Healthcare rallies for blockchains

Keeping patients at the center

Executive Report

Healthcare and Blockchain

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Contrary views: Expecting innovation with little disruption

Healthcare organizations may not be the hidebound institutions many claim them to be. They appear to be setting the pace on blockchain adoption, slightly ahead of the financial industry. They see substantial opportunities for business model innovation in most of the areas we surveyed, more than other industries we've studied to date. Paradoxically, healthcare executives don't anticipate much disruption ahead. In short, they see new possibilities everywhere, but expect their industry as a whole to remain relatively closed to upstart competitors. A dense web of regulatory constraints, they figure, may uphold the status quo.

Executive summary

The latest IBM Institute for Business Value blockchain study surveyed 200 healthcare executives – both payers and providers in 16 countries. We found that 16 percent aren't just experimenting; they expect to have a commercial blockchain solution at scale in 2017. These Trailblazers are leading the charge with real-world blockchain applications that they expect to take down the frictions that hold them back. They're keenly focused on accessing new and trusted information which they can keep secure, as well as entering new markets.

Trailblazers expect the greatest blockchain benefits across time, cost, and risk in three areas: clinical trial records, regulatory compliance, and medical/health records. They also anticipate widespread business model innovation – more than other industries we have surveyed to date – in six out of nine business areas.

Despite their expectations of transformative innovation, healthcare institutions, including Trailblazers, aren't anticipating significant disruption. They may believe that regulatory constraints will keep new competitors and models in check. Regardless, healthcare institutions are going all-in – investing heavily in blockchain pilots, with nine in ten respondents planning to invest by 2018 across all business areas we surveyed them about.

Trailblazers set a fast pace and new direction

16% of healthcare respondents – the Trailblazers – expect to have a commercial blockchain solution at scale in 2017.

6 in 10 healthcare Trailblazers anticipate blockchains will help them access new markets, and new and trusted information they can keep secure.

7 in 10 healthcare Trailblazers expect the greatest blockchain benefits to be in clinical trial records, regulatory compliance and medical/ health records.

Forget, for a moment, "big data." Instead think "long data" – short for longitudinal data – and its application to healthcare.

How valuable would it be to have the full history of an individual's health? What if every vital sign that has been recorded, all of the medicines taken, information associated with every doctor's visit, illness, operation and more could be efficiently and accurately captured? The quality and coordination of care would be expected to rise, and the costs and risks likely to fall.

Long data is simply the lifetime history of data related to a person, place or thing. And that is precisely what blockchains can do exceedingly well.
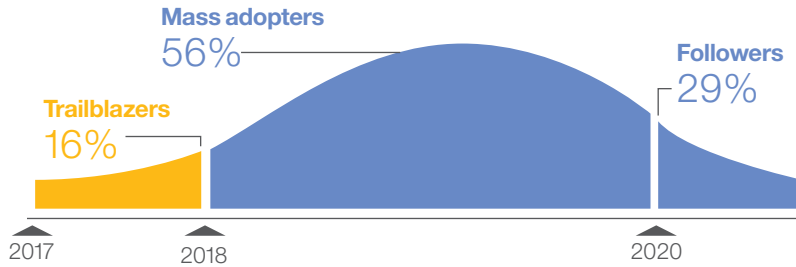
Data captured on blockchains can be shared in real time across a scalable group of individuals and institutions. Every event or transaction is time-stamped and becomes part of a long chain, or permanent record, that can't be tampered with after the fact. On permissionless blockchains, all parties can view all records. On permissioned blockchains, privacy can be maintained by agreement about which parties can view which transactions – and where desired, by masking the identity of the party.

In this way, blockchains shift the lens from disparate bits of information held by a single owner, to the lifetime history of an asset. This holds true whether that asset is a patient's health record or a bottle of pills as it moves through the supply chain.

From the perspective of blockchain adoption, healthcare organizations are moving fast and even seem to have a lead on the financial industry. To our surprise, 16 percent of healthcare organizations are Trailblazers, ready to commercialize blockchains at scale in 2017 (see Figure 1). In our survey of banks and financial market enterprises, just 15 percent and 14 percent respectively, plan to be at commercial scale in 2017.

