Healthcare: Blockchain’s Curative Potential for Healthcare Efficiency and Quality

Blockchain promises to upend the healthcare industry by streamlining operations, integrating patient medical records and creating new business models. Healthcare organizations must come to grips with the blockchain thinking and technology required to remedy key pain points, our latest research reveals.
EXECUTIVE SUMMARY

Blockchain technology – which first emerged in the financial services industry to support the Bitcoin cryptocurrency – could radically restructure the way healthcare payers and providers operate financially. Beyond simply enabling more efficient ways to manage current processes, blockchain promises to upend the industry, eliminating intermediaries and creating entirely new business models.

To understand how healthcare organizations view the potential of blockchain, we conducted a global survey of 558 healthcare professionals on how they expect the distributed ledger technology to impact the industry and the steps they are taking to prepare (see Methodology, page 28).

Although banks and financial services firms have been working on blockchain applications for several years, the technology has the potential to disrupt business processes and operating models across many industries. Healthcare presents one of the greatest opportunities to leverage the power of blockchain’s distributed ledger technology, given the industry’s need to integrate data across providers and plans.

Further, the ability of blockchain networks to automate manual processes, such as the validation of payer-provider contracts and member authentication, could speed processing times and dramatically slash operating costs. Blockchain may also enable greater transparency and reduce errors in areas such as billing and prescriptions. The encryption
in blockchain networks and the permissions that prevent data tampering and unauthorized access promise to strengthen security. When applied to patient data, blockchain’s secure data-sharing capabilities across multiple providers could improve diagnoses and treatment decisions by providing physicians with a patient’s complete medical history over the course of their lifetime.

Unleashing blockchain’s potential in healthcare will require organizations to address significant challenges. Since its greatest benefits revolve around streamlining the coordination among multiple providers, payers and patients, healthcare organizations will need to become more comfortable collaborating with external partners and stakeholders, including competitors. Legal and regulatory issues will also need to be addressed, such as ensuring that blockchain solutions involving protected health information (PHI) comply with HIPAA privacy requirements.
Key Findings

Our study of blockchain in the healthcare industry revealed the following:

- **Blockchain's impact will be far-reaching.** Virtually all respondents believe blockchain will be important to the future of the healthcare industry, with 57% predicting it will fundamentally transform the industry. The top advantage cited was disintermediation/elimination of non-value-generating processes (48%), followed by heightened data security and integrity (47%) and process automation via smart contracts (45%).

- **Promising use cases are plentiful.** Healthcare organizations are planning to explore a wide variety of blockchain applications. Top use cases cited by respondents (and the ones we believe hold the greatest potential) include:
  - Counterfeit drug prevention and detection (51%).
  - Clinical/administrative data interoperability (51%).
  - Enabling value-based care and payment initiatives (50%).
  - Claims processing using smart contracts (49%).
  - Streamlining the efficiency of provider data management (46%).

- **Blockchain strategies are still in progress.** Only 35% of respondents said their organization has identified the functional areas and business processes that could be affected by blockchain; an additional 61% said this is in process. Since blockchain is still in a nascent stage with a multiplicity of platforms, healthcare organizations should gain experience with several environments, both private (permissioned) and public (permissionless); most respondents said their organization is taking this approach. Among the platforms explored were Bitcoin (46%), Ethereum and PeerNova (40%). One-third or more of respondents said their organization had explored several other platforms, including both infrastructure and solution offerings.

- **Understanding blockchain is a top internal challenge.** The internal challenges organizations are primarily concerned with today are strategic rather than technical in nature. Top internal barriers include identifying cost-benefits of use cases (51%) and understanding blockchain technology and its most effective application (48%). Since blockchain is a relatively new technology, another top obstacle is communicating blockchain’s inner workings to key decision makers (47%).

- **Securing blockchain talent is essential.** Healthcare organizations will need to acquire or develop additional blockchain expertise, but many respondents appear to be underestimating the talent challenge, especially when it comes to technical skills. Roughly half the respondents said their organization will need additional expertise in legal (53%), business strategy (52%) and
cybersecurity (51%). Yet, only 33% of respondents believe their organization will need additional technical expertise. In our experience, most healthcare organizations will find they require additional skills in areas such as public key infrastructure (PKI), cryptography, information architecture, software engineering, network infrastructure and integration, and user interface/user experience.

