Blockchain Challenge on ONC Tech Lab

This effort was funded by the Patient-Centered Outcomes Research (PCOR) Trust Fund through a partnership between ONC and ASPE. To learn more about the work ONC's PCOR efforts, click here.

Winning Submissions

Submission Bank

Blockchain Workshop

Code-A-Thon

Blockchain Challenge

Blockchain Challenge Logo

Blockchain Technology and the Potential for Its Use in Health IT and/or Healthcare Related Research Data

The "Use of Blockchain in Health IT and Health-related Research" Ideation Challenge was announced on July 6, 2016. The goal of this Challenge was to solicit White Papers that investigated the relationship between Blockchain technology and its use in Health IT and/or health-related research. Participants were asked to discuss the cryptography and underlying fundamentals of Blockchain technology, examine how the use of Blockchain can advance industry interoperability needs expressed in the Office of the National Coordinator for Health Information Technology's (ONC) Shared Nationwide Interoperability Roadmap, as well as for Patient Centered Outcomes Research (PCOR), the Precision Medicine Initiative (PMI), delivery system reform, and other healthcare delivery needs, as well as provide recommendations for Blockchain's implementation.

ONC received over 70 submissions, fifteen (15) of which were announced winners on Monday, August 29th. Winning submissions were chosen based on several factors, including the papers' proposed solutions or recommendations for market viability; creativity; ability to inform and foster trans-formative change; and potential to support a number of national health and health information objectives, including advancing the flow of health information for where and when it is needed most. Eight of the winning submissions were chosen to present their whitepaper at the "Use of Blockchain in Healthcare and Research" Workshop which starts today, September 26th and goes through tomorrow September 27th. This workshop will be held at NIST headquarters.

To learn more about the workshop and who will be speaking please click the Blockchain Workshop Button to the left.

"We are thrilled by the incredible amount of interest in this challenge. While many know about Blockchain technology's uses for digital currency purposes, the challenge submissions show its exciting potential for new, innovative uses in health care."

-Vindell Washington, M.D., M.H.C.M., National Coordinator for Health IT.

Winning Submissions

Title	Abstract	Authors	Organization
Blockchain and Health IT: Algorithms, Privacy, and Data	A peer-to-peer network that enables parties to jointly store and analyze data with complete privacy that could empower precision medicine clinical trials and research.	Allison Ackerman Shrier, Anne Chang, Nadia Diakun-thibault, Luca Forni, Fernando Landa, Jerry Mayo, Raul van Riezen, and Thomas Hardjono	Project PharmOrchard of MIT's Experimental Learning "MIT FinTech: Future Commerce."

