All Buck, No Bang: A Deeper Look Into the U.S. Healthcare System

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INTRODUCTION

A majority of Americans and international perspectives agree that the United States healthcare system, although home to the newest medical technology advancements and well-trained doctors because of specialized and subspecialized training, is inefficient and notoriously complex (West Health Institute, 2022). Among other systematic problems, the US suffers from rooted technological issues with medical records that can be remedied; more specifically, electronic health record (EHR) systems are decentralized and are unable to communicate among each other, which increases unnecessary spending in administration and overhead. Secondly, because of concerns about and prevalence of data privacy and breaches, patients are growingly less trusting of their physicians, which contributes to poorer health. As a result, Americans do not receive bang for their buck with regards to healthcare because the amount of money pumped into the system is not positively correlated to the quality of care Americans receive. The United States and patients paying shockingly high prices for healthcare while receiving poor outcomes is a significant theme that must be addressed. Along this conversation, blockchain technology shows potential in remediating the communication issue among EHR systems and improving patient privacy, and therefore, cutting costs and improving patient health. And this opportunity has already been seriously considered by hospitals and networks in the US, modeling this moonshot initiative for other hospitals.

After looking at policy proposals to address these issues in past courses and interning in an emergency room, I became interested in the technological inefficiencies in healthcare to see if those could be more directly targeted. An interdisciplinary topic, this research is important for policy-makers and hospital networks, as well as computer scientists and private companies. It is clear that policymakers and hospitals will have to work closely in reconfiguring how EHR systems are managed across hospital networks; similarly, it will be important for computer scientists and private companies to develop robust blockchain-technology that addresses patient privacy, prevents data breaches, and reduces overhead caused by conversation among insurers, patients, and hospitals. And therefore, looking at the potential of blockchain technology in addressing technological

inefficiencies in healthcare will garner a niche audience and group of professionals and is interesting for further research.

Framing

When looking at previous research in this landscape, many researchers look solely at either a lack of interoperability among EHR systems or poor patient privacy in current databases. However, I aim to argue that, although these issues are distinct, they are both grounded in technological issues with medical records and could be addressed with the integration of blockchain technology. This research-based argument paper will describe how the lack of interoperability among electronic health records leads to high spending on healthcare. Next, I will explain how concerns over patient privacy drives patients' mistrust in physicians, and thus, worsens patient outcomes. And lastly, I will introduce blockchain technology and its potential benefits in improving interoperability between electronic health record systems and ensuring trust among patients towards their providers. Through the case study of Intermountain Healthcare and its blockchain company-partner, BurstIQ, I will argue that integrating blockchain in healthcare is a promising idea because it is already being explored and has shown success.

PROBLEM ONE: LACK OF COMMUNICATION BETWEEN ELECTRONIC HEALTH RECORD SYSTEMS

As previously mentioned, electronic health record systems do not communicate with each other effectively, and although not the only, it is a large contributor to the US's high costs for healthcare. Electronic health records (EHR) are simply one's medical records and/or paper chart documented in a digital version. The introduction of EHR systems was a right step away from paper and fax records and allows for real-time updated and instantly-available access to patient records; in this sense, EHR systems help cut costs from administration, but suffers from being fragmented across hospitals and networks. EHR and health information technology (HIT) have been a prime focus in improving healthcare efficiency since the $19 billion investment from the American Recovery and Reinvestment Act of 2009 to advance the implementation of HIT (Behkami, 2010). Especially with the increased reliance on telehealth services, COVID-19 has highlighted the need for better health information technology (HIT) interoperability. According to Elation Health, a clinical technology platform for independent practices and insurers, interoperability is defined as the capability of sharing "patient information between different EHR [electronic health records] systems and healthcare providers." Elation Health continues to explain that the largest barriers to interoperability include: fees required to set up connections among EHR systems, the variety of interfaces that make information exchange difficult, difficulties in sharing health information safely and securely, and the motivation of private companies to block HIE to ensure 'customer' loyalty (Elation Health). This is because each EHR system is coded in a different language

and operates on a different interface, making it extremely difficult to transfer tasks, information, and records across systems.

