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Hashing it Out: Blockchain as a Solution for Medicare Improper Payments

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HASHING IT OUT: BLOCKCHAIN AS A SOLUTION FOR MEDICARE IMPROPER PAYMENTS

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> "Over the past two decades, the Internet has revolutionized many aspects of business and society . . . . Yet the basic mechanics of how people and organizations execute transactions . . . have not been updated for the 21st century. Blockchain could bring to those processes the openness and efficiency we have come to expect in the Internet Era."[1]

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1. Arvind Krishna, Senior VP, IBM Research, *quoted in Blockchain: The Chain of Trust and its Potential to Transform Healthcare – Our Point of View*, IBM GLOBAL BUSINESS SERVICES PUBLIC SECTOR TEAM, 1 (Aug. 8, 2016), https://www.healthit.gov/sites/default/files/8-31-blockchain-ibm_ideation-challenge_aug8.pdf.

INTRODUCTION

Over 126 million Americans place their trust in the federal and state governments to provide and facilitate payment for their healthcare needs.[2] But this *trust* is levied upon a system plagued with a dearth of *integrity*; where roughly $25 million is stolen every hour, expenditures are rising faster than the pace of inflation, and the bureaucracy is working frantically to fend off insolvency in these publicly managed health programs.[3] While the United States has maintained a rapidly increasing growth rate in health spending, the fifteen-year survival rate[4] in America is the lowest among our international counterparts.[5] The entitlement programs of the past—long heralded as heroic endeavors—now teeter on the edge of extinction.[6]

It should come as no surprise that the Government Accountability Office ("GAO") has consistently classified Medicare and Medicaid as "high risk" programs.[7] The federal government, through the Centers for Medicare and Medicaid Services ("CMS"), is the single largest payer for health services in the United States.[8] CMS spent over $984 billion in 2015.[9] For Medicare alone, improper payments accounted for 12.1% of the program's

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2. As of 2015, over 55 million Americans are covered by Medicare, with over 71.6 million beneficiaries enrolled in Medicaid and the Children's Health Insurance Program. *See Press Release*, CTR. FOR MEDICARE & MEDICAID SERVS. (Jul. 28, 2015), https://www.cms.gov/Newsroom/MediaReleaseDatabase/Press-releases/2015-Press-releases-items/2015-07-28.html.

3. REBECCA S. BUSCH, HEALTHCARE FRAUD: AUDITING AND DETECTION GUIDE 2 (2d ed. 2012).

4. *See* Peter A. Muennig & Sherry A. Glied, *What Changes in Survival Rates Tell Us About US Health Care*, 29:11 HEALTH AFFAIRS 2107 (2010), http://content.healthaffairs.org/content/29/11/2105.full.pdf+html (explaining that measuring the fifteen-year survival rate can be preferable to using a life expectancy measurement due to the prevalence of coding errors for a small number of elderly individuals which can bias life expectancy calculations).

5. *See id.* (for example, by 2005, fifteen-year survival rates for forty-five-year-old U.S. white women were lower than in twelve comparison countries with populations of at least seven million and per capita gross domestic product (GDP) of at least 60% of U.S. per capita GDP in 1975).

6. *See* PATRICIA A. DAVIS, CONG. RESEARCH SERV., MEDICARE: INSOLVENCY PROJECTIONS (Oct. 5, 2016), https://fas.org/sgp/crs/misc/RS20946.pdf ("The 2016 Medicare trustees' report projects that, under intermediate assumptions, the [Hospital Insurance] Trust Fund will become insolvent in 2028, two years earlier than estimated in the prior year's report.").

7. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-15-290, HIGH RISK SERIES: AN UPDATE 8 (Feb. 2015), http://www.gao.gov/assets/670/668415.pdf.

8. *See* CTR. FOR MEDICARE & MEDICAID SERVS., CMS ROADMAPS OVERVIEW (2016), https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityInitiativesGenInfo/Downloads/RoadmapOverview_OEA_1-16.pdf.

9. CTR. FOR MEDICARE & MEDICAID SERVS., CMS FAST FACTS, https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/CMS-Fast-Facts/index.html.

total spending, representing $43.3 billion in wasted federal funds.[10] Such improper payments occur, *inter alia*, when federal funds are distributed for medical care or services that were not covered by CMS regulations, were not medically necessary, or were billed for but never provided.[11] Shortcomings in the design, engineering, and implementation of health information technology ("IT") systems,[12] coupled with administrative complexity[13] have led to a healthcare system that struggles with data interoperability and integrity.

A similar issue of integrity exists in the financial industry. The transition into the digitization of cash led to the development of the "double spending" enigma. Once currency involves digital ledgers, electronic manipulation becomes possible.[14] If a user makes a copy of a digital coin before they spend it, they have the possibility to spend that coin again. In November 2008, Satoshi Nakamoto published a white paper[15] that introduced a new electronic payment system aimed at remedying the double-spending problem: Bitcoin.[16]

Since Bitcoin's arrival, many of the most impressive developments surrounding the innovation have not involved the cryptocurrency itself; instead, the data structure underlying Bitcoin—a decentralized ledger

10. DEP'T OF HEALTH & HUMAN SERVS., THE SUPPLEMENTARY APPENDICES FOR THE MEDICARE FEE-FOR-SERVICE 2015 IMPROPER PAYMENTS REPORT (2015), https://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/CERT/Downloads/AppendicesMedicareFeeforService2015ImproperPaymentReport.pdf.

11. Improper Payments Elimination and Recovery Act of 2010, Pub. L. No. 111-204, § 2(e), 124 Stat. 2224, 2227 (codified at 31 U.S.C. § 3321 note) ("The term 'improper payment'— '(A) means any payment that should not have been made or that was made in an incorrect amount (including overpayments and underpayments) under statutory, contractual, administrative, or other legally applicable requirements; and (B) includes any payment to an ineligible recipient, any payment for an ineligible good or service, any duplicate payment, any payment for a good or service not received (except for such payments where authorized by law), and any payment that does not account for credit for applicable discounts.'").

12. *See e.g.*, Arthur L. Kellermann & Spencer S. Jones, *What it Will Take to Achieve the As-Yet-Unfulfilled Promises of Health Information Technology*, 32:1 HEALTH AFFAIRS (2013) at 64, http://content.healthaffairs.org/content/32/1/63.full.pdf+html ("Large, integrated delivery systems such as the Department of Veterans Affairs and Kaiser Permanente provide enterprisewide electronic health records, but the information stored in those records is essentially useless if the patient seeks out-of-network care.").

13. *See* Dhruv Khullar & Dave A. Chokshi, *Toward an Integrated Federal Health System*, 315:23 JAMA 2521 (June 21, 2016), http://jamanetwork.com/journals/jama/article-abstract/2519644 ("The breadth, complexity, and incremental development of the federal health system have resulted in a fragmented patchwork, with many potential areas for integration to increase efficiency and improve care coordination.").

14. *See* University of Birmingham Lecture: Digital Cash (Jan. 3. 2007), http://www.cs.bham.ac.uk/~mdr/teaching/modules06/netsec/lectures/DigitalCash.html.

15. SATOSHI NAKAMOTO, BITCOIN.ORG, BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM 4 (2008), https://bitcoin.org/bitcoin.pdf.

16. Tristan Mazer, Bitcoin: A Worldwide Currency? 3 (July 2015) (unpublished Bachelor thesis, Erasmus University Rotterdam), https://thesis.eur.nl/pub/30037/Bachelor-Thesis-Final-Tristan-Mazer-376526.pdf.

technology known as the Blockchain[17]—has been a pivotal and provocative technological advancement.[18] The blockchain structure has attracted the attention of stakeholders across a wide spectrum of industries, from finance[19] and real estate,[20] to utilities[21] and healthcare.[22] Much of blockchain's appeal derives from its ability to enable *trustless* networks, i.e., where parties can conduct business and process transactions even in an environment void of mutual trust.[23] The blockchain data structure, when utilized in certain transactional settings, replaces the "trusted" intermediary with a system that preserves data integrity and operates in a decentralized fashion, removing the need for central authority without compromising functionality or certainty.[24]

Recently, the Department of Health and Human Services' ("HHS") Office of the National Coordinator for Health Information Technology ("ONC") launched a "Blockchain Challenge," soliciting white papers "that investigate the relationship between Blockchain technology and its use in Health IT and/or Health Related research."[25] On September 1, 2016, ONC selected fifteen winning white papers.[26] Not surprisingly, the majority of the

17. For purposes of this Note, the upper-case "Blockchain" will be used in reference to Bitcoin's specific decentralized ledger, while the lower-case "blockchain" will reference the general data structure class known as decentralized ledger technology ("DLT"). Throughout this Note, the terms "blockchain" and "DLT" will be used synonymously to reference this new breed of data structure.

18. *See* Don Tapscott & Alex Tapscott, *Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World* (2016), excerpt *reprinted in* Don Tapscott & Alex Tapscott, *Here's Why Blockchains Will Change the World*, FORTUNE (May 8, 2016), http://fortune.com/2016/05/08/why-blockchains-will-change-the-world ("The new platform enables a reconciliation of digital records regarding just about everything in real time. In fact, soon billions of smart things in the physical world will be sensing, responding, communicating, sharing important data, doing everything from protecting our environment to managing our health.").

19. *See generally* Victor Li, *Bitcoin's Useful Backbone Blockchain Technology Gains Use in Business, Finance and Contracts*, 102 ABA J. 31 (March 2016).

20. *See generally* U.S. Patent App. No. 20160035054, Systems & Methods for Managing Real Estate Titles & Permissions (filed July 28, 2015).

21. *See generally* Lynne L. Kiesling, *Implications of Smart Grid Innovation for Organizational Models in Electricity Distribution*, WILEY HANDBOOK SMART GRID DEV. (forthcoming 2015), https://ssrn.com/abstract=2571251.

22. *See generally* Ariel Ekblaw, et al., *A Case Study for Blockchain in Healthcare: "MedRec" Prototype for Electronic Health Records & Medical Research Data*, ONC BLOCKCHAIN CHALLENGE (Aug. 2016), https://www.healthit.gov/sites/default/files/5-56-onc_blockchainchallenge_mitwhitepaper.pdf.

23. Konstantinos Christidis & Michael Devetsikiotis, *Blockchains and Smart Contracts for the Internet of Things*, IEEE ACCESS 2292, 2292 (May 10, 2016).

24. *Id*.

25. *See Announcing the Blockchain Challenge*, OFF. NAT'L COORDINATOR, https://www.healthit.gov/newsroom/blockchain-challenge ("The goal of this Ideation Challenge is to solicit White Papers that investigate the relationship between Blockchain technology and its use in Health IT and/or health-related research.").

26. *See ONC Announces Blockchain Challenge Winners*, OFF. NAT'L COORDINATOR, http://www.hhs.gov/about/news/2016/08/29/onc-announces-blockchain-challenge-winners.html.

papers focused on such issues as patient privacy,[27] health record security,[28] and institutional interoperability[29]—all of which are viable issues in need of workable and sustainable solutions.[30] What *was* surprising was the absence of winning papers focused on a solution to the rampant abuse, wastefulness, and fraud underlying our federally-funded healthcare programs. Although many of the "Blockchain Challenge" papers proposed bold moves for the healthcare regulatory system, they tended to focus on a broad spectrum of exciting blockchain possibilities, with little consideration of the relative importance of potential solutions in light of current practicalities. Yet, the everyday challenges facing federal decisionmakers—such as the insurmountable federal debt[31] and gridlock on costly innovation—require a cost-benefit-based prioritization of blockchain applications.[32]

Blockchain will likely lead to a revolution in the realm of American healthcare.[33] But entrepreneurs and federal regulators desiring implementation of this promising technology must refrain from trying to reshape problems to fit a blockchain solution. Instead, they should start by identifying the problems that have the greatest potential for either recouping or saving federal dollars, and then decide whether blockchain is a viable integration to the overall solution. To that end, this Note examines improper

27. *See e.g.*, Allison A. Shrier et al., *Blockchain & Health IT: Algorithms, Privacy, and Data*, White Paper (Aug. 8, 2016), https://www.healthit.gov/sites/default/files/1-78-blockchainandhealthitalgorithmsprivacydata_whitepaper.pdf.

