

# Adoption of block-chain to enable the scalability and adoption of Accountable Care

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**Abstract**—The recent trends in Accountable Care based payment models have necessitated the adoption of new process for care delivery that requires the co-ordination of a “network” of care providers who can engage in shared risk contracts. In addition, the need for sharing in the savings generated equitably is key to encourage the network providers to invest in improved care paradigms. Current approaches to digitize healthcare focus on improvement of operational efficiency, like electronic records as well as care collaboration software. However, these approaches are still based on the classical centralized authorization model, that results in significant expense in implementation. These approaches are fundamentally limited in their ability to fully capitalize on the peer-to-peer digital workflow revolution that is sweeping other segments of industry like media, e-retail etc. In this paper we formulate a new digital health care delivery model that uses a blockchain as the foundation to enable peer-to-peer authorization and authentication. We will also discuss how this foundation would transform the scalability of the care delivery network as well as enable payment process via smart contracts, resulting in significant reduction in operational cost and improvement in care delivery. In addition, this blockchain based framework can be applied to enable a new class of accountable tele-monitoring and tele-medication devices that would dramatically improve patient care adherence and wellness. Finally, the adoption of a blockchain based digital-health would enable the creation of verifiable “personalized longitudinal care” record that can form the basis of personalized medicine.

**Index Terms**—BlockChain; Telemonitoring; Telemedication; Healthcare Asset; Authentication and Authorization; Deep Data Creation; Personalized Data Control; Healthcare Marketplace; Healthcare Security & Reliability; Personalized Healthcare; Two-way Data Authentication; Comprehensive Data Repository.

## I. THE HEALTHCARE LANDSCAPE

THE last decade has seen a significant change in health care ranging from a dramatic shift in the payment method from a “pay-for-service” model to “outcome based” model to a focus on population “wellness” from a focus on “specialized” procedures. This new payment model based on effective care along with a focus on healthy living, called the “Accountable Care” paradigm, outlines the “new” goal for delivery of healthcare in the US [1]. This realignment from a “procedure” based focus to “holistic care of the individual” necessitates that Care Providers form “networks” that work together towards a common goal of improving the care outcome of patients under care, for post-Acute Care episodes or between Acute Care episode. The need for cooperation between care providers ranging from specialist to primary care physician, post-acute care providers to wellness providers (like nutritionist and rehabilitation nurses) has resulted in increasing

digitization of patient care data in order to seamlessly communicate patient data. Over the last decade this has led to increased adoption of Electronic Health Records (EHRs) systems as well as development of care collaboration software that enables the co-ordination of care across the various care providers. Though these solutions have significantly improved the tracking and efficiency for delivering care, they have resulted in creating islands of information. Hence, co-ordination of information between these systems has presented a significant challenge causing the delay of both the adoption of this new healthcare paradigm as well as posed serious challenges for health systems in developing scalable “networks” of providers.

The tsunami of data captured in *Electronic Medical Record* (EMR) systems in hospitals and doctor’s offices as well as information from labs, pharmacies, home care and nursing systems plus the general growth in awareness of taking care of one’s wellness has resulted in individuals capturing personal wellness data ranging from biometric vitals like blood sugar, blood pressure as well as keeping track of the exercise and food intake via *Personal Health Records* (PHRs). This behavior is not limited to individuals that have chronic condition but also, extends to individuals who are interested in pursuing a continued high functioning lifestyle. [2][3]

Though, there has been an increasing sense of “individualized” information both on the clinical as well as wellness front from the accumulation of data by care providers and individuals, including their hereditary profiles, these have not translated into “personalized” plans of care. Furthermore, even though there is a plethora of data, the overall healthcare payors and systems seem to be incapable of “assigning” a value or risk to this information to help better predict future cost of care for the individual or credit him for his focus on actively managing his health. [4]

The key elements that prevent the lingering delay in dramatic transformation of the healthcare landscape are discussed below.