This fragmentation leads to additional spending on requesting, sending, and condensing data. As cited by IBM, an American technology corporation exploring the health-blockchain industry themselves, "the proprietary electronic health record (EHR) systems made by more than 700 vendors routinely don't talk to one another" (IBM). Being a well-recognized issue in healthcare, the Office of the National Coordinator is responsible for generating interoperability standards for healthcare systems. The 4 key areas required for a system to be considered interoperable can be summarized as being able to "communicate well with others, including clinicians, pharmacists, and patients in the comfort of their own homes" (Linde, 2020). However, "the vast majority of EHR systems in use today" don't follow these practices; in fact, "at the average hospital, for example, providers have to tap into 16 distinct EHR systems to retrieve information and update their patients' records" (Chilson, 2021). This unnecessary navigation across platforms adds to cost and confusion, which can contribute to physicians not having access to a patient's full record.

Improving interoperability among these various platforms would allow streamlining of healthcare by allowing these various electronic health record systems from different health networks to communicate. For example, medical records for a patient from Kaiser Permanente could be easily transferred to a physician at Stanford Health without long, unneccessary conversations among physicians, patients, and insurance companies. There are numerous cost-benefits from improving communication among EHR systems. First, fewer malpractice suits would occur since physicians would be able to provide better care with a more complete access to medical records and have proper documentation to support it. Second, there would be a significant reduction in how much money is spent on sifting through records. It is an "opportunity to reduce healthcare costs by an estimated $30 billion" according to research by Fierce Healthcare, a healthcare news organization (Huyunh, 2020).

Additionally, a group of information technology experts conducted a study on the financial incentives for EHR adoption on clinic revenue. They found that the average societal cost savings is $10,548 per hospitalization based on the calculated $640-$1,650 per patient per year savings. Although the initial investment in EHR affects clinic revenue, "effective use of HIT approaches breakeven point for adoption in 1 year (Behkami, 2010). This study also found that "effective and average use of HIT will lead to almost 5 times the revenue in three years compared to poor IT use" because of "internal dynamics of the clinic workflow" (Behkami, 2010). Therefore, interoperability of EHR systems not only reduces costs from logistical overhead, but also increases revenue for hospitals and societal cost savings. In other words, more communication between systems would reduce the "buck" all the stakeholders suffer from.

Why Do We Care? High Costs

As mentioned, the technological issues with EHR interoperability is not the only factor of high costs in US healthcare, but it is a prominent one; and any remediable problem to lower costs should be addressed. According to the Center for Medicare and Medicaid Services, the US spent $4.1 trillion on healthcare in 2020, which equated to 19.7% of its GDP—the highest compared to any other country (NHE, 2023). But the government will not be able to continue supporting these increasing costs long term. Henry Aaron, a Bruce and Virgina MacLaury Senior Fellow at the Brookings Institution, remarked on the Institute of Medicine annual meeting explaining that "either the proportion of income collected in taxes must be sharply increased, or the growth of outlays—and more particularly, Medicare and Medicaid spending—must somehow be cut" (Aaron, 2016). This shows the urgency of a solution, and in particular, emphazies the importance of cutting costs from a lack of interoperability, which is the easiest way the government, hospitals, and patients can save money.

In addition to the government, individual hospitals also suffer from high costs due to administration. According to an estimate by the Center for American Progress, "each year, health care payers and providers in the United States spend about $496 billion on billing and insurance-related (BIR) costs" (Gee, 2021). This number doesn't mean much until one realizes that this is "twice as much as necessary" and that "administrative excess currently [2019] amounts to $248 billion annually" (Gee, 2021).