Figure 1

First to finish: Healthcare respondents' expectations of when they will have blockchains in production and at scale

Mass adopters
56%

Trailblazers
16%

Followers
29%

2017   2018   2020

Figure 2

Frictions framework: Blockchains are expected to greatly reduce nine frictions

1 | Information   Imperfect information
Inaccessible information
Information risks

Frictions

2 | Interaction
Transaction costs
Degrees of separation
Inaccessible marketplaces

3 | Innovation
Restrictive regulations
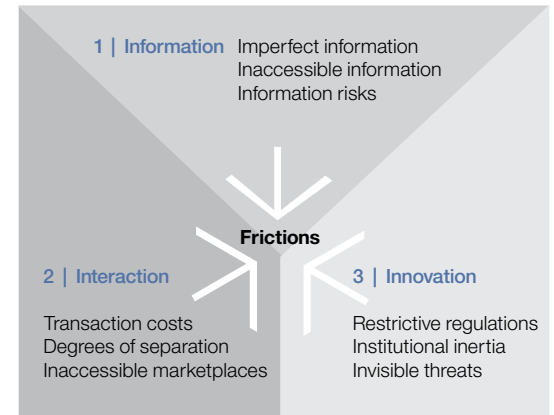Institutional inertia
Invisible threats

Not every region is moving at the same pace. Healthcare organizations in North America are lagging behind all other regions. Just 8 percent of North American respondents to our survey are Trailblazers. In the U.S., organizations adapting to the new models created by the 2010 Affordable Care Act may have had priorities other than blockchains.

First-mover advantages for healthcare organizations include the opportunity to influence the business and technological standards that others may have to follow. Early collaborators may also have the chance to lock in new partnerships and new ecosystems for mutual advantage.

In our first blockchain study, "Fast Forward," we examined the potential for blockchains to eradicate the frictions that hold organizations back, limit their growth and constrain innovation.[1] We identified nine frictions that challenge enterprises today (see Figure 2) and analyzed the impact blockchains might have. This study asked for the views of healthcare executives on these same frictions.
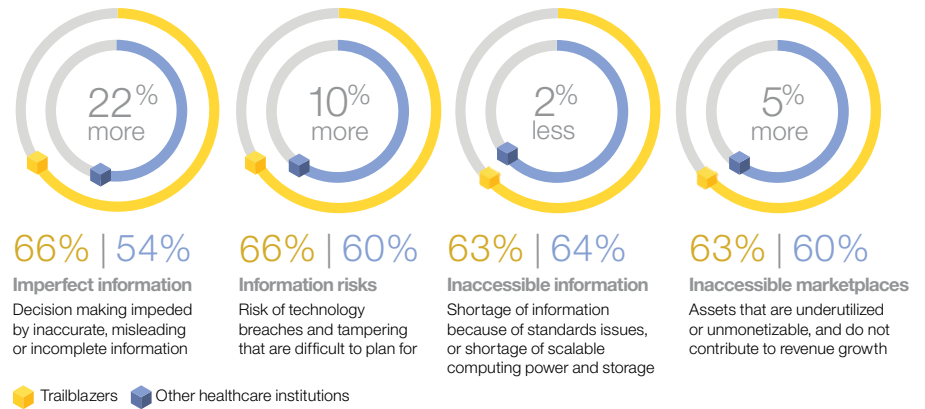
So much healthcare data is digitized but not yet shared, and there are extensive regulations and risks associated with sharing it. It isn't surprising that Trailblazers see the greatest impact from blockchains on those frictions we classified as information frictions – *imperfect information, information risks* and *inaccessible information.* They also view blockchains as a significant opportunity to enter once inaccessible markets (see Figure 3).