28. *See e.g.*, Ariel Ekblaw et al., *supra* note 22 at 2 (proposing a "novel, decentralized record management system to handle EHRs, using blockchain technology").

29. *See e.g.*, Ramkrishna Prakash, *Adoption of Block-Chain to Enable the Scalability & Adoption of Accountable Care* (Aug. 2016), https://www.healthit.gov/sites/default/files/13-71-blockchain_for_healthcare_paper_final.pdf (arguing for "the adoption of a new process for care delivery that requires the coordination of a "network" of care providers who can engage in shared risk contracts").

30. *See id.*

31. *See* Fiscal Outlook: Federal Fiscal Outlook, U.S. GOV. ACCOUNTABILITY OFFICE, http://www.gao.gov/fiscal_outlook/federal_fiscal_outlook/overview ("Moving forward, the federal government will need to make tough choices in setting priorities and ensuring that spending leads to positive results.").

32. *See id*. ("Closing the [fiscal] gap requires spending reductions, increases in revenue, or, more likely, a combination of the two.").

33. Jim Manning, *Blockchain Can Revolutionize Every Aspect of Healthcare*, ETHNEWS (Oct. 28, 2016), http://ethnews.com/blockchain-can-revolutionize-every-aspect-of-healthcare.

payments[34] under Medicare,[35] an area of federal healthcare spending in which corrective measures consistently yield significant returns on investment,[36] and then surveys the underlying features of blockchain technology, proposing a basic blockchain solution accompanied by an endogenous regulatory roadmap to guide its implementation.

Part I highlights the inadequacies and inefficiencies of our Medicare payment system, focusing on the initiatives currently in place and the susceptibilities that persist. Part II offers a broad overview of the development, importance, features, and collateral technologies surrounding blockchain. Part III posits that Congress and HHS, through its various subsidiary agencies, should work in tandem with private stakeholders to create and/or implement a blockchain-based infrastructure to facilitate federal healthcare payments and support future growth of quality-based initiatives. This Note concludes with a recommendation for future agency research focusing on the viability and cost efficiency of a blockchain solution.

I. THE MEDICARE MALADY

Medicare serves as the primary federal mechanism for payment of nongovernment-furnished healthcare services.[37] Its colossal influence stems not only from its sheer size in the marketplace, but also its 55-year track record of transforming indemnity health insurance through research and demonstration.[38] Medicare's clout in the realm of healthcare payments can also be its greatest weakness, as even the smallest changes and inefficiencies

34. The term "improper payments" is very broad and it is apparent that blockchain will not be a viable solution for every wasteful, abusive, and fraudulent transaction that can be classified under said term. Additionally, when capitalized, "Improper Payments" has various implications as defined in statutes. But the solutions proposed in this note focus on those improper payments that primarily occur due to inefficiencies and structural enigmas, rather than fraudulent situations that, currently and in the foreseeable future, require human intervention (e.g., Stark Law and Anti-Kickback violations). Hereinafter, the use of the term "improper payments" in this Note is meant as a reference to only these non-human, structural inefficiencies.

35. Although Medicaid fraud is also a serious issue, the interconnection of federal and state programs adds immense complexity to any solution. This Note focuses on Medicare due to the primarily federal control over the program and the issue of improper payments associated with the program.

36. *See e.g.* OIG News Release (Feb. 14, 2012), http://wayback.archive-it.org/3926/201501 21155547/http:// www.hhs.gov/news/press/2012pres/02/20120214a.html ("[T]he government's health care fraud prevention and enforcement efforts recovered nearly $4.1 billion in taxpayer dollars in Fiscal Year (FY) 2011.").

37. AM. HEALTH LAWYERS ASS'N, MEDICARE LAW 1 (Thomas W. Coons et al. eds., 3d ed. 2012).

38. Stanley B. Jones, *Medicare Influence on Private Insurance: Good or Ill?* 18 HEALTH CARE FIN. REV. 153, 153 (1996), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4193643/pdf/hcfr-18-2-153.pdf.

can have drastic effects on the entire healthcare system.[39] Unfortunately, Medicare's current inefficiencies are anything but small.

The recent Affordable Care Act ("ACA") was an attempt to drive private provider and payer behavior through payment incentives, which were anticipated to save Medicare spending from the impending cost increases across the industry.[40] However, policymakers are concerned that the ACA's focus on incentivizing provider efficiency will lead to rationing, similar to HMOs in the 1980s and 1990s when patients were denied care due to similar financial incentives that accompanies such health plan management.[41] The recent political regime change adds further uncertainty to the realm of healthcare policy and the ACA's longevity.[42]

Legislators and policymakers believe the answer to this problem is quality reporting, which has admittedly improved over the past twenty years.[43] But even with these incentives and improved metrics, the Medicare system is still overwhelmed by fraud and inefficiency.[44] To further complicate the matter, CMS has delegated the bulk of Medicare's administration and oversight to non-federal contractors.[45] Under this system, the HHS Office of Inspector General ("OIG") recently discovered that CMS had over 6,000 Federal Acquisition Regulation ("FAR") contracts, totaling over $25 billion, that were not closed out as required under the FAR.[46] In the same audit, OIG found that CMS had "15 percent of contracts that were completed before FY 2011 at least 10 years overdue."[47]

These are not examples of simple human oversight. These blunders are structural in nature and require an overhaul of the technology underlying the inefficiencies. Obviously, such technical renovations cannot occur to each separate system simultaneously or in a hasty manner. Thus, this portion of the Note is dedicated to examining the systematic inadequacies to find a starting point that is not only in need of innovation, but one which has a high potential return on investment.

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39. *Id.* ("Medicare must be closely monitored because even relatively small changes can have large short-term effects in the aggregate.").

40. THE GUIDE TO HEALTHCARE REFORM: READINGS AND COMMENTARY 226 (Daniel B. McLaughlin ed. 2015) [hereinafter THE GUIDE TO HEALTHCARE REFORM].

41. *Id*. at 228.

42. *See* MJ Lee & Tami Luhby, *Trump Issues Executive Order To Start Rolling Back Obamacare*, CNN (Jan. 20, 2017), http://www.cnn.com/2017/01/20/politics/trump-signs-executive-order-on-obamacare/.

43. *See* THE GUIDE TO HEALTHCARE REFORM, *supra* note 40, at 228.

44. *Id*.

45. HHS OIG Semiannual Report to Congress 1 (October 1, 2015 – March 31, 2016), https://oig.hhs.gov/reports-and-publications/archives/semiannual/2016/SAR_Spring_2016.pdf ("Medicare contractors are responsible for administering more than one-half of a trillion dollars in benefits each year.").

46. *Id*.

47. *Id*. ("Because the closeout process is generally the last chance for improper contract payments to be detected and recovered, delays in the closeout process pose a risk to Government funds.").

A. Defining the Ailment

Before analyzing any solution, one must first understand the evolution, scope, and future implications of the present problem. To be sure, it may be impossible to sufficiently define the Medicare "problem" given the sheer size of the program and the countless intricacies inherent in more than fifty years of development and expansion. The best jumping-off point may be a broad assessment of the American healthcare model that is so heavily influenced by Medicare policy and functionality.

As one author explains, the business of delivering healthcare has at least three distinguishing characteristics:

> [1] the centrality of a relationship *predicated upon trust* between a professional healthcare provider and a patient; [2] the unique potential for *vulnerability and compromised judgment* on the part of a patient who views her physician first and foremost as an advocate for and guardian of her best interests; [3] and the *myriad, integrated issues* of cost, quality, and access related to a finite supply of medical services and providers—all against the backdrop of a fundamental good, i.e., public health, *necessary* for the community to flourish.[48]

Immediately apparent is the juxtaposition of trust and integration with vulnerability and necessity.

Americans have great confidence in their personal physicians, but are unimpressed with the overall performance of the health care system.[49] Yet, this confidence may be unfounded. Under the fee-for-service ("FFS") Medicare system, "providers routinely omit indicated procedures of known value, they frequently perform treatments and surgeries that are unnecessary and inefficacious, and treatment patterns vary widely and for no good reason."[50] CMS recognized the prevalence of such practices and has initiated a move away from the fee-for-service model to a value-based care ("VBC") system for Medicare reimbursement.[51] Currently, about 30% of Medicare

48. Joshua E. Perry, *For Patients and Profits: Ethical Astuteness and the Business of Dialysis*, 2 BELM. L. REV. 37, 40-41 (2014) (citing Ezekiel J. Emanuel & Nancy Neveloff Dubler, *Preserving the Physician-Patient Relationship in the Era of Managed Care*, 273 JAMA 323 (1995)) (emphasis added).

49. David A. Hyman, *Does Medicare Care About Quality?*, 46 PERSP. BIO. & MED. 55, 56 (2003).

50. *Id.* at 57.

51. *Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume: Where We Are Now*, CMS (Jan. 26, 2015), https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2015-Fact-sheets-items/2015-01-26-3.html.

FFS payments are in some way tied to quality.[52] CMS has the goal of tying 85% of all Medicare fee-for-service to quality or value by 2016, and 90% by 2018.[53]

Unfortunately, the actual payment system for such services—whether they be based on volume or value—is entirely inefficient. A deluge of incompatible payment schemes, preadmission certification metrics, and regulatory directives severely throttles the fiscal efficacy of the Medicare payment system.[54] The 2014 Improper Payments Report indicated that Medicare FFS payment accuracy rate[55] was 87.3%,[56] which only slightly improved to 87.9% in 2015.[57] Between July 2013 and June 2014, Medicare paid an estimated $43.3 billion[58] for payments that were not covered by Medicare, improperly coded, or in violation of billing rules.[59]

To make matters much worse, the safety mechanisms currently in place to identify and reclaim these improper payments depend on third-party contractors, such as the Recovery Audit Contractors ("RACs")[60] for FFS payments, that work on a contingency-fee basis.[61] RACs are tasked with

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52. Letter from John Shatto, Director, Medicare & Medicaid Cost Estimates Group, to Rahul Rajkumar, Deputy Director, Center for Medicare and Medicaid Innovation (Mar. 3, 2016), https:// innovation.cms.gov/Files/x/ffs-apm-goalmemo.pdf.

53. Sylvia M. Burwell, *Setting Value-Based Payment Goals — HHS Efforts to Improve U.S. Health Care*, 2015 N. ENGL. J. MED. 897 (2015), http://www.nejm.org/doi/full/10.1056/NEJMp1500445?query=featured_home&.

54. *See* THE GUIDE TO HEALTHCARE REFORM, *supra* note 40, at 272.

55. The term "accuracy rate" refers to the percentage of Medicare FFS dollars paid correctly.

56. CTRS. FOR MEDICARE & MEDICAID SERVS., CMS MEDICARE FEE-FOR-SERVICE 2014 IMPROPER PAYMENTS REPORT 1 (2014), https://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/CERT/CERT-ReportsItems/Downloads/AppendicesMedicareFee-for-Service2015ImproperPayments Report.pdf.

57. CTRS. FOR MEDICARE & MEDICAID SERVS., CMS MEDICARE FEE-FOR-SERVICE 2015 IMPROPER PAYMENTS REPORT 1 (2015), https://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/CERT/Downloads/MedicareFeeforService2015ImproperPaymentsReport.pdf.

58. *See id*. at 4 (showing an overall total of $43.3 billion in incorrect payments for 2015 report).

59. *See id*. at 2 ("CERT contractor reviewers could not conclude that the billed services were actually provided, were provided at the level billed, and/or were medically necessary").