• **Scalability, privacy are top external roadblocks.** A top external challenge for blockchain adoption is scalability/latency (69%). When choosing a platform for a use case, healthcare organizations should assess the speed and scalability required, keeping in mind that performance claims made by platform vendors regarding speed should be independently verified. Other frequently named external roadblocks were privacy and security (67%), interoperability between various blockchains (62%) and legal and regulatory issues (61%). Regarding privacy, permissioned blockchain networks are working actively to design methods to allow limited access. Organizations will need to closely monitor legal and regulatory developments and ensure that networks comply with HIPAA privacy regulations, for example, by first de-identifying healthcare data before applying cryptography.

• **Boosting collaboration will be essential to realizing benefits.** The greatest benefits from blockchain adoption will come from streamlining the interactions of multiple providers and payers in transferring and validating data. However, 60% of respondents named collaboration with partners/ecosystem members as a significant barrier to adoption, especially when it comes to identifying and finalizing blockchain use cases (64%). Other thorny collaboration issues include choosing a blockchain platform (49%), convincing partners to share data (47%) and establishing connectivity with partner systems (45%). Healthcare organizations need to recognize that it will take time and cultural change for their employees and partners to become comfortable with sharing private data for mutual benefit.

Although blockchain is still in the early stages of development and testing, its potential to fundamentally reshape the industry value chain is enormous. But as previous technology cycles have demonstrated, organizations that sit on the sidelines when new paradigm-shifting technological approaches emerge are often unable to catch up once the case for adoption gathers momentum. Healthcare organizations need to begin their blockchain journeys now by exploring promising use cases, gaining experience with platforms and acquiring talent so they are ready when blockchain rewrites the rules of healthcare.
FAR-REACHING IMPACTS

First used in 2009 for the digital cryptocurrency Bitcoin, blockchain technology has applications across every major industry, including healthcare. Blockchain provides a way to conduct and record transactions through a peer-to-peer network that replaces the traditional role of a centrally trusted authority and/or payment adjudicator. Blockchain networks create proof of ownership by using unique digital signatures that rely on both public encryption keys known to everyone on the network and private keys known only to the owner. Complex algorithms drive consensus among users, ensuring that transaction data cannot be tampered with after it is verified, reducing the risk of fraud. “Smart contracts” can be created that execute automatically once their terms are met, without the need for human intervention.1 (For a more industry-specific take on blockchain’s connection to healthcare, please listen to this HIMSS podcast.)

Blockchain platforms can be public (i.e., permissionless), like Bitcoin, with anyone allowed to submit a transaction and take part in validating transactions. Or they can be private (i.e., permissioned), where only authorized participants can share and validate information. Private blockchains pivot around the reputational investment of the network participants. This allows for innovations that address the speed, privacy and scalability concerns of public blockchains while reinforcing the validity of transactions.2

For healthcare, blockchain holds the promise of streamlining processes and reducing costs, while improving patient outcomes and reducing errors. As important as these benefits are, blockchain’s impact could be even more fundamental. While virtually all respondents said blockchain would be important to the future of the healthcare industry, 57% said it would fundamentally transform the industry. As a result, 76% of respondents said their top leadership is very committed to blockchain adoption.
Key benefits that healthcare organizations said they could gain through blockchain include the following.

- **Automate processes and reduce costs.** Blockchain promises to slash cross-industry payment processing overhead by eliminating touchpoints that don’t add value, reducing costly reconciliations and automating transactions through the use of smart contracts. For example, the processing and payment of simple claims can be automated by applying rules to provider data and, eventually, to external data from Internet of Things (IoT)-enabled medical devices. Similarly, payer-provider contracts could be automatically expired on a blockchain, providing patients with accurate information on providers in the network.

Respondents suggested that the cost savings from blockchain projects could be significant. Fifty-nine percent of respondents said their organization would realize cost savings of more than 5% due to blockchain, and much of this will result from increased automation. Ninety percent of respondents predicted that more than 2.5% of the jobs in their organization would be automated due to blockchain, with 48% expecting that more than 5% of jobs would be automated. Two of the top benefits from blockchain adoption, cited by more than 40% of respondents, were process automation via smart contracts and faster/more efficient claims and enrollment processing (see Figure 1).
Blockchain can aggregate clinical data across the multiple care organizations that a patient has visited over their lifetime, as well as data from wearables, such as fitness trackers or heart monitors.

- **Enhance data quality and reduce errors.** Healthcare organizations need safeguards to prevent medical fraud, false claims/billing and excessive care. Blockchain could help achieve each of these goals by automatically identifying duplicate claims or prescriptions and by providing a transparent view of transactions across stakeholders; for example, a pharmacy could improve the process of validating whether or not a dosage was prescribed. Blockchain offers the potential to share attested provider credentials and other data, eliminating substantial redundant processing costs. Blockchain can provide real-time tracking of transactions through a decentralized system that prevents double spending or inappropriate repudiation.

