Healthureum
Your Data. Your Doctor. Your Way.

Your Body
is your most priceless possession.

Take Care of It!

White Paper Version 1.0

"Healthcare is much more than just medicine. It's a combination of attitude, actions and the ability to adapt; to new practises, new cures and new technology."

Our Mission

"Provide a future proof system for managing your health."

We aim to revolutionize the Healthcare Industry by bringing power back to the people.

Abstract

Evolution is natural, progressive and necessary for the development and enhancement of any human, industry, business or technology. So why are we so slow to adapt?

The above statement applies to almost all industries; however, we are going to focus more specifically on the healthcare industry. According to Deloitte's Global Outlook for 2017, health care spending increases shall range between 2.4% and 7.5% between 2015 to 2020. Primarily, this is due to 'infrastructure issues, making it increasingly difficult for public health care systems to sustain current levels of service and affordability'. This really is no surprise, particularly when we consider 'the affordability' aspect. Healthcare is possibly the single biggest expense families experience in terms of health insurance, ongoing treatments, emergency cases and experimental programs. Hence, when families and patients do invest in their healthcare, at least they should feel confident in their decision. This is not always the case.

The level of disparity witnessed across healthcare services and providers is the stem cause of this. With variations in care quality, access to specialist practitioners, and requirements for treatment programs, naturally this causes doubt and concern among patients who are just desperate to recover and willing to pay anything they can afford. Desperation should not be taken advantage of, by healthcare institutions, specialists or insurance providers. In an effort to overcome this major weakness in the industry, we must consider new alternatives to aid the way we make our healthcare decisions.

Blockchain technology may be the answer to this concern. Using blockchain technology, we can eliminate the potential risks of data mismanagement, access limitations, delays in prognosis and human manipulation. Over the course of this white paper we will consider how the adoption of such revolutionary technology can enhance transparency, security and accountability in the way our healthcare in managed.

Healthureum aims to address such concerns through the development of its transparent platform which caters to the needs to all those involved at each step of the process, in healthcare management. By considering the challenges from each users' perspective, Healthureum hopes to eradicate as many variables possible to ensure consistency, transparency and affordability of healthcare services.

TAKE CARE OF YOUR BODY.
YOU ONLY GET ONE!

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Explanatory Terms

TGE – Token Generation Event is an event which allows for a decentralized method of funding, where tokens are sold to raise funding for a project or business concept.

Blockchain – Refers to a new technology which acts as a digital ledger of transactions which is decentralized, meaning its data is distributed across a network of devices, secured using cryptography. Each record on the network is chronological and confirmed through network consensus. It cannot be altered, thus making it secure and tamper proof.

Smart Contract – A computer protocol which facilitates a transaction between parties through pre-defined terms which are locked into the digital contract. The terms of the contract are self-executing and cannot be manipulated or interfered with.

Permissionless Blockchain – Is a network which is open for anyone to join, and get rewarded with tokens for verifying transactions.

Permissioned Blockchain – Is a network that required you to be added by the administrator, and transactions are verified usually through voting which may or may not be rewarded with tokens.

Keys – Refer to the addresses used when validating and securing transactions. Public keys allow you to view only but private keys allow you verify ownership.

Ethereum – An open source, blockchain based distributed computing platform that facilitates the deployment of Smart Contracts and DApps to be built on the system with no downtime, or external influence.

Interoperability – Refers to a computer systems ability to interact, exchange and make use of data with other systems across a wide area network, in a seamless manner. It enables unrestricted sharing of resources between different systems.

Who – World Health Organization directs international health within the United Nations' system.

EHR – Electronic Health Record refers to a digitalized version of a patient's medical chart.

METI – Ministry of Economy Trade and Industry

HIE – Health Information Exchange is an organization that facilitates the electronic exchange of health-related information.

HIPAA - Health Insurance Portability and Accountability Act of 1996, is legislation that safeguards the integrity of medical data in the US, with regards to privacy and security.

> "If you think wellness is expensive... then try illness."

> "Global Healcare spend is projected to reach $8.7 Trillion by 2020."
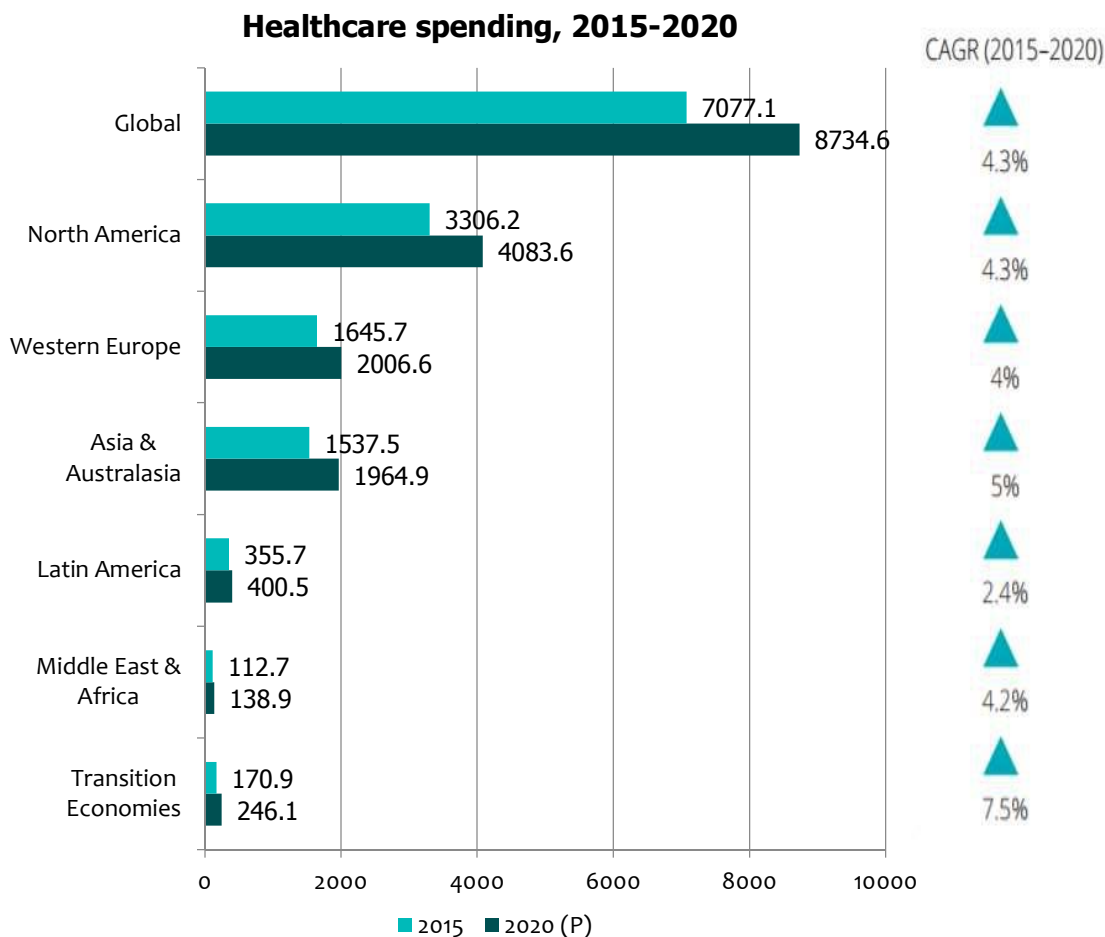> - Deloitte

Introduction

Innovation is evident in the health care industry in the form of robotic surgery, artificial intelligence, 3D printing and other technology enabled devices to improve speed and accuracy. The industry and its practitioners have had a positive response by and large to technology enabled services. So why should the adoption of blockchain technology be any different?

Blockchain may be the most efficient means of bridging the gap between private and public health care. With huge disparities in the quality of care, availability of infrastructure and expertise, blockchain technology has the ability to mitigate such issues. Due to its decentralized nature, blockchain technology can ensure that data is stored securely in chronological order, in a network stored on millions of devices. The data is secured through cryptography and tamper proof, ensuring complete immutability. This method of recording and storing data can apply to almost any process of the health care system, from patient records, billing, treatment plans and diagnosis. The most important aspect of this technology is that every action is tracked with a date stamp which ensures reliability and accountability. This creates an opportunity to achieve standardization in health care levels by providing better access to data, services and expertise, through a decentralized platform. This move towards more scalable and efficient operating models can significantly improve the quality of healthcare and recovery timeframes, while reducing waste, costs and resources required. Through standardization, collaboration and a decentralized ecosystem, blockchain technology can facilitate a more robust care system with competent care givers delivering safe, responsive and efficient care.

Global Healthcare Industry

The task of funding and providing adequate health care on a global scale, has long been a challenge for stakeholders, providers and payers. A recent study by Deloitte revealed that by 2020 global health care expenditure is estimated to reach $8.7 trillion, compared with $7 trillion in 2015, and increase to 10.5% as a percentage of GDP. Contributing factors include an aging pollution, chronic diseases such as obesity and diabetes, and a rise in the number of cases of dementia and HIV-AIDs. The study found that life expectancy is expected to increase by one year by 2020, but the natural progression of aging brings with it challenges. A staggering $4 trillion is estimated to be spent on cancer, cardiovascular and respiratory diseases with obesity on the rise due to poor eating habits and sedentary lifestyles. India and China will be among the highest sufferers of diabetes globally where 69 million and 110 million cases are projected. The most overwhelming discovery is the growing rate of dementia, which is anticipated to double every 20 years resulting in 74.7 million cases by 2030. {9}

Healthcare spending, 2015-2020

Region	2015	2020 (P)	CAGR (2015–2020)
Global	7077.1	8734.6	4.3%
North America	3306.2	4083.6	4.3%
Western Europe	1645.7	2006.6	4%
Asia & Australasia	1537.5	1964.9	5%
Latin America	355.7	400.5	2.4%
Middle East & Africa	112.7	138.9	4.2%
Transition Economies	170.9	246.1	7.5%

■ 2015 ■ 2020 (P)

Source: World Industry Outlook, Healthcare and Pharmaceuticals, The economic Intelligence Unit, June 2016

The Core Focus

Health care spending is expected to rise between 2.4% and 7.5% by 2020 around the globe as depicted above. {9} In an effort to contain and ideally reduce expenditures, measures are being taken to reduce inefficiencies in operations, resources, data, drug sourcing and technology. A shift towards incentivising preventative measures is proving popular in large scale health management, particularly in Japan where the METI program rewards companies which engage in health and productivity management. Other common preventative measures include data and disease screening, which can only be achieved through better population data monitoring. However, on a country specific level, there remains a common barrier, which is the availability of capital for investing in EHR, to enable data sharing and analysis.

A shortfall in available funds, rising labour costs and scarcity of new talent entering the healthcare sector, means a lower doctor to patient ratio which in Japan was just two doctors per thousand of population back in 2012. With limited resources effecting access to adequate healthcare and expertise, both public and private systems are exploring new alternative service methods such as technology-enabled virtual healthcare, in the form of online consultation, wearable and implantable patient monitoring devices. This poses the question; can new technologies solve old problems?