Blockchain: Securing a New Health Interoperability Experience	Globally, and across multiple industries, an innovative model known as blockchain is emerging that enables faster, more efficient and highly secure business-to-business and business-to-consumer transactions. Many involved in healthcare hope the same distributed database technologies enabling this new model can drive similar results within the industry and, as with many other major innovations, recognize that confusion and hype can mask the potential of real world applications.	Brodersen C, Brian Kalis, Emily Mitchell, Eril Pupo, Andy Truscott.	Accenture LLP
Blockchain Technologies: A Whitepaper Discussing how Claims Process can be Improved	The healthcare industry suffers from an inability to clearly communicate costs in a timely and understandable format. This problem is a symptom of interoperability issues and complex agreements between stakeholders. If these agreements were made available in Blockchain technologies, the claim process would be interoperable enabling standardization, research and innovation. This presentation discusses how Blockchain technologies can enable drastic improvements to the overall healthcare experience.	Kyle Culver	Unaffiliated
Blockchain: Opportunities for Health Care	Presentation of an implementation framework and business case for using Blockchain as part of health information exchange to satisfy national health care objectives.	RJ Krawiec, Dan Barr, Jason Killmeyer, Mariya Filipova, Allen Nesbitt, Adam Israel, Florian Quarre, Kate Fedosva, Lindsay Tsai.	Deloitte Consulting LLP
A Case Study for Blockchain in Healthcare: "MedRec" Prototype for Electronic Health Records and Medical Research Data	MedRec, a decentralized record management prototype for EHRs, using blockchain architectures. Our system design gives patients a comprehensive, immutable log and easy access to their medical information across providers and treatment sites. MedRec manages authentication, auditability and data sharing; the modular API design integrates with providers' existing databases, facilitating interoperability. By contributing to network integrity, medical researchers earn access to anonymized, aggregate data.	Ariel Ekblaw, Asaph Azaria, John D. Halamka, MD, Andrew Lippman	MIT Media Lab, Beth Israel Deaconess Medical Center
The Use of a Blockchain to Foster the Development of Patient-Reported Outcome Measures	The use of blockchain can help foster the development and use of patient-reported outcome measures (PROMs) which focus on the impact of disease and its treatment from the patient's perspective. It allows the use of internet-based devices and technologies (the Internet of Things) to be used to collect data on an ongoing and regular basis for PROMs, while protecting patient confidentiality and unauthorized use of data.	Jason Goldwater	National Quality Forum
Powering the Physician Patient Relationship with 'HIE of One' Blockchain Health IT	'HIE of One' links patient protected health information (PHI) to Blockchain identities and Blockchain identities to verified credential provider institutions to lower transaction costs and improves security for all participants.	Adrian Gropper	Unaffiliated
Blockchain: The Chain of Trust and its Potential to Transform Healthcare – Our Point of View	Blockchain creates trustworthy and efficient interactions and will play a significant role to disrupt health IT and deliver process efficiencies. The result will be a new generation of powerful, blockchain-based applications that will shape the next era of business, transform health IT and upend business models. IBM is committed to helping make blockchain real for business, to make it widely adopted and flourish with innovation	Srinivas Attili, Susheel K Ladwa, Udit Sharma, Anthony F. Trenkle,	IBM Global Business Service Public Sector
Moving Toward a Blockchain-based Method for the Secure Storage of Patient Records	Use of Blockchain as a novel approach to secure health data storage, implementation obstacles, and a plan for transitioning incrementally from current technology to a Blockchain solution.	Drew Ivan	Unaffiliated
ModelChain: Decentralized Privacy-Preserving Health Care Predictive Modeling Framework on Private Blockchain Networks	Cross-institutional healthcare predictive modeling can accelerate research and facilitate quality improvement initiatives, but most existing privacy-protecting methods are based on centralized architecture which presents security and robustness vulnerabilities. We describe a new framework, ModelChain, to adapt Blockchain technology for privacy-preserving machine learning, without revealing any patient health information. We also discuss the benefits and potential issues of applying Blockchain technology to increase interoperability between institutions.	Tsung-Ting Kuo, PhD, Chun-Nan Hsu, PhD, Lucila Ohno-Machado, MD, PhD	Health System Department of Biomedical, University of California San Diego and Division of Health Services Research & Development
Blockchain for Health Data and Its Potential Use in Health IT and Health Care Related Research	A look at Blockchain based access-control manager to health records that advances the industry interoperability challenges expressed in ONC's *Shared Nationwide Interoperability Roadmap*.	Linn L, Koo M.	Unaffiliated
A Blockchain-Based Approach to Health Information Exchange Networks	Sharing healthcare data between institutions is challenging. Heterogeneous data structures and disparate use of healthcare terminology limits data comprehension. We present a Blockchain-based approach to sharing patient data that trades a single centralized source of trust in favor of network consensus. We also introduce an alternative to Proof of Work that bases consensus on proof of structural and semantic interoperability using Fast Healthcare Interoperability Resources (FHIR) Profiles.	Kevin Peterson, Rammohan Deeduvanu, Pradip Kanjamala, and Kelly Boles	Mayo Clinic