60. *See* CTRS. FOR MEDICARE & MEDICAID SERVS., STATEMENT OF WORK FOR THE RECOVERY AUDIT PROGRAM 2, https://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/Recovery-Audit-Program/Downloads/090111RACFinSOW.pdf ("Section 302 of the Tax Relief and Health Care Act of 2006 requires the Secretary of the Department of Health and Human Services (the Secretary) to utilize Recovery Auditors under the Medicare Integrity Program to identify underpayments and overpayments and recoup overpayments under the Medicare program associated with services for which payment is made under part A or B of title XVIII of the Social Security Act.").

61. *Id*. at 36 ("The Recovery Auditor will only be paid a contingency payment on the difference between the original claim paid amount and the revised claim paid amount.").

recovering overpayments and underpayments to providers under the FFS framework by auditing medical records and Medicare claims up to three years after the provision of services.[62] For every denied claim, a RAC earns up to a 12.5% commission on his or her recovery total.[63] This payment structure incentivizes RACs to deny even the most appropriate claims.[64] In one region, of those claims that providers appealed, approximately 98% of the RAC-identified overpayments under Medicare Part B were ultimately found to be valid payments.[65]

Speaking of appeals, the HHS Office of Medicare Hearings and Appeals ("OMHA") found that from 2011-2013, the claim and entitlement workload for its sixty-five Administrative Law Judges grew by 184%, accumulating a backlog of 460,000 claims.[66] In 2009, an appeal took an average of 94.9 days to process.[67] By the third quarter of 2016, the average processing time for an appeal was 935.4 days.[68] Given the current state of Medicare appeals, it is no surprise that, when a RAC issues a finding of improper payment under Part A of Title XVIII of the Social Security Act, based on the patient's assigned "status," some hospitals opt to forego an appeal and, instead, submit a Part B inpatient hospital claim.[69] And statistics reveal that providers rarely pursue appeals at all.[70]

While critics of Medicare may be able to appreciate the causes of many of these complex issues, there are some issues for which even Medicare supporters have a hard time reconciling. Year after year, Medicare continues to remit payment to dead beneficiaries, totaling $23 million in 2011 alone.[71]

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62. DEP'T OF HEALTH & HUMAN SERVICES, CONGRESS' LETTER TO THE HONORABLE KATHLEEN SEBELIUS 1 (Feb. 10, 2014), http://www.aha.org/content/14/140210-let-congress-hhs.pdf.

63. Bob Herman, *Medicare and Medicaid RACs in FY 2012: 8 Statistics*, BECKER'S HOSP. CFO REP., (Mar. 26, 2014), http://www.beckershospitalreview.com/finance/medicare-and-medicaid-racs-in-fy-2012-8-statistics.html.

64. *Id*.

65. Office of Inspector Gen., Medicare RACs and CMS's Actions to Address Improper Payments, Referrals of Potential Fraud, and Performance, Appendix A, 21 (Aug. 2013), https://oig.hhs.gov/oei/reports/oei-04-11-00680.pdf.

66. *See* CONGRESS' LETTER, *supra* note 62, at 1.

67. *Average Processing Time by Fiscal Year*, OMHA, http://www.hhs.gov/about/agencies/omha/about/current-workload/average-processing-time-by-fiscal-year/index.html.

68. *Id*.

69. Jessica L. Gustafson & Abby Pendleton, *Healthcare Providers and Suppliers Eagerly Anticipate Planned Improvements to Recovery Audit Program*, 11 ABA HEALTH ESOURCE, no. 6 (Feb. 2015), http://www.americanbar.org/publications/aba_health_esource/2014-2015/february/providers.html.

70. Alan J. Goldberg & Linda M. Young, *What Every CEO Should Know About Medicare's Recovery Audit Contractor Program*, 56 J. HEALTHCARE MGMT. 157, 159 (2011), http://aboutams.com/images/uploads/news/Trends-GoldbergYoung-JofHM_May-June_11.pdf.

71. OFFICE OF INSPECTOR GEN., MEDICARE PAYMENTS MADE ON BEHALF OF DECEASED BENEFICIARIES IN 2011 13 (Oct. 2013), https://oig.hhs.gov/oei/reports/oei-04-12-00130.pdf ("CMS has safeguards to prevent and recover Medicare payments made on behalf of

Similarly, Medicare consistently fails to ensure that illegal immigrants do not receive CMS funds, improperly paying nearly $9.3 million to unlawfully present individuals in 2013 and 2014.[72] While these findings shy in comparison to the billions in overall wasted Medicare funds, they do illuminate one of Medicare's overarching operational struggles: the entire system is built on a pay-and-recover model instead of a preemptive approach. Instead of detecting improper claims and anomalies prior to payment, the efficiency of the Medicare program depends primarily on post-payment audit and recovery initiatives, the majority of which are carried out by third-party contractors working on commissions.[73] Many HHS programs are attempting to tackle the improper-payment conundrum. But as long as they are structurally stuck with the low-ground, post-payment position, their offensive measures to recover lost funds will prevent them from ever gaining control of the situation.

B. Examining Current Initiatives

The federal government is aware of Medicare's payment failures and has pursued innumerable avenues for correcting the deficiencies. The most comprehensive attempt to fight fraud in federal healthcare programs is the Health Insurance Portability and Accountability Act ("HIPAA").[74] When Congress enacted HIPAA in 1996, it expanded the scope of healthcare fraud and abuse prevention in numerous ways.[75] First, HIPAA created the first secure source of federal funding to combat healthcare fraud.[76] Second, HIPAA increased the enforcement power of the federal government by

deceased beneficiaries; however, it inappropriately paid $23 million in 2011 after beneficiaries' deaths.").

72. OFFICE OF INSPECTOR GEN., MEDICARE IMPROPERLY PAID MILLIONS OF DOLLARS FOR UNLAWFULLY PRESENT BENEFICIARIES FOR 2013 AND 2014 i, (Sept. 2016), https://oig.hhs.gov/oas/reports/region7/71501159.pdf ("The Centers for Medicare & Medicaid Services did not always follow its policies and procedures to ensure that payments are not made for Medicare services rendered to unlawfully present beneficiaries, which resulted in $9.3 million of improper payments in 2013 and 2014.").

73. To be sure, Medicare and RACs do have some prepayment tools, such as the National Correct Coding Initiative (NCCI) Edits, Medically Unlikely Edits (MUEs), and Medical Review (MR). *See* CTRS. FOR MEDICARE & MEDICAID SERVS., MEDICARE CLAIM REVIEW PROGRAMS 5 (Sept. 2016), https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/MCRP_Booklet.pdf.

74. Health Insurance Portability and Accountability Act of 1996, Pub. L. No. 104-191, 110 Stat. 1936 (codified as amended at 42 U.S.C. § 1320a-7c (2012)) [hereinafter HIPAA].

75. *See* Philip Hilder & Lon Mullen, *HIPAA: Time for a Health Care Corporate Compliance Program*, 45 FED. LAW. 34 (1998) (examining HIPAA's context and implications).

76. The Act allocated nearly $120 million for fiscal year 1997 with a 15% increase each fiscal year until 2003. *See* DEP'T OF HEALTH & HUMAN SERVS., A COMPREHENSIVE STRATEGY TO FIGHT HEALTH CARE WASTE, FRAUD & ABUSE (2000), http://archive.hhs.gov/news/press/2000pres/20000309a.html [hereinafter HHS COMPREHENSIVE STRATEGY].

establishing programs to coordinate efforts and facilitate prosecution of healthcare fraud, waste, and abuse at both state and federal levels.[77] Additionally, HIPAA created the Medicare Integrity Program ("MIP") which authorizes HHS to enter into contracts with private entities to carry out Medicare investigational activities,[78] including fraud and abuse detection, utilization review, education, audits, provider payment determinations, and recovery of improper payments.[79]

Section 911 of the Medicare Modernization Act ("MMA") of 2003 required CMS to reform its Medicare contracts by replacing fiscal intermediaries and carriers with Medicare Administrative Contractors ("MACs") that will handle both the Part A and Part B programs in specified geographic regions.[80] MACs issue transmittals, bulletins, notices, and general instructions to providers in their designated areas to facilitate the administrative tasks of the Medicare program.[81] Working within the regulatory and statutory requirements, MACs have broad discretion to establish particular guidelines and procedures for remitting Medicare payments, including local coverage determinations, prior approval, utilization limits, specific documentation requirements, and the like.[82] However, MACs must adhere to various cost and performance standards[83] because consistently poor performance may lead to termination of their contract with HHS.[84]

The ACA was another progressive step toward solving the improper payment issue. Section 3021 of the ACA established the Center for Medicare and Medicaid Innovation ("Innovation Center") and appropriated $10 billion to support the Innovation Center through 2019.[85] The mission of the

77. HIPAA§ 201(a) (codified at 42 U.S.C. § 1320a-7c (2012)). For example, one such program established under HIPAA, the Health Care Fraud and Abuse Control Program, coordinates anti-fraud and abuse efforts at federal, state, and local levels under the direction of HHS, the Inspector General, and the Attorney General. HIPAA § 201(a) (creating joint anti-fraud program); *see also* HHS COMPREHENSIVE STRATEGY, *supra* note 76 (discussing use of coordinated efforts to fight health care fraud and abuse).

78. *See* HIPAA § 202(a) (codified at 42 U.S.C. § 1395ddd (2012)) (establishing the Medicare Integrity Program).

79. *See* A. Craig Eddy, *The Effect of the Health Insurance Portability and Accountability Act of 1996 (HIPAA) On Health Care Fraud in Montana*, 61 MONT. L. REV. 175, 201-02 (2000) (discussing the Medicare Integrity Program).

80. Medicare Prescription Drug, Improvement, and Modernization Act of 2003, P.L. 108-173 § 911, 117 Stat. 2378-2386 (adding section 1874A of the Social Security Act, 42 U.S.C. § 1395kk-1).

81. *See* 42 U.S.C.A. §§ 1395h, 1395kk-1 (2012).

82. *See id*.

83. *See id*.; *see also* GOV'T ACCOUNTABILITY OFFICE, MEDICARE ADMINISTRATIVE CONTRACTORS 2, 10 (2015), http://www.gao.gov/assets/ 670/669947.pdf.

84. *See* GOV'T ACCOUNTABILITY OFFICE, *supra* note 83, at 10*; see also* THOMAS C. FOX ET. AL, HEALTH CARE FIN. TRANSACTIONS MANUAL § 17:1, 954 (2016).

85. DEP'T OF HEALTH & HUMAN SERVICES, HHS FY2015 BUDGET IN BRIEF, CMS: CTRS. FOR MEDICARE & MEDICAID INNOVATION (2015), http://www.hhs.gov/about/ budget/fy2015/budget-in-brief/cms/innovation-programs/index.html.

Innovation Center is to test "innovative health care payment and service delivery models with the potential to improve the quality of care and reduce Medicare, Medicaid, and CHIP expenditures."[86] While the Innovation Center has leeway with many of its initiatives, Congress also assigned the program numerous specific models to implement, such as models for improvement in care delivery and payment and for the monitoring of Medicare effectiveness.[87]

HHS' commitment to reducing the incidence of improper payments should not be understated. It is exploring and implementing new measures to focus on prevention, with some initiatives focused on clarifying and simplifying policy, while others aim for more individualized education through more focused reviews.[88] However, before the preventative measures can truly have an impact, it is essential for HHS "to accurately account for where, how, and why these improper payments occur."[89] Answering such inquiries is a skill that HHS still struggles to acquire.[90]

C. Identifying the Vulnerabilities

Current approaches to detection and prevention of improper payments have seen some success, but they still function within a transactional architecture that, as a whole, suffers from serious vulnerabilities and inadequacies. In America's modern healthcare system, "the currency is data."[91] Although we live in an age where data is constantly created[92] and more readily available than ever before, the traditional structure of the healthcare marketplace hinders access to and transmutation of data.[93] Services received in the marketplace are disconnected from the payment for such services.[94] Healthcare providers frequently lack sufficient data on

86. *Id*.