### A. Data Silos & Accountability/ Authorization

There has been a lot of health and wellness related data that has been collected by care providers and individuals but it has not been converted in consumable formats that enable a comprehensive individualized care plan that contributes to effective long term patient wellness. This stems from the key issue that most of these data are in individual silos of a given

care provider and is not readily accessible by their “network” partners engaged in the care of their patient. [5]

Furthermore, the accountability and authorization for accessing and modifying of a given patient’s data is limited to these individual silos. This results in each organization “modifying” its copy of patient data on their interaction with the patient. This has led to the “network” of care providers to be in the constant task of “updating” the patient profile and always trying to catch up the illusive “latest valid profile” of the individual. This has further been exacerbated by minimal authorization from the individual whose data is being modified, leading to erroneous information being introduced into his/her records resulting in both clinical and economic woes.

Another key factor in ensuring sustained wellness, is the active involvement by the individual in their care regime. This has been proven to be challenging, as patients feel that they don’t have an appropriate access and incentives to engage in care management, leading to a frustrating experience for both providers and patients. Hence, this has led to a complete breakdown in the overall accountability of all involved in yielding optimal care outcomes.

### *B. Liability & Shared Compensation*

The providers in the healthcare industry are very weary of whether that data being used for clinical prescription is “accurate” as they expose themselves to significant liabilities unlike other industries if they are found to have made an error. Therefore, they are insistent on “appropriate validation” of the generation of data to ensure that they are not exposed to any liabilities stemming from erroneous information. Hence there is averseness towards using information that has not been collected by an entity that is deemed reliable and is a “liable” participant in their network. This has resulted in “forced aggregation” of health care data which in turn has led to increased costs and delays in care delivery, while still not illuminating data errors. The standard approach, adopted is by the dominant provider mandating that his network partners enter the information into his system which is then the “golden record” for the patient and can only be used by others. Though, this avoids the liability issue it still does not address the fact that the network provider, needs information in a timely manner. This problem is further exacerbated in chronic patients with two or more issues and this has led to a crisis in delivering coordinated care for these patients.

An additional issue in ensuring effective health care delivery is the accountability associated with who has reviewed the data, accessed and authorized the recommended changes and finally executed care delivery. As most of the healthcare EHR systems were built to address a single domain of care providers it was only designed for one “key” individual to access and authorize changes. This was adequate when most of health care providers delivered comprehensive care for an individual with in a single provider system which gathered all data from their “client” the patient. However, with the emerging trend where in many a case this data is collected and processed by a number of providers and intermediaries like labs, technicians, home health care worker or even a family member, this approach is limiting. Furthermore, with the

formation of Accountable Care networks, wherein the penalties are high for bad outcomes resulting in non-collaborative behavior, it is imperative that effective automation of these care coordination capabilities is vital [6]. Finally, in the emerging Accountable Care landscape of healthcare, compensation will be based on how effectively the network of providers’ work together to ensure improvement in the quality of care and wellness outcome while at the same time reducing associated care cost. Hence, to truly incentivize different participants in the network to pro-actively create better care regimes there needs to a merit based compensation of shared savings. To effectively allocate a proportionate share to the provider in the network that contributed the most towards the overall savings a clear tracking of their contribution is vital. Else, it would lead to “least effort” approach by all providers in the network resulting in overall loss of income for care providers and an adverse effect in care quality of patients.

### *C. Portability & Privacy*

As the Care Delivery Model is shifting to “outcome based” accountable care, there is an increasing need for the patient data to move “fluidly” across various approved care providers in the care network without sacrificing the privacy of the patient data. However, the single domain nature of EHR systems, which limits the portability of health data has resulted in significant challenges. Hence, providers have mandated that patients sign a HIPAA waiver to ensure timely care is being delivered to patients. This has led to the leakage of patient Health information resulting in unscrupulous providers targeting patients at their most vulnerable time during need for medical care. [7]

This problem is exacerbated due to the fact that upon receiving this wavier information has been transferred via paper copies leading to this information tending to linger a long time in the care giver community. This has led to persistent fraud practices that effect payor and patients adversely for a long period of time.

Though there have been many efforts via the Health Information Exchanges (HIE) to address the portability of this information across providers in a secure and timely manner it has fallen flat because of the incredible amount of upfront cost and effort and the need for all vendors to participate to provide any meaningful impact.

Hence the current solutions pursued by the Health Care technology industry has resulted in a difficult choice between care and privacy/economic fraud for patient. We see this issue greatly expanding as more and more mental health services are being delivered to individuals.

