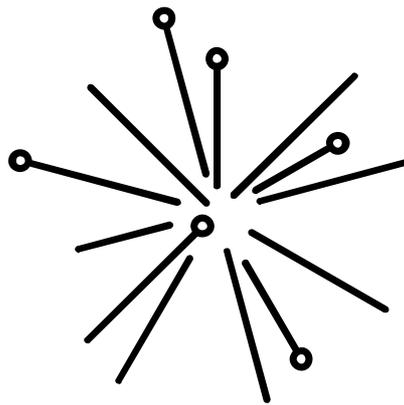


HEX Whitepaper v1.1

September 2018

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**HEX**

Health Evolution on  
X.blockchain

—  
**Whitepaper**

English

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## REFERENCE

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# 1. Abstract

The voluntary and active involvement of an individual in the process of treatment or prevention of the disease has a great impact on the outcome, so the main player of health management should be the individual himself. For individual health management, individuals should be able to easily access, obtain and make full use of accurate their own health data with secure against exposure. However, there are limitation of access to the individual health information especially the medical information which are monopolized by the medical institutions and the accessibility of the individual who is the medical consumer is considerably restricted, and it is difficult to expect continuity of care for individual.

To solve this problem, we are going to provide a practical means to effectively manage personal health information by utilizing the advantages of the blockchain and, based on this, we are going to construct a health information business ecosystem where individuals are the main players and expand the service model through development of various healthcare Apps.

HEX is a specialized platform in personal health information management services based on the Aston platform which uses multi-dimensional blockchains. Developers who use HEX can quickly and easily develop apps that receive personal health information following international standards.

HEX based Apps make users conveniently and safely managing their own and family's health information with no expenditure. Also it provides their own health information to researchers after de-identification process and the providers receive compensation in accordance with the HEX compensation system. In this white paper, the concept, structure and operation of the HEX platform that enables such a new health information business ecosystem, and applicable use cases will be introduced.

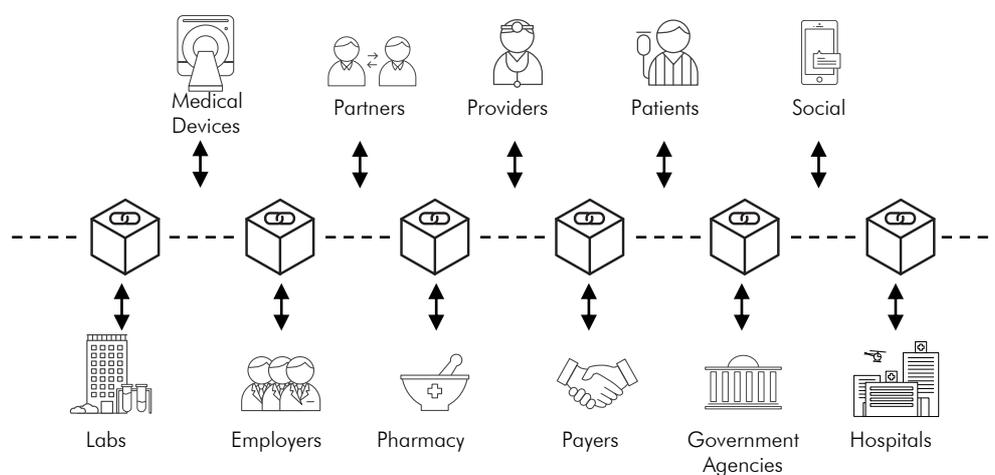


Figure 1. HEX on Blockchain

## 2. Background

### Increased Demand for Self-directed Healthcare

These days the general public's interest in health is increasing and the paradigm of healthcare system is changing from treatment to prevention<sup>1</sup>. People depend on many health professionals without continuous and relevance in the life-long healthcare process. In the end, since the subject of healthcare is the person himself/herself, it is necessary to create an environment in which the person can raise the healthcare ability. That is, individuals should be able to self-manage consistent and integrated health record throughout their lifetime, so that they can take full advantage of the information they need to provide appropriate healthcare and maintain a health condition based on precise evidence in a disease emergence. In addition, globally the aging of society is processing, so the social phenomena lead to increase the cost of medical care<sup>2</sup> and it can cause serious social problems. Therefore, it is necessary to take measures to reduce the increase of medical expenses through self-directed healthcare.

### Serious problem with weighted medical record storage

Information asymmetry<sup>3</sup> is a serious problem between individuals and medical institutions and government agencies. Since personal medical record is kept by medical institutions and government agencies, individuals have limited access to their own medical information. The asymmetry of medical record also implies the possibility of forgery due to moral hazard between the medical provider and consumer and between the medical consumer and the insurer. In addition, people visit lots of medical institutions throughout the life of the patient by symptoms, location and reputation of medical institutions. But personal medical record is distributed and stored in a plurality of medical institutions, because information systems of medical institutions are not linked to each other. So it is difficult to expect the continuity of care because it can not confirm the medical record of the medical institution which was visited before by the person. It may occur the unnecessary examination repeated, drug abuse or misuse problems and in the worst case, it is possible to expand to medical accidents. Although governments around the world are carrying forward health information exchange for connecting medical information systems, most of them are limited to patients' referral services for medical staffs at medical institutions.

### Strong security demand of personal health data

Personal health record exposure has major damage, so it should be managed safely through reasonable security level. There is a security regulation required for the storage and use of personal health information, in particular medical information in most countries. But the content and intensity of regulations vary from country to country, so it is difficult to apply uniform standards. Because there is a difference in the perception of the possession and utilization of medical record by the medical environment and social consensus among various stakeholders plays an important role.

### Increased interest in medical radiation dose

Since the Fukushima power plant accident in 2011, public interest in radiation has increased and various radiation-related policies have been implemented in each country. However, it is difficult to manage individually medical radiation dose due to the speciality of discovery and treatment of disease. There is also a limit to the ability of medical institutions to exchange, collect and utilize radiation data between medical institutions. Therefore, based on individual dose data, it is necessary to integrate medical radiation dose data distributed and stored in various medical institutions.

## 3. Solution

### Continuity of care using personal health record based on standard

Personal Health Record (PHR) refers to Personally Generated Health Data (PGHD) that is created, stored, and utilized by individuals. In a broad sense, it is a concept that includes medical information (medical data) generated by medical staff, biometric information measured by personal health devices, lifestyle information, genome information, and environmental information<sup>4</sup>. So a system for managing personal health record is more practical to start small and expand as needed to fit the purpose and scope of the health information service to provide rather than developing all the necessary functions at once. Personal health record must be transmitted from various equipment or system to other system in order to utilize the information so it is very important to apply the standards to support interoperability. FHIR<sup>5</sup> which supports medical information easily in any mobile applications is recently emerging as a next-generation medical information standard.

### Personal data security using blockchain

Since personal health record is very sensitive information, its security is a key requirement for applying health information services. Blockchain technology is recognized as the best security in publicly and is therefore suitable for use in the storage and use of personal health record. It is possible to root out denial of the original and tamper problem, due to the nature of the blockchain itself, it can be used as a variety of perfect evidence for the original health record. By using blockchain for personal health record management, it is possible to overcome complicated legal regulations related to personal record security by excluding the involvement of third parties and managing individuals' own health information as a subject.

### Integrated medical radiation dose management and utilization

The guideline<sup>6</sup> and the international standard<sup>7</sup> about the measurement and the display method of medical radiation dose record are already disclosed. So medical radiation dose records which are generated from various imaging equipments of the medical institution can be collected as integrated information beyond the regional or national unit. Thus, it is possible to manage individual cumulative doses and broadly it can be used for services such as image equipment operation, management and research of medical institutions and also can be used for policy establishment and research purposes by government or radiation related international organizations.

### Compensation system using token

The main reason for various healthcare apps not joining enough users or not keeping their users is that there are insufficient rewards for users. Adoption of appropriate compensation system using tokens of blockchain can provide better value to App users. Primary use of personal health record such as inquiry of medical history or delivery of medical information can induce voluntary participation of individual because there is utility in terms of user convenience without special compensation. However, secondary use of personal health record for research or commercial purpose is difficult to induce individual participation without compensation for information provided, even though the personal information is de-identified.