The increase in demand for healthcare because of government-funded services like Medicare and Medicaid alongside the increased hospital spending affect how much patients need to pay for their healthcare. Where the largest focus in seeing a physician should be one's health, unfortunately, finances tend to play a larger role. According to a study by the Kaiser Family Foundation published in December 2021, 51% of adults "report they have delayed or gone without certain medical care during the past year due to cost" (Kearney, 2021). And this percentage is larger in marginalized groups, showing a clear correlation between socioeconomic and racial status and the consequences of high costs. According to the same study, "about six in ten Black and Hispanic adults (58% each) report delaying or skipping at least one type of medical care in the past year due to cost" (KFF, 2019). And beyond directly impacting their health, high costs continue to affect the individual's life even after care is provided as families struggle to pay medical bills. A 2019 KFF survey found that about 26% of US adults say that either they or a household member have struggled with paying medical bills (KFF, 2019). As described, the three stakeholders in healthcare—patients, hospitals, and the government—all suffer from increasing costs, pointing to the need for a technocratic solution to lower costs caused by ineffective communication.

PROBLEM TWO: MISTRUST IN PHYSICIANS

There are many reasons as to why patient health outcomes are subpar in the US; however, this paper will narrowly investigate the growing mistrust among patients towards their physicians due to concerns over data privacy and unfamiliarity with these databases, which is known as limited technology literacy. Patients have increasingly become mistrusting and wary of their physicians out of concerns about patient privacy. According to a recent Black Book survey of 12,900 patients, "57 percent of healthcare consumers are skeptical of health IT use" due to "health data security concerns" (Heath, 2017). This statistic is relevant because as noted in the published article, "Breaching confidentiality and destroying trust," mistrust in physicians can lead to patients avoiding care and preventing full disclosure of their health information (Reilly, 2008). This mistrust in physicians is strongly related to patients' general mistrust in technology. Because the healthcare system largely relies on health information technology and the widespread use of electronic health records, there is a spreading concern over data breaches and unsolicited use of one's patient data. And it is unfortunate and shocking how often and to what extent data breaches in healthcare occur. In fact, in 2019, over 41 million patient records were hacked, and one single incident affected 21 million records total" (IBM, 2020).

Another contributor to mistrust in physicians is limited technology literacy. According to the same Black Book survey, "ninety-six percent of patients reported leaving their doctor's office with limited knowledge of how to use the patient portal" and that this was "'exacerbated in minority nonnative speakers, geriatrics, chronic care patients, and low income populations'" according to Doug Brown, Managing Partner of Black Book Market Research (Heath, 2017). This unfamiliarity with electronic health record systems increases mistrust in physicians and health institutions since patients are unaware of how their data is handled. From the same study, "patients were most concerned that their pharmacy (90 percent), mental health (99 percent), and chronic condition (89 percent) data was sent to third parties such as the government, employers, and retailers." Looking at this data, Brown believes that there is an increase in health IT demands from patients and that patients want to be more involved in their own care (Heath, 2017). Simply understanding the technology aspect—where their health data is going and how—would increase the trust between patients and physicians, a fundamental factor in health outcomes.

Mistrust leads to patients compromising on how much they disclose to physicians and providers having less-than-complete access to one's medical history; needless to say, physicians can make better and informed medical decisions with full access to medical records. In fact, in 2016 "eighty-nine percent of patients withheld part of their health data from their providers because of security concerns" (Heath, 2017). According to a study on trust and privacy in healthcare, patients' trust in physicians can be broken down into 3 dimensions: confidentiality, honesty, and competency (Iott).

Most directly impacted by technology, confidentiality should be addressed to boost patient's trust in physicians. As connected earlier, trust in physicians is crucial to patient health. According to a meta-analysis on trust in healthcare, "patients reported more beneficial health behaviours, less symptoms and higher quality of life and to be more satisfied with treatment when they had higher trust in their health care professional" (Birkhauer, 2017). Similarly, patient trust is a strong positive indicator of treatment adherence, continuity, and satisfaction, and these are all factors that improve one's quality of life (Thom, 2004). Patient trust with regards to confidentiality and privacy concerns also vary across socio-economic groups. Marginalized groups tend to be less trusting of their physicians based on personal or shared experiences and medical gaslighting. Other research has indicated that the lower trust levels among African Americans can factor into their reported lower rates of seeking care, preventative services, and surgical treatment when compared to whites (Thom, 2004). Looking at this conversation among scholars, it is clear that there is a connection between concerns over patient privacy and mistrust in physicians; consequently, there is a connection between mistrust and poor outcomes. Thus, it will be important for future policymakers, hospitals, and technical professionals to address patient privacy concerns in order to boost patient health. Simply put, resolving mistrust to improve patient outcomes would correct the current lack of "bang" in the US healthcare system.

