014 Report Based on 2013 Data", 2014, http://www.mgma.com/Libraries/Assets/Industry%20Data/Survey%20Reports/Key-Findings-Cost-Anesthesia-FINAL.pdf?source
121. LeanTaaS, Life Expectancy Infographic, https://leantaas.com/uploads/LeanTaaS_Still_Waiting_for_Dr_Godot_Infographic.pdf
122. Milliman, "Chronic conditions and comorbid psychological disorders", July 2008, http://us.milliman.com/insight/research/health/pdfs/Chronic-conditions-and-comorbid-psychological-disorders/
123. AbleTo, https://www.ableto.com/
124. MobiHealthNews, "AbleTo plans on using $36.6 million in latest funding round to address behavioral health", September 5 2017, http://www.mobihealthnews.com/content/ableto-plans-using-366-million-latest-funding-round-address-behavioral-health
125. MobiHealthNews, "With $10M from Sanofi-Genzyme BioVentures, Evidation Health sets sights on pharma", April 27 2017, http://www.mobihealthnews.com/content/10m-sanofi-genzyme-bioventures-evidation-health-sets-sights-pharma
126. Ginger.io, https://ginger.io/
127. MedCity News, "Ginger.io transforms from mental health management tech for hospitals to healthcare provider", November 22 2017, https://medcitynews.com/2017/11/ginger-io-pivot/
128. TechCrunch, "Figure 1, a knowledge-sharing app for doctors, launches sponsored content", April 19 2017, https://techcrunch.com/2017/04/19/figure-1-a-knowledge-sharing-app-for-doctors-launches-sponsored-content/
129. TechCrunch, "The "Instagram for doctors" just raised a fresh $10 million", June 13 2017, https://techcrunch.com/2017/06/13/the-instagram-for-doctors-just-raised-a-fresh-10-million/
130. HealthLoop, http://healthloop.com/
131. drchrono, Overview, https://www.drchrono.com/about/
132. drchrono, "Manage Your and Your Patients' Health…From Your Wrist", https://www.drchrono.com/ehr-emr/apple-watch/
133. MobiHealthNews, "Inhaler sensor startup CoheroHealth begins pilot at Mt. Sinai Medical Center", October 8 2014, http://www.mobihealthnews.com/37185/inhaler-sensor-startup-coherohealth-begins-pilot-at-mt-sinai-medical-center
134. Mount Sinai Hospital, "Mount Sinai Begins Pilot of Respiratory Disease Management Platform", November 13 2014, http://www.mountsinai.org/about-us/newsroom/press-releases/mount-sinai-begins-pilot-of-respiratory-disease-management-platform
135. MobiHealthNews, "Cohero Health adds another $1.5M to Series A with new backing from Samsung, Omron", March 15 2017, http://www.mobihealthnews.com/content/cohero-health-adds-another-15m-series-new-backing-samsung-omron
136. Bright.md, "Bright.md Closes $8 Million Series B Round", July 17 2017, http://bright.md/media/press/2017/07/17/brightmd-closes-8million-seriesb-round.html
137. MobiHealthNews, "Cognoa raises $11.6M to continue validation, FDA submission for child development assessment app", March 27 2017, http://www.mobihealthnews.com/content/cognoa-raises-116m-continue-validation-fda-submission-child-development-assessment-app
138. Conversa, https://conversahealth.com/
139. Conversa, "Talking to Your Health Data", May 18 2017, https://conversahealth.com/talking-to-your-health-data/
140. MobiHealthNews, "Buoy Health gets $6.7M, plans to work with payers, providers", August 9 2017, http://www.mobihealthnews.com/content/buoy-health-gets-67m-plans-work-payers-providers
141. *Ibid.*
142. Robot Launch Pad, "Catalia Health uses social robots for health", January 19 2017, http://robotlaunch.com/2017/01/catalia-health-uses-social-robots-for-health/
143. MobiHealthNews, "Sansoro Health, which helps integrate digital health apps and EHRs, gets $5.2M from Bain", April 24 2017, http://www.mobihealthnews.com/content/sansoro-health-which-helps-integrate-digital-health-apps-and-ehrs-gets-52m-bain
144. MobiHealthNews, "Spry Health raises $5.5M to commercialize wearable for chronically ill patients", June 20 2017, http://www.mobihealthnews.com/content/spry-health-raises-55m-commercialize-wearable-chronically-ill-patients
145. Chicago Tribune, "Explorer Surgical lands $3 million more for operating room software", August 29 2017, http://www.chicagotribune.com/bluesky/originals/ct-bsi-explorer-surgical-series-a-funding-20170829-story.html
146. *Ibid.*
147. CNBC, "A start-up helping patients stay on top of their meds", June 5 2017, https://www.cnbc.com/2017/06/05/a-start-up-helping-patients-stay-on-top-of-their-meds.html

About PwC

PwC Israel helps organizations and individuals create the value they're looking for. We're a member of the PwC network of firms with 208,000 people in more than 158 countries. We're committed to delivering quality in assurance, tax and advisory services. Tell us what matters to you and find out more by visiting us at www.pwc.com/il

For more information please contact:

Rubi Suliman
+972 54 495 4851
rubi.suliman@il.pwc.com

Edouard Samakh
+972 54 774 3713
edouard.samakh@il.pwc.com

Claudio Yarza
+972 54 495 4590
claudio.yarza@il.pwc.com

Omer Gavish
+972 54 811 7803
omer.gavish@il.pwc.com

Rafael Broch
+972 58 736 9938
rafael.broch@il.pwc.com

About Start-Up Nation Central

Start-Up Nation Central is a not-for-profit, completely neutral and non-conflicted organization that promotes Israeli innovation. Start-Up Nation Central connects companies and countries to the people and technologies in Israel that can solve their most pressing challenges.

We are the authoritative source on, and the GPS to, the Israeli innovation community. We provide international clients with their first tangible point of connection to the Israeli innovation ecosystem by designing highly customized engagements for government and business leaders, acquainting them directly with the innovation they need. We also created the largest and most up-to-date free platform for data and connectivity to more than 5,000 Israeli companies, as well as investors, and multinational corporations operating in Israel.

For more information please contact:

Sharon Shapira
+972 54 584 3414
sharon.shapira@sncentral.org

Eitan Elkin
+972 52 552 2892
eitan.elkin@sncentral.org