## 4. HEX(Health Evolution on X.blockchain)

### 4.1 Definition

HEX stands for 'Health Evolution on X.blockchain' and is a platform specialized in the development and operation of personal health record management applications based on a multidimensional structure blockchain "X.blockchain platform" <sup>8</sup>. That is, HEX is a platform to support and operate various application development that can manage the health of oneself and family by overcoming the limitation of existing medical information platform by taking advantages of blockchain such as guarantee of data integrity. The name of the cryptocurrency distributed among various applications running on the HEX platform is HEX. The individual user is required to provide personal health record to a third party through the de-identification process of personal health record and consent to information provision. And they will receive HEX tokens according to the HEX compensation system to be able to purchase services and goods from the HEX ecosystem participants.

### 4.2 Mission

HEX platform provides means to manage a personal health record by using blockchain technology, such as personal medical information stored in a medical institutions and biometric information collected or created by individual. Using HEX platform, individual users can safely store various health record of themselves or their family and utilize them conveniently in necessary situations of anytime and anywhere. Although personal health record is generated from various systems such as medical institutions visited and bio-signal measurement devices used by individuals, it can be converted and collected into the international standard FHIR message. So consistent and integrated management of personal health record is possible as "longitudinal life record". In addition, individual dose data received from radiological examinations of medical institutions can be collected and utilized for each medical institution through the internationally accepted DICOM (Digital Imaging and Communications in Medicine) standard.

Also it is possible to reduce the risk of hacking by attempting to tamper with previously stored health record because HEX is a blockchain based platform, thus enabling transparent information management based on facts. Individuals will get rewards according to HEX compensation system when they create their health record (Push method) or they provide de-identified health record to the health information survey or receiving a participation request (Pull method) through the survey. It is possible to construct big data of health information and it can build and operate various health information services that process, distribute and utilize it through data mining.

The HEX platform will support the development of various healthcare applications that can be run on the HEX ecosystem by releasing the API SDK for developing healthcare applications, and ultimately we want to build a health information business ecosystem where individuals are the main player. Furthermore, by expanding various service models that utilizes the ecosystem and the healthcare applications, we will build health big data and maximize the effective value.

### 4.3 HEX Ecosystem

Individuals produce a large number of health data for a lifetime and medical data generated during hospital treatment, family history, genetic information, physical information, and life activities are linked organically and affect their health. However, it is virtually impossible for an individual to manage such data as systematic, verifiable, and reliable data. HEX which implement the platform using X.blockchain to collect and utilize health data on an individual basis will build an ecosystem that not only promotes individual health but also enables various studies.

HEX enables to organically link medical data generated by medical institutions and all health related data such as personal health data, activity data, and genome inspection data through personal input or health device. In addition, environmental, health, and public information will be used within HEX ecosystem analyze and research interactions between data and to provide various healthcare services. An individual can receive healthcare services tailored to personalized disease prediction services, health management and family health-related services through the interaction of data related to one's own health.

The HEX ecosystem provides data services and platform services that can be utilized by various companies and organizations such as public institutions, medical institutions, research institutes, pharmaceutical companies, pharmacy systems, insurance companies, survey agencies, etc. through various types of API SDK and data standardization. So it is possible to provide various services, such as utilizing healthcare mobile services and IoT devices, that can be utilized by individuals as well as research purposes for institutions and companies.

Ultimately, HEX ecosystem will play a big role that it is used to provide personalized medical services, identify health issues in various fields, and reduce information disparities among individual institutions, countries, and individuals through information sharing to address the needs of unmet medical services.

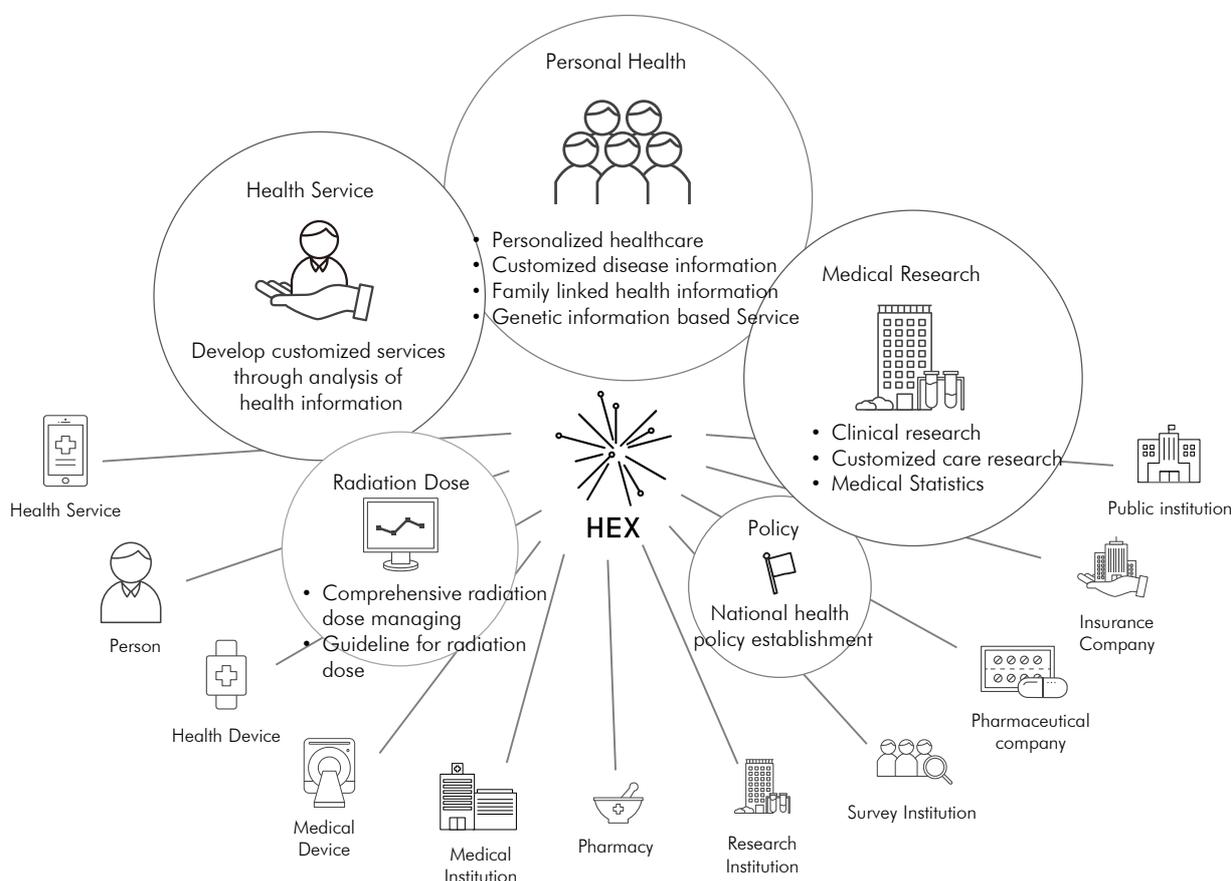


Figure 2. HEX Ecosystem

## 4.4 HEX Platform

The HEX Platform stores medical and health data on blocks in FHIR message format. Using the API SDK of HEX Platform, various devices and programs such as smart phones, wearable devices and hospital information systems are linked each other, and various applications such as personal medical record management and simple insurance claims can be implemented. Individuals and medical institutions (Data Creator) using the HEX Platform can create and utilize a wide range of medical and health data, each of which can grant and retain access and retrieval rights to the system. It provides the necessary data to medical institutions, research institutes, pharmaceutical companies and insurance companies, etc. (Data Consumer) which enables medical consumers to receive high quality medical services. It can also exchange medical and health data among diverse stakeholders and create and activate a data business ecosystem