## II. BACKGROUND

A number of approaches have been proposed to deal with the issues identified in the previous section associated with the Centralized Data Model. Though, these solutions are temporary fixes to leverage the existing care delivery model and Health Care IT infrastructure they are fundamentally limited in addressing the significant change that is sweeping health care at a national and global level.

Figure 1, illustrates the core architecture of current Electronic

Health Record (EHR) systems and the associated challenges with the existing architectural design. As illustrated, by Figure 1(a), EHR systems are based on an isolated credential validation architecture in which patient data is kept in each of the separate systems. This has resulted in one-to-one care co-ordination software “add-ons” solutions to these systems to enable the co-ordination of care across other providers and ancillary health organizations as illustrated in Figures 1(b).

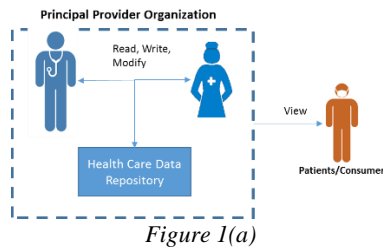


Figure 1(a)

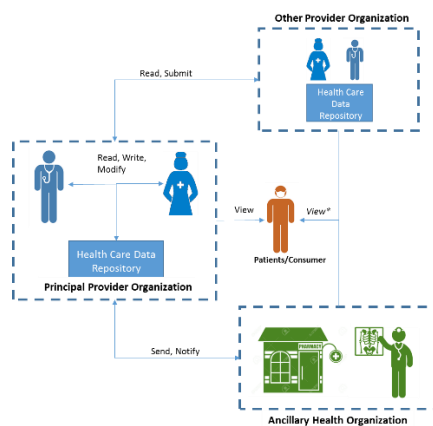


Figure 1(b)

**Figure 1: The Centralized Health System Model**

However, as is illustrated by the figure the access of the information from the Principal Provider organization to the other organizations is only via limited capability like to Read, to Submit, to Send or to Notify. Furthermore, the Patient/Consumer has very limited interaction or involvement in this exchange of information. In addition, any error related to the miscommunication or error is very hard to rectify. In the sections below we discuss how the limitation presented by these systems has been augmented to accommodate for Care Service Optimization or Payment management under the new Paradigm. We will discuss how these augmentations have impacted care delivery.

#### A. Care Service Optimization

The new health care paradigm demands the need for effective and optimal care delivery for patients to yield better care outcomes. This requires that Principal Care providers are able to actively co-ordinate and collaborate with other care providers involved and ancillary health organizations like Labs and Pharmacy in care delivery.

This requires that the patient records are updated and modified in a timely manner. Though there are a number of add-ons that have been implemented based on new emerging healthcare data standards, this add-on collaboration software still relies

on the Principal Care Provider “orchestrating” the care. Furthermore, this software only provides a limited capability of exchange of information from one system to another and usually requires a designated individual who is capable of such information transfer. This has led to an increasing amount of delay between organizations in delivering care for the patient and also resulted in the overall decrease in quality of delivery of care services to the patient. Also, as care providers are spending more of their time involved in coordination of care their effectiveness in treatment of patients and workload has significantly increased resulting in a counterintuitive impact in care outcomes for patients.

In addition, given that many doctors don’t want patients to access EHRs, has resulted in the patient adopting a passive role in tracking their health, and resulting in them feeling a lack of control and ownership of their health leading to the patient becoming frustrated and being disengaged in their care. Though there has been a recent increase in Mobile Health Care apps helping individuals track their vitals and health parameters, the novelty has not translated to improved patient care or adherence and outcomes as it too faces the challenges of getting integrated into EHRs.

#### B. Payment Management

Another key impact of the new health care paradigm is the compensation model where-in the providers are eligible for receiving additional compensation beyond the care delivered. This compensation is the result of savings that are generated based on how effectively the providers manage the care of the patient’s health outcome. Any savings generated through efficient management of the patient’s care can be retained by the providers and their network partners as part of the shared savings aspect of the new healthcare paradigm.