- **Strengthen data security.** Healthcare organizations are required to maintain the confidentiality of patient health information, limit access to individuals to whom the patient has given consent, and prevent data hacking and phishing. Blockchain technology enhances privacy through modern public key encryption techniques, reinforces data integrity with its properties of immutability, and improves security with its decentralized data model. Heightened data security and integrity (47%) was the second most often cited benefit of adopting blockchain, and 49% of respondents said that a tamper-proof, digital transaction history of the type that blockchain creates would deliver a very high level of value to their customers.

- **Improve patient care through data interoperability.** Blockchain technology is a missing piece of the puzzle for enabling the efficient aggregation of clinical data across the multiple care organizations that a patient visits over their lifetime, as well as data from wearables, such as fitness trackers or heart monitors. Physicians and clinicians would gain a comprehensive understanding of each patient’s medical situation and history, allowing them to make more informed health decisions and improve outcomes. The improved access to clinical data would also support research on the effectiveness of medical procedures and on precision-medicine initiatives. Forty-one percent of respondents cited improved patient care (through personalization and real-time patient data monitoring) as one of the top benefits of blockchain. Blockchain’s distributed ledger technology could also provide a single source of truth regarding payer, provider and patient records. The result would be better collaboration and increased efficiency, and 41% of respondents cited improved legal health records (LHR)/EHR interoperability as one of blockchain’s top benefits. For example, a provider practice could quickly identify whether or not a patient is part of an accountable care organization (ACO) plan.
Blockchain’s greatest long-term potential in the healthcare industry is transformational disintermediation of middlemen; however, realization of market changes of this magnitude will take considerable time. Therefore, leading healthcare organizations should pursue blockchain-related efforts in areas that tackle smaller problems first to develop capabilities, before attempting to disrupt entrenched incumbents.
In addition to helping healthcare organizations overcome many of the industry’s traditional challenges, the technology will also upend industry structures, business models and service offerings. Among the expected disruptive changes:

- **Disintermediation.** Seventy-one percent of respondents said blockchain has the potential to eliminate intermediaries, such as third-party administrators (TPAs), clearinghouses and health information exchanges. Disintermediation/elimination of non-value-generating processes (48%) was cited by respondents as a top blockchain benefit. Blockchain’s greatest long-term potential in the healthcare industry is transformational disintermediation of middlemen; however, realization of market changes of this magnitude will take considerable time. Therefore, leading healthcare organizations should pursue blockchain-related efforts in areas that tackle smaller problems first to develop capabilities, before attempting to disrupt entrenched incumbents.

  Just as travel agencies have been increasingly displaced by online travel sites, payers will become less central to the reimbursement process. For instance, the use of smart contracts enabled by blockchain could also eliminate intermediaries in healthcare, such as brokers that provide identify validation and reconciliation, and third-party administrators that process claims payments.

- **Emergence of peer-oriented health insurance.** Peer-to-peer (P2P) health insurance enabled by blockchain has the potential to remake the group insurance market, while increasing transparency and reducing administrative costs. As smart contracts mature, they could replace many of the administrative functions of claims settlement, making the emergence of P2P business models possible. Savvy new entrants will likely build their businesses on a blockchain stack, marketing P2P models at a significant cost advantage.

- **Dynamic health insurance.** Data integration facilitated by blockchain could allow for real-time risk adjustment to premiums. Smart contracts could be programmed to read inputs from wearables, wellness centers; and prescription refills, and automatically risk-adjust premiums as an incentive to customers. Many organizations attempt these programs today but rely on self-reported information. They are also difficult to administer and track in perpetuity.

- **Serving the underserved.** Blockchain can help overcome the lack of reliable data and identification documents for the underserved, opening up new markets. It could also facilitate non-adjustable insurance that replaces the traditional claims process with smart contracts that enable auto-payouts. By providing verifiable data history, blockchain could also enable spot insurance (i.e., immediately issued contracts) for underserved populations.
A shared and secure blockchain ecosystem could be used to authenticate drugs sold, as well as provide a full audit trail of production, including sourcing of raw materials, manufacturing, packaging and distribution.

PROMISING USE CASES

Given the far-reaching impacts of blockchain across the value chain, respondents cited many different use cases that their organizations are planning to explore in the near term (see Figure 2, page 13). Leading the list of use cases – each cited by roughly half of our respondents – were counterfeit drug prevention and detection (51%), clinical/administrative data interoperability (51%), enabling value-based care and payment initiatives (50%), and claims processing using smart contracts (49%). Each of these use cases is discussed below. In addition, we also illuminate blockchain’s potential to substantially streamline the efficiency of provider data management, which 46% of respondents said their organization plans to explore.