Why Do We Care? Poor Patient Outcomes

Improving patient health outcomes should be at the center of healthcare; so when a technological issue such as patient mistrust rooted in concerns about patient privacy distracts from this goal, it should be looked at more closely. This is especially important, because current patient outcomes in the United States are subpar. According to *A Healthcare Solution*, the US's longevity is at the "middle of the pack at best," has high frequencies of hospital-acquired infections—which can be avoided—and is in danger from obesity, among many other health outcome measurements (Vonderembse, 2021). Additionally, against a comparable country average, the United States premature date—measured in the number of years of life lost—continues to be higher (Wager, 2021). And according to a systematic analysis conducted by the Global Burden of Disease that was cited by Peterson-KFF Health System Tracker, the "US ranks last in a measure of healthcare access...indicating higher rates of amenable mortality than peer countries" (Wager, 2021). This often roots from a lack of access to quality healthcare despite one's insurance status, physicians not having access to one's complete medical record, and general mistrust in providers.

More importantly is the imbalance in how these poor outcomes are more significantly prevalent in marginalized populations. According to a qualitative study and general consensus, there is a clear relationship between socioeconomic status and healthcare. As noted, "people of lower SES are more likely to have worse self-reported health, lower life

expectancy, and suffer from more chronic conditions when compared with those of higher SES" (Arpey, 2017). And this is emphasized since the high costs and incomplete coverage serve as additional barriers to receiving care. Although US healthcare is at the forefront of research, specialized procedures, and technological innovation, the US falls toward the back when looking at general and routine services—this can be looked at more closely when investigating the US's diminishing preventative care and primary care physician workforce.

BLOCKCHAIN: AN OPPORTUNITY
What Is Blockchain?

As alluded to in the beginning, both the lack of interoperability among electronic health records and privacy concerns causing mistrust are rooted in technological inefficiencies with medical records. I argue that blockchain has the potential to lower costs and improve health outcomes by streamlining electronic health records and strengthening the trust in patient-physician relationships.

To provide an overview and technical explanation, blockchain technology is a way to record information without concern for it being changed, hacked, and/or manipulated (Ravikiran, 2023). Blockchain is difficult to visualize because it exists in cyberspace, but it can be thought of as a structure. Specifically, it is a platform for storing information in nodes in a decentralized and digital format in a growing chain of blocks, which means no single person or agency has full control over what information circulates through the chain. Importantly, blockchain creates an "irreversible time line of data," which means there are time stamps on every transaction where data is shared, accessed, and added (Hayes, 2022). This is why blockchain has become so popular recently. In any business, recording transactions and data is important; and specifically, in order to protect this data, it is imperative that the information is handled with the fewest number of people possible. However, often, companies rely on third-parties to handle the data, increasing cost, time, and potentially compromising security (Ravikiran, 2023). Blockchain avoids these concerns as it is highly secure because it is impossible to mutate information, and it's decentralized, which reduces the need for third-party companies to handle the data. To explain less technically, Ravikiran efficiently summarizes that "Blockchain technology is a structure that stores transactional records, also known as the block, of the public in several databases, known as the "chain," in a network connected through peer-to-peer nodes. Typically, this storage is referred to as a 'digital ledger'" (Ravikiran, 2023).

Blockchain technology is a combination of three main technologies: cryptographic keys, peer-to-peer network with a shared ledger, and a way to compute for storing transactions and records (Ravikiran, 2023). Cryptographic keys are used for authenticating transactions between parties. Users have two keys, which together produce an individual's digital identity,

and the key is important in authorizing transactions like a digital signature of sorts. Briefly, there are four different types of blockchain networks: private, public, permissioned, and consortium. They are differentiated by who can participate with the blockchain. Less intuitive, permissioned blockchain networks are private networks that allow access for authorized users; the consortium blockchain is similar but works better when collaborating with more than one company or organization (Ravikiran, 2023).