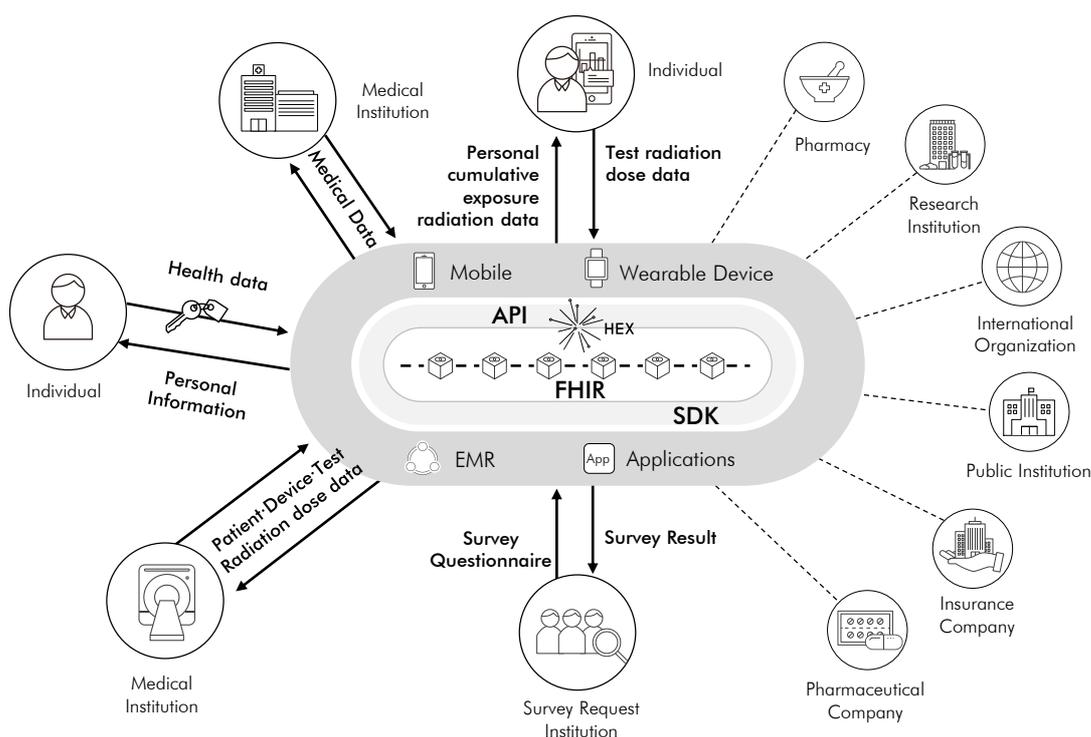


Figure 3. HEX Platform

### Individual

- Transmitting personal health record such as biometric information and lifestyle information generated by the individual
- Providing patient-approved de-identified dose data for research
- Providing personalized health information for individuals

### Medical institutions

- Transmitting medical data generated by medical staff
- Provision of high quality medical services based on patients' integrated medical history
- Comparing the reference dose value between medical institutions and applying it to the optimal dose value

### Pharmacies, research agencies, public institutions, insurance & pharmaceutical companies

- Providing medical data to pharmacies, research agencies, public institutions, insurance and pharmaceutical companies under consent of the data providers

### Survey agencies

- Requesting survey participation to more accurate target group by screening the conditions of data providers for better survey results

## 4.5 Token Economics

HEX collects personal health records from various institutions and individuals in a standard format and provides customized information to the necessary places. In this process, HEX tokens will be paid to individuals when registering their own personal health records, participating in research, or participating in surveys so that they can actively participate in the collection of their own health data. These tokens are stored in electronic wallets created by HEX. These tokens are stored in electronic wallets and can be consumed in various forms, such as making donations, accessing health services, reducing medical costs, and purchasing health products.

### Data Creator

- Receive tokens as rewards for registering medical data to the HEX system and use data-utilizing services
- Receive tokens by storing personal input data, data input through device, etc.
- Receive a token when participating in survey commissioned by survey agency
- The medical institution transmits the individual's medical data to the HEX system with the patient's consent

### Data Consumer

- Consuming various medical data in the HEX system for research, marketing, providing services to individuals, etc., and paying for tokens in rewards for data consumption
- Medical institutions and research agencies, etc. pay tokens to use refined medical data for research
- Pharmaceutical companies and insurance companies, etc. pay tokens to use de-identified data for product development or marketing purposes.
- Pay tokens to select target group and request survey

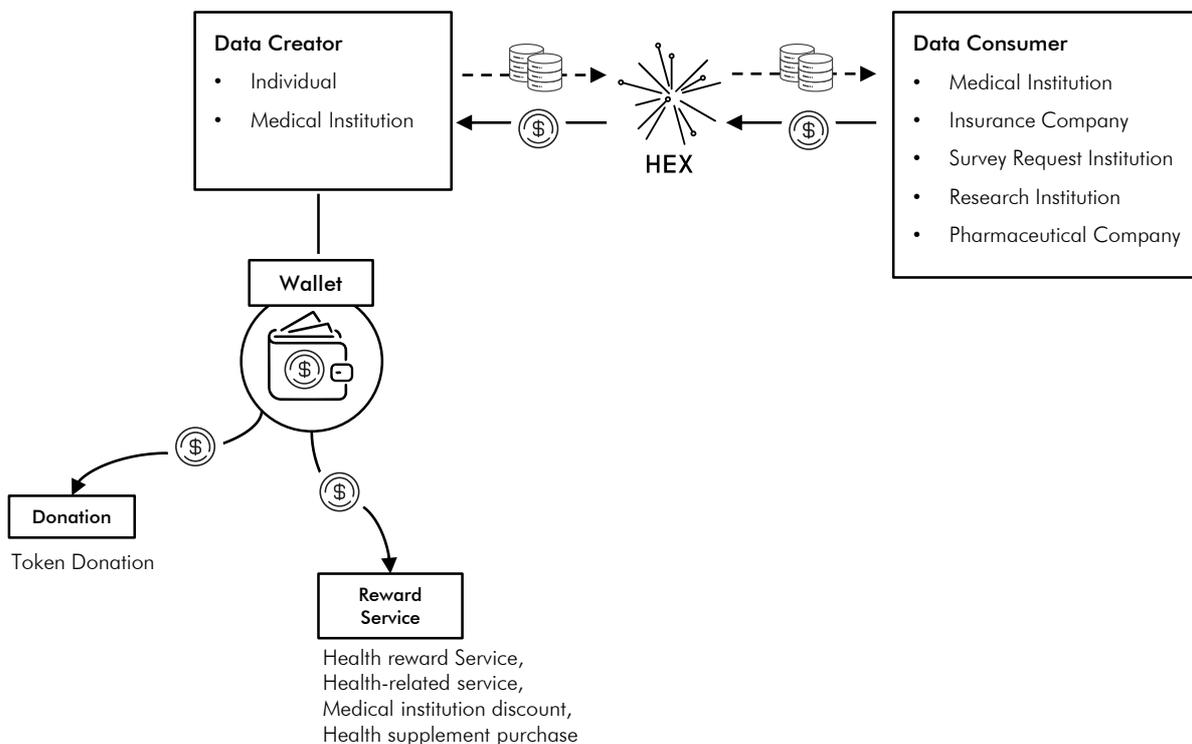


Figure 4. Token Economics

## 4.6 Technology

# System Architecture

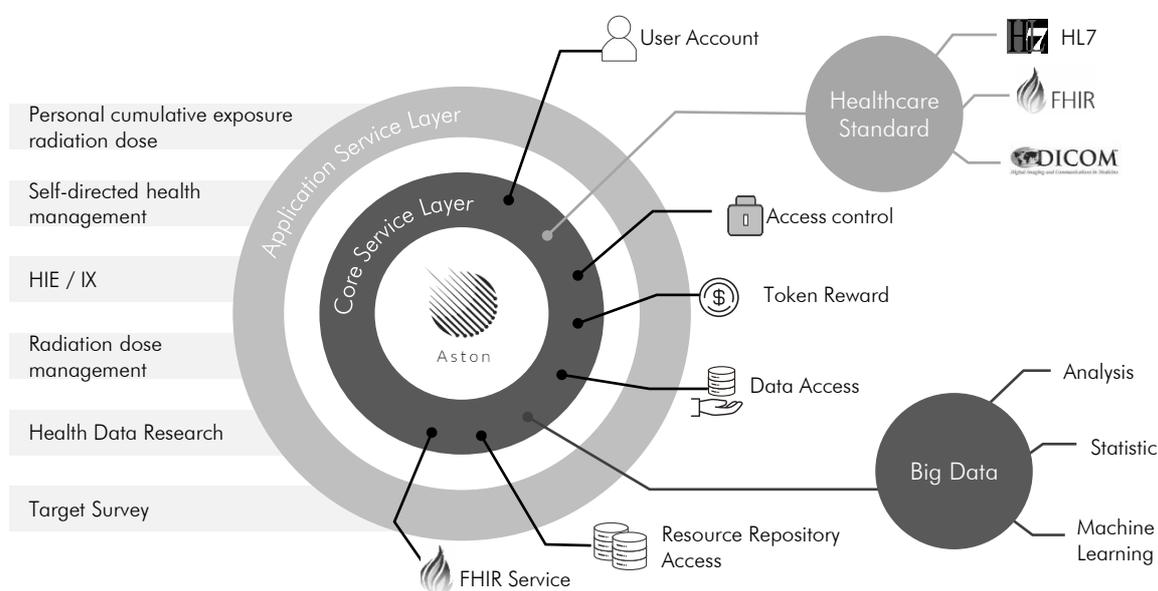


Figure 5. System Architecture

HEX platform consists of three layers: Aston, Core Service, and Application Service.