87. *See* CTRS. FOR MEDICARE & MEDICAID SERVICES, ABOUT THE CMS INNOVATION CENTER (2016), https://innovation.cms.gov/About/index.html.

88. DEP'T OF HEALTH & HUMAN SERVICES, MEDICARE FEE-FOR-SERVICE, https://paymentaccuracy.gov/program/medicare-fee-for-service/ (last visited Sept. 4, 2017).

89. *Id*.

90. *See* James Swann, *Medicare Dinged for Failing to Lower Payment Error Rates*, HEALTH CARE ON BLOOMBERG L. (May 18, 2017), https://www.bna.com/medicare-dinged-failing-n73014451171/ ("[I]t's evident the improper payment rates are still higher than expectations and in some case higher than in 2015 . . . ").

91. Kristen Johns, *Blockchain Technology and Applications for Healthcare: A Conversation with Kristen Johns*, NASHVILLE MED. NEWS BLOG (Jan. 3, 2017), https://nashvillemedicalnews.blog/ 2017/01/03/blockchain-technology-and-applications-for-healthcare-a-conversation-with-kristen-johns/.

92. This is, perhaps, most noticeable with the increased prevalence of electronic medical records.

93. *See* Peter Chawaga, *Blockchain and Health Care's Future*, NASHVILLE POST MAG. (Dec. 8, 2016).

94. *Id*.

patients due to inefficiencies in—or utter lack of—interoperability between doctors and information systems.[95]

Underlying these issues is a regulatory agenda focused on transitioning to quality-based care.[96] The healthcare system was originally designed to facilitate episodic care, treating illnesses and injuries as they occur and reimbursing providers on a fee-for-service basis.[97] The majority of Medicare payments to physicians and hospitals are still primarily transacted on the volume of care provided, "with little or no emphasis on the quality or value of that care."[98] Studies have shown, however, that a higher volume of care does not equate to better or more effective care for patients.[99] Statistics such as these prompted legislators of the ACA to adjust the trajectory of care toward a system of value-based payment initiatives.[100]

Experimentation with new, value-based alternatives has been met with significant practical difficulties. First, there's the issue of defining and measuring "value" and "quality."[101] There are innumerable complexities inherent in any measurement of value or quality; and, when combined with the high level of subjectivity involved, it is nearly impossible to create a

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95. *Id*.

96. This regulatory transition is usually referred to as either quality-based purchasing (QBP) or pay-for-performance (P4P). P4P was developed as part of the evidence-based medicine movement, which argues that providers too often rely on their own judgment, because scientific evidence on the effectiveness of medical interventions is either unavailable or ignored. P4P attempts to use financial incentives to encourage providers to adhere more closely to evidence-based standards of care. *See* R. Brian Haynes, *What Kind of Evidence Is It That Evidence-Based Medicine Advocates Want Health Care Providers and Consumers to Pay Attention To?*, 2 BMC HEALTH SERVS. RES. 1 (2002), http://www.biomedcentral.com/content/pdf/1472-6963-2-3.pdf.

97. *See generally* Corbin Santo, *Walking A Tightrope: Regulating Medicare Fraud and Abuse and the Transition to Value-Based Payment*, 64 CASE W. RES. L. REV. 1377 (2014).

98. *See* MEDICARE PAYMENT ADVISORY COMM'N, REPORT TO THE CONGRESS: VARIATION AND INNOVATION IN MEDICARE 108 (2003), http://medpac.gov/docs/default-source/reports/June03_Entire_Report.pdf ("In the Medicare program, the payment system is largely neutral or negative towards quality. All providers meeting basic requirements are paid the same regardless of the quality of service provided. At times providers are paid even more when quality is worse, such as when complications occur as the result of error."); *see also* John E. Wennberg, Variation in Use of Medicare Services Among Regions and Selected Academic Medical Centers, Duncan W. Clark Lecture at New York Acad. of Med. (Jan. 24, 2005), *in* DARTMOUTH GEISEL SCHOOL OF MED. (highlighting the overuse of low-quality care and under-use of high-quality care in Medicare), http://geiselmed.dartmouth.edu/cfm/education/PDF/Wennberg_Article.pdf.

99. The Dartmouth Atlas Project found that "geography becomes destiny for Medicare patients." In higher-spending regions, more patients are hospitalized more frequently and see physicians more frequently. In contrast, patients receive less care, and Medicare spends less, in regions with relatively fewer medical resources. *See* Elliott Fisher et al., *Health Care Spending, Quality, and Outcomes: More Isn't Always Better*, DARTMOUTH INST. FOR HEALTH POL'Y & CLINICAL PRAC 2 (2009), http://www.dartmouthatlas.org/downloads/reports/Spending_Brief_022709.pdf.

100. *See* Santo, *supra* note 97, at 1383.

101. *Id*. at 1395.

uniform standard that will apply effectively and equally across America's diverse population.[102] Second, assuming the creation of a reasonable standard for quality care was practicable, the next challenge is the translation of quality measures into meaningful financial incentives.[103]

Even more important, for purposes of this Note, is the challenge of aggregating useful data necessary for facilitating a quality-based approach, and the difficulty of translating, exchanging, verifying, and updating such data.[104] A prerequisite for the success of any value-driven payment system is health information technology ("HIT")[105] that has widespread interoperability.[106] For over a decade,[107] the federal government has endeavored to develop a HIT architecture that will enable a national exchange platform for electronic health information.[108] Notwithstanding significant progress from many public and private collaborations focused on building a suitable framework and standards for adoption of interoperable HIT, the goal of widespread implementation is still a work in progress.[109]

Despite these numerous impediments that frustrate the departure away from the fee-based system, the current regulatory scheme has set a goal that, by the end of 2018, 50% of all Medicare payments be made through alternative payment models, such as value-based payments.[110] If this goal is to become a reality, it is paramount for CMS—and other HHS entities—to "develop appropriate cost and quality measures, to attribute these measures to the appropriate providers, and to collect the necessary data in a cost-

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102. Michael F. Cannon, *Pay-for-Performance: Is Medicare A Good Candidate?*, 7 YALE J. HEALTH POL'Y, L. & ETHICS 1, 4 (2007).

103. *Id*.

104. *See generally* Anne B. Claiborne et al., *Legal Impediments to Implementing Value-Based Purchasing in Healthcare*, 35 AM. J.L. & MED. 442, 471 (2009).

105. The GAO defines HIT as "technology used to collect, store, retrieve, and transfer clinical, administrative, and financial health information electronically." *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-04-991R, HHS'S EFFORTS TO PROMOTE HEALTH INFORMATION TECHNOLOGY AND LEGAL BARRIERS TO ITS ADOPTION 1 (2004), http://www.gao.gov/products/GAO-04-991R.

106. *See* Claiborne et al., *supra* note 104, at 448.

107. A Presidential executive order in 2004 established the Office of the National Coordinator for Information Technology ("ONC") to promote interoperable HIT at the national level. *See* Exec. Order No. 13,335, 69 Fed. Reg. 24,059 (Apr. 30, 2004).

108. *See* Claiborne et al., *supra* note 104, at 451.

109. *See id.* at 454. ("For example, ONC's plan to develop [a nationwide health information network] relies in part on connecting established regional organizations ("regional health information organizations" or "RHIOs") that share electronic health information across provider networks. Yet a recent survey of 145 RHIOs in the U.S. found that only 20 were "of at least modest size and exchanging clinical data.").

110. *Better Care. Smarter Spending. Healthier People: Improving Quality and Paying for What Works*, CTRS. FOR MEDICARE & MEDICAID SERVS (Mar. 3, 2016), https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2016-Fact-sheets-items/2016-03-03-2.html (explaining that CMS has a goal of tying 90% of Medicare FFS to quality by 2018); *see also* Burwell, *supra* note 53.

effective way."[111] To do so, there must be a database structure in place that will allow for the necessary uptake of data capture and storage without sacrificing the integrity, functionality, or confidentiality of such health information.

II. A BIT ABOUT BLOCKCHAIN

Hope for a data solution to alleviate the strain of Medicare improper payments may exist in the form of a promising new ledger technology. On October 3, 2016, hundreds of technology and healthcare innovators congregated in Nashville, Tennessee, for the first-ever conference on blockchain and its potential to revolutionize the healthcare industry.[112] The conference accompanied the explosion of blockchain technology in 2016 across industries that rely on data; which is so say, nearly every industry.[113] But any discussion of blockchain requires a basic understanding of the origins of its use in facilitating the transmission of digital currencies—the first, and most famous of which, is Bitcoin.

Put simply, Bitcoin is an electronic system facilitating payments from one party to another without the use of a financial intermediary, e.g., a bank.[114] More technically, "Bitcoin is an open source digital currency."[115] Advocates of Bitcoin frequently claim that it is as revolutionary today as were personal computers in 1975 and the Internet in 1993.[116] Despite Bitcoin's popularity—or, to some, infamy—the Blockchain system upon which it is built has erupted from its humble and abstract birth to gain notoriety for its lucrative potential as a practical data solution.[117]

The use cases for this cryptographic marvel go far beyond the financial realm. Blockchain "offers a way for people who do not know or trust each other to create a record of who owns what that will compel the

111. Kristin Madison, *Rethinking Fraud Regulation by Rethinking the Health Care System*, 32 HAMLINE J. PUB. L. & POL'Y 411, 424 (2011).

112. *See* Distributed: Health, (Oct. 3, 2016), https://godistributed.com/events/health-2016/.

113. *What is the Blockchain?* 3:2 YBITCOIN 52 (Sept. 12, 2016), https://issuu.com /ybitcoin/docs/volume_3__issue_2.

114. KEVIN C. TAYLOR, FINTECH LAW: A GUIDE TO TECHNOLOGY LAW IN THE FINANCIAL SERVICES INDUSTRY 12-2 (2014).

115. *Id*.

116. Marc Andreessen, *Why Bitcoin Matters*, N.Y. TIMES (Jan. 21, 2014, 11:54 am), https://dealbook.nytimes.com/2014/01/21/why-bitcoin-matters/.

117. *See The Promise of the Blockchain: The Trust Machine*, ECONOMIST (Oct. 31, 2015), http://www.economist.com/news/leaders/21677198-technology-behind-bitcoin-could-transform-how-economy-works-trust-machine ("The notion of shared public ledgers may not sound revolutionary or sexy. Neither did double-entry book-keeping or joint-stock companies. Yet, like them, the blockchain is an apparently mundane process that has the potential to transform how people and businesses co-operate.").

assent of everyone concerned. It is a way of making and preserving truths."[118] While blockchain technology nears the peak of the Hype Cycle,[119] business and governments around the world are engineering new ways to utilize this revolutionary data structure.[120]

Section A of this Part gives a brief overview of Bitcoin as a means of understanding the political and systemic undercurrent of blockchain. Then, Section B introduces the broader classification in which blockchain belongs: distributed ledger technologies. Finally, Section C explores related concepts that are integral to and have developed alongside blockchain systems.

A. The Bitcoin: Birth of the Blockchain

As with most technologies, to more fully understand and appreciate blockchain, it is useful to view it in the context of its origins and initial applications. Bitcoin is a burgeoning virtual currency[121] that, unlike traditional currencies, is not backed by a government or private institution and is without specie, such as coin or precious metal.[122] Instead, Bitcoin's operation relies on peer-to-peer networking and advanced cryptography.[123]

Blockchain's conception can be traced back to the 1990s, when a group of libertarian idealists began tinkering with the idea of cryptography as a solution for achieving privacy.[124] As described by its founder, Satoshi Nakamoto,

> [Bitcoin is] completely decentralized, with no central server or trusted parties, because everything is *based on crypto*

118. *Blockchains: The Great Chain of Being Sure About Things*, ECONOMIST (Oct. 31, 2015), http://www.economist.com/news/briefing/21677228-technology-behind-bitcoin-lets-people-who-do-not-know-or-trust-each-other-build-dependable.