Blockchain In Healthcare

Meaningful to healthcare specifically, blockchain ensures that transactions and data can't be easily changed or deleted once recorded, making an individual's information immutable. And these transactions can be processed in less than ten minutes, saving time and therefore, money. The potential for blockchain has been explored in many fields from cryptocurrency to simplifying supply chain; but blockchain integrated into healthcare is still a rather novel idea. Given the large amounts of data in healthcare, blockchain has the potential to securely store patients' records, remove human involvement—and error—in verifying identities, and cut costs by eliminating unnecessary involvement from third parties. According to an US FDA estimate, this type of data sharing—allowing health professionals to access patient data securely and electronically—could save hospitals $93B and 950,000 lives in over five years because in privatized healthcare, HIE is complicated and difficult to share patient records (Marie, 2021).

In specific, blockchain technology has great potential in addressing issues with EHR interoperability and data sharing. It is no surprise that efficient healthcare relies on advanced information technology, "particularly in the ability to record and store information easily...and share it securely among disparate applications and systems" (Donovan, 2019). And this is where blockchain comes into play. In this sense, the "blockchain transactions" and "data" would refer to information on doctor's appointments, procedures, test results, etc. The US spends money excessively on administration, but blockchain is predicted to save $77.8 billion per year from interoperability alone (Carpio, 2018). According to a report by BIS Research, "Blockchain technology is increasingly being touted as the panacea for the interoperability and security issues that plague the antiquated health systems" (BIS Research, 2018). To validate, there are already several companies that are tackling this market such as Hashed Health, iSolve, IBM, Microsoft, FarmaTrust, and more. Hospitals that pay external third-party companies to handle their population data will also be able save money in that regard since blockchain eliminates the need to outsource transactions.

In the same vein, blockchain helps improve trust in physicians largely because of blockchain's guarantee of keeping data secure and private since patients can prevent unauthorized use of their medical

information. There are two types of blockchains: private and public. In a public blockchain, users do not need permission to participate. In other words, any person can join and make a node, and the chain is secured via cryptography and a proof of work (PoW). On the other hand, a private blockchain allows only selected people to enter and users can allocate certain permissions to selected users. With regards to healthcare, a private blockchain will allow patients to control who gets access to their patient data, know when their data has been accessed and by whom—because of the precise time stamps—and their privacy will be guaranteed. Healthcare systems could also employ permissioned network or consortium blockchains because of its emphasis on private and public aspects and also ability to work with multiple organizations, or hospitals in this case. Therefore blockchain implementation will tackle the confidentiality aspect of trust. Patients will no longer have to worry about their health data being shared with unauthorized providers or people, since they hold complete control over their data. Moreover, data breaches will be nearly impossible to execute. Because data is decentralized, if there is a breach incident with a node, the other nodes would not be affected, unlike most current hospital EHR databases. Moreover, it is easy for nodes to cross-reference each other to figure out if a node was hacked or compromised. And lastly, because a successful data breach requires at least 51% of the data to be altered to become the new "majority copy," it is nearly impossible to carry out because of the timestamps and cost. And allowing patients to have full control over their data and requiring less third-party handling will increase technology literacy. And as a result, patients should be able to share their medical data without the fear of it being leaked, which will allow doctors to have a more complete picture of their patients' data.

Another Perspective On Blockchain: Disadvantages

Although there are many advantages and benefits blockchain would offer, there are a couple of concerns that exist with regards to scalability and the environment. Specifically, in terms of scalability, there is a limit on the number of transactions per node. On a wider scale, this can mean it takes longer to complete transactions. Additionally, the inherent nature of blockchain is that information inputted can not be changed or manipulated, which although is important for security, it can be difficult for doctors or hospitals to modify incorrect information or add information. Furthermore, most people have heard of the environmental effects of data mining from cryptocurrency. Consequently, putting multiple hospitals or systems on the blockchain could pose a negative for the environment. And lastly, hospital administrators should consider the time and energy it would take to implement blockchain in their hospitals. This process would not happen overnight, and would require robust technical support to ensure personal identifiable information is protected through the process.