Adoption of Blockchain to enable the Scalability and Adoption of Accountable Care	A new digital health care delivery model that uses Blockchain as a foundation to enable peer-to-peer authorization and authentication.	Ramkrishna Prakash	Unaffiliated
A Blockchain Profile for Medicaid Applicants and Recipients	A solution to the problem churning in the Medicaid program that illustrates how health IT and health research could leverage Blockchain-based innovations and emerging artificial intelligence systems to develop new models of health care delivery.	Kathi Vian, Alessandro Voto, and Katherine Haynes-Sanstead	Blockchain Futures Lab - Institute for the Future
Blockchain & Alternate Payment Models	Blockchain technology has the potential to assist organizations using alternative payment models in developing IT platforms that would help link quality and value.	King Yip	Unaffiliated

Submission Bank

Title	Author	Author	Organization
Supply-Chain-Integrity Blockchain Solution for Healthcare	RMTM uses Blockchain to enable the medical supply chain (pharmaceuticals, non-prescription medications, and medical devices) to collaborate to remove counterfeit and sub-standard products from the supply chain, before they become a public health issue	Not specified	
Blockchain is a warehouse for medical data in emergency situations with biometrics based access	This paper discusses how the use of blockchain advances healthcare emergency services and proposed system architecture and data structures to build this system. ONC, PMI and PCOR can review this proposal for their interoperability needs.	Not specified	
The Missing EMR Cornerstone: Securing HIPAA Permissions on the Blockchain	In this paper a specific implementation for improved interoperability is presented, in which the focus changes from an EMR-centric permissions model to a patient-centric permissions model. The implementation leverages and preserves existing health information infrastructure, including existing private EMR vendors, EMR portals, state-based Health Information Exchange (HIE), and the Open Authorization Protocol (OAuth).	Charles S. Kaplan, M. D., C.M.D	
Blockchain and Its Emerging Role in Healthcare Related Research	Intel recognizes the promise in the new blockchain technology, and has developed the Sawtooth Lake Distributed Ledger Platform (SLDLP), that is targeted at building, deploying, and running distributed ledgers. Intel is testing SLDLP in proof-of-concept (POC) environments in partnership with various external companies to prove the integrity and applicability of the technology.		Intel Corporation – Health and Life Sciences Group
Decentralized Care: Leveraging Blockchain to Re-design Risk Sharing	We believe that blockchain can be harnessed to create a new model of health insurance: decentralized autonomous health insurers (DAHIs). Using a decentralized blockchain based on smart contracts and pegged sidechains, we believe that DAHIs can be engineered to provide the services of traditional health insurers, while possessing clear benefits such as greater efficiency, mutual ownership, and the advantages of both centralized and decentralized healthcare systems.	Wei-Chun J. Hsu, M. D., Ph.D.	
Peer to Peer Technologies for Health Information Exchange	This paper will provide an overview of general properties of blockchain technologies, the challenges of healthcare information exchanges, and the role of the blockchain in improving data sharing in health information exchanges.	Michael Dufel	Ipseity Solutions
ONC Blockchain Challenge - Blockchain Clinical Trial	This whitepaper show how blockchain implementations can be used to improve the efficiency and quality across clinical trials in the following areas; safety reporting, trial data integrity, consent management, and computable regulatory compliance.		Merck & Co., Inc.
ModelChain: Decentralied Privacy-Preserving Healthcare Predictive Model Framework on Private Blockchain Networks	Cross-institutional healthcare predictive modeling can accelerate research and facilitate quality improvement initiatives, but most existing privacy-protecting methods are based on centralized architecture which presents security and robustness vulnerabilities. We describe a new framework, ModelChain, to adapt Blockchain technology for privacy-preserving machine learning, without revealing any patient health information. We also discuss the benefits and potential issues of applying Blockchain technology to increase interoperability between institutions.	Tsung-Ting Kuo, PhD, Chun-Nan Hsu, PhD, Lucila Ohno-Machado , MD, PhD	Health System Department of Biomedical, University of California San Diego and Division of Health Services Research & Development
MedChain: Secure, Decentralized, Interoperable Medication Reconciliation Using the Blockchain	We describe “MedChain,” a medication-specific private blockchain network that would enable members to share patient medications events through a decentralized blockchain of medication data. Members would include patients, outpatient prescribers, inpatient facilities, pharmacies and benefit managers.	William Gordon, MD Adam Landman, MD, MS, MIS, MHS	