Figure 3
Top frictions that Trailblazers expect to reduce using blockchains

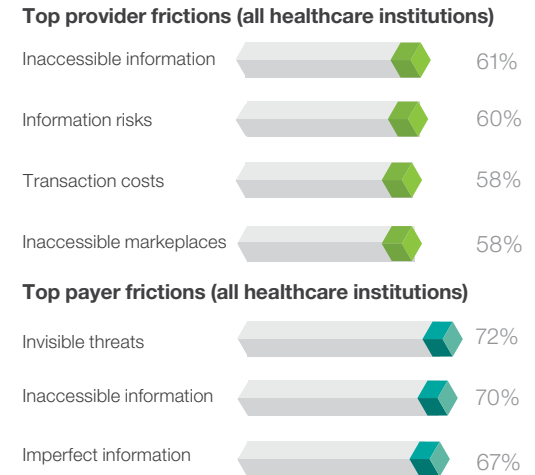| 22% more	10% more	2% less	5% more
**66%	54%**	**66%	60%**	**63%	64%**	**63%	60%**
Imperfect information	**Information risks**	**Inaccessible information**	**Inaccessible marketplaces**
Decision making impeded by inaccurate, misleading or incomplete information	Risk of technology breaches and tampering that are difficult to plan for	Shortage of information because of standards issues, or shortage of scalable computing power and storage	Assets that are underutilized or unmonetizable, and do not contribute to revenue growth

🟨 Trailblazers 🔷 Other healthcare institutions

The three information frictions act in concert to thwart meaningful coordination and collaboration in healthcare. Privacy concerns and the prevalence of cyber-attacks put information at risk and constrain how it might be shared. The lack of interoperability standards further shuts down the exchange and accessibility of information. Finally, even where data is shared, too often it isn't trusted – in part because it's incomplete or includes errors that result from the manual re-entry of data. Verifying data adds to costs and delays. Intermediaries and exchanges established to confer trust in data become bottlenecks.

Six in ten Trailblazers are also hopeful that blockchains could open up new markets. The blurring boundaries between payers and providers could fall completely. New services could be introduced that defy geographical distance. The total population of healthcare respondents segmented by payers and providers, very much like the Trailblazers expect to focus blockchains primarily on information frictions, although some distinctions emerge. Providers regard blockchains as an opportunity to enter new markets, payers to defend against invisible threats, which include new competitors and business models that are difficult to anticipate (see Figure 4).

How individual organizations respond to blockchain opportunities in the next few years will depend on their circumstances, capacity and ambition. As with any new technology that has the potential to transform, there is no "cookie-cutter approach." However, the plans, priorities and investments of the Trailblazers that are poised to enter the market today do illuminate a direction.

Figure 4
Frictions in freefall: providers and payers have different views

Top provider frictions (all healthcare institutions)

Inaccessible information	61%
Information risks	60%
Transaction costs	58%
Inaccessible markeplaces	58%

Top payer frictions (all healthcare institutions)

Invisible threats	72%
Inaccessible information	70%
Imperfect information	67%

Source: To what extent would each of the following challenges be reduced if blockchains were implemented in your business today? Percentage of respondents expecting a moderate or significant reduction of each friction.

Regulations – the easy audit trail

Blockchains are widely recognized in many industries as an exceptional platform for *regulatory compliance.* They establish a trusted audit trail verifiable in real time. This means blockchains don't just track compliance; they streamline enforcement; and deter bad actors from the outset.

Instead of relying on periodic spot inspections, blockchain-enabled smart contracts can ensure that the appropriate parties are notified of non-compliant events as they happen. In short, blockchains establish a platform to automatically enforce privacy regulations; rules embedded via smart contracts dictate what they can see and when. Moreover, as data and transactions are shifted or linked to blockchains, organizations can track who has shared data and with whom, without revealing the data itself.

Opportunity seekers: New benefits and business models

By now, most healthcare organizations, like institutions in other industries, recognize that blockchains could greatly reduce the time, costs and risks associated with how they operate. We asked healthcare executives about nine areas core to their business and analyzed their answers to calculate a blended score for each. Our analysis reveals near unanimity; blockchain benefits are compelling and can be gained in every aspect of healthcare.