Technology-driven healthcare offers enormous potential in improving access to healthcare in developing, rural and widely dispersed populations, particularly in Southeast Asia and Africa. The benefits are not limited to improved access, but also reducing costs, resources, infrastructure and operational requirements in the process. Telehealth, virtual reality and immunotherapy were identified by Deloitte, among the top 10 innovations in healthcare to "achieve more for less". Another effective means of improving access and reach while being budget conscious, is through collaboration. Depicted below is the number mergers and acquisitions which have occurred as strategic efforts to leverage better reach and access to healthcare while overcoming financial and regulatory pressures. A report issued by the NHS Improvement estimates a savings of 12-14% through service consolidation between hospital providers. {9} This method of collaboration and physician and hospital bed sharing is very common in Japan, but one major struggle is the technical ability to integrate and share data between systems effectively. Could blockchain technology be the solution?

Announced Hospital Mergers and Acquisitions, 1998-2014
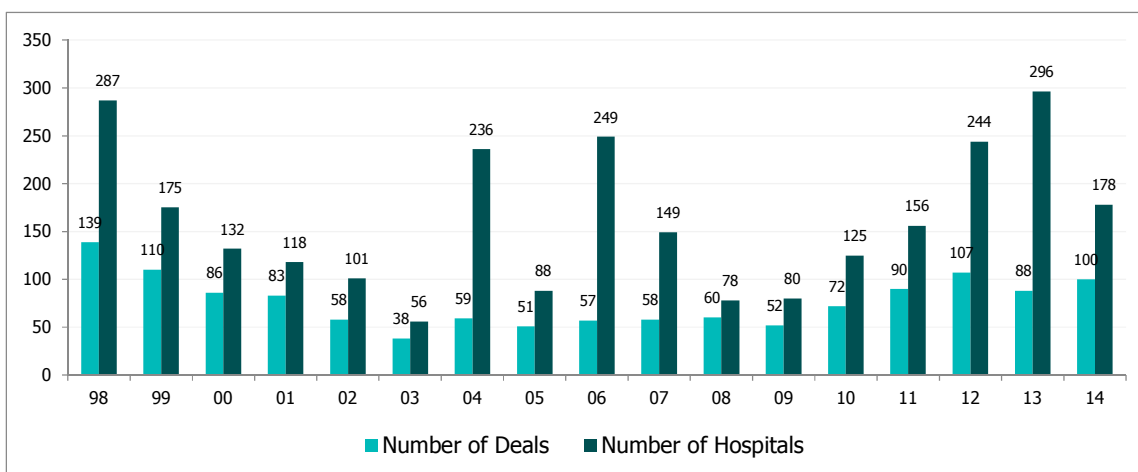
Typically, healthcare data is stored in a centralized system known as an EHR system, which is often customized as per the healthcare providers requirements. This results in a fragmented approach to data storage, preventing ease of information sharing between systems, otherwise known as 'interoperability'. Instead, information ends up in siloes that act as bottlenecks in the sharing of data, causing frustration among providers, regulators, researchers and patients. This lack of standardization and centralized storage approach results in two fundamental flaws, privacy and security. {6}

Blockchain can eradicate these flaws. A recent Forbes article describes "blockchain technology, at its simplest, a distributed and immutable (write once and read only) record of digital events that is shared peer to peer between different parties (networked database systems)". {11} As blockchain operates on a decentralized approach, no single entity is in charge of storing the data, but all participants on the network share the responsibility for maintaining data integrity and security. Blockchain uses a time stamp to authenticate any change in data, which is perfectly suited to EHR management, as it will track and record each edit carried out by each user permitted to access the data. This ensures transparency and accountability at each step of the process. This addresses the need for providers and patients to have access to up-to-date records of test results, diagnoses, prescriptions, services rendered, bills outstanding etc., while being able to view, edit and share data in real time. Blockchain technology allows for a more coordinated approach to EHR management with structured access and privacy controls. Due to the inherently sensitive nature of patient data, "blockchain is ideally suited to address a number of trust issues, such as patient identification, patient consent, provider-sider user authentication, and even the discover and reduction of billing fraud and erroneous malpractice in claims." {3} IBM supports this, referring to blockchain as the "chain of trust", capable of improving peer to peer accountability.

Challenges Ahead

Let us not assume that blockchain is a one stop solution for all pre-existing healthcare problems. "Like every technology, blockchain has limitations and is not suited for application to all scenarios," IBM says. Blockchain technology offers many potential use cases in the healthcare sector, but it presents challenges for low-value, high volume transaction. Hence the choice of blockchain protocol is crucial when considering the application of it, as it may impact on the number of users and possible applications. For example, the Ethereum platform allows for the creation of decentralized applications on the system, and hence is popular for both permissioned and permission less blockchain development.

How would a blockchain-powered healthcare network operate and what are the foreseen challenges?

Regulatory and Data Compliance

As blockchain stores all data in a distributed manner, rather than a centralized system, the data goes outside the walls of the health organization, exposing it to potential risks and breaches in confidentiality and integrity. This must be considered from a regulatory and data compliance perspective, most notably with existing privacy regulations like HIPAA. {6}

File Size & Scalability

Medical records such as large images or scans are considered very heavy files which may impact the performance of the blockchain. A more efficient solution would be to just create reference points using hash codes pointing to the source of the data which can be stored off the blockchain. The role of the hash code is to verify the integrity of the data pulled from the source, and the source may also have access control so that only those authorized can access it. {5}

Blockchain-Enabled Medical Devices

Stricter monitoring of medical devices is required, following a number of recent disasters including Europe's PIP breast implant blunder, followed by an extensive recall of hip replacements. Both of which highlight a huge deficiency in current regulatory systems. Can this be avoided through the adoption of blockchain-enabled devices and at what cost? {9}

Response from the Industry

According to a survey carried out by IBM, on 200 healthcare executives across sixteen countries, approximately 16% admitted to taking a proactive approach in adopting a commercial blockchain solution in 2017. {8} That's quite a positive responsive for a technology which is so new, with few real life uses cases operational. England's NHS recently stated, "that technology which enables patients to manage their own health is the key to improving care, promoting efficiency and cutting costs throughout the NHS." The NHS is taking keen steps towards virtual health, setting aside £100 million to establish centres of global digital excellence. A similar mindset is clear in Australia with the integration of telehealth and telemedicine services, and plans to introduce artificial intelligence (AI) in clinical settings.

Adopting Blockchain in Healthcare

Deloitte explains that "blockchain truly shines when four conditions have been met: (1) multiple parties generate transactions that change information in a shared repository, (2) parties need to trust that the transactions are valid, (3) intermediaries are inefficient or not trusted as arbiters of truth, and (4) enhanced security is needed to ensure integrity of the system." The Health Information Exchange (HIE) outlined to Deloitte, the biggest pain points and the opportunities of blockchain. {12}

Benefits

	HIE pain points	Blockchain opportunities
	Establishing a trust network depends on the HIE as an intermediary to establish point-to-point sharing and "book-keeping" of what data was exchanged.	**Disintermediation of trust** likely would not require an HIE operator because all participants would have access to the distributed ledger to maintain a secure exchange without complex brokered trust.
	Cost per transaction, given low transaction volumes, reduces the business case for central systems or new edge networks for participating groups.	**Reduced transaction costs** due to disintermediation, as well as near-real time processing, would make the system more efficient.
	Master Patient Index (MPI) challenges arise from the need to synchronize multiple patient identifiers between systems while securing patient privacy.	**Distributed framework for patient digital identities**, which uses private and public identifiers secured through cryptography, creates a singular, more secure method of protecting patient identity.
	Varying data standards reduce interoperability because records are not compatible between systems.	**Shared data** enables near real-time updates across the network to all parties.
	Limited access to population health data, as HIE is one of the few sources of integrated records.	**Distributed, secure access** to patient longitudinal health data across the distributed ledger.
	Inconsistent rules and permissions inhibit the right health organization from accessing the right patient data at the right time.	**Smart contracts** create a consistent, rule-based method for accessing patient data that can be permissioned to selected health organizations.

The pain points above reflect a disjointed system, due to a lack of common standards and poor systems for sharing sensitive information between stakeholders. Let's consider the types of benefits which blockchain could offer, if adopted throughout the healthcare industry.

Cost: By transitioning from resource intensive processes, to blockchain-enabled processes, the costs can be significantly lowered.

Delivery: Adopting delivery models that focus on a cooperative technology and interoperability, it can improve efficiency in all internal processes, positively influencing care delivery.

Population Health Management: Standardization and interoperability would allow for more collaboration between hospitals in the form of data sharing which would aid population health management and future capital planning.

Innovation: Technology-enabled solutions can offer greater efficiency to the entire ecosystem, resulting in patient satisfaction, higher standards in service provision, faster recovery, better utilization of resources and reduced costs overall.

Operations: By transitioning from paper based processes to technology-enabled ones, we can deliver much more efficient processes, reducing time, effort and resources required. Through a standardized approach, we can enhance integration and data sharing in a more secure and user-friendly manner.

Regulation: Information sharing, and partnerships helps can help lower operational and regulatory risks. However, standardization and interoperability are necessary to establish a consistent approach to compliance framework and implementation to maintain regulation in global health standards.

Use Cases

Tamara StClaire, former chief innovation officer at Conduent Health, recently suggested several potential use cases for blockchain in healthcare including master patient index, claims adjudication, interoperability, longitudinal health records, supply chain and clinical trials. Let's take a closer look at these possible use cases and the benefits for adoption.

Master Patient Index

With the introduction of blockchain in patient data management, we can improve standardization which is a critical element preventing interoperability among systems. The second critical element revolves around ownership and the portability of user owned data. Quite often there is a resistance from medical institutions in releasing medical records, which would need to change for a blockchain based system to be successful and for patient data integrity. StClaire suggests that blockchain technology "could solve the challenge health systems have when their data sets get mismatched, or the problem of duplicate records."[1]

The concept of master patient data will reoccur in many use cases which will be explored further. Privacy and security of patient data is a primary concern, with data being sold, leaked, mismanaged and hidden due to fraud and malpractice. Converting to a blockchain based system would significantly improve patient data integrity enabling the sharing of identifiable data with doctors but the ability to share only unidentifiable data with research programs, where you would prefer to remain anonymous. [2]

Claims Assessment

Claim assessors and insurance companies have been accused of fraud and manipulation of claim assessments, causing patients to suffer huge time delays and loss of claims due to incomplete or 'mismanaged' records. "Roughly 6 percent of all claims are denied because of incomplete or incorrect information," according to StClaire. [1] Furthermore, 5-10% of billing costs arise from over billing or billing for non-performed services, as estimated by Forbes. [11] Blockchain technology could eradicate this human risk through disintermediation, as claims would be settled using a smart contract which will auto issue the claim on satisfaction of pre-defined terms. By automating the majority of claims and payment processing activities, blockchain could significantly reduce the burden of patient losses, cost of disputes and reconciliation of accounts.

Interoperability

This refers to the ability of two or more systems to share, exchange and use the information shared between them. This is essential to facilitate patients to own their data, and give access to others to view or add new data to their record. Similarly, two hospitals should be able to easily pull, and push data related to the same patient without needing to replicate that data in a different format for utilization. Blockchain-enabled health IT systems that are irrevocable and cryptographically secured, could remove the hassle and cost of data reconciliation and provide access to both real time and historic data to multiple users at one time.