Counterfeit Drug Prevention & Detection

Counterfeit drug estimates range from $75 billion to as high as $200 billion globally, and counterfeit drugs account for half of all drugs sold in some low-income countries. At the same time, consumers are demanding greater transparency about the products they purchase, especially with regard to food and drugs. A shared and secure blockchain ecosystem could be used to authenticate drugs sold, as well as provide a full audit trail of production, including sourcing of raw materials, manufacturing, packaging and distribution. Patients would receive assurance of the provenance and production.

Blockchain can also further automate the supply chain system and provide healthcare organizations with real-time tracking of drug manufacturing details, such as the active ingredients and distribution throughout the supply chain. Organizations could verify that all transfers of ownership were explicitly authorized by their relevant controllers without having to trust the behavior or competence of a central authority. (For more on product provenance and blockchain, please read our report “Blockchain: A Catalyst for the Next Wave of Progress in the Life Sciences Industry.”)

Clinical Data Interoperability

While progress has been made in moving from paper to digital records, the industry has yet to fully enable the sharing of patient data across providers. Over the course of their lives, patients create medical records at a variety of healthcare providers as they change healthcare plans, move to a new city or visit specialists. These records typically reside in separate data silos, each with its own storage structure, descriptive semantics and security mechanisms. This makes it difficult for patients, providers and payers to easily and securely share data. Providers store different patient demographic information, tests may be duplicated, prescription data is often incomplete, and physicians lack comprehensive information to understand a patient’s medical history and total health.
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One approach would be to store patients’ complete electronic health record directly in a blockchain built for this purpose, although this would require existing blockchain infrastructure to be able to scale massively. A more promising approach that avoids the scalability problem would be to store only metadata about health and medical events on the blockchain – such as patient identity, visit ID, provider ID and payer ID – along with a pointer to the actual electronic health record stored in a separate universal health cloud.

A blockchain pilot project addressing interoperability for medication data is MedRec, which is led by the MIT Media Lab and Beth Israel Deaconess Medical Center. MedRec creates a decentralized records management system for medications. Under the project, a signature of the record of the prescription – rather than the prescription itself – is stored on the blockchain, and the patient is notified and has control over who has permission to see the record.

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X Marks the Spot

Respondents were asked to name the use cases their organizations planned to explore in the near future.

![Bar chart showing the use cases respondents planned to explore](image)

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Bundled Payments

Healthcare organizations recognize the enormous amount of time wasted on identifying patients, processing claims and conducting retrospective reconciliation. High administrative costs are also associated with poor care delivery (e.g., ordering duplicate lab tests). A 2014 National Institutes of Health study found that in 2012, $375 billion was wasted in paperwork related to billing and insurance.\(^4\)

Further, detailing the specific challenges of bundled payments, a recent study by the Agency for Healthcare Research and Quality identified the primary obstacles to realizing the benefits of this value-based payment model as mistrust between payers and providers on reimbursement and a lack of transparency on price and cost.\(^5\)

Blockchain’s inherent capabilities can be extended to resolve these challenges. Leveraging blockchain as a shared bundled-payment platform between providers and payers, greater transparency of price, cost and quality data could be achieved, helping to alleviate the mistrust. Further, smart contracts could be used to autonomously execute reimbursement per bundle contract terms further mitigating the trust barrier.

As an added benefit, administrative costs related to processing and verifying the bundle reimbursement could be greatly reduced through the automation that smart contracts provide. Patients would ultimately benefit as the industry would be able to shift focus away from the administrative burden of bundled payments towards improved focus on quality of care.

Claims Processing

Blockchain technology can drastically reduce the costs and inefficiencies of adjudicating and paying health plan claims. The claims process often results in errors and leaves patients unclear on how much they need to pay. Fraudulent claims are another major problem. For example, improper Medicare payments cost $59.6 billion, or 10.5% of total payments, in 2015.\(^6\)

Blockchain can redefine the claims process by storing the data and using smart contracts that automatically validate and pay claims when specified conditions are met. If the claim is pended, an automatic transaction would be triggered to the member/provider requesting additional information. Once the claim is resolved, payment can be issued automatically to the provider or member with minimal human intervention.

Since claim events are recorded in the distributed ledger, duplicate claims reporting can be prevented and fraud attempts minimized. Multiple stakeholders would have access to a single source of truth, thus eliminating the need to exchange documents. By making the process transparent, smart contracts can reduce the potential for legal challenges.