To realize these savings, a provider has to effectively track all the costs associated with the care of the patient and actively work with his partners to ensure timely health outcome. However, this requires that all the providers enter the care costs in near real-time while delivering care, which is very difficult to achieve based on the current EHR architecture. In addition, it is very hard for the principal care provider to divvy up the savings across the “key” provider partners to appropriately incent them to explore new care approaches. Though, the new healthcare policies provide the potential to incentivize providers to work together to improve care pathways, the current EHRs architectures come short of enabling this ability.

#### C. Centralized Care Delivery

To take advantage of the new healthcare paradigm healthcare providers have adopted two aggressive approaches to ensure that they can fully take advantage of the opportunity. The first approach is to try to consolidate all of the care providers as part of a centralized health care system. This, ensures that all providers are within their centralized EHR thus enabling them to actively manage all the aspects of the care offerings for a patient. The second approach has been for “regionally dominant” providers to “persuade” other providers and ancillary health providers to assimilate within their health system by using their EHR. Though these two approaches provide the desired trifecta goals stipulated by the new

healthcare paradigm, it however results in reducing the choices for both patients and innovation of healthcare. Furthermore, tough “dominant” regional healthcare providers can consolidate the delivery of health care, but in the long run overall improvement in patient health can be achieved only by the inclusion of consumer wellness service providers like nutritionist, exercise providers and other such service providers, who would be difficult to assimilate. Furthermore, this model will not be applicable at a national level as there are many second and third tier cities and rural areas where care is delivered by a number of independent care providers. In addition, there are specialist care provider groups who value their dedication towards improvement of patient care and would resist assimilation into a single health system.

To conclude, in this section, we have described that though the current Centralized Health Care Data management approach is applicable in the short-term, in the long-term it results in significant impediments for the enablement of innovation and motivation for sustained patient health as intended by the Affordable Care Act.

### III. TENETS FOR A NEW APPROACH

In this section we discuss the two fundamental tenets toward realizing the full potential of the objectives of the new health care paradigm which are: (i) strengthening healthcare delivery; (ii) advance scientific knowledge and innovation; (iii) advanced health, safety and wellbeing of patients; and (iv) improve efficiency, transparency, accountability and effectiveness.

The first of the two tenets that we will be discussing is Patient Centered Care that focuses on providing individual specific care needs for one and all, while enabling their long term well-being. The second tenet is the capability of an infrastructure that can truly enable advanced innovation and deliver seamless transparency and accountability for all participating in the delivery of care.

#### A. Person Centered Care

To achieve effective superior care, a person centric approach is important. Such an approach should take into account not only the clinical aspects but the social and economic factors that impede one’s ability to successfully engage in care compliance and healthy living to yield sustained wellness.

#### *Outcome and Wellness Optimization*

To yield effective care outcomes requires clearly identifying the barriers of individual health and life situations. With the growing number of patients having 2+ co-morbidities, the “siloeed” one-type of care fits-all care delivery approach is not conducive in motivating and addressing effective care outcomes. Hence a more flexible care model tailored to include patients’ multi-faceted health and wellness needs has to be considered. This requires that a comprehensive, dynamic interactive care plan in which the patient can actively track, manage and participate in his care is vital.

#### *Distributed and Scalable “Care Network”*

To deliver Person Centric Care requires that Care delivery network can include a wide variety of Care Providers and not just a predefined set of select providers. Such a restriction would limit the ability of patients to seek care via the most optimal path. For example, most of the folks that are most vulnerable to health care issues typically work multiple jobs with no standard hours. In addition, many of the most vulnerable patients either have limited transport options or live in “healthcare deserts”. Hence it is necessary to be able to use alternate care delivery partners like paramedics or visiting nurse to help address these challenges. That said the general concern that is raised is the aspect of ensuring that these “non-traditional” care providers are well vetted. This limitation is a result of inadequate infrastructure and not a resource issue, which we will address in subsection B of this section.

#### *Data Portability and Privacy*

The final aspect to achieve effective Patient Centric Care is the need to be able to send data to a care provider just in time so that he can deliver the appropriate care. Furthermore, while we desire this capability it is also important that we maintain the patients’ privacy. It has been repeatedly stated that these two aspects are mutually orthogonal. However, this seems to be a fallacy limited only to the health care industry. Other industries like e-retail, finance and even media have transformed their entire infrastructure to let consumers have the flexibility to choose their vendor of choice with minimal liability. We believe that by leveraging some of the similar infrastructure concepts already being implemented in other industry sectors but adding a higher level of data protection we can achieve both data privacy and portability.