### Aston

Aston is a decentralized document authentication platform built on advanced blockchain technologies and data security solutions. The X.blockchain technology applied to Aston solves the problems of existing blockchain systems with linear structures by using a multi-dimensional block structure.

### Core Service

Core Service consists of User Account for managing user accounts, FHIR Service for data creation and retrieval based on FHIR standard, Data Access for creation and retrieval of blocks, Resource Repository Access for storing and retrieval of origin data, Access Control for management of access rights to block and repository, and Token Reward Service for management of token flows according to data registration and use.

### Application Service

Application Service refers to all applications using the HEX platform, and the Aston platform is available through the Core Service. HEX also provides API SDK that enables easier development of mobile, app, and web.

## FHIR (Fast Healthcare Interoperability Resources)

Medical institutions stores and manages the same type of medical information in different forms, and the need for structuring and standardizing medical information is emphasized so that they can be combined and reused organically. In addition, due to the heterogeneity of terminology, expression and format configuration, and the structure and operation of individual medical information systems, it is not easy to utilize clinical data and information between medical institutions, so that it is necessary to search for an effective utilization method.

As a way to address these data standardization problems faced by medical institutions, HEX applies the FHIR international standard to support a variety of data formats and maximize interoperability.

FHIR<sup>9</sup> is a next-generation standard framework developed by HL7. It implements various health information data in Resource form and transmits it using web standard supporting RESTful, XML, JSON, HTTP, OAuth, etc. to be easily exchanged. Also it presents data mapping standards<sup>10</sup> with the existing HL7 message services V2, V3 (and ISO 21090), CDA (Clinical Document Architecture), and RIM (Reference Information Model) to support interoperability between systems using different frameworks.

“Resource” is a unit of medical information for exchanging data, which contains filled and meaningful medical information based on the standard. Defined FHIR standard STU3 (Standard for Trial Use) to date has already been used in the field, such as Patient, Referral Request, Condition, and Imaging Study, and there are various modeled resources which clinical data as needed in the future can be structured and expressed. Through this, users can combine resources in various forms as desired, and it can be separated and extracted the information as needed

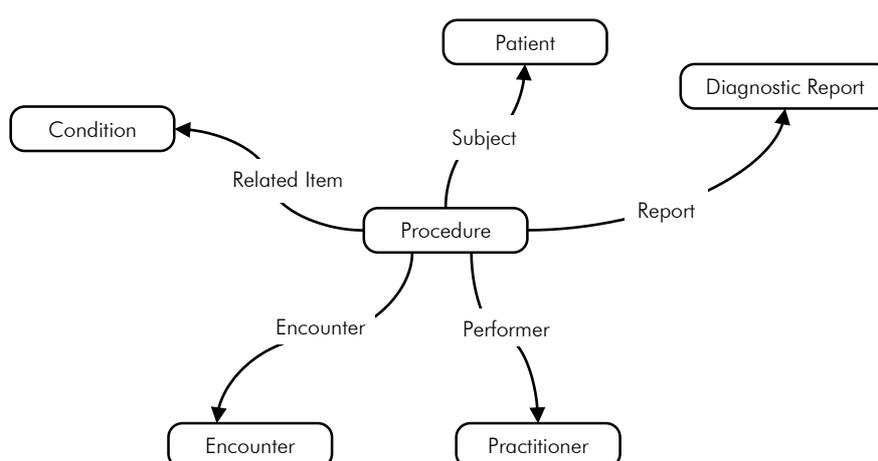


Figure 6. FHIR Resource Diagram

## FHIR on Blockchain

The structure of the medical information system using FHIR is a centralized form providing resource storage, inquiry and retrieval service, but it can guarantee the integrity of data through decentralized and distribution of blockchain technology.

All medical information and service history data generated when an individual visits a medical institution are standardized through the FHIR service and transmitted to the FHIR server. The FHIR server stores the received message in a separate repository (Off-Chain-Repository) and creates a new block (On-Chain-Repository) containing the information.

In this way, each resource generated by the user is freely distributed according to the user's needs and is registered and managed in a separate block. The data stored in the block is not the raw data actually input by the user but the encrypted resource so that it is managed more securely.

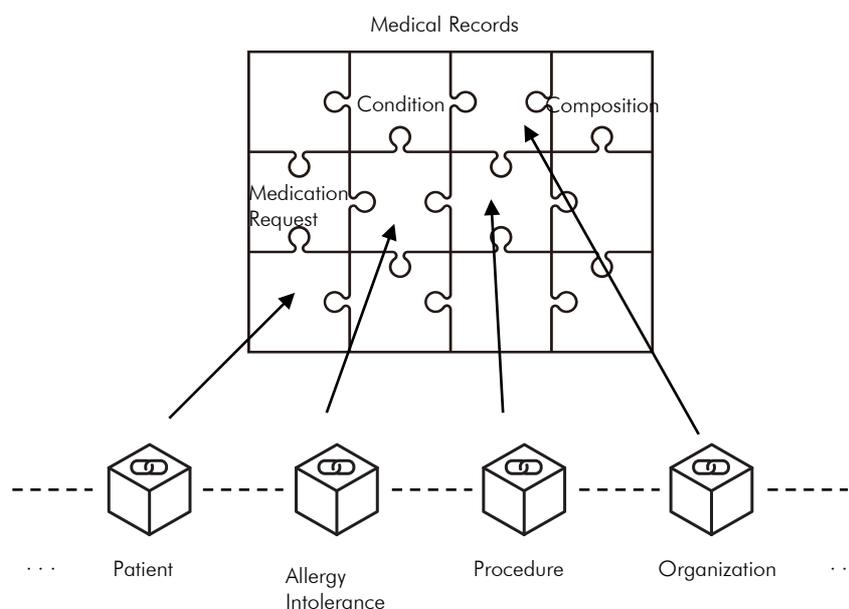


Figure 7. FHIR on Blockchain

HEX platform registers FHIR message containing the actual data at off-chain-repository. And it get returned information such as off-chain-repository URL which serve as a pointer and resource type and then and creates a new block (On-chain-repository) which contains information such as Hash, Patient Url, Resource type, Off-chain-repository URL, index, etc.

If large size data such as X-ray and MRI are stored and registered in the on-chain repository, it may reduce the speed of block processing and the system congestion may occur due to an increase in load applied to each node. So to speed up the blockchain process, the off-chain repository stores large size data, while the on-chain stores relatively light capacity data such as hash and pointer information.

## Access Control

Patient's medical record protection is not only an ethical responsibility but also a legal obligation. Failure to protect medical records can cause financial and legal consequences as well as problems in patient care and management.

HIPPA's privacy rules<sup>11</sup> state that all medical information must be kept encrypted. Most medical information systems have many stakeholders including administrators. Therefore, it is difficult to secure the integrity and reliability of the stored medical information because there are several persons who can decrypt the medical information even if it is stored encrypted.

### Hybrid Encryption & Secure Key

Hybrid Encryption<sup>12</sup> is a way to use advantage of each formation: The Asymmetric Encryption method has high security by using user's private key and public key, whereas the Symmetric Encryption method has better speed by using one key during encryption/decryption process.

HEX supports high level of user authentication and fast data encryption/decryption through Hybrid Encryption. In the above process, HEX generates a secure key (symmetric key) used for data encryption/decryption. This key is assigned a different value frequently according to various events such as the patient's visit to the medical institution or the user's choice or a certain period of time. This is to minimize the leakage of user data in case a system security problem occurs such as a leakage of a secure key for any reason.