Longitudinal Health Records

Most patients visit their family general practitioner for day to day health concerns, however when they need to visit a specialist or a different care provider, it's difficult as the new care provider does not have a longitudinal view of the patient's state of health, including pre-existing illnesses, prescriptions, family history etc. By shifting to a decentralized system, we could provide a longitudinal view of one's health and therefore more efficient treatment of patients, naturally resulting in better patient experience.

Supply Chain

Supply chain plays an important role in resource management, both human resources and medical. Blockchain technology could record details like wages and employment contracts reducing HR efforts and grievances. It can also track the authenticity of medical infrastructure ensuring it's fit for purpose. Most notably, the authenticity of drugs, particularly when the counterfeit drug market is estimated to be worth $200 billion annually. {2} The World Health Organisation recently revealed a frightening statistic stating that 100,000 deaths per year are connected to the counterfeit drug trade. Blockchain technology can be used to accurately track the production and movement of a drug through the supply chain using the hash which is generated during production. Similarly, if a drug needs to be recalled for any reason, it should enable ease of traceability.

Clinical Trials

Authenticity of data is equally important when carrying out clinical trials. Usually the individual or organization is trying to prove a hypothesis based on supporting data from the trial, which if proven will generate huge financial gain, thus creating a hidden agenda. This often results in fraud, potentially in the form of manipulation of

data or hiding of unfavorable data which goes against the hypothesis. In this scenario, proof of existence is essential, and blockchain technology enables the secure recording of this, in chronological order. Due to the characteristics of blockchain the data gets distributed across millions of machines, hence altering or tampering with the data is virtually impossible without being detected. {2} Blockchain technology can also be used in maintaining patient data integrity in clinical trials, where patients may contribute their data for research purposes while hiding identifiable data.

Data Protection

Data integrity whether patient or research related is essential and blockchain can assist in protecting this data. By introducing a decentralized blockchain based system, it can mitigate the risk of cybercrime, data leakage and tampering. With life sciences and healthcare organizations suffering 340 more security attacks when compared with other industries, the need for a more robust system is evident. Likewise, the US and UK have witnessed economic losses of more than $279 billion due to cybercrime, which could have been avoided had blockchain been implemented. {9}

The Problems Being Addressed

Healthcare represents one of the largest business sectors globally, so it's no surprise that there's plenty of problems in need of solutions to progress the quality of healthcare. The key areas of concern are:

1) Data management
2) Access to affordable medical care
3) Authenticity of healthcare providers
4) Counterfeit drugs
5) Population health management
6) Fraud in operational procedures

Healthureum
Your Data. Your Doctor. Your Way.

How We Will "Add Value"
By using blockchain we will be able to create Smart Contracts to enable users to manage their healthcare more efficiently.

"

A **Smart Contract** is a formalization of contractual relations in a digital form.

Key Areas of Concern

1) Data management

Every first visit to a doctor or clinic requires a registration process, which presents the first big challenge; disparities in what data is captured and how it is recorded. This prevents interoperability between care providers, and thus there is a need for more trusted strategies for managing big data. {4}

2) Access to affordable medical care

A major factor to be addressed is the high costs associated with health-related services, particularly in emergency cases where a patient has not opted for medical insurance. In such instances, patients have limited options to choose from; seek help from family, take a loan, look for cheaper and riskier treatments, go abroad for more competitive rates, or source pro-bono programs for assistance. Healthcare providers are also concerned with patients having access to the best possible treatments, and innovative services on the blockchain could facilitate this with video consultations, referrals and second options on the network and the ability to strengthen permission sharing protocols.

3) Authenticity of healthcare providers

Another risk associated with sourcing cheaper alternative healthcare, is the opportunity for under qualified practitioners to gain access to patients in desperate need. With no time or knowledge of how to validate their qualification, patients can end up in dire situations after botched surgeries and unregulated procedures. The blockchain would enable patients to verify the authenticity of a health professional including where they are allowed to practice, licenses and affiliations. A pilot project in Illinois has been launched earlier this year, as a joint venture between Hashed Health consortium and state officials to create one of the first blockchain based registry systems. Capturing data such as medical schools, residency programs, certifying boards and hospital affiliations, accurately recording practitioner data over the course of their careers. This builds confidence with employers, patients and regulatory bodies while mitigating the risk of fraud. {4}

4) Fraud in counterfeit drugs

This cost cutting attempt can be seen in the manufacturing of drugs also. This is a particularly large issue in developing nations such as India and China, where

branded drugs are simply too expensive when compared with locally produced alternatives. The WHO estimates that "16% of counterfeit drugs contain the wrong ingredients" which means from a qualitative and quantitative aspect, the drugs may not actually treat the symptoms they are intended for, and may result in adverse side effects. {2} This is a notable concern, highlighting the need for more accurate supply chain management. A survey by Pistoia Alliance carried out mid 2017 revealed that 68% of pharma and life science leaders said that "blockchain could drastically improve medication supply chain management and produce associated gains in patient safety." {4}

5) Population health management

Now let's consider not only deliberate fraud, but also misuse on an epidemic level. In large scale emergency situations, the collection, collaboration and analysis of big data can be tedious, slow and in some cases a matter of life and death. But what if we could take a proactive instead of reactive approach to managing public health surveillance? Blockchain could facilitate a secure and compliant method to overcome complex data sharing agreements between health institutions, and ensure reliability and speed in high risk or epidemic scenarios. From a preventative measure, blockchain could also be utilized for monitoring population health, in identifying risks and trends in disease spread. Similarly, to anticipate future expenditure on chronic disease, and thus take a proactive approach in encouraging better practices, exercise and eating habits to reduce risks which seem inevitable. Health insurance providers would also benefit, and could reassess their risk profiles by gaining better insight into an individual's general health and habits.

6) Fraud in operational procedures

Many of these problems identified stem back to one thing which is the standardization and sharing of data. Once again, this is evident even among the walls of a hospital, between accounts departments and claims departments. Patients often cannot get access to their records before clearing their billing, which is debilitating for a patient when it's their data. The adoption of blockchain based patient data would significantly reduce time, resources and costs across all health-related services. It also has the power to drastically reduce fraud and manipulation which is witnessed time and time again in the claims procedure, where smart contract technology could eradicate it entirely, doing away with the human interference and simply executing once the pre-defined terms are met.

*"In 2015, a record 112 million health care record data breaches occurred due to IT hacks. Now imagine how the use of an inoperable blockchain could mitigate this risk due to its cryptographic nature, bringing a **new level of integrity** to health care data management."*

The Resolution

Healthureum is a dynamic and multi-functional ecosystem designed to bring Healthcare services on the blockchain to transform 'How We Manage Our Healthcare'. Healthureum will guarantee its users, the most efficient healthcare treatments, access to Physicians and Specialists globally, access to quality medical infrastructure and opportunities to access first of its kind innovative treatment plans including philanthropic sponsorship programs.

Blockchain and Smart Contract technology integration in healthcare's critical services will bring S3, **standardization, scalability and social responsibility**, while tackling the inflated costs, limited access to adequate services and misutilization of patient data. "Through blockchain, we can achieve decentralized healthcare, closing the gap between services; through transparency, security and most importantly accountability."

A conglomerate of healthcare related services operated on the blockchain using smart contract technology on the ethereum based platform. By exploring the key issues from the angle of each party involved, we have identified five core focus areas where this innovative approach can bring widespread efficiency and transparency.

Data Systemization   **Doctor Consult & Referral**

Medical Infrastructure   **Research Programs**   **Philanthropic Activities**

Let's consider these fields in more detail.

Data Systemization

Healthureum will enable patients to consolidate all their data, whether personal, medical or emergency, stored in a single platform which is secured with encrypted codes, keeping all your information private, safe and all in one place. The goal is to create a system that does not reply on trust, and facilitates information storage, sharing and collaboration to improve efficiency in the management of healthcare and population health.

Type of data to be consolidated

- Medical records
- Personal data
- Test results
- Scans
- X-rays

- Treatment plans
- Prescriptions
- Referrals
- Billing
- Claims

Your data is stored on the blockchain in chronological order and cannot be tampered with or mismanaged. The cryptographic nature will mitigate the risk of hacking or illegal sharing of your data. Access your data and medical history at your fingertips, making it easy to share with your doctors. Give access to view or add additional data to your records, enabling hospitals and care givers to access and update your data in real time.

How it works

DATA CONSOLIDATION AND EXCHANGE

Patient takes services from hospital

Standard data is passed to blockchain via API

Transaction stored in Blockchain, containing patient public key

Patient's data tracked in existing IT system

Smart contract processes data transaction

Data remains non-identifiable to those who don't have the private keys

Data can be analyzed to uncover new insights

Identifiable data remains hidden to those without private key

Patient's non-identifiable data visible

Patient can share private key with doctor to view all data

Due to the sensitive nature of medical data, we have identified how to deal with both identifiable and non-identifiable data. Using blockchain technology Healthureum will enable permissioned users to access and view the data, which you want to share. In the case of your doctor, you ideally would like to give them full access to gain a longitudinal view of your health. This can be achieved by sharing the secret private key that makes identification possible. However, in the case of research programs, you want to volunteer your data but not your identity, hence only your public key shall be shared. The method of encryption creates permission layers, which ensures your data is secure and private. {13}
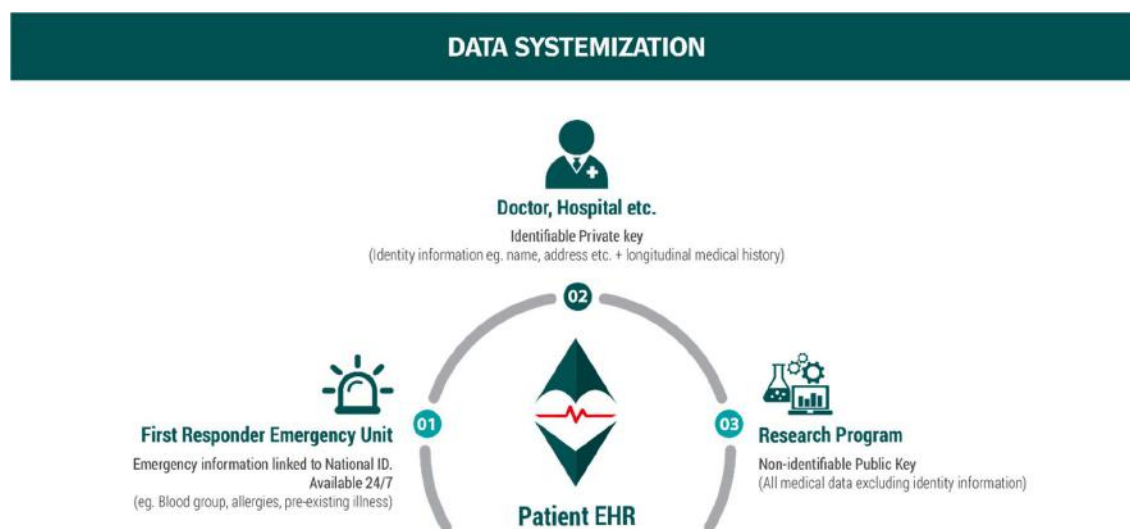
Now that we have addressed how Healthureum will manage patient data integrity, let's understand what type of data is to be stored both on and off the blockchain to give the most efficient outcome. Blockchain performance is influenced by the size and format of files being stored on the chain. For example, large data files like abstract MRI images are not suitable for storing on the chain as they will hamper overall performance. Healthureum will deal with such data by keeping it off the chain but adding encrypted links which will point to a separate location containing the data. {7}

Healthureum aims to address patient data integrity, while implementing realistic frameworks for defining the size and format of data to be submitted on the blockchain. By developing a standardization in data sets, Healthureum can act as a transaction layer for the sharing of data between users in a secure ecosystem. The goal is to achieve interoperability to facilitate the seamless sharing of data between

health organizations and patients in a secure and efficient manner without compromising on privacy and regulatory compliance. The same can be applied within the four walls of a hospital or clinic, to enable collaboration between departments to prevent fraud or human errors in billing and claims, thus creating a more pleasant patient experience. Healthureum will take a proactive approach towards data protection according to the proposed General Data Protection Regulation (GDPR) due to be implemented in 2018 for all EU patient data.