A Blockchain Profile for Medicaid Applicants and Recipients	A solution to the problem churning in the Medicaid program that illustrates how health IT and health research could leverage Blockchain-based innovations and emerging artificial intelligence systems to develop new models of health care delivery.	Kathi Vian, Alessandro Voto, and Katherine Haynes-Sanstead	Institute for the Future Blockchain Futures Lab
Blockchain Applications in Healthcare IT	To tackle scalability and storage of the large amount of data in the healthcare space, a distributed database could be combined with Blockchain architecture and made publicly available, or privatized according to individual healthcare systems. This model will be the primary application of blockchain discussed in this paper, as it offers practical organization and manipulation of data in the high levels of volume, variety, and velocity of data that is collected in the healthcare field.	Jordan Harris	Encrypted Labs
Blockchain Technologies: A whitepaper discussing how the claims process can be improved	The healthcare industry suffers from an inability to clearly communicate costs in a timely and understandable format. This problem is a symptom of interoperability issues and complex agreements between stakeholders. If these agreements were made available in Blockchain technologies, the claim process would be interoperable enabling standardization, research and innovation. This presentation discusses how Blockchain technologies can enable drastic improvements to the overall healthcare experience.	Kyle Culver	
Blockchain: Securing a New Health Interoperability Experience	Globally, and across multiple industries, an innovative model known as blockchain is emerging that enables faster, more efficient and highly secure business-to-business and business-to-consumer transactions. Many involved in healthcare hope the same distributed database technologies enabling this new model can drive similar results within the industry and, as with many other major innovations, recognize that confusion and hype can mask the potential of real world applications.	Brodersen C, Brian Kalis, Emily Mitchell, Eril Pupo, Andy Truscott.	Accenture, LLP
Enabling the Realization of Nationwide Interoperability and Patient Centered Research Through a Blockchain Solution	We propose the use of a permissioned distributed blockchain solution to address pitfalls in current systems nationwide. The solution allows sharable data to be captured from healthcare providers, other stakeholders, and IoT devices, while enabling large scale de-identified data analysis.	Mathew E. Rose, MB BCH BAO, MS	
Blockchain & Alternative Payment Models	Blockchain technology has the potential to assist organizations using alternative payment models in developing IT platforms that would help link quality and value.	King Yip	
A Blockchain-Based Approach to Health Information Exchange Networks	Sharing healthcare data between institutions is challenging. Heterogeneous data structures and disparate use of healthcare terminology limits data comprehension. We present a Blockchain-based approach to sharing patient data that trades a single centralized source of trust in favor of network consensus. We also introduce an alternative to Proof of Work that bases consensus on proof of structural and semantic interoperability using Fast Healthcare Interoperability Resources (FHIR) Profiles.	Kevin Peterson, Rammohan Deeduvanu, Pradip Kanjamala, and Kelly Boles	Mayo Clinic
A Case Study for Blockchain in Healthcare: "MedRec" prototype for electronic health records and medical research data	MedRec, a decentralized record management prototype for EHRs, using blockchain architectures. Our system design gives patients a comprehensive, immutable log and easy access to their medical information across providers and treatment sites. MedRec manages authentication, auditability and data sharing; the modular API design integrates with providers' existing databases, facilitating interoperability. By contributing to network integrity, medical researchers earn access to anonymized, aggregate data.	Ariel Ekblaw, Asaph Azaria, John D. Halamka, MD, Andrew Lippman	MIT Tech Lab
A Data Provisioning Blockchain and Data Pricing Model for Maximizing Social Welfare to Patients	We describe a novel use of blockchain technology for patient-powered data provisioning. We apply this together with a well-established data pricing model to promote research that provides maximum benefit to patients in distributed networks.	Lisa M. Schilling, Caden MacKenzie and Jason N. Doctor	University of Colorado, Colorado College, and University of Southern California
Blockchain and its Emerging Role in Healthcare and Health-related Research - Energy Efficient Futures Foundation, SOLES, Inc.	We demonstrate the potential of blockchain technology to upgrade and re-architect healthcare information networks, give patents back the ownership of data that will help incentive personal responsibility and provide superior data immutability with state-of-the-art security and sharing mechanism.		Energy Efficient Futures Foundation (E2F2), SOLES, Inc.
Adoption of Blockchain to Enable the Stability and Adoption of Accountable Care	A new digital health care delivery model that uses Blockchain as a foundation to enable peer-to-peer authorization and authentication.	Ramkrishna Prakash	
The Application of Blockchain Cryptography in Health Information Technology and Health Research Data Management	We examine the current state and limitations of Health Data Management; then discuss Elliptical Curve Cryptography, a modified Generalized Blockchain Technology Model and he potential application of this model to addressing key problem areas in Health IT and related Health Research Data. Finally we conclude by describing possible avenues for implementing this model.	Dr. Robert Steven Owor, Dr. Zephyrinus Okonkwo, Dr. Anilkumar Devarapu, and Dr. Khalil Dajani	Albany State Univesity and Ashford University