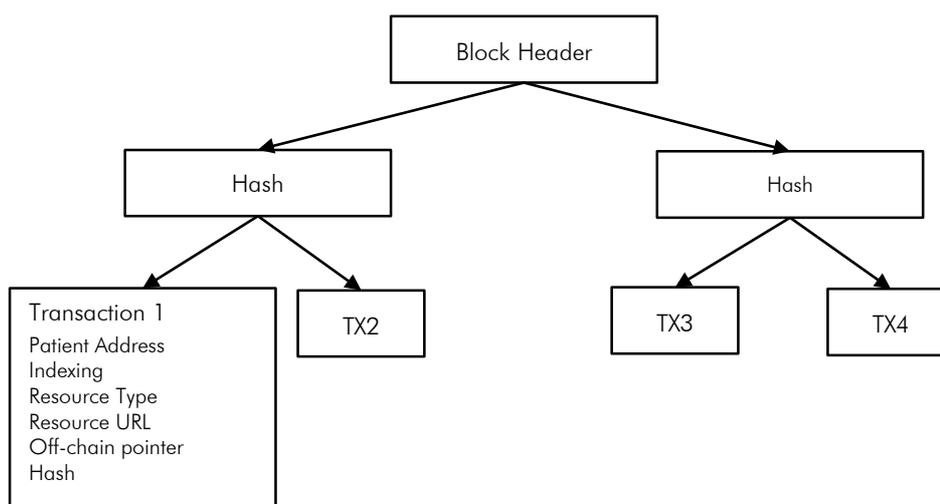


Figure 8. Block Structure

## Data retrieval authorization

The patient's data can be basically retrieved only by himself/herself. However, the medical record may be allowed to be accessed to the other person, in case consuming medical services to a medical institution or providing data to a service provider using the patient data.

The patient extracts the necessary information for accessing the data in the related block and stores the encrypted data in the block after the necessary information and the authority allocation information are encrypted by the public key of the data receiver. The receiver retrieves the corresponding data after extracting the necessary information for accessing the data with his/her own private key. This applies equally to the case of patient and recipient being both 1-to-1 and 1-to-N.

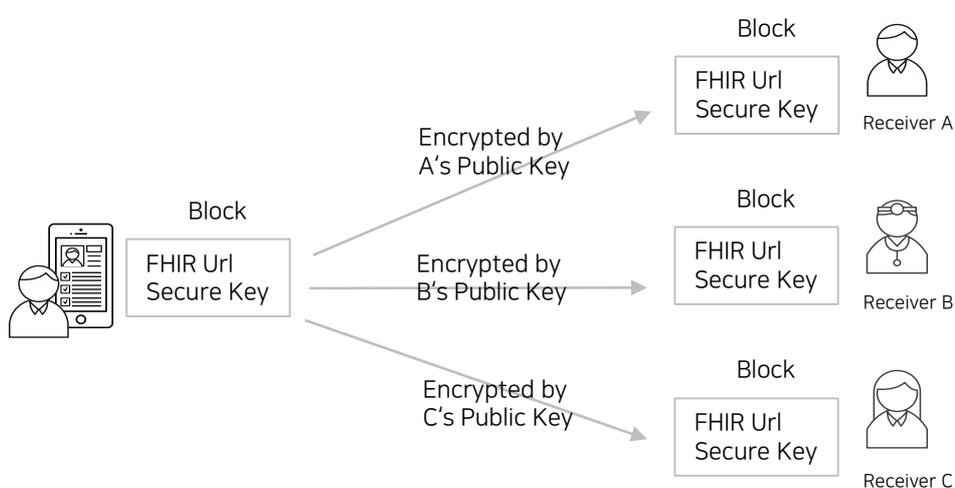


Figure 9. Grant Data Retrieve Permission

## Fine-Grained Access Control

Patients should be able to provide detailed data on the situation, such as providing past medical data for consultation purposes to medical institutions or providing research institutes with data for research purposes. HEX can provide detailed and convenient access control based on various conditions such as single record / date of treatment / hospitalization period / episode / period of health check-up etc

## X.blockchain

All participants in a blockchain network is impossible to store and manage the entire blockchain. Also it is burdened to hold a large number of blocks up to the block in which the version of the document is stored in order to verify the integrity of a specific version of a document, when the history of creation, viewing, modification, and approval of a document are stored in chronological order.

X.blockchain is a multidimensional blockchain consisting of multiple chains of 'documents' or any 'baseline' equivalent thereto. The 'originally created' document is written in the main chain of the linear structure, and the additional record such as its modification is recorded on the sub-chain, which is another blockchain that makes the corresponding block on the main-chain as a genesis block.

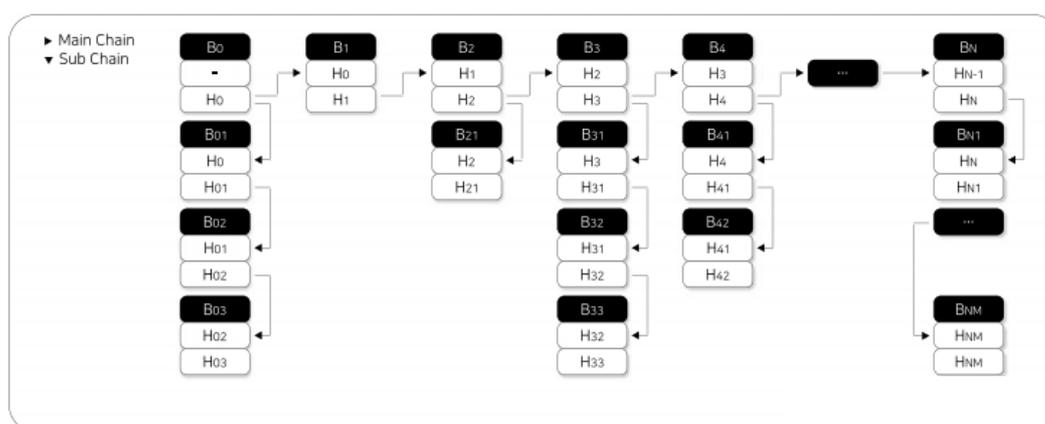


Figure 10. Two Dimensional Blockchain Structure

### Sub-Chain Utilization

Companies and organizations conduct surveys on a variety of occasions, such as collecting customer feedback, conducting employee evaluations, or organizing events. There may be variations depending on the size of the population during questionnaire selection, questionnaire request (written, face-to-face, online, etc.) and response to the questionnaire due to the nature of the questionnaire, but responses written by many people are intermittently collected with a lengthy period of time.

Research institutions dealing with statistics want to control of large amounts data managing collecting, storing, processing and managing. Large quantities of structured or unstructured data stored in the blockchain can be a starting point for this.

As shown above figure, if the data to be searched by companies, organizations or research institutes is large, the data may be stored sporadically in a large number of blocks, and it is highly likely that a large number of blocks need to be retrieved in order to collect data. If the owner of each data is varied, the access control method may be complicated to grant data access authority.

In addition, data that is valid for a specific company or organization but is likely to be meaningless to most participants may be stored in the main-chain, causing many other nodes to store all of the data. This can cause problems of waste of computational resources such as storage space and network, and degradation of processing speed.

This problem can be simplified by using the sub-chain of X.blockchain. If the questionnaire is correlated with the response and the structured data is stored in one sub-chain, the survey company node can retrieve only the sub-chain, and can easily access the data through simple access control. Research agencies will also be able to receive data through sub-chains and perform repetitive tasks such as collecting, storing, and processing data. Also nodes that are not directly related to the data stored in the sub-chain will not need to store the blocks. This avoids unnecessary waste of storage space and makes it possible to use related resources more efficiently.

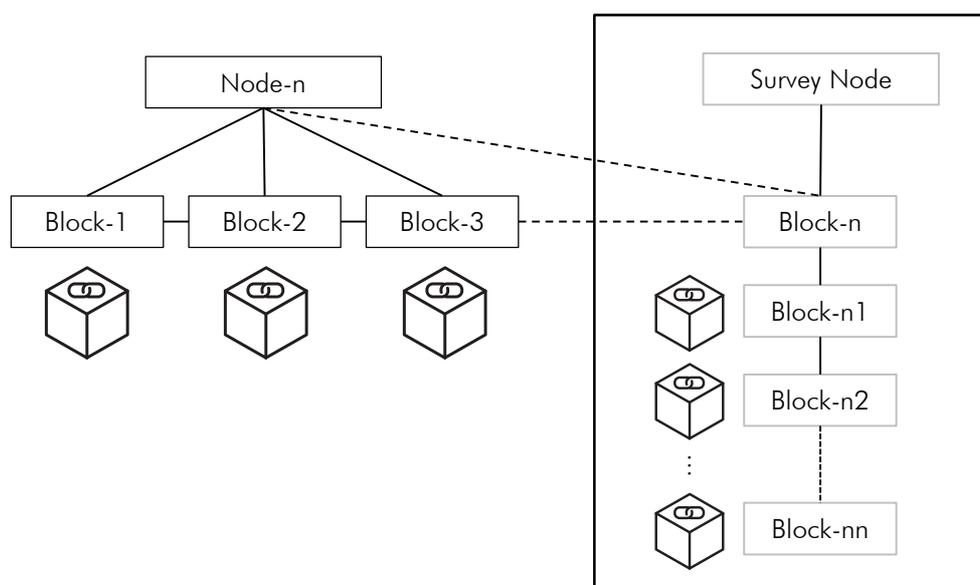


Figure 11. Example: Research results storing and managing in sub-chain

The main-chain has expanded considerably in terms of regional. However, sub-chains can be an alternative, even if the correlation of data between regions is low.