119. *See Gartner's 2016 Hype Cycle for Emerging Technologies Identifies Three Key Trends That Organizations Must Track to Gain Competitive Advantage*, GARTNER (Aug. 16, 2016), http://www.gartner.com/newsroom/id/3412017 ("The Hype Cycle for Emerging Technologies report is the longest-running annual Gartner Hype Cycle, providing a cross-industry perspective on the technologies and trends that business strategists, chief innovation officers, R&D leaders, entrepreneurs, global market developers and emerging-technology teams should consider in developing emerging-technology portfolios.").

120. *See Gartner: Blockchain and Connected Home Are Almost At the Peak of the Hype Cycle*, PR WIRE (Aug. 16, 2016), http://prwire.com.au/pr/62010/gartner-blockchain-and-connected-home-are-almost-at-the-peak-of-the-hype-cycle.

121. *See* UNITED STATES DEP'T OF THE TREASURY FIN. CRIMES ENF'T NETWORK (FINCEN) RULING, FIN-2013-G001, APPLICATION OF FINCEN REGULATIONS TO PERSONS ADMINISTERING, EXCHANGING, OR USING VIRTUAL CURRENCIES 1 (March 18, 2013).

122. *See* Derek A. Dion, *I'll Gladly Trade You Two Bits on Tuesday for a Byte Today: Bitcoin, Regulating Fraud in the E–Conomy of Hacker–Cash*, U. ILL. J.L. TECH & POL'Y 165, 167 (2013).

123. *See* Dustin M. Monroy, *Bitcoin and Banks—A Primer*, 19 HAW. B.J. 14, 15 (2015).

124. Reuben Grinberg, *Bitcoin: An Innovative Alternative Digital Currency*, 4 HASTINGS SCI. & TECH. L.J. 159, 162 (2012).

> *proof instead of trust*. The root problem with conventional currency is all the trust that's required to make it work. The central bank must be trusted not to debase the currency, but the history of Fiat currencies is full of breaches of that trust. Banks must be trusted to hold our money and transfer it electronically, but they lend it out in waves of credit bubbles with barely a fraction in reserve. We have to trust them with our privacy, trust them not to let identity thieves drain our accounts . . . With e-currency based on cryptographic proof, without the need to trust a third-party middleman, money can be secure and transactions effortless.[125]

Since its inception in 2009, Bitcoin has facilitated approximately 62.5 million transactions between 109 million accounts.[126] The daily transaction volume, as of March 2015, was more than 200,000 bitcoins, which represents nearly $50 million at market exchange rates, with a total market value of $3.5 billion for all bitcoins in circulation. [127] The total amount of Bitcoins is capped at 21 million, creating resource scarcity that drives the price-setting market forces.[128]

The transactional system underlying Bitcoin is the cornerstone of its immense popularity and speedy adoption. In any digital transaction of currency or goods—let's call them "coins"—there is an expectation that, when the owner of the coins agrees to transfer them to a different owner, the recipient will remit to the sender the expected product or service in return.[129] The transactional model is destabilized if a sender is able, upon receipt of the expected product or service, to transmit a contradictory transaction that sends the same coin back to the sender.[130] This common loophole—known as a "double-spending attack"—allows an attacker to first confirm a transaction with a merchant, and then convince the transactional network to accept an alternate exchange, leaving the merchant without product or coins and the attacker with both.[131] The sum of the problem is synchronization: a need for an indication of transactional finality that thwarts conflict between transactions.[132]

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125. Maria Bustillos, *The Bitcoin Boom*, NEW YORKER (Apr. 1, 2013), http://www.newyorker.com/tech/elements/the-bitcoin-boom (emphasis added).

126. Rainer Böhme et al., *Bitcoin: Economics, Technology, and Governance*, 29 J. ECON. PERSP. 213-14 (2015), https://www.aeaweb.org/articles?id=10.1257/jep.29.2.213.

127. *Id*.

128. *See* Danton Bryans, Note, *Bitcoin and Money Laundering: Mining for an Effective Solution*, 89 IND. L.J. 441, 446 (2014).

129. Meni Rosenfeld, *Analysis of Hashrate-Based Double-Spending* 2 (Dec. 11, 2012), https://bitcoil.co.il/Doublespend.pdf.

130. *Id*.

131. *Id*.

132. *Id*. ("Given two conflicting transactions, it does not really matter which of them will be accepted, as long as there is a way to know that one transaction has been accepted and can no longer be reversed.").

Through a "proof-of-work" ("POW") process, Bitcoin's transactional structure provides protection against double-spending attacks.[133] In the Bitcoin POW system—referred to as "mining"—data is replicated and shared across a decentralized network.[134] This is where the Blockchain arrives, housing the authoritative ledger of transactions to establish exactly who owns what.[135] To better explain the Blockchain, it is helpful to walk through the steps of a Bitcoin transaction.

First, Bitcoin utilizes a public key infrastructure ("PKI") mechanism. The use of public addressees and private keys is central to the functionality of bitcoin.[136] Each user is assigned a pair of public and private keys.[137] In the same way that banks identify a person's account through a unique series of numbers, an alphanumeric string—known as a public key—serves as the outward-facing destination address for an individual's Bitcoin account or "wallet."[138] Like most bank accounts that have a PIN or a password, each Bitcoin owner has a private key for authorizing transfer of Bitcoin to the public address (i.e. from one wallet to another).[139] Each Bitcoin is really just a chain of digital signatures. Thus, the Bitcoin transaction consists of a coin owner digitally signing over the history of a coin (a cryptographic "hash" of its previous transactions) to the public key of the next owner, all of which is added to the coin's string of historical transactions.[140]

Second, after approximately ten minutes, the transaction is written in a block. Each block references a previous block by including in its header the authentic identification hash of the earlier block. Thus, the blocks form a chain: the very first block—the "genesis block"—as the primary root, and each subsequent block as a child of the block that it references.[141] The entire chain of blocks, including the time-stamped information regarding every transaction ever made, are recorded on the disk storage of the so-called "miners".[142]

Third, the miners validate the correctness of new, incoming transactions by comparing them to the ledger of the previous block and its

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133. *Bitcoin Developer Guide Payment*, Subsections *Payment Processing, Verifying Payment*, https://bitcoin.org/en/developer-guide#verifying-payment.

134. Carl. L. Reyes, *Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation: An Initial Proposal*, 62 VILL. L. REV. 191, 198 (2016).

135. Christidis & Devetsikiotis *supra* note 23, at 2293.

136. Jess Yli-Huumo et al., *Where is Current Research on Blockchain Technology—A Systematic Review*, PLOS ONE2 (Oct. 3, 2016), http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0163477.

137. Max I. Raskin, *Realm of the Coin: Bitcoin and Civil Procedure*, 20 FORDHAM J. CORP. & FIN. L. 969, 975 (2015).

138. Reyes, *supra* note 134, at 200.

139. *Id*.

140. *See* Nakamoto, *supra* note 15, at 2.

141. Rosenfeld, *supra* note 129, at 2.

142. These miners are also referred to as users and "nodes." *See* Yli-Huumo et al., *supra* note 136, at 3.

information.[143] Instead of a purely democratic model of validation, the Bitcoin network utilizes a puzzle-solving process.[144] Miners are incentivized[145] to expend significant computational effort to solve complex mathematical problems in order to process the validation request.[146] This POW process is intended to protect against the "Sybil attack", where a single entity could seize control of the network and influence the data structure to favor its interests.[147] When the miners successfully confirm all the transactions, a distributed consensus exists—a unique, authoritative, transactional chronology.[148]

As with any disruptive innovation, the positive aspects of Bitcoin must be weighed against a number of potential downsides. As one scholar explained,

> The benefits for users of Bitcoin include user anonymity, low transaction costs, no foreign exchange fees, greater financial inclusion (e.g. those who may not be able to acquire traditional banking services), and not being subject to the influence of central authority or governments like traditional currencies. Drawbacks for Bitcoin users include price volatility, technological dependence, potential for losses due to hacking, no FDIC backing, no recourse due to the anonymity (e.g. refunds, exchanges), and the ability to finance illicit activity. The current market for Bitcoin compared to the broader economy is small, but growing.[149]

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143. *Id*.

144. *See id*.

145. *See* Lulu Chang, *Mining for Bitcoins Just Got a Lot Harder*, DIGITAL TRENDS (July 10, 2016), http://www.digitaltrends.com/computing/bitcoin-mining-reward/#ixzz4Pj354Ngj ("[Miners] run tens of thousands of computers at all hours of the day in order to process blocks of the latest bitcoin transactions, with rewards coming in the form of new bitcoins. In effect, these miners keep tabs on and validate the 225,000 bitcoin transactions that occur on a daily basis, and as a result, continuously increase the amount of currency in circulation (the current value of which is estimated to be $10 billion).").

146. Reyes, *supra* note 134, at 198.

147. *See* Christidis & Devetsikiotis, *supra* note 23, at 2294; *see also* Rosenfeld, *supra* note 129, at 2 ("By linking the blocks to form a chain, the total work spent on any transaction is perpetually increasing, making it difficult to elevate any conflicting transaction to the same confirmation status without a prohibitive computational effort.").

148. *See* Tsung-Ting Kuo & Lucila Ohno-Machado, *ModelChain: Decentralized Privacy-Preserving Healthcare Predictive Modeling Framework on Private Blockchain Networks* (2016), https://www.healthit.gov/sites/default/files/10-30-ucsd-dbmi-onc-blockchain-challenge.pdf ("[G]iven that the probability that an honest node finds then next block is larger than the probability that an attacker finds the next block, the probability the attacker will ever catch up drops exponentially as the number of the blocks by which the attacker lags behind increases.").

149. *See* Monroy, *supra* note 123, at 15.

Understanding Bitcoin in the transactional sense can assist with visualization elements necessary for contemplating other applications of the underlying structure. But Bitcoin is only the first implementation of blockchain technology as a tool of distributed consensus. Blockchain itself is where the true value for the healthcare industry lies.

B. The Backbone: Decentralized Ledger Technologies

Although blockchain technology was introduced alongside Bitcoin as a solution to the double-spending problem,[150] the blockchain data structure has independent significance aside from its cryptocurrency counterpart. Basically, blockchain is like an operating system ("OS") and Bitcoin is but one program running on top of the OS framework. And just as Windows, Mac, and Linux are each different forms of operating systems, the Blockchain is only one varietal of a class of technologies known as decentralized public ledgers.[151] Regulatory activity has, nevertheless, focused chiefly on the virtual currency applications of the decentralized ledger technology ("DLT"), with a majority of such attention on Bitcoin.[152]

From a broad perspective, the Blockchain is simply one form of a DLT; a distributed, tamper-proof public ledger of time-stamped transactions. The technology can be used to share this ledger of transactions across a network of users without control by any single entity. A DLT simplifies the creation of "cost-efficient commercial relationships where virtually anything of value can be tracked and traded without requiring a central point of control."[153] Trust is established on a DLT through mass collaboration and ingenious technological design—not through the traditional intermediaries, e.g., banks and private companies.[154] To secure the data involved and ensure privacy of such transactions, the DLT enables a cryptographic one-way hashing process to "tokenize" the identities of the transactional participants.[155]

Many projects have followed in the footsteps of the Blockchain, building upon the central premise by expanding functionality and versatility for innumerable applications across a spectrum of industries.[156] These

150. *See generally* Rosenfeld, *supra* note 129.

151. *See* Reyes, *supra* note 134, at 196.

152. *Id*. at 202.

153. IBM, *Blockchain: The Chain of Trust & Its Potential to Transform Healthcare—Our Point of View* 1 (2016), https://www.healthit.gov/sites/default/files/8-31-blockchain-ibm_ideation-challenge_aug8.pdf.