Also, in the case of emergencies, the first responders will be able to view your 'mission critical' data including blood group, allergies, pre-existing illnesses or current prescriptions. Time save lives, so adopting the Healthureum way, you can be treated quicker, more efficiently and it might just save your life.

We hope to integrate this Data Systemization in healthcare clinics, nursing homes and hospitals to facilitate better patient record handling, and ease of sharing data between doctors, patients, laboratories and all relevant departments. Through this we can achieve standardization, security and social responsibility.

DATA SYSTEMIZATION

Doctor, Hospital etc.
Identifiable Private key
(Identity information eg. name, address etc. + longitudinal medical history)

02

First Responder Emergency Unit
Emergency information linked to National ID.
Available 24/7
(eg. Blood group, allergies, pre-existing illness)

01

Patient EHR

03

Research Program
Non-identifiable Public Key
(All medical data excluding identity information)

Blockchain-enabled EHR will bring value to the industry by significantly reducing the resources, time, errors, updates, and reconciliations required, which will directly correlate to more efficient healthcare provision, higher patient satisfaction and benefits to the bottom line.

Token Purpose: Gaining access to the Healthureum ecosystem requires the purchase of Healthureum tokens. Then, users will be allocated an app to manage and store your medical data in a user friendly, systematic manner. This unique feature facilitates interoperability, between patient and carer, hospitals, labs and departments across locations. The Healthureum platform will give you unlimited

access to your real time and historic medical data, while maintaining your data integrity.
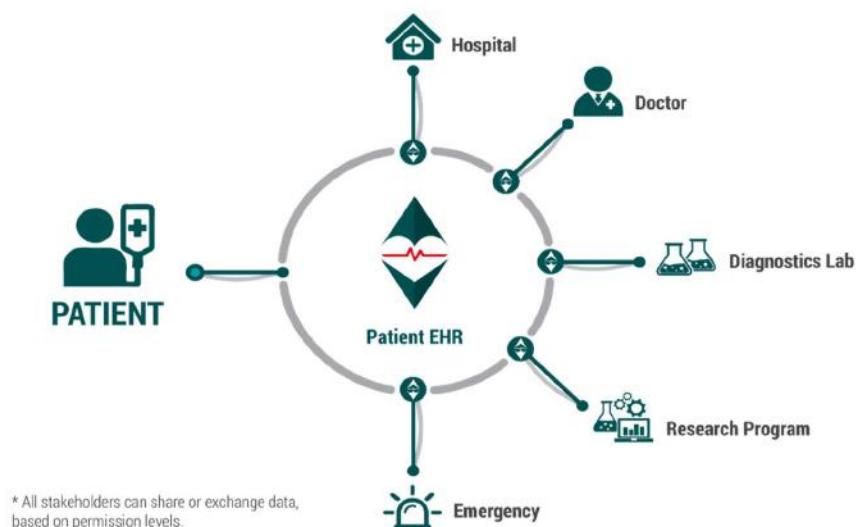
"Your Data Your Way! You Own Your Data!"

Doctor Consults & Referrals

On the Healthureum platform you can opt for a doctor consult or even a second opinion if you are unsure of your prognosis or treatment plan. This can benefit those particularly with:

- Symptoms in need of prognosis
- Limited access to healthcare advisors
- Busy schedules, unable to attend in person
- Complex or rare symptoms
- Lack of trust in the first opinion received
- A need for specialist opinions

Doctor Consolation

Through the Healthureum video consultation you can obtain quick and easy access to a healthcare professional, who can guide you with treatment plans, prescriptions and referrals to a relevant and qualified practitioner in your locality. Using blockchain a patient can share their symptoms, diagnosis or treatment plan with healthcare professionals on the Healthureum network to get second opinions, in cases of

uncertainty or rare symptoms. The Healthureum ecosystem will develop APIs enabling practitioners to access the permissioned data, and to integrate with other organization systems, during the referral process, to ensure all care providers get a longitudinal view of your medical health, so as you can be treated most efficiently.

How it works
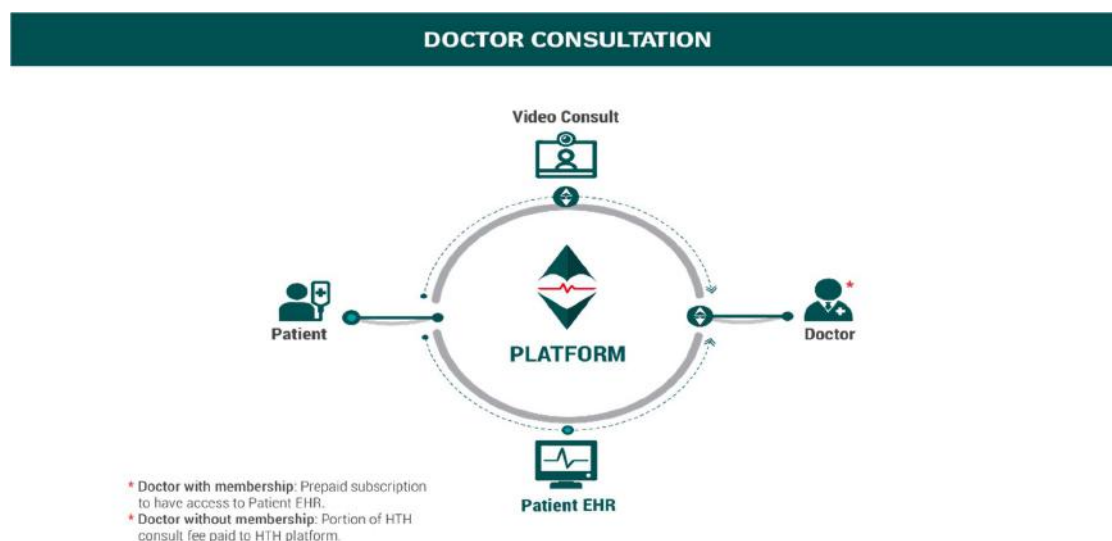
Referral

Attending specialist practitioners usually requires a referral from your general practitioner resulting in additional and unnecessary costs which could be avoided on the Healthureum platform. Get referred by a registered professional who can even guide you on finding a specialist in your nearby locality, for better convenience. By sourcing a registered professional on the Healthureum platform, you can be rest assured that all referrals are vetted by us as legally and qualified practitioners, reducing the risk to the patient. The referrals made by Healthureum will be tracked on the blockchain along with the practitioner's background in terms of education, residency, qualification and affiliation, to ensure you are being treated by those qualified to do so.

How it works
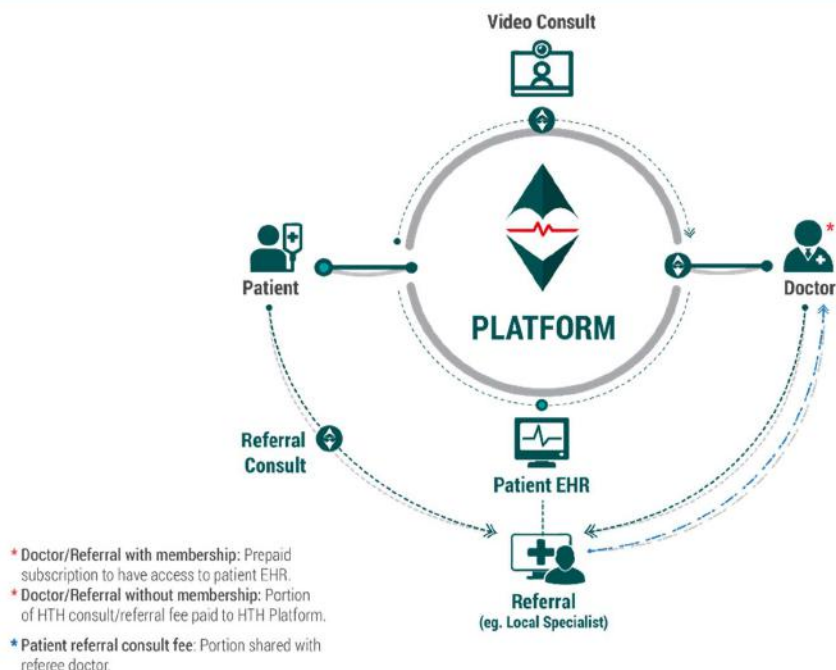
Diagnostics

In addition to getting advice on the Healthureum platform patients may also undergo pathology and diagnostic tests through a supply chain of laboratories and pay using Healthureum tokens.

Types of Diagnostics

- Lipid profile
- Glycosylated hemoglobin
- Complete blood count
- Thyroid profile
- Liver / kidney function test

- Culture / Urine test
- Vitamin D / B12
- Fever Panel
- Iron Studies
- Diabetes Panel

Once again, the referred labs and clinics are vetted by us to ensure a standard of qualification and professionalism. Pathology laboratories can upload your results and data to your records file on the Healthureum ecosystem, so you can store it and share it easily with your healthcare physician. This facilitates faster diagnosis while maintaining the integrity of your personal data.