For example, when using the HEX Platform in Korea with a small number of participants and relatively larger participants in the United States, there is no need to store data for US participants in all the nodes in Korea if there is no need for Korean participants to look up data from the United States.

In this case, the data generated in each region can be saved in the sub-chain under the block of the main-chain which is mainly managed by the nodes in each region, thereby reducing the storage space and related resources.

## API SDK (Software Development Kit)

API SDK provided by the HEX platform can be used if a software developer wishes to develop applications such as personal medical records management, simple insurance claims, etc. that operate on the HEX Ecosystem. Participants or organizations using HEX will be various such as personal, medical institution, pharmaceutical companies, insurance companies, etc. and an application using HEX should be linked with various devices and programs such as smart phone, wearable device, Hospital Information System (HIS). So API SDK should support a variety of equipments and programming languages.

API SDK does not require developers to have a deep understanding of the blockchain and FHIR, but it helps them focus on business logic. Data generation and retrieval, validation of users calling the API SDK, and access control to authorize other participants to access personal data.

API SDK helps developers focus on business logic rather than having a deep understanding of blockchains and FHIR. API SDK provides functions such as data generation and retrieval, validation of users, and access control to authorize other participants to access personal data.

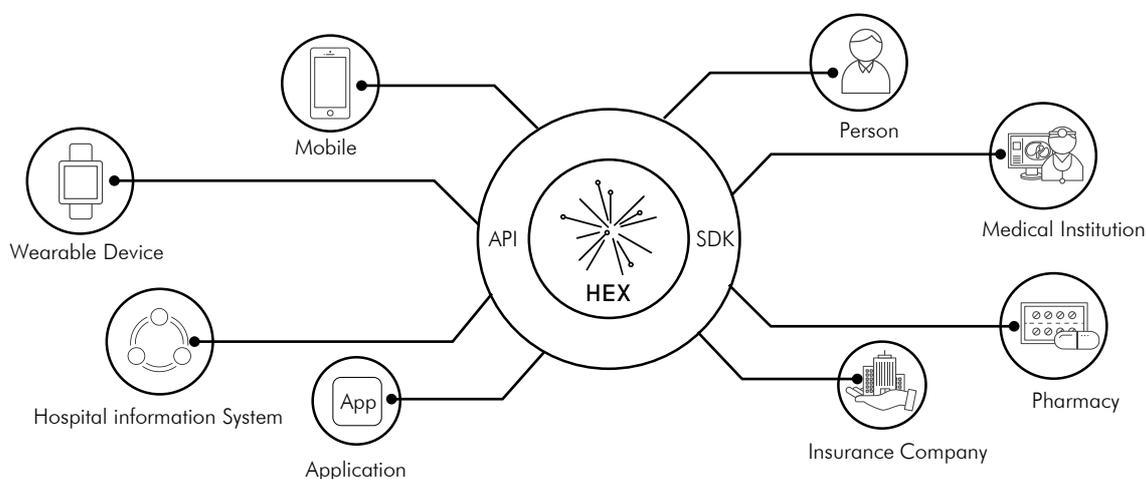


Figure 12. API SDK

## 4.7. Use Cases

# Radiation Dose Management of Individual

Individuals experience many diseases throughout their lives. Radiation exposure from radiation medical equipment can not be avoided during the diagnosis and treatment of disease. This is called radiation dose or dose. In the meantime, dose management have been used only within medical institutions. Dose data is very sensitive for individual and medical institutions and also it is sensitive to send their radiation dose information to other medical institutions.

It is not realistic to manage individual radiation dose at each medical institution, because individuals are diagnosed with diseases through various medical institutions, and receive medical treatment, migrating to other medical institutions in the region or country, and further to visit a medical institution in foreign. Dose management should be able to collect all the dose data that have been exposed from multiple medical institutions beyond one medical institution.

HEX platform collects doses received by individuals from various medical institutions and is easily viewed by individuals. This can be the individual cumulative dose that is exposed through medical radiation from multiple medical equipments. People knowing individual cumulative doses is very important factor in future personal care and health plans, beyond showing the sum of simple numbers.

If an individual cumulative dose is high, it may require different medical services considering dose. Dose can also be an important factor when choosing a medical institution to receive medical services, since not only the total individual cumulative dose but also the cumulative dose per medical facility can be checked.

- Provide cumulative dose information that individuals receive from multiple medical institutions
- Provides radiation dose statistics for hospitals, equipment, and tests
- Risk notification when individual cumulative dose limit is exceeded
- Provide radiation dose guide

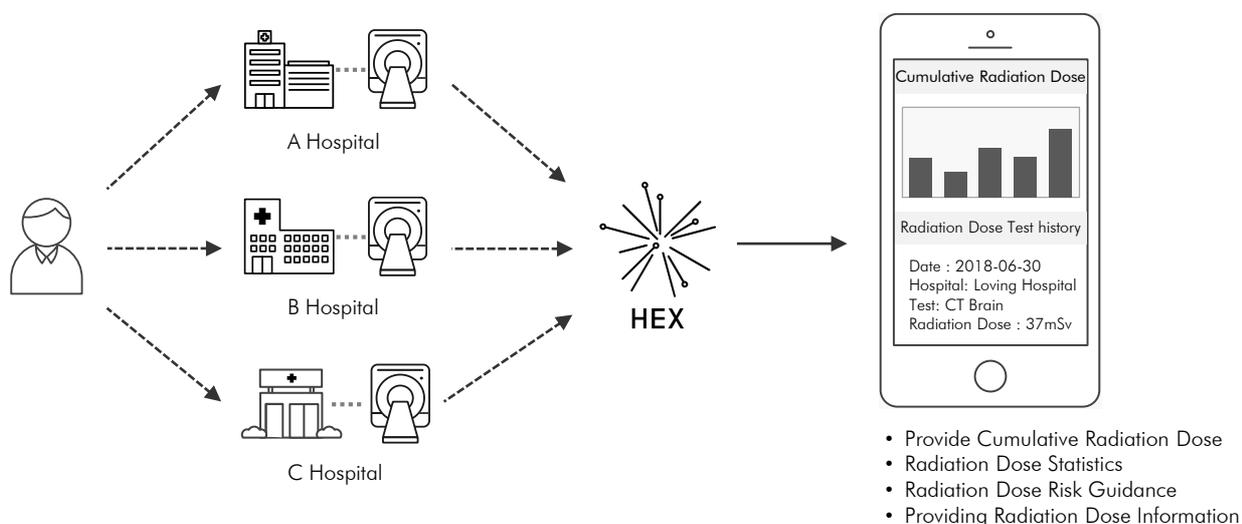


Figure 13. Management of Personal Cumulative Radiation Dose

## Radiation Dose Management of Medical Institutions

While medical institutions seek the least amount of radiation within a reasonable range, some examinations conduct tests using radiation or expose more than necessary for reasons such as equipment operation and efficiency of medical treatment. Also individuals may be exposed to more than necessary by unnecessary examinations and more than double check etc. Relatively instant low doses of individuals are less risky, but they can be dangerous when the individual has already received many doses. HEX platform manages a collection of doses received by individuals from multiple medical institutions, and medical institutions can provide appropriate medical services at that value. This can have a major impact on improving the quality of medical services as well as image improvement of medical institutions.

There are many radiation equipments in the medical institution. Depending on the type of equipment, timing of introduction, and equipment specifications, patients are given various doses. The doses received by the patients differ depending on the equipment, even when they are the same manufacture date or manufactured at a similar time, the dose received by the patient varies depending on the basic specifications and options of the equipment. However, due to the limitations of the hospital scale, there are not many equipment of the same kind or similar equipment in the same hospital. Therefore, it is difficult to measure whether the radiation dose given to the individual person is appropriate.

Since HEX platform collects the examination information and the equipment information together, it collects the data of similar equipment or similar specification used in various medical institutions. This includes equipment used in a variety of countries outside of local boundaries, and this data can help to manage the equipment of a medical institution.