Blockchain technology for Private Health Information Interoperability	This paper talks about how the technology can be leveraged to create a more patient-centric healthcare system facilitating easier, more efficient and more secure interoperability that could reshape our medical experience.		Droice Labs
Blockchain and Health IT: Algorithms, Privacy, and Data	A peer-to-peer network that enables parties to jointly store and analyze data with complete privacy that could empower precision medicine clinical trials and research.	Allison Ackerman Shrier, Anne Chang, Nadia Diakun-thibault, Luca Forni, Fernando Landa, Jerry Mayo, Raul van Riezen, and Thomas Hardjono	MIT
Adverse Event Analytics & chain of Custoy Tracking for Medical Services	Marked as Confidential.		
Blockchain as a warehouse for medical data in emergency situations with biometrics based access	Describes a system of medical data stored in a public blockchain and accessible through toe fingerprint biometrics, to provide access to medical information in a critical emergency situation in which the patient may not be conscious or in possession of their documents. It builds on the Emercoin blockchain platform for industrial applications.		
Keyless Signature Infrastructure® (KSITM) Technology	Describes the Merkle Hash Tree based Keyless Signature Infrastructure (KSI) technology and contrasts it with other types of blockchains, and describes applications to health IT such as patient records inquiry, PII compliance, telehealth integrity and healthcare fraud detection.		Guardtime Federal
The Cancer Gene Trust	Proposes the use of a blockchain public ledger to serve as a data access management layer for the Cancer Gene Trust. Genomic data would be held by data stewards on behalf of patients, and the ledger would record operations on data sets such as submission, mirroring, downloading, removing, updating, recontacting data stewards, and recomputing genomic analysis based on the genomic data curation services performed by the Global Alliance for Global Health (CA4GH).		UCSC Genomics Institute
Blockchain and Its Emerging Role in Healthcare and Health-related Research	ShoCard is a technology that uses blockchain to provide identity management services for end users and enterprises. Blockchain is used to allow the parties to validate who is offering data, who certifies that data is correct and accurate and who is receiving the data. The platform includes functionality for authorizing the sharing of personal information with another party and verification of identity and/or professional certifications.		ShoCard Inc
Use of Blockchain in Health IT and Health-related Research	Describes a composite blockchain formed from Ethereum and kreateIoT to provide a decentralized storage and management of electronic health records and protected health information. Access to private health records is split across a number of nodes, and users grant access to data using “permission slips” which are recorded on the ledger.	Sirish Bajpai, Raj Sharma	
Co-Creation of Trust for Healthcare: The Cryptocitizen Framework for Interoperability with Blockchain	The co-creation of trust for healthcare framework is divided into four concepts applied to healthcare based on the underlying theoretical foundation – blockchain is a database and technology that facilitates an exchange of value within a trustless network, without intermediaries. These conceptualized propositions suggest that co-creation of trust ecosystems have a direct positive impact on patient satisfaction, fraud, healthcare outcomes, and reduce the security risks associated with interoperability. This paper contributes to the literature on co-creation of trust within healthcare ecosystems leveraging blockchain.	Peter Nichol, Jeff Brandt	Otoca Innovations, OHSU School of Medicine
Micro-Identities Improve Healthcare Interoperability via Blockchain: Deterministic Methods for Connecting Patient Data to Uniform Patient Identifiers	Proposes using a hybrid blockchain model to provide patient identification and data access using HL7 FHIR resource format with a goal of enabling provider-to-provider data transfers in a trustless environment. The authors suggest that blockchain will address identity, confidentiality, integrity of data and accessibility in access to privacy health records.	Peter Nichol and William Dailey	Oroca Innocations, Golden Valley Memorial Healthcare
Blockchain Technology & the Potential for Its Use in Healthcare	A number of specific use cases are offered including patient linkage across government services, pooled population risk, fraud reduction, personalized health care and payment for outcomes through smart contracts, and data access management for clinical research or genomic data.	Tal Rapke, MD	Color Space Post
Blockchain in Healthcare	Describes an implementation of a large scale research and implementation program with the goal of applying blockchain (BC), multiplier encryption models (including homomorphic encryption), personal data accounts and novel patient consent technologies to the problem of data and identity protection in medicine.	Davide Zaccagnini	Lynkeus Global