#### B. Accountable Care Networks

In this subsection we will discuss the tenets of an Accountable Care Network infrastructure that is needed to ensure the four healthcare objectives listed earlier. Any infrastructure that is being deployed to achieve these objectives should have built-in ability to ensure all the facets of a collaborative nature of the new care relationships are seamlessly enabled. In the subsection below we will discuss these aspects.

#### *Liability Protection and Accountability*

In any Care network it is necessary to ensure that participants who are collaborating together can depend on each other to deliver the necessary services that are expected of them. To achieve that, there has to be a means to ensure accountability of task and services that are expected to be delivered in a timely manner and also associated liability if they are not delivered in a timely manner at the level of quality that is expected. Hence, any Health Care infrastructure has to be capable of seamlessly being able to monitor the necessary information to enable the Primary Care Provider to evaluate his Care network. Furthermore, as the Care network grows and these interactions between network care providers increase the Health Care infrastructure should be capable of effectively addressing this scale.

### Care and Expenses Auditability

One key aspect is the auditability of Care providers on two fronts. The first is the verification of whether the care provider actually delivered the care that he was obliged to deliver to the specification of the referring physician and at the same time the validation that the patient actually received it. Furthermore, in addition to the delivery of the care the financial expense incurred as part of this care should also be audited so as to ensure that care was appropriately paid and the charges were accurate. Tying the Care Auditability with the payment auditability provides the key advantage of reducing the significant fraud that currently plagues our healthcare system.

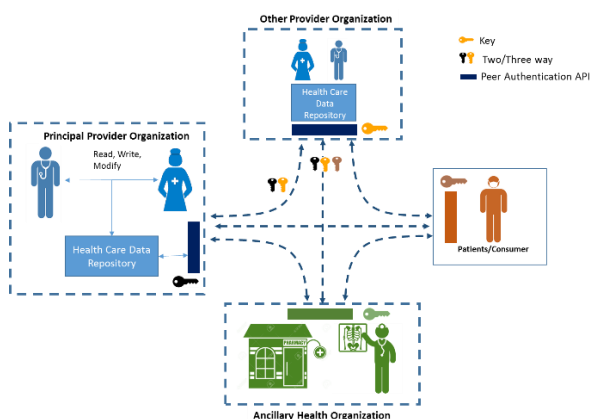
### Compensation and Ownership Rights

It is important that care providers that provide superior care that yield better patient care outcomes be compensated proportionally to their effort in the resulting shared savings. If this were not ensured it would not motivate care providers to innovate new care methods as well as go beyond the basic care requirements for a patient. Furthermore, if a care provider has innovated a new care procedure, he should be able to protect his rights to his invention and be able to get duly compensated for his efforts. So an Accountable Care infrastructure should be able to track and compensate the designer of the care pathway so that health systems that adopt it can duly compensate the innovator for the benefits that avail. An infrastructure that preserves these aspects will enable continued innovation in healthcare.

In this section we outlined the two main tenets that are necessary for delivering the promise of the new healthcare paradigm. In the next section we will discuss how these tenets can be realized via a blockchain peer-to-peer architecture approach [8].

## IV. IMPLEMENTATIONS

In this section we will describe a peer-to-peer architecture which in contrast to the centralized architecture described in section II. The proposed architecture is highly scalable and distributable.



**Figure 2:** *The Peer-to-Peer Health System Model*

Figure 2 illustrates the basic framework for this peer-to-peer model. Also illustrated is the two or three key validation

model. In the subsections below we will describe in detail the various aspects of this model and also how a blockchain architecture with modification is very suited to accomplish this framework.

### A. Peer-to-Peer Authentication & Authorization

The key aspect to building a highly scalable and distributed Care Management system is a peer-to-peer architectural framework. Such a framework has already been used in a number of industry segments like, media, e-retail, supply-chain, etc. Furthermore, recent technologies like blockchain have also enabled this framework to be adopted in other segments in which security is of prime concern like finance. Furthermore, it has been shown that blockchain can easily be an add-on software connector to existing centralized frameworks [9]. This has led us to explore using a blockchain framework for its applicability to help with enabling a peer-to-peer framework for healthcare.