Providers would also benefit from claims being automatically submitted and adjudicated, speeding payment and redefining the value proposition of traditional intermediaries.
Because blockchain promises to restructure how healthcare organizations conduct business, organizations should move quickly to develop their blockchain strategy rather than adopting a wait-and-see approach.

**Provider Data Management**

Commercial health plans and providers spend at least $2.1 billion annually to maintain their provider databases, and it is estimated that up to 75% of these costs could be saved by integrating with an external source of truth. In addition to requiring extensive manual processes that drive up costs, these databases store data in silos that are not shared across providers, regulatory groups or other sources of credentialing (e.g., medical schools or state medical boards). Thus, managing and certifying provider credentials and licenses is a cumbersome and disjointed process that is susceptible to misrepresentation by individual providers themselves.

Blockchain technology could be the network infrastructure that substantially reduces costs by streamlining the process of accessing and updating provider data, credentials and certifications. Rather than requiring a third-party validator, the network would instead verify or update credentials, licensing information or current provider information directly across the network. The result would be the replacement of a system with unconnected data sources and incomplete views of relevant provider information, with an environment in which all parties’ data is ubiquitous, seamlessly shared and linked to the originating source. Cryptographic methods of blockchain would allow this to be achieved in a secure fashion; smart contracts would allow information updates and checks to be automated.

**DEVELOPING A GAME PLAN**

Because blockchain promises to restructure how healthcare organizations conduct business, organizations should move quickly to develop their blockchain strategy rather than adopting a wait-and-see approach. Organizations need to identify the concrete business and clinical issues that blockchain can help address, and then gain experience with pilot projects to understand the benefits and implementation challenges. Organizations can test the potential of blockchain to enable new service offerings, enhance data management and automate operational processes such as claims management.

By moving quickly, organizations will be in the position of influencing the development of blockchain networks and industry consortia, including the choice of participants and governance rules. In addition, they will develop the talent and organizational capabilities required to be successful in a blockchain-enabled world.
Rather than being seen as simply a technology issue, developing a blockchain strategy should involve stakeholders from across the healthcare organization (see Quick Take, page 19). A blockchain pilot project may demonstrate how the technology works, but it is even more important to learn whether the initiative can solve the business problem tested and how a full-scale implementation would impact the organization's business processes and technology.

A key step in developing a blockchain strategy is to identify the functional areas and business processes that could be impacted by blockchain. Roughly 35% of respondents said their organizations have already done this, while an additional 61% said they are in the process of doing so.

Organizations also need to decide whether they will employ an open (permissionless) blockchain or a private (permissioned) blockchain. So far, it is unclear how the blockchain ecosystem will develop and which platform or platforms will emerge as dominant players not only in healthcare but also across other industries. It is likely that healthcare will leverage different types of blockchains for its various use cases.

Respondents were divided on which type of ecosystem would likely emerge. Approximately 44% believe a sustainable private blockchain would prevail, while 38% anticipate a sustainable open (i.e., public) blockchain would emerge. Consistent with this outlook, 44% of respondents said their organization is planning to adopt a permissioned blockchain that is only accessible to trusted participants, while 38% said they are planning to adopt a public blockchain. Organizations recognize that the benefits of blockchain can only be fully realized by collaborating with other stakeholders, and just 16% said their organization is planning to employ a private blockchain used only by departments within the organization's firewall.

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With the proliferation of blockchain product and platform offerings, it is inevitable that many will not survive, and organizations are worried about committing to a platform that may not last. Forty-nine percent of respondents said their organization is very hesitant to join a platform on which to develop solutions.
Platforms Under the Microscope

Respondents were asked which platforms their organization has explored for blockchain projects.

Given ongoing uncertainty, respondents said their organizations have explored a variety of public and private platforms (see Figure 3). The top-cited platform was Bitcoin (46%), which was the original blockchain platform, while roughly 40% of respondents named Ethereum and PeerNova. In addition, roughly one-third or more of respondents reported exploring several other platforms, including both infrastructure and solution offerings from a variety of companies.

Permissioned blockchains offer the advantage of customizable features for specific requirements. Permissioned platforms have different capabilities, such as those that are optimized for smart contracts like Corda, Hyperledger Fabric and Monax. Businesses have recently sought our help in exploring permissioned platforms such as Corda, Hyperledger Fabric, MultiChain and Monax.

Differentiation among public networks is also occurring, such as Bitcoin’s strength as a cryptocurrency and Ethereum’s in smart contracts. Hybrid models continue to emerge, such as the efforts to build a corporate version of Ethereum, called Quorum, with increased privacy functionality.