154. Don Tapscott & Alex Tapscott, *The Impact of the Blockchain Goes Beyond Financial Services* (May 10, 2016), https://hbr.org/2016/05/the-impact-of-the-blockchain-goes-beyond-financial-services#.

155. Kyle Culver, *Blockchain Technologies: A Whitepaper Discussing How the Claims Process Can Be Improved* 5 (2016), https://www.healthit.gov/sites/default/files/3-47whitepaperblockchainforclaims_v10.pdf.

156. For example, in the cryptocurrency arena, as of January 25, 2017, there are 713 alternative virtual currencies that have been created based upon the Bitcoin architecture. *See*

projects have mainly followed three approaches when building advanced applications: using scripting on top of an existing blockchain, engineering a meta-protocol on top of an existing blockchain, or engineering an entirely new blockchain.[157] The third option—engineering a new blockchain—grants developers "unlimited freedom in building a feature set, but at the cost of development time, bootstrapping effort and security."[158]

Ethereum is an example of an initiative that built a new DLT for the purpose of expanding the possibilities for the blockchain model.[159] Ethereum is a "programmable blockchain" that incorporates many of the same features and technologies of the Bitcoin Blockchain while forging a new level of adaptability and flexibility.[160] Specifically, Ethereum is designed to allow creation of complex solutions that integrate "smart contracts,"[161] which are discussed in detail below.

Blockchains are just the jumping-off point for the future of DLT and have prompted corporations and governments to reimagine the entire architecture and infrastructure of the evolving digital world. In many cases, centralized networks remain a preferred solution.[162] But the industries that have the most to gain from the DLT revolution are those that depend on centralized authority and trusted intermediaries to facilitate transactions—such as the healthcare system.[163]

C. The Buzz: Collateral Concepts

Just as Bitcoin is only one possible application built on the Blockchain system, there is an innumerable variety of DLT applications, most of which have no direct relation to virtual currency or the financial industry.[164] As discussed above, regulatory initiatives have primarily focused on payment and currency applications for DLTs. This is problematic, however, because strict regulations have the potential to hamper even those

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CryptoCurrency Market Capitalizations, COINMARKETCAP.COM, https://coinmarketcap.com/all/views/all/ (last visited Jan. 25, 2017).

157. *See A Next-Generation Smart Contract & Decentralized Application Platform* (White Paper), GITHUB, https://github.com/ethereum/wiki/wiki/White-Paper#alternative-blockchain-applications.

158. *Id*.

159. *See What is Ethereum*? (2016), http://ethdocs.org/en/latest/introduction/what-is-ethereum.html; *see also* ETHEREUM, https://ethereum.org (last visited Sept. 8, 2017).

160. *What is Ethereum*?, http://ethdocs.org/en/latest/introduction/what-is-ethereum.html.

161. *See* Lance Koonce, *The Wild, Distributed World: Get Ready for Radical Infrastructure Changes, From Blockchains to the Interplanetary File System to the Internet of Things*, 28 No. 10 INTELL. PROP. & TECH. L.J. 3, 3 (Oct. 2016).

162. *Id*. at 4.

163. *Id*.

164. *See* Reyes, *supra* note 134, at 199.

DLT applications that do not fit a financial services model.[165] An examination of these collateral technologies illustrates the need for differentiation and specialized treatment based on the particular function and purpose of such applications. For purposes of this Note, there are two collateral concepts that would likely play a large role in any blockchain solution for federal healthcare payments: smart contracts and sidechains.

Smart contracts[166] are one of the most talked-about DLT applications in the legal industry, and for good reason. Smart contracts use distributed databases to allow parties to "confirm that an event or condition has in fact occurred without the need for a third party."[167] The result is "digital, computable contracts where the performance and enforcement of contractual conditions occur automatically, without the need for human intervention.[168]

A smart contract is created when traditional contract terms are coded and uploaded to a DLT.[169] This produces a decentralized, digital agreement that does not rely on an intermediary for recordkeeping or enforcement.[170] Contracting parties are thus enabled to structure their relationships more efficiently, forging self-executing deals that are void of any linguistic ambiguity.[171] Additionally, whenever real-world data triggers a certain condition in a smart contract (e.g., the price of a particular stock at a given time) agreed-upon external systems—known as "oracles"—can be developed to keep track of such triggers.[172] Many of these contractual triggers will be measured by Internet enabled devices and relayed through machine-to-machine communications, the facilitation of which will rely on the underlying DLT.[173]

For example, a Los Angeles wholesale meat distributor (A) enters into a smart contract with a Japanese Kobe beef producer (B). The underlying contract code conditions automatic payment from A's bank account into B's account upon the following: (i) the beef will be loaded on the cargo vessel prior to [X timestamp], (ii) the temperature of the beef will remain between

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165. *Id*. at 203; *see* Jerry Brito et al., *Bitcoin Financial Regulation: Securities, Derivatives, Prediction Markets, & Gambling*, 16 COLUM. SCI. & TECH. L. REV. 144 (2014) ("The next major wave of Bitcoin regulation will likely be aimed at financial instruments, including securities and derivatives, as well as prediction markets and even gambling."); *see e.g*., U.S. DEP'T OF TREASURY, FINCEN, ADMIN. RULING, FIN-2013-G001, *Application of FinCen's Regulations to Persons Administering, Exchanging, or Using Virtual Currencies* 5 (2013), https://www.fincen.gov/statutes_regs/guidance/pdf/FIN-2013-G001.pdf.

166. Smart contracts are also called "self-executing contracts," "blockchain contracts," or "digital contracts."

167. Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology & the Rise of Lex Cryptographia* 10 (2015), https://ssrn.com/abstract=2580664.

168. *Id*. at 10-11.

169. Bradley Cohen, *The Blockchain Revolution, Smart Contracts & Financial Transactions*, 21 No. 5 CYBERSPACE LAWYER NL 3 (June 2016).

170. *Id*.

171. Wright & De Filippi, *supra* note 167, at 11.

172. *See* Cohen, *supra* note 169, at 3-4.

173. *See* Wright & De Filippi, *supra* note 167, at 8.

[specified range], and (iii) land carrier will deliver to A's warehouse at [specified coordinates]. Utilizing the Internet of Things,[174] various internet-enabled devices will follow the shipment and upload data to the DLT. One of B's employees will verify delivery to the vessel via a handheld device. A GPS locator on the product packaging, along with the ship's GPS device, will confirm that the location of the beef matches the location of the vessel. A wifi-enabled thermometer accompanying the product will track the temperature along the voyage. If the meat temperature deviates from the specified range, the smart contract will not remit payment from A to B. The digital contract will likewise refuse payment if any of the other variables fall outside the set parameters, such as the shipment arriving to the vessel late.[175]

Currently, smart contract applications are still in their infancy, with the majority of actual uses limited to the automatic execution of derivatives, futures, swaps, and options.[176] But the research and development of use cases is growing exponentially.[177] Numerous projects are aiming to develop smart contract programming languages to facilitate the creation of increasingly sophisticated and diverse agreements.[178]

Sidechains are another example of innovation that has resulted from the development and expansion of DLT.[179] Over the years, the Bitcoin ecosystem has grown tremendously. With this growth came concerns that the Blockchain network was not expanding at a sufficient rate due to a cap on the allowable block size. It was out of these concerns that the concept of a sidechain emerged.[180]

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174. *See generally* Susan D. Rector, *'Internet Of Things' Protocols: Past And Future Trends*, LAW360 1 (Oct. 12, 2016) (defining Internet of Things as an "interconnected world involv[ing] the networking of personal devices, vehicles, appliances, buildings and other everyday objects embedded with electronics, software, sensors and network connectivity to enable them to exchange data with the internet and /or with each other.").

175. This hypothetical is based on an example from a presentation by Joshua Rosenblatt for the "*BLES & HLS Present: Blockchain, Healthcare, and the Law*" event at Belmont University College of Law on September 28, 2016.

176. *See* Wright & De Filippi, *supra* note 167, at 11.

177. *See e.g.*, Timothy Nugent, David Upton, Mihai Cimpoesu, *Improving Data Transparency in Clinical Trials Using Blockchain*, F1000RESEARCH 2 (2016) ("We propose a private, permissioned Ethereum blockchain network maintained by regulators (e.g. MHRA, FDA), pharma and contract research organisations [SIC] (CROs), to be used in parallel with traditional clinical data management systems (CDMS), framing the process as a transactional inter-organisational [SIC] record keeping model between untrusted.").

178. For example, the Solidity tool "is a contract-oriented, high-level language whose syntax is similar to that of JavaScript and it is designed to target the Ethereum Virtual Machine (EVM)." *See* READTHEDOCS, https://solidity.readthedocs.io/en/develop/ (last visited Sept. 8, 2017.

179. *See generally* Adam Back et al., *Enabling Blockchain Innovations with Pegged Sidechains*, https://blockstream.com/technology/sidechains.pdf.

180. *See* Sarah Jenn, *What is a Blockchain Sidechain All About?*, NEWSBTC (June 11, 2015), http://www.newsbtc.com/2015/06/11/what-is-a-blockchain-sidechain-all-about/.

In basic terms, "[a] sidechain[181] is a blockchain that validates data from other blockchains and enables bitcoins and other assets to be transferred between blockchains, fostering a new, open platform for innovation and development."[182] Engineers of sidechains can structure them in such a way as to increase the level of centralization, allowing for a greater degree of permissioned use and control of transactions on the sidechain.[183] Sidechains also allow communication and transactions to occur between two or more blockchains, while also permitting a greater degree of experimentation without the need to create an entirely separate structure.[184]

Smart contracts and sidechains increase the viability of decentralized applications by expanding the possibilities for applications in nearly every data-dependent industry. Smart Contracts emulate the responsibilities of a trusted administrator, improving the transparency of data and protecting the integrity of transactions from manipulation.[185] Sidechains work in concert with other systems and blockchains, creating "the opportunity for new models of trust" and a potential platform for the development of interoperable protocols.[186]

Given its general-purpose data structure, the blockchain technology and the innovations that surround it are not limited to the financial industry. Healthcare is an industry that suffers from many of the very maladies and inefficiencies[187] that blockchains are intended to remedy. If approached in an inclusive and collaborative manner, blockchain applications may restore trust and forge interoperability within the federal healthcare payment infrastructure, along with providing for the evolution in data collection and transmutation necessary for the shift from volume to value.

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181. A sidechain may also, in some contexts, be referred to as a "pegged sidechain". However, the two are technically different. Unlike a basic *sidechain* which only validates data from other blockchains, "a *pegged sidechain* is a sidechain whose assets can be imported from and returned to other chains; that is, a sidechain that supports two-way pegged assets." *See* Back et al., *supra* note 179, at 8.

182. BLOCKSTREAM, https://blockstream.com/technology/.

183. *See* Kyle Croman et al., *On Scaling Decentralized Blockchains (A Position Paper)* at 12, http://www.tik.ee.ethz.ch/file/74bc987e6ab4a8478c04950616612f69/main.pdf. ("Sidechains can potentially have a lower degree of decentralization than the top-level blockchain.").

184. *See generally* Richard G. Brown, *A Simple Explanation of Bitcoin "Sidechains"* (Oct. 26, 2014), https://gendal.me/2014/10/26/a-simple-explanation-of-bitcoin-sidechains/.

185. Nugent et al., *supra* note 177, at 2.

186. *Our Vision: An Ecosystem of Financial Networks*, Blockstream, https://blockstream.com/about/.

187. *See* Ashish Sharma, Ravi Shankar, & Kaiwen Zhong, *Opportunities For Blockchain In Healthcare And Pharma*, ETTECH (Aug. 30, 2017), http://tech.economictimes.indiatimes.com/news/technology/opportunities-for-blockchain-in-healthcare-and-pharma/60290193 (Identifying issues in healthcare—such as inconsistent data standards, lack of compatibility across systems, varying rules and permissions impeding efficient access, and inefficiency due to multiple patient identifiers across the network—all of which are major pain points that could be alleviated through a blockchain solution).