Powering the Physician-Patient Relationship with HIE of One Blockchain Health IT	'HIE of One' links patient protected health information (PHI) to Blockchain identities and Blockchain identities to verified credential provider institutions to lower transaction costs and improves security for all participants.	Adrian Gropper, MD	
Blockchain: The Chain of Trust and its Potential to Transform Healthcare - Our Point of View	Blockchain creates trustworthy and efficient interactions and will play a significant role to disrupt health IT and deliver process efficiencies. The result will be a new generation of powerful, blockchain-based applications that will shape the next era of business, transform health IT and upend business models. IBM is committed to helping make blockchain real for business, to make it widely adopted and flourish with innovation	Srinivas Attili, Susheel K Ladwa, Udit Sharma, Anthony F. Trenkle,	IBM Global Business Service Public Sector
Secure and Decentralized Sharing of Medical Imaging Data via Blockchain Consensus	This paper outlines a framework that utilizes blockchain technology to enable patients to delegate electronic access to their medical imaging data in a secure manner. The authors discuss the appropriateness of blockchain technology for this indication, and describe the relative merits and drawbacks of this approach relative to several alternatives.	Vishal Patel	UCLA
Blockchain: Opportunities for Health Care	Presentation of an implementation framework and business case for using Blockchain as part of health information exchange to satisfy national health care objectives.	RJ Krawiec, Dan Housman, Mark White, Mariya Filipova, Florian Quarre, Dan Barr, Allen Nesbitt, Kate Fedosova, Jason Killmeyer, Adam Israel, Lindsay Tsai	Deloitte
Securing Healthcare IT Infrastructure with Blockchain and Modern Cryptography	Discusses the blockchain principles of openness and decentralization, including discussion of secure multi-party computation and verifiable computation, and discusses applications such as authorization and audited access to medical records, use of smart contracts to support prescriptions or insurance, sharing personal data for either marketing or clinical trial purposes and managing patient medical devices with proof-of-storage techniques.	Yan Huang, Haixu Tang	Indiana University
The Use of a Blockchain to Foster the Development of Patient-Reported Outcome Measures	The use of blockchain can help foster the development and use of patient-reported outcome measures (PROMs) which focus on the impact of disease and its treatment from the patient's perspective. It allows the use of internet-based devices and technologies (the Internet of Things) to be used to collect data on an ongoing and regular basis for PROMs, while protecting patient confidentiality and unauthorized use of data.	Jason Goldwater	National Quality Forum
A Blockchain-Based Approach to Drug Diversion Monitoring	This paper proposes a drug monitoring solution based on blockchain technology and Internet of Things inspired smart dispensing hardware, designed to address the limitations of current drug monitoring programs.		
Adopting Blockchain Technology for Electronic Health Record Interoperability	This white paper explains how blockchain could enable a comprehensive, interoperable and secure EHR data exchange in which health consumers are the ultimate owners of their EHRs. It enable its wider adoption as a cornerstone for EHR interoperability. It also examines the underlying technology that powers blockchain security, privacy and data integrity.	Nitesh Gupta, Anand Jha, and Purna Roy	Cognizant Technology Solutions
BlockChain for Healthcare: Implications for Privacy and Data Security	This paper examines the theoretical perspective of using blockchain to share patient health information in a secure way. It also also provides an example of how blockchain can be used to keep track of healthcare transaction audit events so that the process of health information exchange can be managed according to a patients' desire for information.	Ioana Singureanu	Eversolve, Inc.
Blockchain for Healthcare Proposal	The paper observes that the true power of Blockchain is for establishing a public, peer-moderated, "ledger" that is resistant to integrity and availability attacks. As such, this technology is not directly useful for applications that require confidentiality, although it may be used in support of those applications. Rather, it is the power in applications that require integrity and to achieve availability by avoiding single points of failure.		Leidos
Blockchain Applications in Health Care and Health Research	This paper provides an overview of blockchain technology including smart contracts, and discusses potential applications to healthcare including decentralized management of EHRs, sovereign online identity, and recording of medical procedures and data.		
Healthcare Record Modernization through the Application of Blockchain	This paper proposes a healthcare model for blockchain that addresses nationwide interoperability challenges to aggregate disparate distributed Healthcare records securely and privately. The approach we're recommending isn't revolutionary by itself, instead our recommendation of the implementation of blockchain further builds upon the nationwide interoperability foundational goals.	Rudy Bochek, Antonio Fernandez, Hadrian Zbarcea, Will Tesch	TESCHGlobal, apifocal, HealthLX
Curbing Fraud and Improving Health Data Privacy Using Blockchain	Describes how Estonian citizens use their universal patient identifiers to manage data authentication with blockchain technology, and then applies those concepts to the U.S. health industry by discussing a use case involving a patient requiring access to an expensive prescription drug.		CGI