Permissioned blockchains offer the advantage of customizable features for specific requirements ... and have different capabilities, such as those that are optimized for smart contracts.
Healthcare organizations should choose the platform and approach that can best meet the specific business needs of each use case. This assessment should consider:

- **Applicability.** Does the platform offer features, such as smart contracts, that meet the needs of the business use case?
- **Capability.** Does the technology meet the business requirements for privacy, security, scalability and speed?
- **Business risk.** Does the platform create unacceptable levels of business risk? For example, organizations should consider whether a platform has reasonable long-term prospects, such as having gained traction and diverse developer support, or if there is the potential for vendor dependency derived from strict IP rights or platform lock-in.
QUICK TAKE

Designing an Effective Strategy

Healthcare organizations need to develop a cohesive blockchain strategy rather than taking on projects in a piecemeal fashion. Strategic considerations include:

- **Blockchain projects should be driven by cross-functional teams with a business sponsor.** Ensure the blockchain project addresses specific business problems or opportunities. Rather than emanating from IT, the initiative should be driven by business stakeholders from the outset. Blockchain’s industry potential is to drive new operating models, new revenue streams and even new business models and ventures.

- **Set clear goals.** Assess whether blockchain technology is well suited to the business issue being addressed, and clearly specify which objectives will be achieved.

- **Don’t wait until costs and benefits are clear.** Learning will be iterative, and costs and benefits may only become defined more clearly as the project progresses. In addition, many reasons to move forward are strategic in nature and cannot be quantified at the outset.

- **Stay flexible.** Recognize that blockchain is still in the early stages of development; innovation will continue, and the infrastructure will evolve.

- **Explore a variety of platforms, including both permissioned and permissionless.** For each use case, choose a platform based on how well it is tailored to the business need, and not the one with the most buzz.

- **Gain experience collaborating with other players across the value chain.** Don’t underestimate the importance - and challenge - of managing people to create an effective culture of collaboration. Work with industry partners on blockchain projects and assess the obstacles to working successfully with external organizations.

- **Focus on blockchain projects with real-world potential.** The risk of doing nothing is greater than the risk of doing the wrong thing.
UNDERSTANDING BLOCKCHAIN APPLICATIONS

Healthcare organizations are still working overtime to understand how blockchain can be leveraged to increase efficiency and create new business opportunities. When asked to name the biggest internal barriers to blockchain adoption at their organization, most of the top concerns related to difficulties in understanding how blockchain can best be deployed in their organization, including evaluating the cost-benefits of use cases (51%) and understanding blockchain and use cases (48%) (see Figure 4).

These challenges point to the need for healthcare executives to gain more experience with blockchain capabilities and the ability to address concrete business problems. However, the expectation that an organization can precisely determine the expected costs and benefits of a blockchain project at this stage may be unrealistic, given that blockchain is in an early stage of development. The costs and benefits of a project are typically long-term in nature and will only become more apparent over time. Yet, an organization should be able to specify the objectives that each project is designed to achieve in order to measure success.

Respondents also find it difficult to communicate blockchain’s potential and the implementation issues involved to senior management, who are understandably less familiar with the technology. Communicating blockchain to key decision makers (47%) was cited by many as a top internal barrier. It is critical to view blockchain in terms of the business problems it can address rather than as a technology issue best left to the IT department.

The technical question of how blockchain will be integrated with existing systems is a subordinate concern. Only 21% of respondents considered legacy systems integration with blockchain networks as a major barrier to adoption. Healthcare organizations are well advised to plan how they will integrate

Top Internal Obstacles

Respondents were asked to name the top five internal barriers to adopting blockchain technology for their organization.

![Figure 4](percent of respondents indicating each as a top five barrier)
blockchain solutions with their existing legacy systems wherever possible, rather than making extensive changes to their infrastructure, which would delay implementation and require a substantial upfront investment.

SECURING BLOCKCHAIN TALENT

The widespread adoption of blockchain will require many organizations to attract or develop additional expertise. Many respondents believe their organization will require additional skills in a variety of areas, including cybersecurity (51%), legal (52%) and business strategy (52%) (see Figure 5).

However, we believe that many respondents are underestimating the additional blockchain expertise they will require, especially with respect to technical expertise, cited by only 33% of respondents. In our experience, most organizations will need additional technical skills in blockchain-specific areas such as PKI infrastructure, information architecture, software engineering, network infrastructure and integration, and user interface/user experience, among others.

Expertise Needed

Respondents were asked to gauge their organization’s level of blockchain expertise in the following areas.