As organizations get closer to blockchain commercialization, we'd expect their forecasts of potential benefits to grow sharper. More than seven in ten Trailblazers anticipate the highest benefits to accrue in three areas: *Clinical trial records, regulatory compliance* (see sidebar, "Regulations – the easy audit trail") and *medical/health records* (see Figure 5).

Figure 5
High impact: Blockchains' trim time, costs and risks

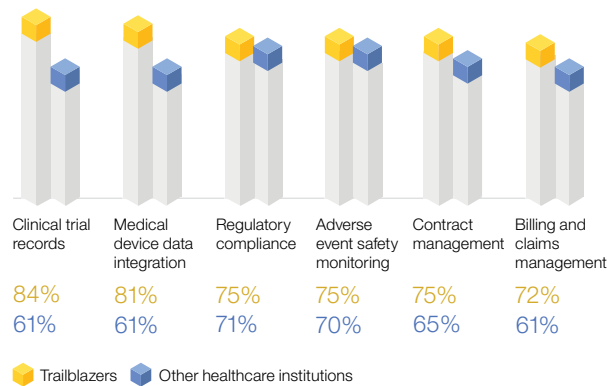|	Clinical trial records	Regulatory compliance	Medical/ health records	Medical device data	Medication/ treatment	Billing and claims	Adverse event safety	Asset management	Contract management
Trailblazers	76%	74%	72%	69%	69%	67%	63%	62%	58%
Other healthcare institutions	63%	62%	56%	61%	56%	59%	57%	58%	56%
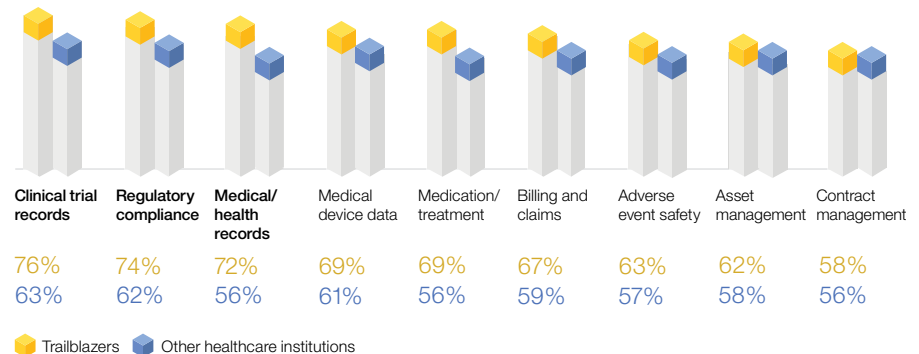
New business models tuned to trust

When data is trusted and protected, collaboration takes off. Blockchains could replace the intermediaries that once existed to secure this data, perform these tasks. Smaller organizations could join ecosystems to take on larger competitors. Private sector participants could gain access to and create new sources of data, whether that's wellness data streaming from personal devices or information collected by home caregivers.

More than any of the industries we've surveyed to date, healthcare Trailblazers see a broad array of opportunity to substantially innovate in the years to come. More than seven in ten Trailblazers expect significant business model innovation in six of the nine areas we surveyed (see Figure 6).

Figure 6

Innovation everywhere: Trailblazers' top blockchain-enabled business models

Clinical trial records	Medical device data integration	Regulatory compliance	Adverse event safety monitoring	Contract management	Billing and claims management
84%	81%	75%	75%	75%	72%
61%	61%	71%	70%	65%	61%

🟨 Trailblazers 🟦 Other healthcare institutions

Billing and claims – no surprises

PokitDok, Capital One and Gem propose a novel approach.[2] A blockchain-enabled platform that aims to help patients determine out-of-pocket costs before they select providers or undergo treatments. It also facilitates pre-payment options and other patient-centric services. Patients could avoid unexpected costs and institutions reduce uncollected payments.

They're focused most on *clinical trial records*, followed by *medical device data integration, regulatory compliance, adverse event safety monitoring/reporting, contract management,* and *billing and claims management*. While some areas, such as billing and claims, seem to be pure efficiency plays, new opportunities to collaborate with patients are changing the model (see sidebar, "Billing and claims – no surprises").