Blockchain holds the promise of validating two or more entities engaged in a “healthcare transaction”. This provides two key attributes compared to a centralized authentication model. The first being, that interested parties can engage with each other at a “transaction level” of “trust relationship”. The second is that the liability exposure in such a relationship is limited to only “transaction level” engagement. This is very useful as it limits the access of information and liabilities between parties involved and at the same time enables a party to get into a transaction relationship with a number of other providers based on their specific capabilities and type of care needed to be delivered to the patient. This is significantly better than a conventional centralized systems needing to limit the number of providers for a wide range of patient needs due to effort required to manage the access and liabilities. This is very much akin to Amazon being able to create a wide range of relationships with a variety of suppliers based on their customers’ needs versus Walmart having to limit themselves to a limited number of suppliers.

### B. Two-way/+ Validation

Another key aspect of a peer-to-peer architecture is the ability to involve two or more parties in the validation of a transaction which may be necessary in the case of healthcare. A prime example is where a payor incentivizes a provider and a consumer in a three-way agreement to provide better compensation if they (provider, patient) jointly work together in reducing the overall cost of healthcare. Another alternative is when a primary provider engages another ancillary provider like a nutritionist to help train a patient adopt to a “low sodium” diet. Such a three-party agreement can also be validated by using blockchain technologies.

### C. Smart Contracts

The new healthcare paradigm promises the opportunity for care providers as well as the patient to engage in a collaborative relationship that improves overall health of the patient and participate in the savings achieved. However, to effectively compensate all the key participants in a manner in-line with their contribution any contractual framework should be able to validate the milestones and their contributions. In a classical centralized data model this requires significant effort

to manage such a contribution and as the number of parties involved increase the process becomes more complicated. In the case of a peer-to-peer framework using a blockchain as the validation model this is doable as smart contracts can be embedded in the blockchain [10]. Furthermore, the fact that such an arrangement can also be quickly monetized by parties involved provides the added incentive for providers to engage in such arrangements.

#### D. Personalized Control

Since blockchain uses personalized keys to validate transactions any of the participants can ensure that only folks that are deemed to be authorized have access to the patient health data. This avoids the “unintentional” leak of patient health data due to carte-blanch HIPAA releases that are currently signed by patients in order to receive care services. Thus the application of blockchain peer-to-peer frameworks enable the patient to have better control of their health data while providing access to those they deem necessary to be involved in their care. Furthermore, having such control also enables patients to provide “complete health information” about themselves in contrast to snapshots of information held in different systems.

#### E. Application of BlockChain

As described above a blockchain framework provides all the necessary ingredients for building a peer-to-peer healthcare system as described earlier. However, to ensure that it is truly doable a serious concerted effort needs to be embarked on at a national level through a strategic partnership between, both public and private payor, healthcare providers, technology and solutions providers and patient. We further believe that though there is great potential in pursuing such an effort there is also significant effort required to extend blockchain technology to be adapted in a manner that enables healthcare centralized frameworks to be seamlessly transitioned to the new peer-to-peer world.

In this section we have discussed how blockchain promises the possibility of developing a peer-to-peer health care framework that would significantly accelerate the goals outlined by healthcare reform. In the following section we elaborate briefly on the evolution that such an infrastructure would provide in the future to the healthcare landscape.

## V. FUTURE OUTCOMES

In this section we briefly discuss the future outcome that are possible via the successful implementation of peer-to-peer health care framework using blockchain. We believe that there are significant tangible benefits that can be achieved by such an implementation and also such an endeavor would lead to a transformational impact to the healthcare landscape in the future. Some of these are discussed below.

#### A. Benefits

The keys benefits that result from the adoption of a blockchain based peer-to-peer framework are in the areas of fraud prevention, achieving high quality healthcare, affordable care, and health care based on an individual’s clinical and socio-environmental factors and enabling adoption of a wellness

lifestyle by the masses. We briefly elaborate on these benefits in the subsequent subsections.

#### *Patient and Provider accountability*

Ensuring a framework that tracks and rewards patients and providers for taking ownership of care will drastically reduce the overuse and misuse of care services. By being able to track the care being delivered allows prevention of fraud and also hold both the patient and provider accountable for “validating” the care services being delivered at the stipulated quality in a real-time manner. This would significantly reduce the significant burden placed on payors, providers and patients because of a few malicious healthcare participants.