"Blockchain and Its Emerging Role in Healthcare and Health-related Research" Challenge White Paper	The solution we propose makes use of a programmable blockchain, Ethereum, and a decentralized file system, IPFS. In addition to familiar encryption technology, our solution also makes use of hashing algorithms which are used to generate a unique fingerprint for data. We will use IPFS to store encrypted data, and the hashes of the data are stored in a smart contract on the Ethereum blockchain.		Booz Allen Hamilton
How Blockchain Technology Can Enhance EHR Operability	Payers with the right permissions could have access to relevant information in order to process claims rapidly and with more precision. Patients would have transparency into the entire continuum of care. Importantly, blockchain technology would not be centralizing health information in healthcare exchanges, but instead, decentralizing the system in a securely and interoperable manner.	Chris Burniske, Emily Vaughn, Dr. Alex Cahana, Jeff Shelton	Ark Invest, Gem
YouBase An Open Framework for Secure Private and Individual-Centric Health Data Collection and Exchange	YouBase is a trusted, privacy-enabled, peer-to-peer data layer for health information storage and exchange built on blockchain technology, which uses encryption, digital signatures, digital wallets, and distributed data stores, to provide an individual--centricframework for management of personal and medical data. The core technology allows each personal data element of to be assigned a blockchain--compatible personal wallet address that cannot be linked back to an individual without the proper private key.		
Implementing Clinical Blockchain Interoperability To Address Specific Use Cases in Patient Care, Public Health, and Pharmaceutical Research	A discussion of the current application of blockchain as cryptocurrency, and exploration of additional use cases in the healthcare domain including clinical data sharing, medication reconciliation, patient-physician messaging or clinical data sharing.	Edward Bukstel and Robert Coli, MD	Diagnostic Information Systems Company
Using Blockchain Technology in Healthcare	The blockchain can be seen as a design approach that binds a number of peer computers together to collectively obey the same “consensus” process for releasing or recording what information they hold, and where all related interactions are verified by cryptography.	Taimur Aslam & Baber Ghauri, MD	
Healthcare Provider Data on the Blockchain	Data on licensure, qualifications, and availability of healthcare providers is important to the delivery of healthcare and touches virtually every business process. Immutability, transparency, and verifiability of provider data on the blockchain would help ensure that disparate parties share the same view of all healthcare providers.	Ferdinand Hui, John Koshy, Andrew Pomerance, Ron Urwongse	
Blockchain and Health Transactions: The Secure, Distributed Four-Party Health Services Ledger	We propose that the true value and adoption of blockchain for healthcare, including the portability and enhanced usability of EHRs, occurs by systematically linking the entire value chain, notably the payment and transaction system, to health data. The initial result is a four-party ledger among consumer, provider, payer/insurer and government governed by smart contracts.	Max Janasik, CPA and Nicole Cathcart, MA	