- No delays
- No loss of data
- No mix ups
- No hassles

How it works
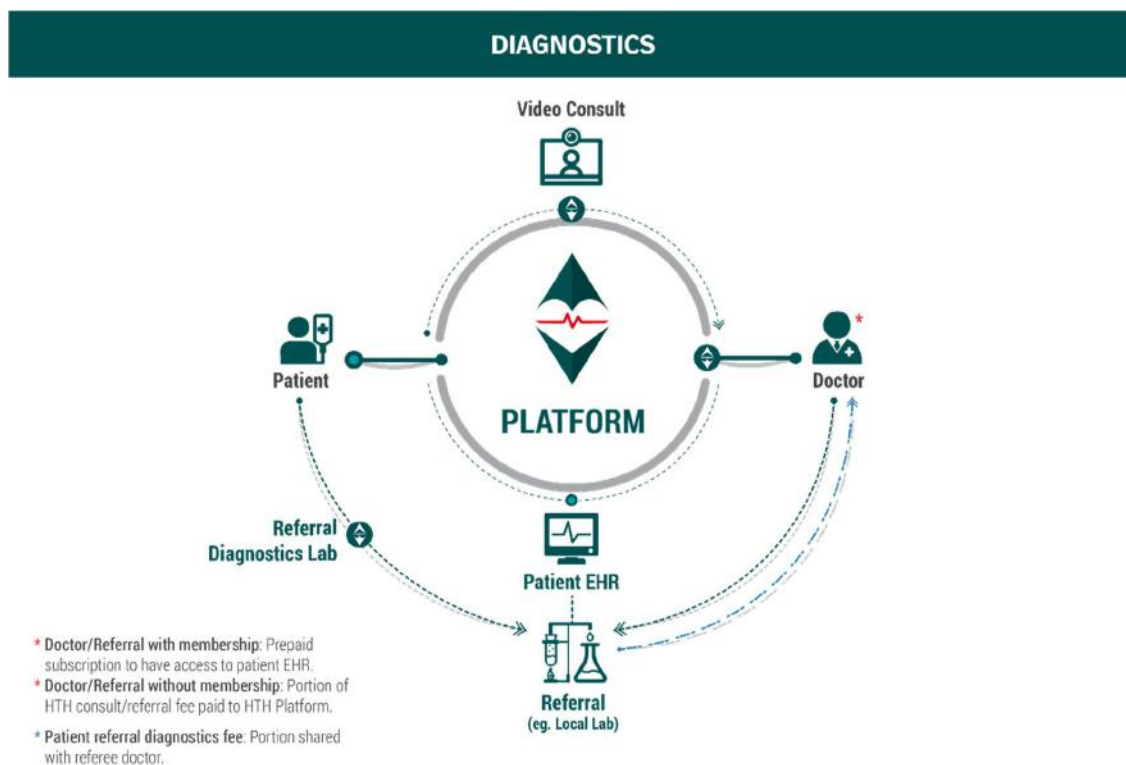
Token Purpose: Doctor consults and referrals can be carried out in the Healthureum ecosystem, and patients can pay directly to doctors and consultants using Healthureum tokens. Similarly, referrals to laboratories for tests or screening may also be booked on the platform and paid for using Healthureum tokens, for faster payment processing, and sharing of results and data on your Healthureum data storage app.

"If you think wellness is expensive ...then try illness!"

DOCTOR CONSULTATION AND REFERRAL - TOKEN PURPOSE

* Doctor/Referral with membership: Prepaid subscription to have access to patient EHR.
* Doctor/Referral without membership: Portion of HTH consult/referral fee paid to HTH Platform.
* Patient referral diagnostics/consultant fee: Portion shared with referee doctor.
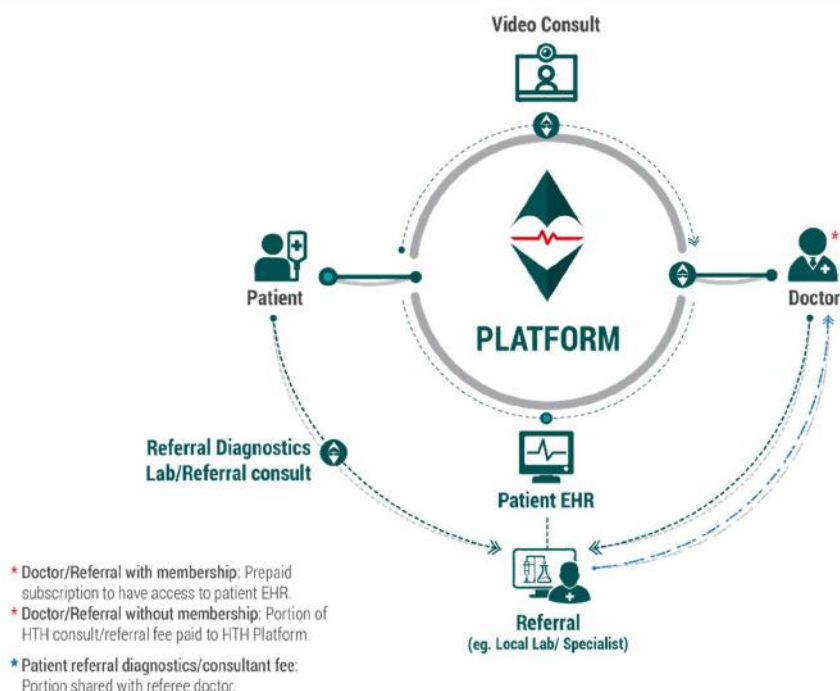
Medical Infrastructure

Typically, medical infrastructure accounts for the largest capital investment, for any medical institution. Healthureum will integrate blockchain in medical infrastructure to measure

- Return on investment
- Maintenance and upgradations
- Demand and usage
- Supply chain and reliability

By using blockchain technology we can record and assess every action related to a piece of medical infrastructure, with regards to the cost versus the usage, the waiting period for patients and therefore demand, the scheduling of maintenance checks and the authenticity of the supplier. These facts and figures are beneficial for medical institutions to ensure they have adequate infrastructure to best service their patients, while also building confidence in patients, that their resources are fit for purpose and readily available. This can be very beneficial particularly when looking at investment versus return, and to aid hospitals in planning annual budgets and anticipating future capital outlay. The Healthureum platform can provide access to non-identifiable data sets with regards to services rendered to analyze usage levels.

By combining this function with the data systemization function, Healthureum can assist with population health management. By analyzing data trends, hospitals and governments can identify potential risk factors for the future including a rise in chronic diseases. To be able to adequately care for these diseases in the future, we must plan now, by addressing the demand vs supply of medical infrastructure both now and in the future, which can be analyzed using smart blockchain technology. This enables health organizations to take a proactive approach to healthcare and make decisions now that will benefit future patients.

How it works
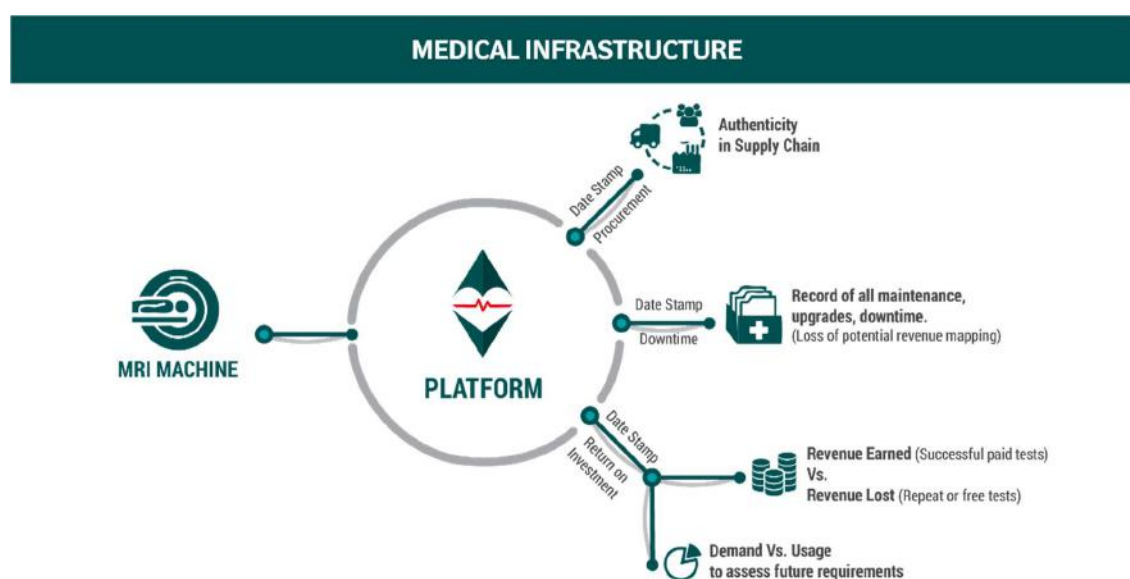
Token Purpose: By using Healthureum tokens for the purchasing, servicing and renting of medical infrastructure, we can record important facts and date stamps from procurement to each time the machine is used, and which patient used it. The decentralized nature of blockchain technology enables us to record every step in a chronological and systematic manner, while verifying the authenticity of the supplier. The Healthureum token will be the method of payment for each step of the process, including purchasing, servicing and services rendered which will enable the Healthureum ecosystem to record such payments in the data management app also.

MEDICAL INFRASTRUCTURE - TOKEN PURPOSE

MRI Scan

Patient

PLATFORM

Provider
(eg. Hospital)
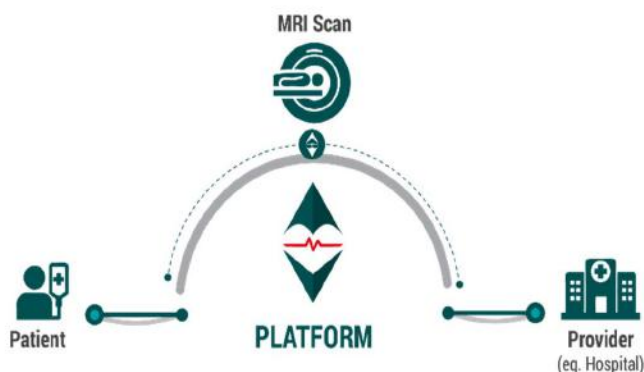
* Doctor with membership: Prepaid subscription to have access to Patient EHR.
* Doctor without membership: Portion of HTH consult fee paid to HTH platform.

Research Programs

Research and learning are at the forefront of medical cures, hence Healthureum will include blockchain based Research Programs to ensure that every piece of data is properly monitored, recorded and accessible in a scalable and secure system which is tamper proof. This will mitigate the risk of external manipulation, while aiding researchers and patients to track and measure any relevant data required for the program. It will enable patients and practitioners to be proactive in their monitoring of treatments trials, particularly in the fields of AIDs, Cancer and Diabetes.

Patients not directly related to the treatment trails, may also contribute their medical data for research purposes in both paid and unpaid programs. This will encourage the sharing of medical data for social cause as patients control their own data, and their data may only be utilized for research purposes by giving their permission through the Healthureum ecosystem. In this instance, Healthureum will act as a transaction layer facilitating access to non-personally identifiable demographics, using APIs to submit defined query parameters, for example patients in a specific region.

As already identified, fraud is a prevailing risk in research programs and clinical trials, so Healthureum will be using an ethereum based blockchain system to ensure that data integrity is maintained. If attempts were made to change a historic block, it would require consensus from the majority of the network for it to be verified. This mitigates the risk of tampering, as any change is immediately broadcasted to the entire network, thus making it secure. In this manner any research programs carried out under Healthureum would rely on only genuine data and outcomes from the research program, removing the potential manipulation which commonly occurs in the field of medical research.

How it works

RESEARCH PROGRAMS

Non-identifiable data
(All medical data excluding identity information)

Patient — PLATFORM — Research Program (Read Only Access)

Token Purpose: All participants offering their data for research purposes may be rewarded with Healthureum tokens. Similarly, those choosing to participate in new clinical trials or treatment programs will use their Healthureum tokens for the purpose of payment for services through the Healthureum ecosystem.