Medical equipment at a medical institution is not easy to exchange or buy new one, because most medical equipment with the latest technology is expensive. Especially radiation equipment is more expensive among the medical facilities. So staffs in a medical institution will purchase it very carefully. Dose can be one of the evaluation indicators in evaluating various equipment and selecting the optimum equipment. HEX platform will contain the dose information and it can be compared to measure the performance of the equipment, and the efficiency compared to the existing equipment can also be evaluated.

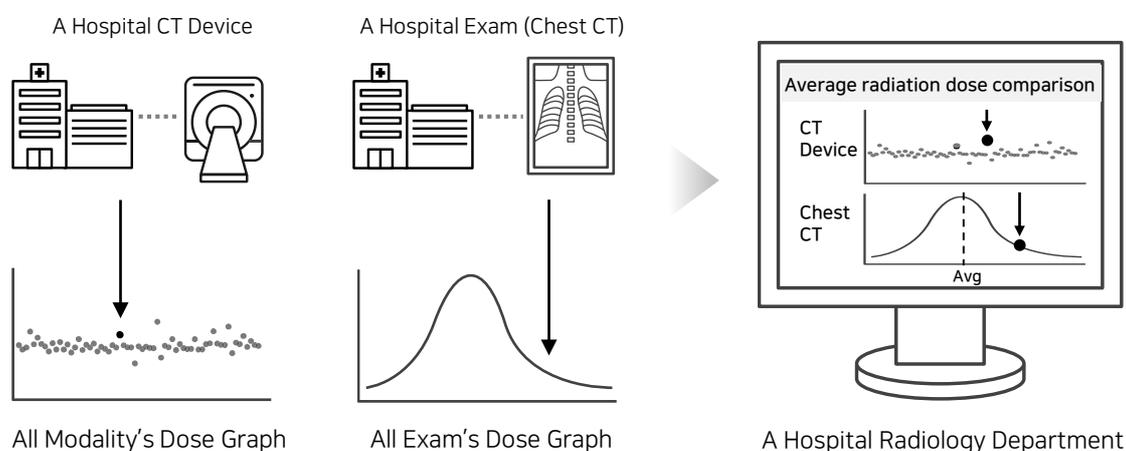


Figure 14. Radiation Dose Management of Medical Institutions

## Radiation Dose Guideline

Governments in each country and international organizations are aware of the importance of dose management. Various projects and business are underway. However, they are faced to limit in collecting actual dose data. Because the gathering of dose data from medical institutions is frustrated by the cost of infrastructure construction and system configuration, technical limitations, and security issues. So most of the studies have been collecting data by designating a specific group or individual in a specific medical institution in a specific area, collecting data for a specific area, and financing research, standards, and policies based on the data.

HEX platform based on international standards for dose and encrypted personal information can collect data regardless of the size or location of a medical institution. This means that data from multiple medical institutions in a region can be collected, not from a specific medical institution in one area, and that data can be utilized from not only one region but also several regional hospitals. It also means that data from one country or several countries can be collected beyond the region. This can be an important reference for establishing a government healthcare policy, and HEX data can be used to an important criterion and data in international standard.

For example, if using the patient's demographic information, inspection conditions, and dose information of the medical institutions in the country that are listed in the HEX by a government, it is possible to establish a DRL (Diagnostic Reference Level) suitable for the reality of the country. Even if when criteria for the replacement of old equipment in a medical institution is needed, medical institutions can also establish realistic policies by using dose data as well as the equipment year or specification of the HEX platform information. Furthermore, international organizations can use the data of the HEX platform, which is assembled from the whole continent or from all over the world, to establish standards such as standard DRL on the continental or global basis and reference dose per inspection site.

- Establishment of international standard of dose management and health policy
- Dose Management Guide based on the actual dose data

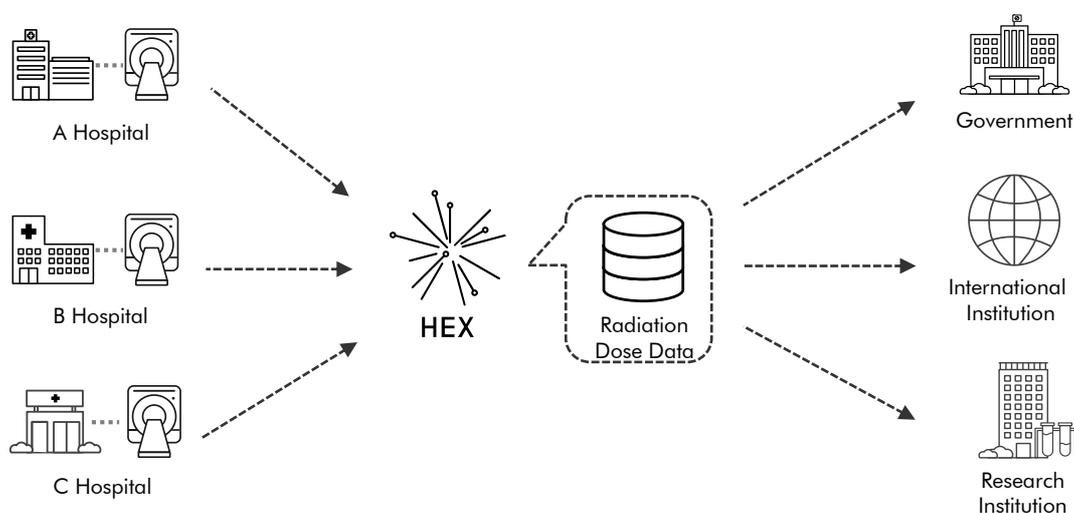


Figure 15. Establishment of Government and International Organization policy

## Personal Driven Healthcare

Personal medical records are very important clues to healthcare and treatment, however, the records are currently scattered among the various medical institutions, making comprehensive analysis and management difficult.

HEX platform integrates health information such as blood pressure, blood sugar, and the amount of activity and calorie measured by wearable and/or IoT devices, as well as medical records and examination results scattered across various medical institutions. The information will be used for consumers and patients conveniently through personal mobile devices.

The integrated personal health records are helpful for personalized treatment when they receive medical care or especially managing chronic diseases and special diseases. Also people can track and check their own prescription and identification information of medicines and helps to manage their medication history. The individual's medical history and prescription history can be easily identified at a glance, and compared with past medical records, individuals can set their own goals for disease treatment and healthcare.

- Providing customized and personalized medical services using an integrated personal health record
- Setting and executing own goals for prevention and treatment
- Tracking personal health trend

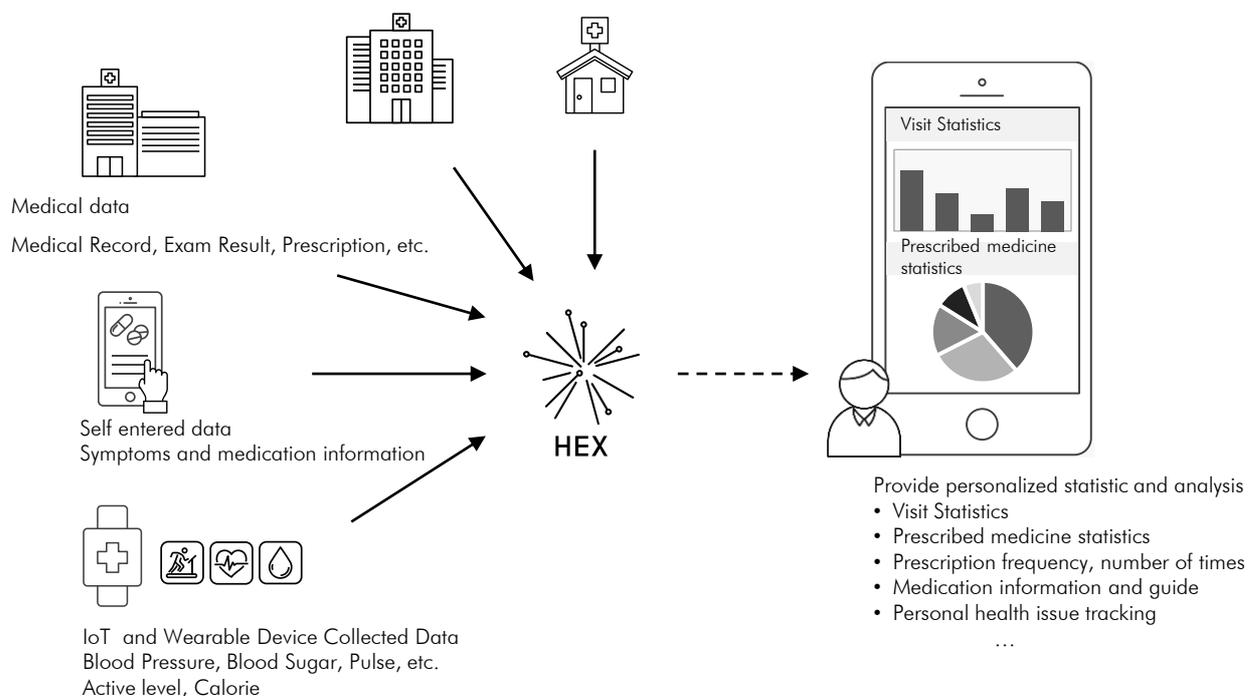


Figure 16. Personal driven healthcare

## HIE/IX (Health Information Exchange / Image Exchange)

Personal medical records stored through personal authentication can be delivered to the authorized users. The object to which the access is permitted is to be able to view the item allowed by the patient. The items provided by the patient include various medical information on the HEX such as medical history, prescription history, and medical image (CT/MRI). A medical staff can view the medical information allowed by the patient and provide high-quality medical service to the patient.