Using Blockchain Technology for Healthcare Administration	Proposes a blockchain system that would allow all authorized participants to have the most current, validated provider information available. This information could be used by health plans for purposes of contracting with the provider, and could be used by other providers for purposes of referrals, care coordination and care transition (e.g. patient transitions from hospital to outpatient physician care).	Henry A Perretta	HAPCO International
BlockInsure	Blockchain technology has a place in Health IT. Although there will be high implementation costs and questions to the security of the system, a properly designed private blockchain will provide a protected way to verify individuals' insurance information, while creating an extra component to defend against fraud.		Pieces Tech
Unleash the Data: Blockchain Technology and the Potential for Its Use in Health IT	Blockchain technology has the potential to shift control of data to the patient and to unleash information currently held in centralized systems to all entities involved in providing healthcare services. Unleashing data will result in fundamental shifts in the way healthcare is provided to not only individual patients but also the general U.S. population.	Kristen Johns	
PyQy - A protocol to enable open, trustworthy physician quality reporting and payments using the blockchain technology	In this white paper, we propose the application of blockchain technology and smart contracts to the process of physician quality reporting and payments that are cornerstones of quality driven healthcare and pay for performance approach to health care.	Chintan Patel PhD, Sharib Khan MD, MA, MPH, Nadeem Nazeer, MS	Applied Informatics
Blockchain Computing Systems in Healthcare	This paper presents the concept of the blockchain computing system, which builds on smart contracts to form a distributed computation platform. Describes how this concept could be used in support of a hospital enterprise system and compares numerous features against traditional systems such as centralized database servers, including such steps as data acquisition, recording data in a patient record, data storage, computation, notifications and direct actions taken based on computation results.	Conrad Barski MD, Stephen Claypool MD, Tony Little MD	

Blockchain for Health Data and Its Potential Use in Health IT and Health Care Related Research	A look at Blockchain based access-control manager to health records that advances the industry interoperability challenges expressed in ONC's *Shared Nationwide Interoperability Roadmap*.	Linn L, Koo M.	Unaffiliated
Moving Toward a Blockchain-based Method for the Secure Storage of Patient Records	Use of Blockchain as a novel approach to secure health data storage, implementation obstacles, and a plan for transitioning incrementally from current technology to a Blockchain solution.	Drew Ivan.	Unaffiliated