RESEARCH PROGRAMS - TOKEN PURPOSE

Non-identifiable data
(All medical data excluding identity information)

Patient — PLATFORM — Research Program (Read Only Access)

* Research program pays patient and platform participation + facilitation fee in HTH token.
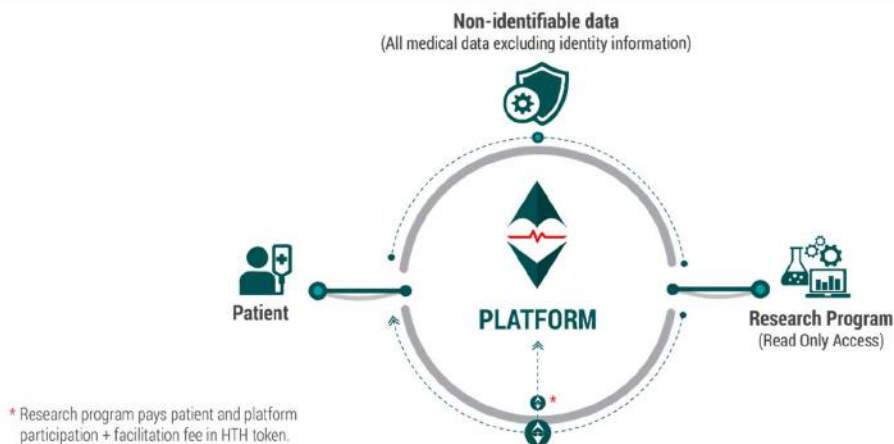
"If you're in the luckiest 1% of the humanity, you owe it to the rest of humanity to think about the other 99%".

Now using Healthureum, you can choose to fund projects of social cause in the form of philanthropic activities. Healthureum will promote four key activities;

1) Research programs to enable new medical breakthroughs.
2) Innovation in the treatment of Cancer.
3) Innovation in the treatment of Hepatitis and HIV AIDs.
4) Medical infrastructure in technology enabled devices.

How it works

Healthureum is devoted to improving all standards of healthcare by enabling philanthropists to join the ecosystem and make valuable contributions towards the future of healthcare. Healthureum realizes that healthcare research benefits all of us, and hence is encouraging philanthropists to part take in funding research programs that could help any one of us in the future. The same applies, in the case of finding new and innovative methods of treating Cancer, Hepatitis and HIV AIDs. They are rampant in societies globally and with no found cure, Healthureum is pushing for philanthropic activity in these fields of high concern. Healthureum is adopting innovation in the form of blockchain and smart contract technology, but it also promoting the development of new technology enabled medical devices to facilitate better monitoring, and better patient outcomes.

Healthcare has long been a focus for philanthropic activities but there is a stigma or doubt on whether the funds are reaching those purposes for which they were intended. Using blockchain technology Healthureum can enforce accountability and traceability, to ensure donations are being used ethically.

Token Purpose: All donations for philanthropic activities will be carried out using Healthuerum tokens for ease of transfer and to bring transparency in the usage of these funds. A time stamp will occur for each transaction on the blockchain clearly tracking the use of funds donated by philanthropists in the Healthureum ecosystem.

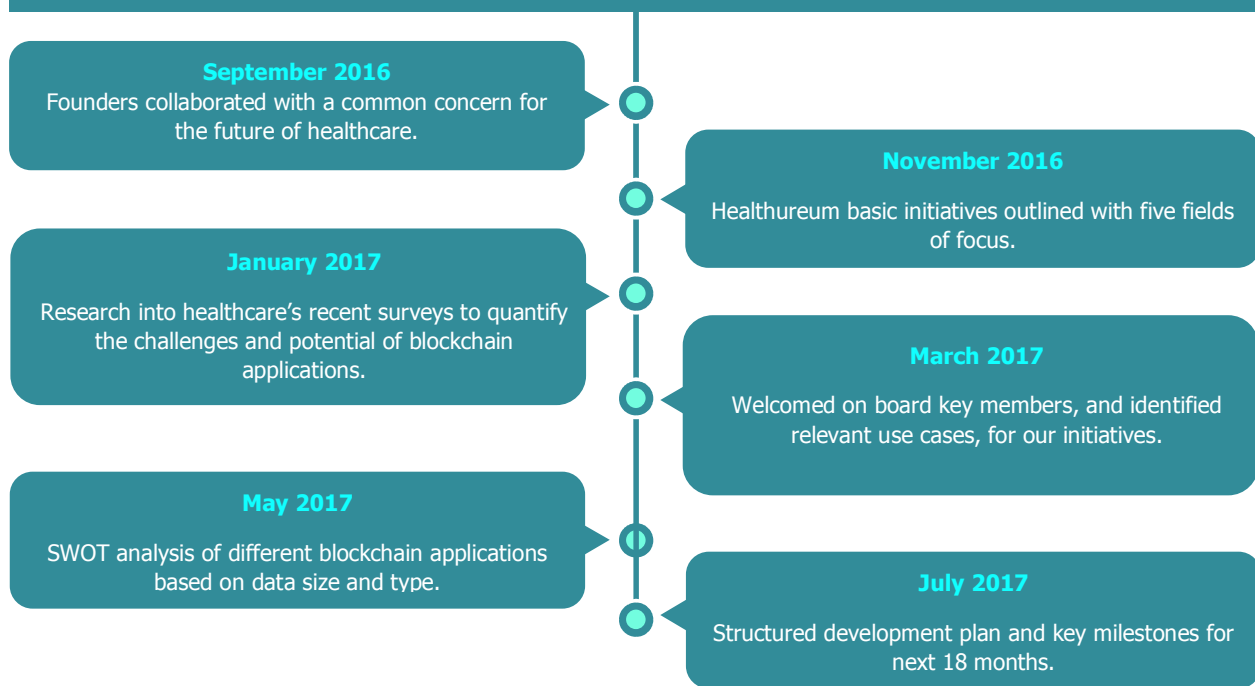## PHILANTHROPIC ACTIVITIES - TOKEN PURPOSE
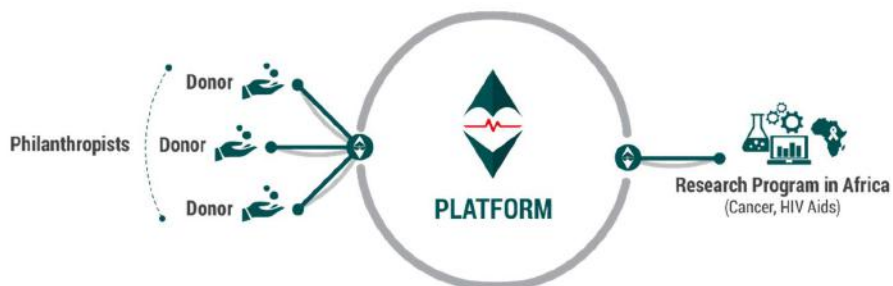
* Each transaction is recorded on the blockchain to ensure ethical use of funds.

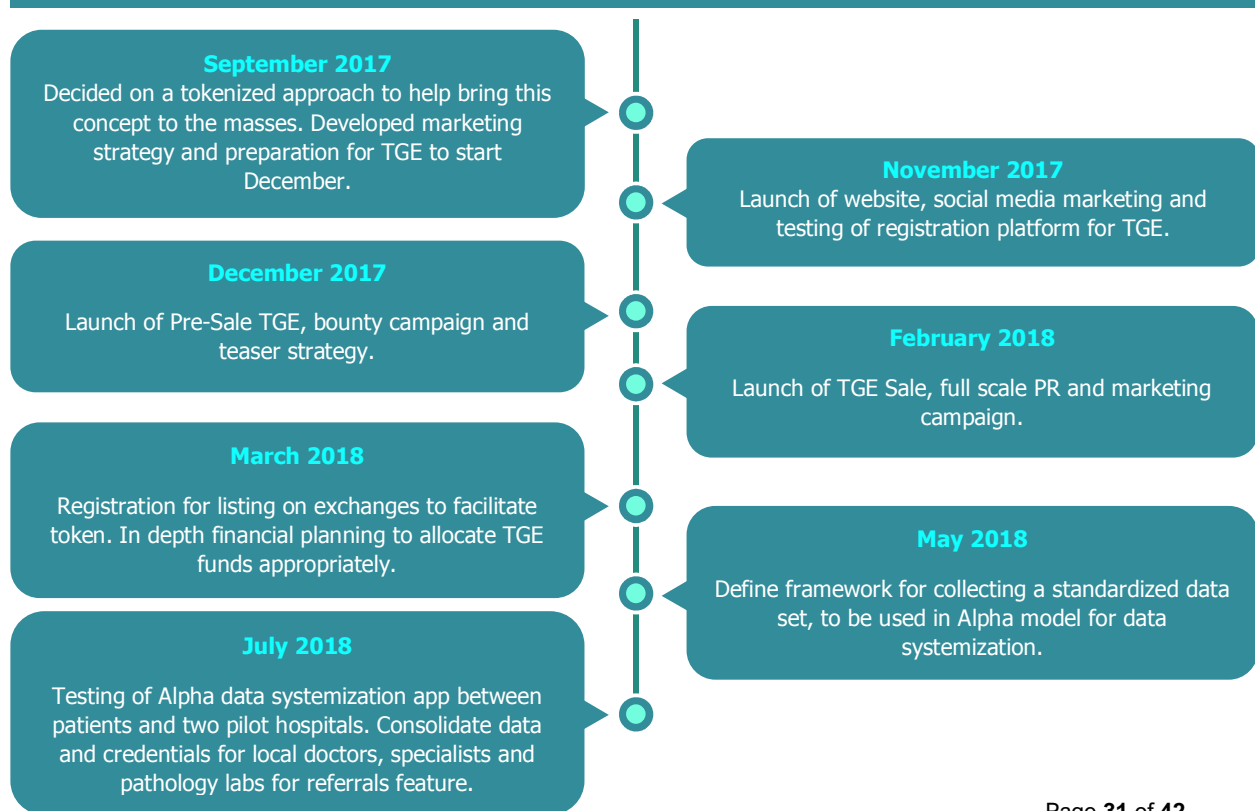**We make a living by what we get. But we make a life by what we give.**

-Winston Churchill

Road Map

Phase 1

September 2016
Founders collaborated with a common concern for the future of healthcare.

November 2016
Healthureum basic initiatives outlined with five fields of focus.

January 2017
Research into healthcare's recent surveys to quantify the challenges and potential of blockchain applications.

March 2017
Welcomed on board key members, and identified relevant use cases, for our initiatives.

May 2017
SWOT analysis of different blockchain applications based on data size and type.

July 2017
Structured development plan and key milestones for next 18 months.

Phase 2

September 2017
Decided on a tokenized approach to help bring this concept to the masses. Developed marketing strategy and preparation for TGE to start December.

November 2017
Launch of website, social media marketing and testing of registration platform for TGE.

December 2017
Launch of Pre-Sale TGE, bounty campaign and teaser strategy.

February 2018
Launch of TGE Sale, full scale PR and marketing campaign.

March 2018
Registration for listing on exchanges to facilitate token. In depth financial planning to allocate TGE funds appropriately.

May 2018
Define framework for collecting a standardized data set, to be used in Alpha model for data systemization.

July 2018
Testing of Alpha data systemization app between patients and two pilot hospitals. Consolidate data and credentials for local doctors, specialists and pathology labs for referrals feature.

Phase 3

November 2018
Make any necessary revisions for regulatory & privacy compliance. Introduce to 5 hospitals for implementation. Float Alpha model for virtual doctor consultation & referrals.

September 2018
Create Beta version of data systemization app and float into two pilot hospitals to implementation and testing. Develop Alpha model for virtual doctor consultations and referrals.