![Figure 5](image-url)
Organizations are using a mix of strategies to close the skills gap. Many are deploying internally-focused strategies, including training (65%), innovation labs (56%), hiring (44%) and offering incentives to retain key employees (34%). But they are also taking advantage of externally-focused approaches, such as partnering with blockchain technology companies (57%), investing in startups (45%) and targeted acquisitions (44%).

**OVERCOMING EXTERNAL ROADBLOCKS TO ADOPTION**

Healthcare organizations also face a series of significant external barriers that need to be addressed (see Figure 6).

**Scalability/Latency**

The top-cited external roadblock was scalability/latency (69%). Blockchain platforms have been working to improve speed and transaction volumes. Ripple announced its Ripple Consensus Ledger, which can handle nearly 1,000 transactions per second, and the speeds of blockchain networks are expected to continually rise. Healthcare organizations should consider the transaction volumes that will be required for each use case when choosing a platform. For example, an application involving patient records or claims may require high transaction volumes and speed, while a use case involving the provenance of drugs through the supply chain may need much lower volumes.

**Overcoming External Barriers**

Respondents were asked to name the top five external roadblocks to blockchain adoption.

![Percentage of respondents naming each as a top-five external roadblock](image-url)
Privacy concerns are mainly related to permissionless blockchains. Much of the innovation underway in permissioned platforms is designed to provide additional ability for participants to limit access to their data.

Organizations should remember that blockchain platform speed claims may not be achievable in practice. When testing speed, organizations need to assess the time required for the complete process, from transaction initiation to final confirmation. Some platforms quote times that are misleading because they don’t consider the entire lifecycle of the transaction.

Healthcare organizations are advised to identify realizable use cases that can be extended as blockchain scalability improves over time. This will position the organization to embrace high-volume, industry-transforming applications as they emerge.

**Privacy and Security**

Privacy and security (67%) was another frequently cited impediment to adoption. Patient records are sensitive, and healthcare organizations must comply with HIPAA privacy rules (see below). Hacking of healthcare databases is a serious problem, with 35.3 million records stolen in 2016.³

Privacy concerns are mainly related to permissionless blockchains such as Bitcoin and Ethereum. In particular, Bitcoin is built on the principles of data transparency and anonymity. Much of the innovation underway in permissioned platforms is designed to provide additional ability for participants to limit access to their data.

Top innovations that permissioned blockchains have developed include:

- **Channels.** These allow peers to “subscribe” to what can be characterized as an independent chain of blocks, where the information is only available to peers with access to the channel.

- **Specialization of nodes.** Banking industry consortium R3 has pioneered the concept of notaries, which are specialized nodes that counterparties can designate to validate the transaction and thus prevent double spend. Other network nodes are not able to see any details of the transaction, which helps maintain privacy. (For more on blockchain in banking, read our report “Financial Services: Building Blockchain One Block at a Time.”)
While many respondents expressed security concerns, blockchain networks provide much higher levels of security than are available currently and can protect data from tampering. Data is always digitally signed and encrypted to ensure maximum security and privacy.

The concerns over blockchain security can be compared to the fear of self-driving cars. People expect self-driving cars to have a flawless safety record, and whenever one is involved in an accident, this is cited as evidence that the technology cannot be trusted. In reality, most vehicle accidents are the result of human error, and self-driving cars are expected to be much safer than traditional vehicles. As with other technologies, it takes time for people to become comfortable with a new technology, which we believe will also occur with blockchain.

**Interoperability Between Blockchains**

Interoperability between various blockchains was cited as a top roadblock to adoption by 62% of respondents.

Multiple competing platforms are vying to become the TCP/IP standard for blockchain. Each has a unique go-to-market strategy and differing underlying structures. While we anticipate market consolidation, multiple networks could persist on different platforms for some time. Thus, healthcare organizations must be prepared for market uncertainty and allow ongoing innovation to solve blockchain’s interoperability issues. Therefore, we suggest that healthcare organizations focus on building blockchain capabilities and gaining experience with multiple platforms in the near-term, as the market innovates around interoperability and inevitable platform consolidation ensues.

**Legal and Regulatory Issues**

Legal and regulatory concerns pose another significant obstacle, cited by 61% of respondents. A chief concern is the need to comply with HIPAA standards for healthcare payers and providers governing the privacy and availability of PHI. For example, the rule prohibits the use of generating hash-using mathematical algorithms, a blockchain staple. However, blockchain networks can comply with regulations by first de-identifying the healthcare data and then applying the cryptographic function.

Regarding consent, it needs to be determined whether regulations will allow patients to provide their consent electronically for their records to be shared rather than by signing a physical form. State regulations will also need to be considered. Many states require providers to store patient records for a minimum period, such as six years after the last visit.