Building blocks for better care

Our respondents identified four areas where blockchains introduced new business models or significant efficiencies that could contribute to the quality of care. These were: *medical/health records, medical data device integration, adverse event safety* and *clinical trial records.* Blockchains can be applied in each area. Over time, we would expect that blockchains that bridge these areas and integrate the data would have even greater impact.

Medical health records – the price of siloes

The value of sharable and secure electronic health records (EHRs) is easily apparent. According to the Premier healthcare alliance, sharing data across organizations could save hospitals USD 93 billion over five years in the U.S. alone.[3] Seventy-two percent of Trailblazers expect big impact from blockchain-enabled medical records (see Figure 5).

In healthcare, as in other industries, universal or interoperable identity management is the single biggest dependency to sharing records. Conflicting regulations and legal constraints as to who owns the data raise other challenges. Legacy systems and investments in existing EHRs need not be rendered obsolete. Blockchains don't require organizations to abandon existing databases; they can integrate what exists. Data records can be stored "off chain" and linked to blockchain technology. In other words, you can pull data from existing processes to create a single version of truth.

Already, a number of use cases, proofs of concepts and pilots involving identity management and EHRs are underway (see sidebar, "Blockchain nation"). Some, like one being developed at IBM, take a patient-centric approach.[4] Control of the data is in the hands of individuals who can access their records across institutions to see a lifetime history of their health records and decide which physicians can see which records. With patient consent, anonymized and aggregated data could be made available to researchers and other organizations that benefit from access to total population health data

Medical device data – no longer "vapor"
If medical records are already viewed as the epicenter of transformation, data from medical devices just might be the elusive next frontier, until now, that is.

In healthcare, just 10 percent of data covers clinical factors. A massive 60 percent is made up of exogenous factors or things that happen outside the clinical setting, such as nutrition and home monitoring.[5] Eight in ten Trailblazers are focusing on the latter: data that can be gathered from medical devices and make possible new business models (see Figure 6).

The torrents of data gathered by wearable devices to track an individual's health is streaming to the cloud and our smartphones, but rarely landing in a physician's hands. Much of this patient-generated health data (PGHD) is going nowhere – sometimes not even to the patient. Even the data generated by at-home devices and transmitted to physicians is frequently not stored. Despite the challenges, blockchain-enabled device data has captured the interest of entrepreneurs (see sidebar, "A home for device data").

Blockchain nation

In Estonia, considered by most to be the most advanced "blockchain nation" in terms of government and citizen services, all medical health records are already stored online. They're not yet blockchain-enabled. In 2016, Estonia announced its intention to secure health records on a blockchain that would provide real-time visibility to individuals and institutions. Experts have cautioned that the privacy, security and regulatory hurdles are so high that, even in Estonia where citizens already carry a unique ID, enabling medical records on blockchains could take considerable time.[6]

A home for device data

Swiss-based Healthbank is just one of several organizations working on integrating PGHD data with more traditional medical information. Data like sleep patterns, glucose and heart rates pulled from wearables and other devices – along with information from doctor visits, health records and medical equipment – could all be polled and stored using the Healthbank blockchain.[7]

Before data from devices moves from the edge to epicenter, several hurdles will need to be cleared. Like medical records, utilizing and trusting this data is contingent on robust and universal identity management, including identity of the devices themselves. Regulations in the E.U., like the U.S., will soon require a unique device identification system to be in place.[8] In cases where the data is less precise, as when counting the number of steps or a device malfunctions, organizations will need to establish new protocols and algorithms to separate good data from bad.

Adverse events – a more inclusive approach
Blockchains that pull in patient-reported outcomes from home devices and wearables or for that matter, home health providers, are one way to widen the aperture on adverse event safety. Today, less than one-fifth of hospitals routinely integrates patient-reported outcome data into their care routines or factors it into their decision-making. Even where there has been interest, developing statistically valid patient-reported outcome measures (PROMs) is costly and can take several years.[9] What's required to curtail the labor is trusted data at scale. Interoperable blockchains spanning institutions could be a platform for aggregating trusted data.