Intermountain Healthcare: A Living Example

Using blockchain technology in healthcare can seem far-fetched, unfeasible, or like a moonshot goal; however, this idea shows strong promise since hospitals and private companies in the healthcare industry have already begun to invest in this solution. Integration has garnered recent attention from the healthcare and computer science industries and has been especially accelerated because of COVID-19. According to a report by Global Market Insights, this market is predicted to top $1.6 billion by 2025 (Donovan, 2019).

Blockchain technology developed by BurstIQ has fully been implemented at Intermountain Healthcare, a health system comprising 22 hospitals that provide hospital and medical care in Utah, Idaho, and Nevada. BurstIQ is at the forefront of blockchain solutions for the healthcare industry. Using blockchain, big data, machine learning, and granular data ownership, BurstIQ achieves their goal of connecting health data on a global scale (Burst IQ). According to BurstIQ's website, its blockchain layers on top of any one-layer blockchain and then connects the smart contracts. It lives as a covering over the Internet and permits the sharing of valuable information safely and privately. Moreover, it employs permission-based data sharing, which is optimal for healthcare data exchange, and is HIPAA compliant, which means patient privacy is ensured as per stringent federal standards. We can see the promise of blockchain in healthcare by investigating Intermountain Healthcare and BurstIQ's success. In fact, Intermountain Healthcare was able to save "tens of millions of dollars over a two-year period" after its integration of BurstIQ blockchain technology (Tinianow, 2019).

BurstIQ has solved two primary problems in healthcare: "supporting large volumes of data and securing the underlying data" (Tinianow, 2019). This goes hand-in-hand with the two overarching problems, high costs and poor outcomes, I had proposed; supporting a large amount of data is expensive, and unsecure data creates poor outcomes. Although BurstIQ is not the only blockchain company in healthcare, it is the only one that is publicly implementing its solution in the US healthcare system. Unfortunately, there is a current gap in research about how BurstIQ has improved patient health by directly targeting mistrust and cut costs by addressing EHR interoperability, and as a researcher, I do not have data on these direct factors beyond total cost savings.

However in terms of cost savings, the hospital "realized more than $90 million in savings using the Empiric technology [which is BurstIQ's blockchain-based big data platform]...to identify operational efficiencies across the Intermountain Healthcare system" (Burstiq). On the other hand, Burst IQ approaches patient privacy in a unique way because of its combined use of blockchain and machine to create smart data. Smart data is data that "carriers with it all of context, access rights, and security that it needs to be trusted" (Burstiq, 2021). Put together, there is strong evidence

to support blockchain's success in healthcare by tackling patient privacy concerns and mistrust in physicians along with streamlining communication among EHR systems. Equally important is that because blockchain is extremely scalable, this type of hospital-blockchain company partnership can be successful anywhere.

CONCLUSION

Looking at the conversation among researchers, it is clear that Americans don't receive bang for their buck with regards to healthcare. The US—patients, hospitals, and the government—suffers from excessively high costs and poor patient health outcomes. And as I've argued, a large factor of both of these problems is a lack of communication between electronic health record systems and concerns over patient privacy leading to mistrust, respectively. These of which can be looked at by analyzing technological inefficiencies relating to medical records. And as a result, technocratic solutions should be considered to lower costs and improve patient outcomes by tackling these root causes. Thus, blockchain technology should be implemented across hospitals. The United States, with a one-off example, is still at the point where each hospital would individually have to change to blockchain. But, it is possible that the US healthcare system will eventually become fully digitized and on blockchain like it is done in Estonia, which has made healthcare more accessible and efficient for Estonians for over ten years. But until then, more work needs to be done in the US to eventually give Americans what they don't know they need: quality healthcare.

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