January 2019
Address any scalability concerns before introducing data systemization to 5 more hospitals. Launch Beta virtual doctor consultation and referrals.

March 2019
Reveal final virtual doctor feature with complete referral for doctors, specialists and pathology labs. Develop smart contract for research programs feature.

May 2019
Launch research program feature where users can contribute their non-identifiable data in unpaid programs.

July 2019
Launch research program where users can contribute their data for both unpaid and paid programs and get rewarded with HHEM tokens.
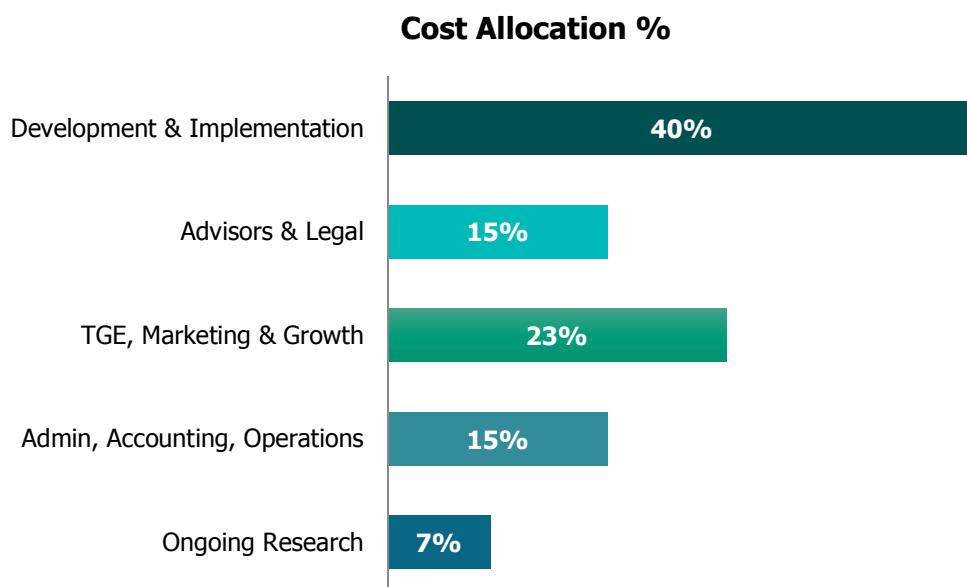
Phase 4

August 2019
Implement blockchain based system for medical infrastructure in 2 pilot hospitals. Beginning with tracking the downtime to assess successful and paid tests versus repeat and unpaid tests.

October 2019
Look to integrate blockchain-enabled philanthropic activities for peer to peer donations, which are traceable and fully transparent. Begin tracking demand versus usage for medical infrastructure in 2 pilot hospitals.

Cost Allocation

We have seen throughout, the importance of allocating resources appropriately to drive the best results. As Healthureum has an extensive development plan and lengthy road map ahead, the costs have been allocated to enable sustainable milestone based development. The success of any project depends on how efficiently resources are utilized and we have structured our budgets to ensure we can bring the best possible product in the most realistic timeframe.

Cost Allocation %

Category	Percentage
Development & Implementation	40%
Advisors & Legal	15%
TGE, Marketing & Growth	23%
Admin, Accounting, Operations	15%
Ongoing Research	7%

Development and implementation will form the largest cost to be allocated with a four-phase development plan bringing the project up to mid-2019 and at a minimum an alpha version of each of the five services underway and in testing. The second largest chunk shall drive growth and awareness of the project and the TGE, to attract early participants and contributions to aid faster development. The advisory and operational costs shall reflect the level of skillsets we have acquired for both advising and operating the daily running of this project. A key aspect of bringing this project to a successful completion relies upon the strength of the research, which is be ongoing and location specific to reflect the regulation and compliance requirements with regards to privacy and data sharing.

Token Structure

Healthureum has opted for a tokenized approach as it provides a mechanism for utilizing services and paying for them in the ecosystem. It acts as a utility token for

services rendered on the platform. Healthureum is an ERC20 token developed on the ethereum based system enabling the smooth deployment of smart contracts.

Features

Token Name: HHEM

Platform: Ethereum

Token Standard: ERC20

TGE Soft Cap: $15 million

Total Supply of Tokens: 150 million

TGE Supply of Tokens: 32.7 million

Price per Token for TGE Sale: $3.95

Can be Purchased with: BTC or ETH or ECH

The HHEM token will be used for all transactions on the Healthureum platform. The token will enable the purchase of services offered on the platform and payment will be fast reliable, secured with cryptography. The token will be used for five main functions in the Healthureum ecosystem:

- Service fee for the storage and management of medical data.
- Reward for medical practitioners who offer doctor consultations and referrals. Reward for laboratories carrying out tests and diagnostics.
- Service fee for the purchase, repair and use of medical infrastructure.
- Service fee for participation in Research programs. Reward for patients submitting their medical data for research purposes.
- Service fee for donations to philanthropic activities offered through the Healthureum ecosystem.

Technology
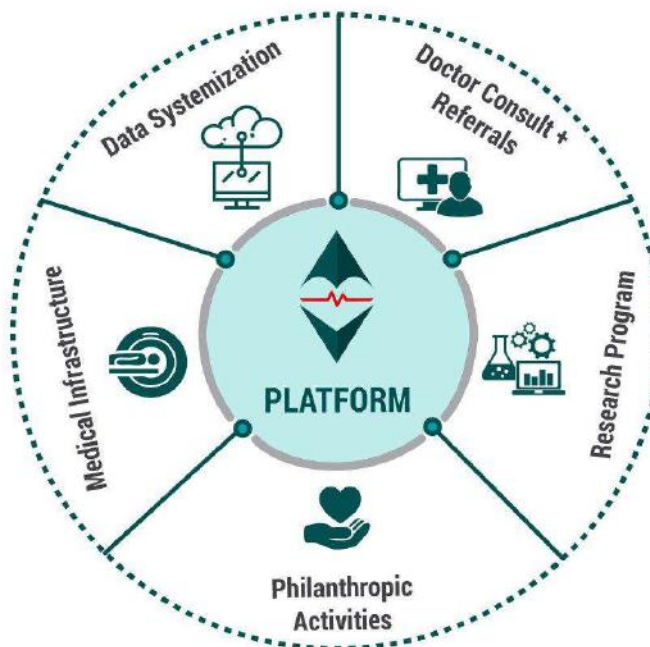
The Healthureum token is an ERC20 token applied on the Ethereum open source system. The ERC20 token has a defined set of rules which when deployed in the Ethereum system will accurately function according to these rules. Healthureum will deploy smart contracts on the ethereum blockchain and transactions will be sent to the network fueled with gas. The smart contract enables the asset or token to be pushed into the program, and once the conditions of the contract are automatically validated, the smart contract protocol will automatically determine where the token gets sent. Healthureum will used this application in the five core processes outlined herein.
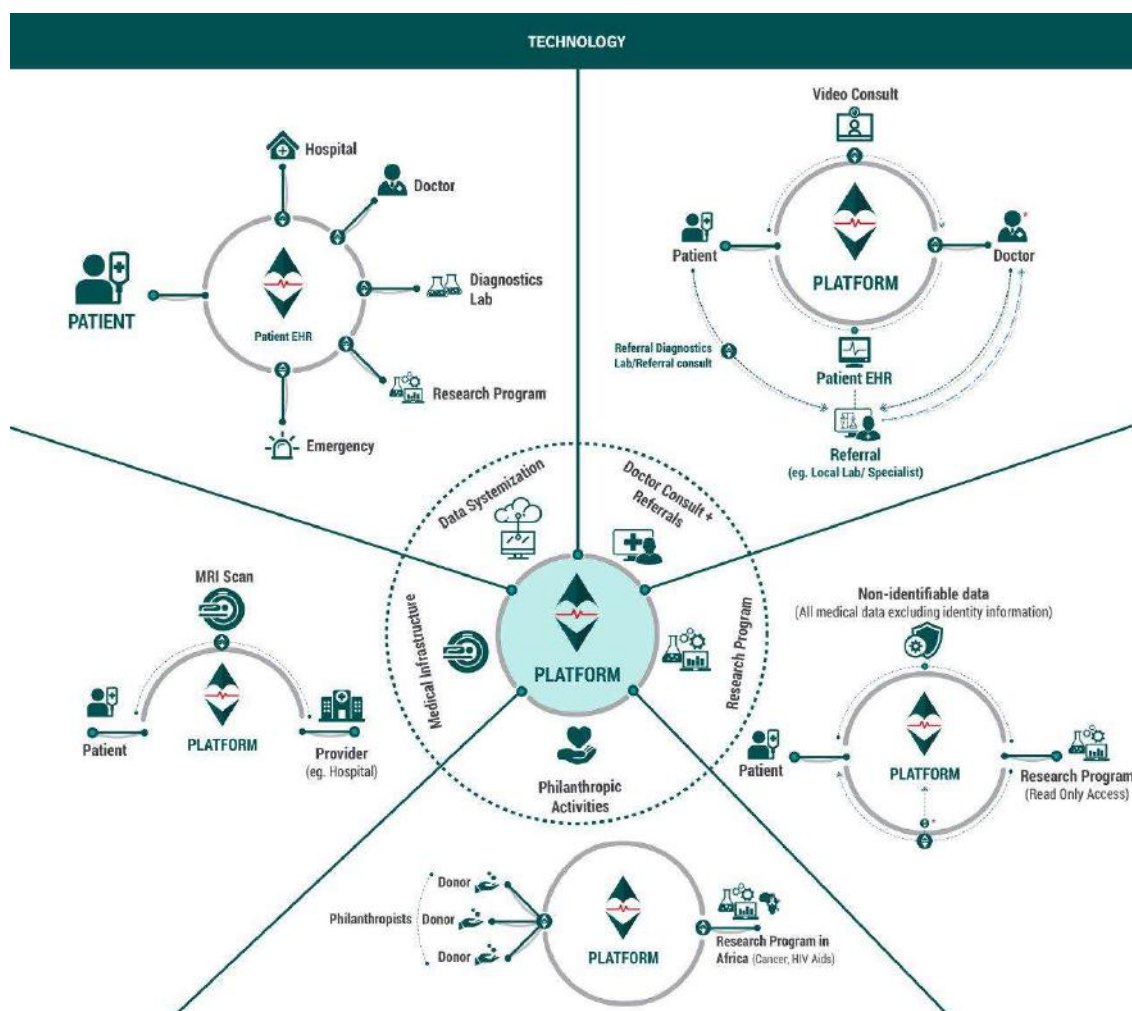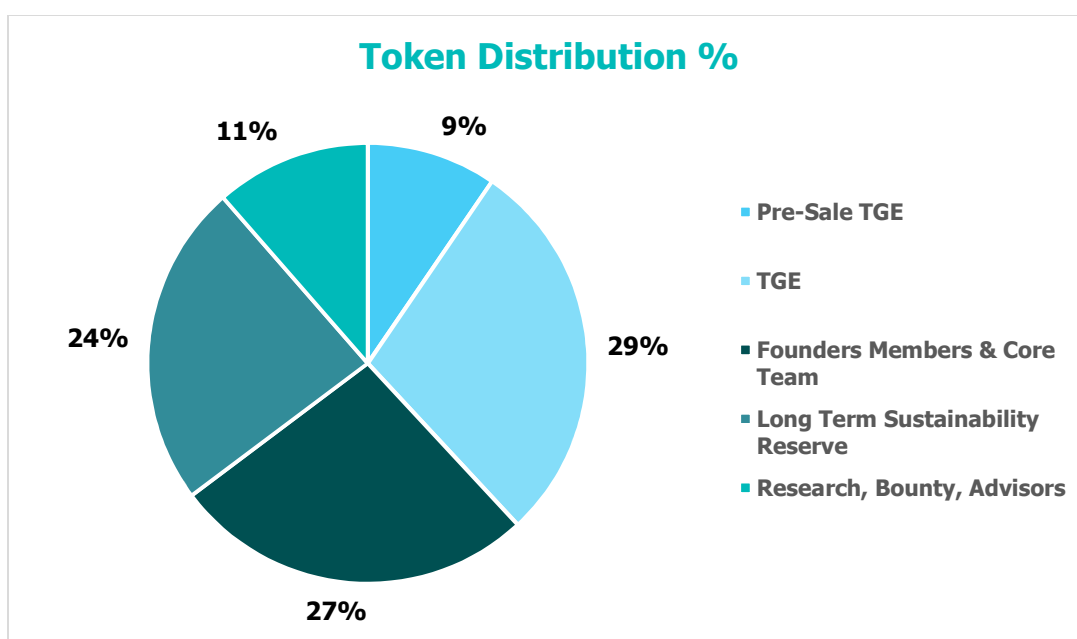
In the Healthureum system, the HHEM token provides a mechanism for payment of both service fees and rewards for services carried out in the ecosystem. This creates demand for the token to procure services offered on the Healthureum platform. The token provides you with access to a one stop shop solution to help you manage your healthcare in the most efficient and cost-effective manner. As more users enter the ecosystem, the demand for the Healthureum token will grow, as they will require it to procure services. This will create substantial market value, which will be further strengthened once the token is listed on exchanges for trading ability.