On the more immediate horizon are two critical areas to maintain safety: medication reconciliation and counterfeit medicines. Medication reconciliation, of course, is both prone to human error and time-consuming – and frequently redundant, as each provider collects much of the same information on each visit. On blockchains, data can be kept instantly up to date – and shared widely, including with pharmacies. In the fight against counterfeit medicines, blockchains can also help to safeguard patients (see sidebar, "Trust in medicine").

Clinical trial records – a return to trust
No matter how you slice the response segments in our survey, *clinical trials management* stood out. It is the only area that was ranked in the top three benefits by both Trailblazers and

all other surveyed healthcare organizations, as well as by the providers' and payers' segments (see Figure 5). It also claimed the top spot for new business models (see Figure 6).

Despite mandates for open access to the protocols and data captured in clinical trials, this information remains incredibly hard to obtain and share. More recently, it has become clear how difficult it is to trust. According to COMPare, a recent project to monitor clinical trials, just nine in 67 trials it studied (13 percent) had reported results correctly.[11] When clinical trials are error-prone or manipulated, of course, patient care is diminished and the consequences are borne by all.

Blockchains that capture the lifetime history of clinical trials as they unfold could go a long way to restoring trust in science. Notably, the protocols of a trial, recorded and time-stamped as they are developed, could expose the practice of "outcome switching," which increases the chance that the data being reported is random noise rather than a real result. Transparency to all data could dissuade those who attempt to selectively report only good outcomes. Moreover, despite their transparency, blockchains could assure that protocols of a trial are recorded in real-time – verifying their authenticity – without exposing protocols to competitors before the public release of a trial.

Once clinical trials are linked to blockchains and trust is better assured, what new business models are possible? Could data from clinical trials be merged with patient outcomes long after the close of a trial and provide a truly long view of the efficacy of treatments? Could more physicians tap into clinical trial data to devise much more personalized treatment plans? At Mayo Clinic, physicians have already turned to cognitive analytics to mine clinical trials for personalized treatment plans.[12] Clinical trial records on interoperable blockchains would increase the universe of available trusted data.

Trust in medicine

Provenance-based blockchains can track the manufacture and distribution of medication across the supply chain, ensuring medications are properly stored and handled, and that counterfeit drugs don't enter the market. Blockverify in the U.K. is just one organization working on medication provenance pilots that allow medical professionals and consumers to scan pills to verify their integrity.[10]

Figure 7
Across the board: Healthcare investment by 2018

Medical/health records	94%
Billing and claims management	94%
Medical device data integration	92%
Asset management	91%
Contract management	90%
Medication/treatment adherence	89%
Clinical trial records	88%
Regulatory compliance	87%
Adverse event safety monitoring	86%

Shifting profit pools: New vectors for growth and disruption

Healthcare organizations aren't just moving faster to market than many expected; they're investing broadly. By 2018, nine of ten healthcare organizations plan to finance blockchain applications in each of the areas we surveyed (see Figure 7).

Despite a keen focus on business model innovation, fewer than one in ten healthcare organizations are expecting significant disruption. In part, this may be because *some* areas like EHRs could take longer to clear regulatory hurdles. The patient-centric models being advocated could be blocked by the fact that in some jurisdictions, patients aren't allowed to "own" their data.

However, more than six in ten healthcare organizations do anticipate some disruption in two areas: *medical device data integration* and *asset management* (see Figure 8). Providers and payers concur that these two areas are the most likely to face some level of disruption.

No doubt, the recent proliferation of wearables and a growing interest in wellness will spark entrepreneurial innovation and consequent disruption. Medical devices connected to the Internet of Things (IoT) could shift more healthcare services out of the office and into the home. By 2019, forecasts indicate there could be a many as 5.5 billion people using mobile and wearable biometric devices.[13] As populations age, governments and organizations with already-stressed budgets may welcome a new approach.