#### *Shared Liability and Savings lower care costs*

The ability to seamlessly track and manage smart contracts in which the benefits can be redeemed with significant ease provides the necessary “carrot” for providers and patients to actively engage in a symbiotic collaboration. In contrast if one or more participants tend to misbehave appropriate penalties, via liabilities, can also be levied with similar ease. This “carrot/stick” approach we believe would provide the necessary push that is needed to shift the healthcare industry from a sickness management mindset to a wellness lifestyle mindset.

#### *Personalized medicine and sustained wellness*

A key challenge is the inability of current frameworks to track “individual” impact on prescribed care plans. This framework enabling “individualized health information” to be easily accessed provides the necessary building block for the creation or real-time personalized care plans that are tailored based on an individual clinical and socio-economic challenges. Furthermore, access to such an individual centric care plan also enables real-time correction of the plan resulting in a focus on prevention yielding to a path to sustained wellness.

#### *TeleCare a Lifestyle not a fad*

Finally, through there has been a huge rise in self-care via the use of TeleCare devices like fit-bit, Apple/Samsung watch and vital monitoring devices, these devices have not been effectively integrated into the mainstream aspect of healthcare. The implementation of blockchain at such a low cost as that demonstrated by the newly emerging P2P payments using a modified version of blockchain implemented on chip cards and smart phones holds the promise that future TeleCare devices could come embedded with this capability, thus becoming an integral part of the peer-to-peer healthcare framework.

#### B. Impact

In this subsection we will discuss the long-term transformational impact that we believe could be possible with the implementation of peer-to-peer healthcare framework built on blockchain technologies.

#### *Enablement of Personalized Medicine*

Given that a blockchain based peer-to-peer healthcare framework has the potential of being able to formulate a complete horizontal patient health information (PHI) profile



relatively inexpensively it holds the promise of providing specific care plans and care regimes tailored to the individual's needs. This capability of generating complete PHIs holds the promise of eventually achieving personalized medical treatment for the masses.

#### *Enablement of "care" innovations*

The capability to track and validate specific care regimes that yield significant improvement in care outcomes combined with the fact that the care provider could be adequately compensated for his efforts would provide the necessary impetus to rejuvenate "care" innovations. Furthermore, the ability for a care provider to "license" his care methodology to any interested individual or care provider system via a peer-to-peer arrangement further holds the promise that entrepreneurs will pursue "innovative clinical" solutions that target a large number of individuals and will be cost prohibitive for care regimes.

#### *Access to targeted Clinical Sets*

The significant cost associated with the creation of new drugs or clinical solutions is linked to the ability to get validated data sets from patients. Significant amounts of money is spent in developing and capturing such data sets. With the use of a peer-to-peer network with the ability to get a well validated PHI, it becomes very affordable to garner large data sets as well as individuals interested in participating in clinical trials. Thus such a framework holds the potential of significantly reducing the cost of developing new drugs and clinical regimes.

## VI. SUMMARY AND CONCLUSION

In this paper we present a discussion of transformational possibilities of a peer-to-peer healthcare framework built on blockchain technology. An overview of how one would go about building such a framework was also discussed along with the benefits that this framework would provide. We also discuss how such an endeavor would dramatically enhance and accelerate the impacts promised by the new health care paradigm. Finally, we briefly review the long-term impacts of this pursuit in transforming the healthcare landscape.

#### ACKNOWLEDGMENT

The discussion presented here is a result of the efforts that TrustedCare has been engaged in since its inception in 2010 in Transitional Care and population management. These concepts are further enhancements of the vision and effort towards the creations of the building block that are necessary for the formation of individual health information as an Asset Class originally formulated by the author in the paper called "Foundations for enabling Health Information as an *Asset Class*" [11]. The author, would like to thank Sergio Demian Lerner and Pradeep Cheruvathoor for the discussions that helped him crystalize the concept of the applicability of blockchain technology in healthcare. In addition, he would also like to thank Rhonda Holt for reviewing and providing feedback on this document. Finally, this work would not be possible without the numerous discussions that the author has

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