Token Distribution

Healthureum is most suited for a Token Generation Event due to the sheer scale of the project. A TGE empowers interested parties and purchasers to get involved in the project initiative early on, which can be beneficial for both the project and the purchaser. The TGE plays an important role in launching the concept of the Healthureum initiative to the masses, while disclosing our future plans and

development framework. This enables us to be upfront with the public, take a proactive approach in marketing this innovative multi-functional healthcare solution, while building confidence in early adopters and potential participants for the TGE, who are keen to partake in our initiative.

The Healthureum tokens will be collected in multi sign wallet, and distributed in a transparent and structured format to benefit the sustained development of the project.

Token Distribution %

- Pre-Sale TGE
- TGE
- Founders Members & Core Team
- Long Term Sustainability Reserve
- Research, Bounty, Advisors

TGE Pre-Sale

No. of Tokens Available: 4.4million
Beginning: 16th December 2017
Ending: 30th December 2017 or
On sale of 4.4 million Tokens
(whichever happens first)

TGE Sale

No. of Tokens Available: 28.3 million
Beginning: 26th February 2018
Ending: 01st April 2018

Purchaser Benefits

Healthureum is best suited for a TGE model as the project is so vast that it will be executed in stages and according to milestones, which can be achieved through TGE project funding. By contributing to the project, you are enabling this innovative product to be released to the public sooner. So, what's in it for the early purchasers?

- Early token appreciation for Pre-Sale TGE participants
- A first glance at healthcare's most revolutionary project.
- Potential to gain token appreciation even before token listing.
- Involvement in healthcare's most revolutionary blockchain-based ecosystem.
- Ability to capitalize on a projects potential from day one.
- Opportunity to be part of Healthureum, the future proof healthcare management system.

Bonus Program

The Pre-Sale TGE will begin on 16th December 2017 offering early bird participants to benefit from much anticipated bonus tokens. The sooner contributors partake in the TGE, the greater the benefit and higher the bonus. So, we encourage any interested participants to do your research early on and be equipped to take that leap once TGE Pre-Sale opens. The Pre-Sale will be a public sale, offered to any potential purchasers who are keen to be involved from the outset. The bonuses offered are most rewarding during this period, to reflect our appreciation for early believers in this project and supporting our vision to bring innovative blockchain-based solutions to healthcare.

If you miss that opportunity, there will be another chance to participate during the main TGE which will run for 35 days, beginning 26th February 2018 and ending 1st April 2018. Again the sale will be publicly offered to interested purchasers who want to be part of this change and contribute towards the Healthureum initiative and towards the development of this revolutionary platform.

TGE Pre-Sale Token Price :
1HHEM = $3.53

TGE Pre-Sale Bonus

Day 1 (16th Dec) : 45%
Week 1 (17th – 23rd Dec) : 35%
Week 2 (24th – 30th Dec) : 25%

TGE Sale Token Price : _1HHEM = $3.95_

TGE Sale Bonus

Day 1 : 22%
Week 1 : 17%
Week 2 : 12%

Week 3 : 7%
Week 4 : 2%
Week 5 : 0%

Long Term Strategy

The founders spear heading the Healthureum initiative have a long-term strategy planned, as described in the detailed road map for development. A milestone based approach best fits this project, with five prime goals to be delivered over the next 30-36 months. Healthureum is a complete multi-pronged solution to bring positive disruption to the healthcare sector, with its ethereum based blockchain solution and smart contract solutions for medical research and operations processes. This will be the most dynamic and cohesive ecosystem which will truly revolutionize healthcare. Although the token's primary purpose is utility, we anticipate enormous demand as the platform services become active, and vast potential for appreciation once listed for trading.

The Scope of Work

The scope of the Healthureum project is comprehensive and dynamic which makes it that much more exciting. The first of its kind to attempt to address such large-scale issues in one single ecosystem. Healthureum has integrated a knowledgeable team, an extensive road map and a single goal to transform 'How We Manage Our Healthcare'. Blockchain will be the success of tomorrow that we will implement today.

Value Benefit to Society

The underlying mission of Healthureum is to provide a future proof system for managing healthcare. This project is a perfect example of we can change the lives of millions including patients, providers, regulators and researchers, by using an innovative technology such as blockchain. The benefit is not limited to financial gain, but the value added to society cannot be measured purely with numbers, as patient satisfaction, recovery timeframes and overall population health with benefit.

Conclusion

The challenges identified in healthcare are not new, nor have they progressed much in recent years. There is an imminent need, in this resource constrained environment, to bring large scale change and Healthureum believes that blockchain and smart contract technology is the answer. Healthureum has matured a concept which has the potential to bring immediate benefits in addition to transformational long-term value. Blockchain will eliminate the need for regular updates, troubleshooting and reconciliation of inadequate and isolated data management systems. By adopting a decentralized and transparent technology, we can reform how data is shared, encouraging collaboration and interoperability while maintaining patient data integrity, privacy and security standards. By achieving standardization

and interoperability, it benefits all sectors of healthcare as described herein. Healthureum is taking ground breaking steps to transform healthcare to radically improve service standards and care delivery. All services rendered on the Healthereum platform shall be paid for using the Healthureum token which will act as a utility token. Participants will be able to purchase HHEM tokens during the TGE which is much anticipated. The Healthureum ecosystem aims to achieve widespread transparency and accountability along with S3 – standardization, scalability and social responsibility in healthcare.

Disclaimer

This white paper should be read in conjunction with our full Terms & Conditions available on www.healthureum.io.

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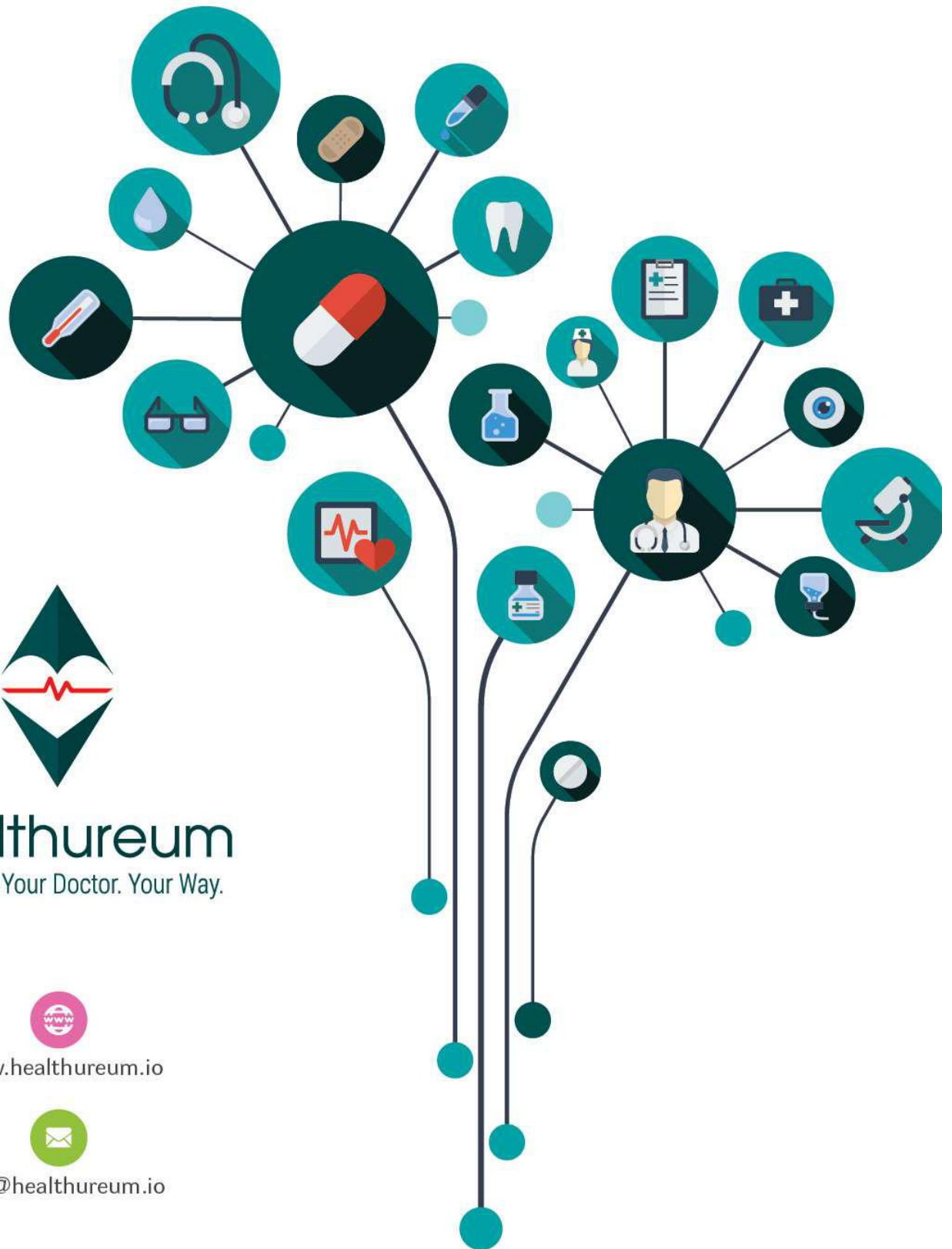
Healthureum

Your Data. Your Doctor. Your Way.

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