Asset management – which blockchains track exceedingly well, thanks to non-repudiation capabilities – could cut through the complexity and costs of one of healthcare organizations' largest expenses: the supply chain. But disruptive? Today, multimillion-dollar machines confer advantage and revenues to select institutions. Imagine if those same machines could become part of the sharing economy. Instead of a physician sending you to another organization for an MRI, either you or they could bid for the lowest-cost available facility.

Figure 8

Complacency or common sense: Healthcare organizations see minimal disruption

All healthcare anticipated disruption

Category	No disruption	Some disruption
Medical device data integration	35%	65%
Asset management	40%	60%
Medical/health records	58%	42%
Clinical trial records	60%	40%
Adverse event safety monitoring	61%	39%
Medication/treatment adherence	64%	36%
Regulatory compliance	66%	34%
Billing and claims management	67%	33%
Contract management	68%	32%

■ No disruption   ■ Some disruption
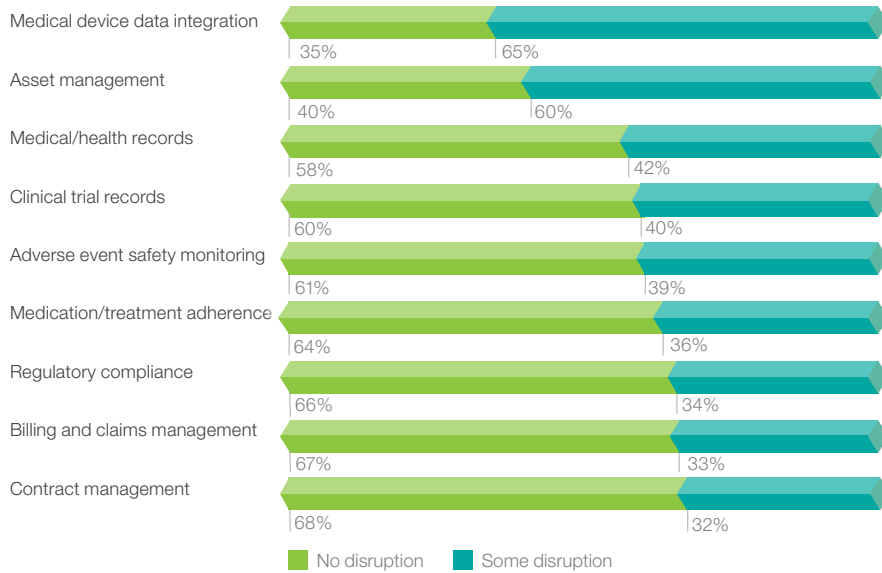
What if?

Trusted peer-to-peer care networks compete for on-demand services
Could practitioner RFP (request for proposal) services "uberize" some professional services? Blockchain-enabled credentialing and performance contracts would go a long way to establishing trust for decentralized services and medical care.

Patients claw back their data
Enabled and empowered by blockchains, might patients take back control of their data, requiring clinical researchers and health to compete for access to population health data?

Decentralized coalitions prevail
If we can efficiently share assets, including multimillion-dollar machines, health records and patient-generated outcomes, what value does a controlling authority bring? Hospitals' brick walls and beds won't go away, but could blockchain-enabled credentialing liberate the workforce, as well as its assets?

Industry disruption rarely emerges from the transformation of a single process. Rather, disruption takes shape as start-ups and institutions reconsider boundaries – like those between payers and providers (see sidebar, "What if?").

On a blockchain platform, institutions that were once vertically integrated can laterally scale through partners. And as trust becomes pervasive and embedded in each transaction, third parties, once necessary to broker trust could be disintermediated. Some expect that the Health Information Exchanges that currently exist will be made obsolete, reducing costs and lowering the barriers to participation by smaller organizations.[14]

When considering blockchain-enabled disruption, direct peer-to-peer and patient-centric models are the most likely scenarios. Some believe that although the possibilities are vast, a dense web of regulations will confine innovation to incremental changes to the *status quo*. Some will avoid the most intractable challenges. Others will take them head on. It's too early to predict how blockchains in healthcare plays out. But one in six of the organizations we surveyed say they will take the plunge in 2017; these Trailblazers will be well worth watching.