III. A THEORY OF TOGETHERNESS

While scholars and innovators have proposed numerous potential use cases for blockchain in healthcare,[188] the growth of DLTs has developed alongside a transition in political power and a regulatory agenda that will be focused on cost-effectiveness.[189] The notion of cost-benefit analysis in the healthcare industry has been consistently rejected by legislators[190] due to the negative implications associated with cutting or limiting federal healthcare entitlement programs.[191] Thus, regulators tend to focus on measures that will decrease inefficiencies and waste. But any novel technological solution, if it is to be successful in gaining approval through the political process, must be grounded in efficiency and cost-effectiveness.[192]

As such, this Note approaches the potential use of blockchain as a solution for the healthcare industry by focusing on a persistent problem in a "high risk" arena which, by its very nature, lends itself to a data-driven solution: Medicare improper payments. The issue of improper payments is one that centers around a lack of data integrity, due in part to a structure that fails to provide effective interoperability between providers and payers. This Note proposes the creation of a permissioned Ethereum blockchain network, the implementation of which will involve a three-step legislative and administrative process.[193]

Section A of this Part details the basic ideation for a federal blockchain system that will enable transactions involving federal healthcare

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188. *See e.g.*, OFF. NAT'L COORDINATOR, *supra* note 26.

189. *See* Jennifer Jacobs & Eric Wasson, *Trump Budget Pick Seeks Entitlement Cuts as Urgent Step on Debt*, BLOOMBERG POLITICS (Jan. 24, 2017), https://www.bloomberg.com/politics/articles/2017-01-24/trump-budget-director-says-national-debt-needs-action-quick ("President Donald Trump's pick for budget director, Mick Mulvaney, said Tuesday the nearly $20 trillion national debt needs to be 'addressed sooner rather than later' and that he would push Trump to break his campaign promises and cut Social Security and Medicare.").

190. Peter J. Neumann, Allison B. Rosen, & Milton C. Weinstein, *Medicare and Cost-Effectiveness Analysis*, 353 NEW ENGL. J MED. 1516, 1519 ("Opposition from interest groups remains strong. Politicians rarely, if ever, mention limits or rationing when discussing Medicare policy. Still, there are concrete steps that could be taken toward the use of cost-effectiveness analysis for Medicare.").

191. *See e.g.*, John Geyman, *Cost Effectiveness Analysis (CEA) in U. S. Health Care—Long Overdue*, HUFFINGTON POST (June 17, 2016); Bob Cesca, *Keep Your Goddamn Government Hands Off My Medicare*, HUFFINGTON POST, (Sept. 5 2009), http://www .huffingtonpost.com/bob-cesca/get-your-goddamngovernme _b_252326.html.

192. *See* Peter R. Orszag & Ezekiel J. Emanuel, *Health Care Reform and Cost Control*, 363 NEW ENGL. J MED. 601 (Aug. 12, 2010) ("As concerns appropriately mount about the nation's medium- and long-term fiscal situation, critics of the ACA have resurrected doubts about its cost-containment measures and overall fiscal impact.").

193. Although some may suggest a market-based approach for a blockchain solution is more appropriate, American healthcare regulation has evolved in a manner that refutes many of the traditional attributes of the free market. *See generally* Madison, *supra* note 111. As such, this Note approaches a solution under a methodology that is consistent with the federal government's reliance on regulation, but which allows for market participants and industry stakeholders to participate in the design, engineering, and implementation of such solution.

entitlements, facilitate more efficient payments, and support further implementation of quality-based initiatives. Section B sets forth necessary implementation steps for Congress and HHS. Section C details the strengths and weaknesses of any application of DLT within the Medicare claims and payment infrastructure.

A. Ideation of a DLT Solution

The solution that this Note proposes is not a complete elucidation or a precise algorithmic Band-Aid to heal the festering wound of Medicare improper payments, nor is it meant to be a quick or convenient fix. Instead, it is a functional approach to healthcare payment regulation and architecture that takes into account the ever-evolving nature of the industry and disruptive technologies. By leveraging existing blockchain technologies and interoperability standards, the proposed solution involves a three-stage process: (1) creating the foundational blockchain system, (2) engineering various applications on top of the blockchain, and (3) structuring the data relationships.[194]

For a blockchain solution to exist, a threshold requirement is deciding which blockchain to utilize, or whether it is more practical to create an entirely new chain. Each option has its benefits and pitfalls, but the ultimate decision should be based on the same cost-effectiveness analysis that drives the overall solution. Thus, although this Note maintains that a solution built upon the existing Ethereum blockchain will most likely be the most cost-effective option, Congress and HHS may discover—through the solicitation of proposals—that creation of a separate blockchain is either more efficient or otherwise desirable over any DLT that currently exists.

Ethereum stands out among the other blockchains for three main reasons. First, although it has a cryptocurrency[195] underlying the data structure, it was specifically built to be a next-generation, decentralized application platform.[196] Second, the Ethereum network has superior scalability due to a block time[197] that is significantly faster than Bitcoin's Blockchain and an anticipated processing capability of 10,000 transactions per block.[198] Third, Ethereum allows for more elaborate data encryption techniques, such as zero-knowledge proofs and homomorphic encryption to

194. This three-stage development correlates with the three-step regulatory plan that follows in Section B. Thus, many of the aspects of the solution are driven by the endogenous and functional approach that Section B posits.

195. The Ethereum cryptocurrency is called "ether." *See What Is Ether?*, https://www.ethereum.org/ether.

196. Nugent, *supra* note 177, at 2.

197. As of January 25, 2015, the average time between blocks on the Bitcoin blockchain is 9.08 minutes, while the Ethereum average block time is 14.70 seconds. *See id.*; *Cf.* ETHEREUM STAT., https://ethstats.net/; BITCOIN CURRENCY STAT., https://blockchain.info/stats.

198. Nugent, s*upra* note 177, at 2.

ensure data security.[199] These features translate into a blockchain foundation that will facilitate faster transaction speeds with larger transaction volume and a greater degree of protection against security incidents—all of which will be vital to the exchange of data to process federal healthcare payments.

The second step for the setup of the solution architecture, regardless of the regulatory choice as to the type of blockchain foundation, involves engineering the necessary applications that will layer on top of the blockchain. An issue that must be taken into account prior to any development of the applications is the determination as to which parties will have access to the application. Initially, there are three groups of stakeholders that will most likely need access: government, providers, and contractors. The government and provider access is obvious given they are the two parties transacting business. But contractors, such as CMS contractors and healthcare clearinghouses, will also require access due to their crucial role in facilitating the processing and auditing of claims and payments. In the future, assuming the blockchain solution is successful, new applications may be integrated, or the original application altered, to expand access to groups such as patients[200] and private payers.[201]

Once access is decided, smart contracts need to be created and integrated. These smart contracts will contain the logic required to automate the terms and conditions that predicate payment between the government entitlement programs and the provider based on the particular patient's eligibility and coverage. These smart contracts, once implemented on the blockchain, are automatically executable and will be fully transparent to the stakeholder groups.[202] The submission of a claim by a provider will correlate with the smart contracts in place between that provider and the federal government and will autonomously apply the most up-to-date payment metrics to the transaction.

Such an exchange of claim information must be premised on the existence of sufficient security structures and protocols. Two security measures are proposed that will provide the necessary level of data privacy and security. First, the patient and provider identities will be "tokenized"

199. *Id*.

200. The blockchain structure could enable patient health records to be updated to reflect and include certain health data measurements recorded by wearable devices, such as smart watches and smart phones.

201. Private payers may eventually require access to the payment application to verify Medicare and Medicaid coverage, especially under the Medicare Advantage program, which partners with private insurers to provide beneficiaries with alternative coverage options.

202. Culver, *supra* note 155, at 5; *See* Kathi Vian, Alessandro Voto, & Katherine Haynes-Sanstead, *A Blockchain Profile for Medicaid Applicants and Recipients*, INSTITUTE FOR FUTURE 3 (Aug. 8, 2016), https://www.healthit.gov/sites/default/files/14-38-blockchain_medicaid_solution. 8.8.15.pdf ("[B]y thinking of the blockchain profile simply as a broker that can answer questions about you as the need arises, your identity remains distributed. No one can ever see everything about you at once, including yourself.").

through a cryptographic one-way hash that is similar to the Bitcoin blockchain method.[203] As one scholar described,

> An example of the patient inputs would be "Health Plan Company Identifier + Member Id + DOB + First Name + Last Name". Tokenizing these properties would allow for patients to be uniquely identified by the health plan and provider. Using this design, a patient's token would change as the health plan information changed so one user is not tightly coupled to the same token. Loose coupling reduces the impact of a security breach because a compromised token would be limited to a specific time range.[204]

The second security measures involves structuring the storage and access mechanisms in a manner that keep the majority of a patient's private and identifying health information on traditional databases.[205] This data will then be associated with the tokenized identities on the blockchain, which will serve as a doorkeeper and administrator.[206] By using "off-chain" storage of sensitive health information with access granted via a secure hash function stored on the blockchain, both the data at rest and access to such data will remain secured.[207]

The third phase of development centers around organizing the duties, relationships, and permissions of stakeholders in relation to the utilization, creation, alteration, and dissemination of data. While the first two phases implement the basic structure necessary to perform the basic government healthcare payment transaction, the purpose of the third phase is to setup a regulatory and contractual scheme that will support current initiatives and future innovation. This will require collaborative decision-making to reach a consensus on various questions surrounding the flow of information, such as the specific data elements permitted on the blockchain and a set of uniform audit-logging functions. Although this third phase is crucial to any workable solution, it is hard to predict how such relationships should be structured at such an early stage of blockchain development. Thus, while the third stage is briefly mentioned here, the ultimate actors—from both the public and private spheres—are yet to be determined, but their symbiosis will be invaluable to creating a sustainable and viable solution.

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203. Culver, *supra* note 155, at 5.

204. *Id*. at 6.

205. *See* C. Brodersen et al., *Blockchain: Securing a New Health Interoperability Experience*, ACCENTURE LLP 4 (Aug. 2016), https://www.healthit.gov/sites/default/files/2-49-accenture_onc_ blockchain_challenge_response_august8_final.pdf.

206. *Id*.

207. *Id*.

B. Regulatory Implementation

To accomplish the three-phase development of the proposed blockchain solution, Congress and the various agencies under HHS should follow a corresponding three-step regulatory roadmap. First, Congress should pass a legislative measure requiring HHS and its subsidiary agencies,[208] through negotiated rulemaking,[209] to engineer—and promulgate rules governing—a blockchain solution for federal healthcare payments. Second, HHS and its relevant subsidiaries should solicit a request for proposals ("RFP") regarding the creation of a blockchain substrate, collaborating with the industry leaders to devise the requisite applications for implementing a workable and scalable blockchain system. Third, these same regulators will need to work with existing contractors and clearinghouses to develop the standards underlying security and exchange of health data.

The overarching theme of this regulatory path challenges the traditional dichotomy between self-regulation[210] and government regulation. The emergence of DLT applications in healthcare is likely to involve a situation where neither regulatory choice effectively incentivizes industry stakeholders to prevent the market and governance failures that are of primary concern to regulators. State regulation is likely to take an increasingly aggressive approach by imposing dramatic regulatory barriers, even when the ultimate goal is aimed at alleviating current pitfalls in the system. And self-regulation may take an overly hands-off approach that will open the door to more fraud and abuse of the DLT solution. This Note suggests an alternative course based on the hybrid approach of endogenous regulation.

An "endogenous[211] model of regulation" encourages lawmakers to engage in a concerted effort to administer "from within and without, and sidesteps the *ex ante/ex post* regulatory choice by building compliance into the protocol and thereby eliminating the need for incentives."[212] The three-step process highlighted above encourages regulation to be endogenously

208. The ONC and CMS will likely play the largest roles due to their corresponding roles and duties under their enabling acts.