Respondents said the most common approach for dealing with a lack of regulatory direction was working closely with regulators (65%). Roughly half of respondents said their organization intended to hire consultants (55%) or would adapt blockchain applications according to future regulations (53%) or had designed a flexible blockchain strategy in order to accommodate regulatory changes (53%).
Fostering Collaboration

Although blockchain can generate limited benefits when restricted to internal processes, the most transformational use cases require healthcare organizations to collaborate with external entities. For example, supply chain partners need to share information on the manufacture and distribution of drugs to ensure authenticity; patients, hospitals and providers need to share patient data to create complete medical histories; and payers and providers need to coordinate closely in order to streamline the claims process.

Yet, 60% of respondents cited working with partners/ecosystems members as a significant challenge for blockchain adoption. Most organizations are unaccustomed to collaborating and sharing data with external organizations, and many are just now beginning to redefine these processes with blockchain. When asked whether their organization is working with stakeholders/partners on blockchain projects, 46% of respondents said they are working with external partners, while 49% said this was in progress; just 30% said they are working with other industry partners, while an additional 52% said this was underway.

Working with external partners presents difficulties. As with the internal barriers to adoption, the most frequently cited issue was identifying and finalizing blockchain use cases (64%) (see Figure 7). Other issues were choosing a blockchain platform (49%), convincing partners to share experiment data (47%) and establishing connectivity with partner systems (45%), according to respondents.

Working collaboratively and sharing data with external stakeholders, partners and even competitors will require a significant culture change for most organizations. However, many appear to underestimate the challenges in changing long-standing assumptions and business practices, with only 7% of respondents citing culture and change management as a major internal barrier.

Challenges of Collaboration

Respondents were asked to gauge the level of difficulty involved in the following areas while working with external partners and stakeholders.

![Figure 7](image_url)
While it can be easy for organizations to simply continue with business as usual until competitive pressures force them to change, healthcare organizations need to begin the process of understanding how they can leverage blockchain to streamline their operations and reduce costs.
LOOKING FORWARD

Blockchain will allow organizations to reimagine virtually every aspect of their operations, including security, payments, interoperability, revenue cycle, claims processing, supply chain and contractual matters. The technology will also disrupt the industry, eliminating intermediaries and enabling entirely new business models. The benefits will be equally dramatic, from improved patient health outcomes and greater transparency, to lower operating costs, fewer errors and enhanced security.

While it can be easy for organizations to simply continue with business as usual until competitive pressures force them to change, healthcare organizations need to begin the process of understanding how they can leverage blockchain to streamline their operations and reduce costs. Executives should use a zero-based approach to identify potential use cases, asking themselves how they could leverage blockchain if they were designing each of their processes from scratch. Organizations can then experiment by developing proofs of concept and eventually pilot projects to test the technology and understand what will be required to apply blockchain-enabled solutions.

It is essential that organizations avoid the pattern of many IT projects that are massive in scale and slow to implement, and often fail to meet expectations. Instead, a more nimble, entrepreneurial approach is required to keep pace with fast-changing blockchain technology, which can be summarized as: start small, fail fast, identify what works, and scale quickly.

The ability for blockchain to allow multiple organizations to share data securely while automating processes will rewrite the rules of competition in the healthcare industry. Organizations need to begin the journey now to prepare for the blockchain-enabled world that is on the horizon.
METHODOLOGY

We conducted an online survey among 588 respondents familiar with blockchain from healthcare firms from January through early March 2017. When asked to describe their level of understanding of blockchain, 43% described themselves as expert, 40% as proficient, 11% as competent, and 6% as beginner or novice.

Forty-four percent of respondents were from the U.S., 28% from across Europe, 14% from Australia, and 14% from the Middle East/Africa. Regarding industry segments, 28% were from pharmacy benefit management organizations, 24% from health insurance companies, 24% from hospital and acute care facilities/academic health centers, and 24% from healthcare product vendors.

Respondents have the following titles: 27% C-suite, 35% vice-president, 26% senior manager, and 12% chief medical information officer/chief clinical information officer.

Respondents work in the following functional areas: 21% in strategy, 19% in clinical, 20% in operations, 19% in IT, 10% in R&D/innovation, 10% in compliance and security, and 1% in legal.

Respondents come from organizations with a variety of sizes: 21% from organizations with revenues of $500 million or less; 38% from organizations with revenues of more than $500 million to $1 billion; 24% with revenues of more than $1 billion to $2 billion; and 17% with revenues of more than $2 billion.
FOOTNOTES

1. Smart contracts are not unique to blockchain, but they are greatly enhanced by blockchain networks.


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