Recommendations

How fast should I move?

Sixteen percent have already started. These Trailblazers are setting a fast pace and charting a direction for early advantage. Mass adopters can look to Trailblazers for lessons learned, but they should be prepared to join them in real-world applications as soon as possible.

Fifty-six percent of organizations view immature technology as a barrier (see Figure 9), and seven in ten cite the need for a robust mechanism to establish identity and a high degree of control over access. The Linux Foundation's open-source technology initiative, Hyperledger Project, has focused on identity and permissions as core to blockchains' evolution.[15]

Figure 9
Stalled at the gate: Barriers to healthcare adoption of blockchains

Immature technology
56% | 44%

Insufficient skills
55% | 45%

Regulatory constraints
52% | 48%

Lack of executive buy-in
51% | 49%

Lack of clear ROI
43% | 57%

Insufficient business cases
43% | 57%

■ Percentage citing this as a top three barrier   ■ Percentage not citing this as a top three barrier
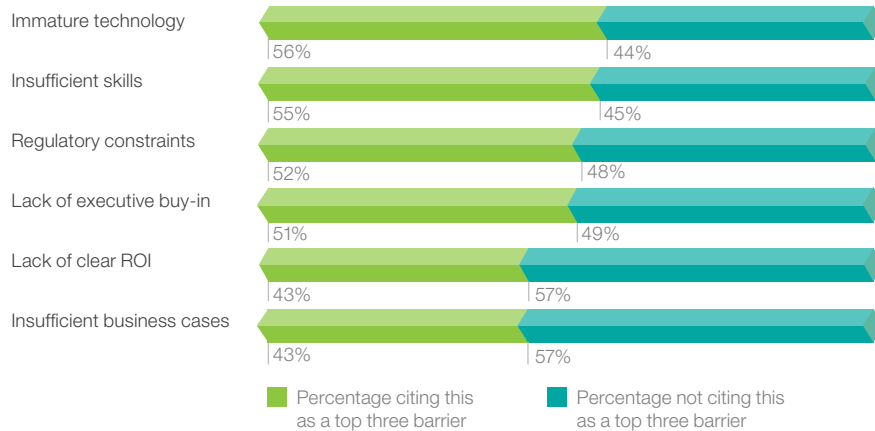
Source: What are the top three barriers your company would need to overcome in order to implement blockchain in your organization today? Select your top 3.

"The Hyperledger Healthcare Working Group is a destination for those who want to contribute to the development of technical standards necessary for blockchain innovation to be meaningful."

John Bass, Founder and CEO, Hashed Health

The Hyperledger Healthcare (HLHC) Working Group, which includes Accenture, Gem, Hashed Health, IBM and Kaiser Permanente, was announced in October 2016.[16] Early work will focus on establishing registries, interoperability and identities. The HLHC Working Group, by advancing interoperability across blockchains, expects to ensure that blockchain platforms can evolve as conditions change.

Can we achieve network-wide standards?
Trailblazers are already working on the new business and technology standards required for scale. Mass adopters should join them and begin building strong partnerships, including joining the consortia that are establishing business standards today.

Technical standards may be established with projects like Hyperledger. But standards for core health issues like patient privacy and safety are most often set by regulators. Fifty-two percent of respondents are concerned that regulatory constraints could stall adoption (see Figure 9). But because blockchains could make it easier to enforce regulations, regulators have every reason to collaborate with institutions in the healthcare industry.

Can we scale with new revenue models?
Consortia lay the groundwork for a better understanding of blockchains' benefits, but many in healthcare already recognize that more focused collaborations with a few key partners are necessary to innovate business models.

Although respondents in our study proved relatively complacent about the potential for disruption, healthcare organizations that take the long view on transformative change should keep an eye out for developments like these: Blockchains begin to span the public and private sectors, and new ecosystems emerge. Patient-centric platforms for sharing data improve the quality of care. Other technology advances – in the IoT or cognitive analytics, for example – coupled with blockchains make possible new remote care or on-demand services.

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Related publications

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