209. *See* Negotiated Rulemaking Act, 5 U.S.C.A. §§ 561 *et seq*. (West 2016); *see also* § 8177 *Rulemaking Through Negotiation*, 32 FED. PRAC. & PROC. JUD. REV. § 8177 (1st ed.) ("In general, the Act establishes a 'consultative process in advance of the more formal arms' length procedure of notice and comment rulemaking.' Thus, agency's negotiating position is not binding on the agency. Even the final negotiated position is not binding as such until it is adopted as the final rule through the prescribed procedures.").

210. Typically, self-regulation involves market-based mechanisms or support of a private regulatory body.

211. "Endogenous" generally refers to something "produced or synthesized within the organism or system." *Endogenous*, MERRIAM-WEBSTER DICTIONARY, https://www.merriam-webster.com/dictionary/endogenous (last visited Jan. 27, 2017).

212. Reyes, *supra* note 134, at 222.

fused into the DLT[213] and its related applications by allowing regulators to initiate a statutory scheme and implement that statute through programming code, all while engaging in a continually cooperative venture with industry leaders and the core developers of the DLT technology.[214]

While not without its critics,[215] the negotiated rulemaking procedure has been seen by many as a useful tool in the regulatory arsenal for dealing with complex and divisive issues, especially when its focus is targeted and properly calibrated to avoid adversarial tension.[216] Negotiated rulemaking can be beneficial in allowing an agency to flesh-out important issues prior to the devotion of significant time and resources to rule drafting.[217] Given the technical expertise that is required for writing of code within the limitations of the relevant protocol, regulators must necessarily rely on assistance from stakeholders in the DLT ecosystem.[218] Formulating rules through consensus also increases the likelihood that interested stakeholders will "buy-in" to the final solution by fostering opportunities for give-and-take discussions.[219] Additionally, having been required by Congress under the ACA to utilize the negotiated rulemaking process,[220] the consensus-based regulatory approach is not a novel concept for HHS.

The endogenous theory may similarly benefit the other stages of implementation. Collaboration is inherent in the course of RFP solicitation, which synthesizes cost effectiveness with creativity by allowing an agency

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213. *See generally id*. at 227 (arguing that regulation of DLT should build upon the work of Lawrence Lessig, which advocated for the use of code-as-law, by expanding into technology-assisted regulation, or law-through-code).

214. *Id*. at 195.

215. *See e.g*., William Funk, *Bargaining Toward the New Millennium: Regulatory Negotiation and the Subversion of the Public Interest*, 46 DUKE L.J. 1351, 1356 (1997) ("[W]hile negotiated rulemaking may formally satisfy current legal requirements, the principles, theory, and practice of negotiated rulemaking subtly subvert the basic, underlying concepts of American administrative law--an agency's pursuit of the public interest through law and reasoned decisionmaking. In its place, negotiated rulemaking would establish privately bargained interests as the source of putative public law.").

216. *See* Orly Lobel, *The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought*, 89 MINN. L. REV. 342, 376 (2004) (arguing that the "commitment to collaboration falls naturally from the commitment to participation [in regulatory matters] since an inclusive structure facilitates multiparty cooperative exchanges"); *see also* Daniel P. Selmi, *The Promise and Limits of Negotiated Rulemaking: Evaluating the Negotiation of a Regional Air Quality Rule*, 35 ENVTL. L. 415, 469 (2005) ("[T]he expectations for regulatory negotiation need to be re-calibrated and, to be effective, its use must be targeted.").

217. *See* Richard Seamon & Joan Callahan, *Achieving Regulatory Reform by Encouraging Consensus*, 56 ADVOC. 27 (2013).

218. *See* Reyes, *supra* note 134, at 228.

219. *See id*.

220. The ACA directed HHS to use negotiated rulemaking in determining "a comprehensive methodology and criteria for" designation of "medically underserved populations" and "health professions shortage areas." Pub. L. No. 111-148, § 5602, 124 Stat. 119, 677-78 (2010).

to choose a solution that is both innovative and practical.[221] Further, both ONC and CMS have extensive experience with contracting out support services and working in partnership with the private sector to find answers to everyday problems.[222] In retaining these endogenous dynamics while also forging new levels of cooperative engagements, the federal government can use the development of a healthcare payment solution as an opportunity to lay a fertile DLT substrate upon which other agencies may build new solutions for other intricate data issues.

C. Strengths and Weaknesses of an Endogenously-Engineered DLT Solution

Like every technology, DLT has limitations and is not suited for every possible application; there are many hurdles that any solution will face. By focusing through the lens of Medicare improper payments, the strengths and weaknesses of a blockchain solution can become apparent. Although an exhaustive list is far removed from the scope of this Note, the following points highlight a few of the most prominent pros and cons underlying a blockchain remedy.

Numerable benefits arise when applying blockchain's inherent features, especially in the context of taming improper payments under Medicare.[223] The decentralized, immutable, stakeholder-to-stakeholder ledger can alleviate the interoperability issues that the ONC has been fighting since its inception. The validation of data integrity through the POW model drastically reduces administrative costs by reducing the need for certain auditing intermediaries, leaving more resources available for the prevention and recovery of improper payments. Automated smart contracts can be coded to integrate logic that fulfills the promulgated regulatory standards. This will facilitate real-time claims adjudication that incorporates a heightened degree of privacy and security due to the cryptographic tokenization of identities and the ability to keep the majority of private data and records off the main

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221. *See* Jack M. Beermann, *Privatization and Political Accountability*, 28 FORDHAM URB. L.J. 1507, 1522-23 (2001) ("Privatization of support goods and services often is advocated as a money saving proposition . . . "); *Cf.* Mark E. Nissen, *Reengineering The RFP Process Through Knowledge-Based Systems*, ACQUISITION REV. Q. 87 (Winter 1997) (arguing that—at least for Department of Defense acquisitions—the RFP process is unnecessarily complicated and needs to be restructured).

222. *See* Steve Charles, *Opinion: Inside the Private Sector's Role in the Health IT Opportunity*, WASH. TECH. (Feb. 17, 2015), https://washingtontechnology.com/articles/2015/02/17/insights-charles-health-it.aspx ("Advancing technical and scientific knowledge . . . requires cooperative agreements with federal, state, business, and payers.").

223. For blockchain technology solutions in general, Deloitte has defined nine benefits: (1) disintermediation and trustless exchange; (2) empowered users; (3) high quality data; (4) durability, reliability, and longevity; (5) process integrity; (6) transparency and immutability; (7) ecosystem simplification; (8) faster transactions; and, (9) lower transaction costs. *See Blockchain Technology: 9 Benefits & 7 Challenges*, DELOITTE, https://www2.deloitte.com/nl/nl/pages/innovatie/artikelen/blockchain-technology-9-benefits-and-7-challenges.html.

blockchain. The features seem to counter the main structural issues that lead to improper payments, such as the temporal lag in the claims process and inconsistent data variables. Blockchain can also lend itself to the level of scalability necessary to expand the value-based payment initiatives that focus on quality metrics.

There are certainly intrinsic limitations associated with the blockchain model.[224] The costs of building, maintaining, and utilizing a blockchain system will be significant. For instance, the mining process that is necessary to incentivize transaction processing requires a small fee for each transaction that is paid to the node for validating the integrity of a block of transactions.[225] Although initial gaps in blockchain adaptability are being further closed with each new day of development, there remain challenges in integrating new DLT solutions with corporate legacy architectures and record systems.[226] And one of the greatest assets of blockchain—the "creation of a permanent, immutable ledger of transactions"—may also have its limitations in instances where real-world healthcare transactions demand that certain data be removed from the record.[227]

Nevertheless, there is a steady stream of new use cases for blockchain solutions in the healthcare industry arising each day.[228] Blockchain's open, decentralized, and immutable characteristics have sparked excitement in healthcare when considering the potential impact on verifying patient identities and managing the vast ocean of health records.[229] These same features, coupled with the functionality of sidechains and computational logic of smart contracts, make a blockchain-enabled solution an ideal candidate for automating the processing and payment of Medicare claims.[230] Overall, as blockchain emerges from its infancy, "it has the

224. Deloitte also defined seven challenges facing blockchain in general: (1) nascent technology; (2) uncertain regulatory status; (3) large energy consumption; (4) control, security, and privacy; (5) integration concerns; (6) cultural adoption; and, (7) cost. *See id*.

225. However, such fees would likely be far less expensive than current transactional costs and must be viewed in the context of the cost-saving features that accompany the switch to a blockchain member. *See* Culver, *supra* note 155, at 9.

226. *See* Bill Genovese, *Blockchain Technology: Hype or Reality?*, CIO (April 22, 2016), http://www.cio.com/article/3058266/security/blockchain-technology-hype-or-reality.html.

227. Richard Lumb, *Downside of Bitcoin: A Ledger That Can't Be Corrected*, NY TIMES (Sept. 9, 2016), https://www.nytimes.com/2016/09/10/business/dealbook/downside-of-virtual-currencies-a-ledger-that-cant-be-corrected.html.

228. *See* Mike Miliard, *How Does Blockchain Actually Work for Healthcare?* (Aug. 13, 2017), http://www.healthcareitnews.com/news/how-does-blockchain-actually-work-healthcare ("While the two most commonly cited examples of how blockchain can be used in healthcare are data interoperability and security, the stream of new possibilities is flowing as well . . . including master patient index, claims adjudication, supply chain and clinical trials.").

229. *See id*. ("[Blockchain's] open and decentralized nature could lend itself well to managing health records and proving identity.").

230. *See id*. ("Blockchain could also be used to automate adjudication . . . such that the decision to deny or pay a claim is made without human intervention.").

potential to standardize secure data exchange in a less burdensome way than previous approaches."[231]

This Note encourages regulators to thoroughly evaluate these benefits and pitfalls, and promptly invest in the research necessary to determine the viability of a blockchain answer to the improper-payment problem. The openness and efficiency of the DLT structure offers a promising path to real-time auditing and fraud prevention that can remedy the existing overhead of collecting, aggregating, and exchanging healthcare information. Perhaps the most daunting hurdle that lies ahead is the uncertainty regarding cross-industrial regulation of such technologies and the acceptance of a blockchain solution by institutions that are greatly invested in outdated mechanisms and a healthcare system that is slow to change.

CONCLUSION

The blockchain revolution coincides with the shifting paradigms of healthcare as a whole. Although scholars have proposed many exciting use cases to exploit the benefits of blockchain, few have approached the topic by first identifying a pressing issue of inefficiency lending itself to a solution that incorporates the novel characteristics of blockchain technology. This Note presents a functional, cost-effective, and collaborative approach to analyzing blockchain in the context of Medicare improper payments—a wasteful vulnerability in a high-risk government program.

Rather than disseminating an overly technical or theoretical proposition, the solution presented herein was intentionally shaped to be flexible for an area of technology that will likely, within a short duration of time, evolve into an entirely different beast. Current CMS and ONC initiatives focused on quality-based care and interoperability are worthwhile endeavors. Yet, without approaching the solution from the ground up by restructuring the foundational framework through which federal dollars are paid for health services, the government will be promoting a cycle of shortcomings and fueling additional squandering of already depleting funds. Despite the tantalizing prospect of an all-encompassing DLT fix, technology is a fragment of the answer. But if properly harnessed and endogenously implemented, a blockchain system and its connected applications may ultimately achieve a solution that is both competent and efficient.

231. John D. Halamka, Andrew Lippman, & Ariel Ekblaw, *The Potential for Blockchain to Transform Electronic Health Records*, HARV. BUS. REV. (Mar. 03, 2017) at 5, http://www.medtronic.com/content/dam/medtronic-com/harvard-business-review/downloads/insight-center/potential-for-blockchain_paper_hbr.pdf.