For example, if a patient wants to continue taking a medication they are taking, he/she can provide the own prescription history to the medical staff via mobile and the medical staff can confirm the patient's taking the medication through access permission, and the patient can be prescribed a necessary medication or alternative medicine.

HIE/IX system based on HEX enables medical staff to get the information needed for medical care, such as patient's past medical history and medication being taken, and provide optimal medical services. Patients can avoid unnecessary reexamination, duplicate prescriptions, etc., and ultimately benefit from continuity of care, convenience, and savings of medical expense.

- Patients can personally choose a person who access their own health information
- Provide only your selected health records
- Medical staff provide better diagnosis through integrated medical history
- Prevent unnecessary re-examinations or duplicate prescriptions

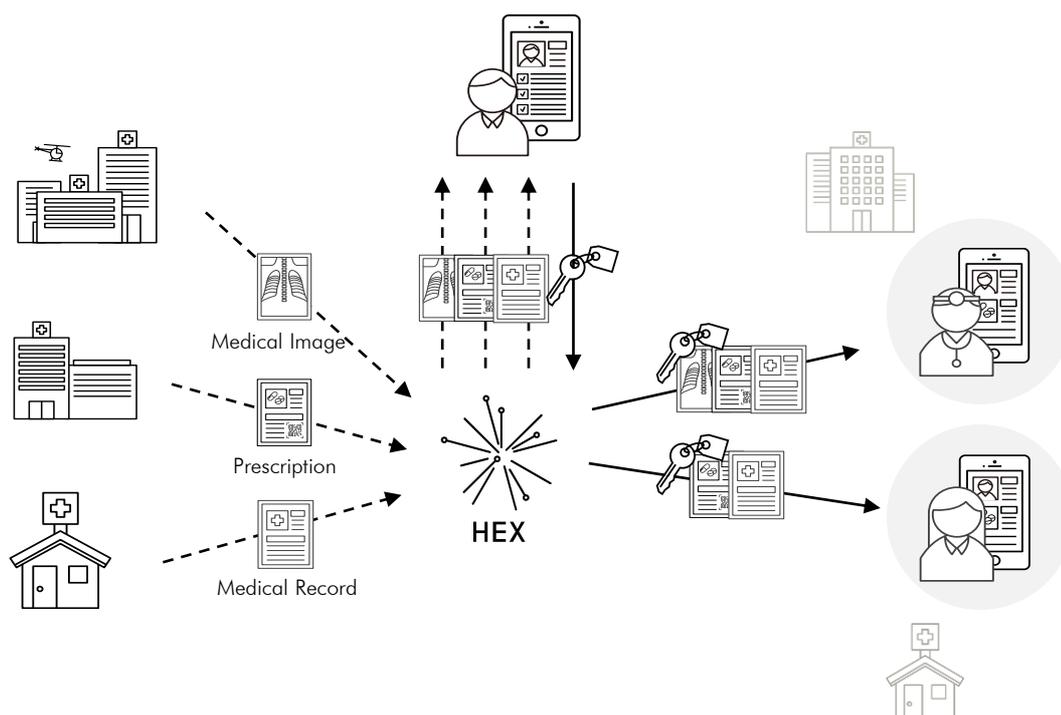


Figure 17. HIE / IX

## Target Survey

Target Survey based on HEX selects the target group of the desired condition among the individual users who agree to receive and conduct the survey. Surveys related to medical data contain a variety of information including medical information, it was difficult to recruit appropriate target groups. Therefore, elaborate target group selection provides useful data for the purpose of the survey progress.

The survey agency can obtain results such as reduction of survey period and cost and acquisition of refined data. Users can obtain own health information and compensation through participation in research related to their health status. Ultimately, Target Survey can be expected to improve the quality of healthcare surveys and researches.

### Individual user

- Registration of demographic information and information on major diseases and special conditions
- Pre-consent to receiving Survey
- Receiving token payment in reward to target survey response

### Survey institution (Company, agency and public institution, etc.)

- Sophisticated target setting improves survey accuracy
- Survey request and notification to selected target groups
- Control the number of tokens according to the survey situation

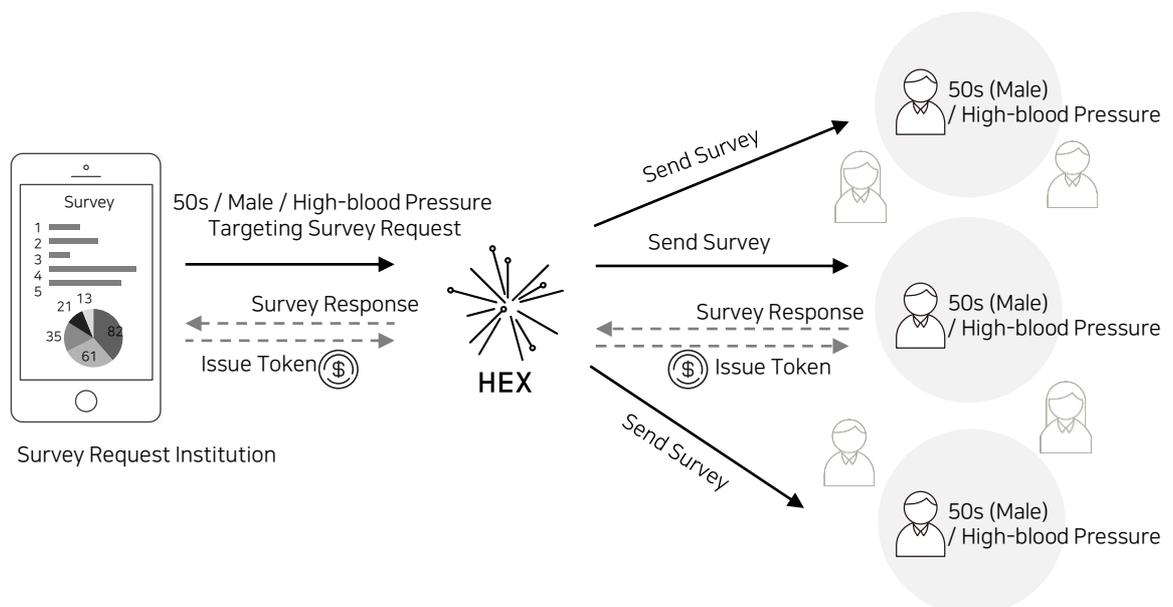


Figure 18. Survey

## Medical Certificate Service

It is a service that can easily apply, issue and inquire the certificate of medical records such as individual's disease and medical records and test results through online or mobile without visiting the medical institution.

Currently, medical institutions treat personal medical information as the most sensitive data, but because they manage the data on the central server, there are disadvantages such as the possibility of forged and falsified at central server, weak security, and increase of maintenance cost. In addition, the patient had to visit the patient directly due to the problem.

In case of HEX platform, medical certificate document without risk of forgery of certain medical institutions is issued. Rather than centralized server, distributed nodes enhance security, maintains management and reduces administrative costs. In addition, it is not necessary for the individual to visit the medical institution and it is possible to use and transmit the issued document according to the purpose for which it is needed, so that the cost reduction effect can be obtained.

- Check and issue a list of medical certificates that can be issued based on your medical history without visiting the hospital
- Check the history of medical certificate issued and the contents of the issued document through mobile
- Use for insurance claim after issuing required medical certificate
- Utilize the contents of the medical certificate document in conjunction with the HEX personal healthcare service

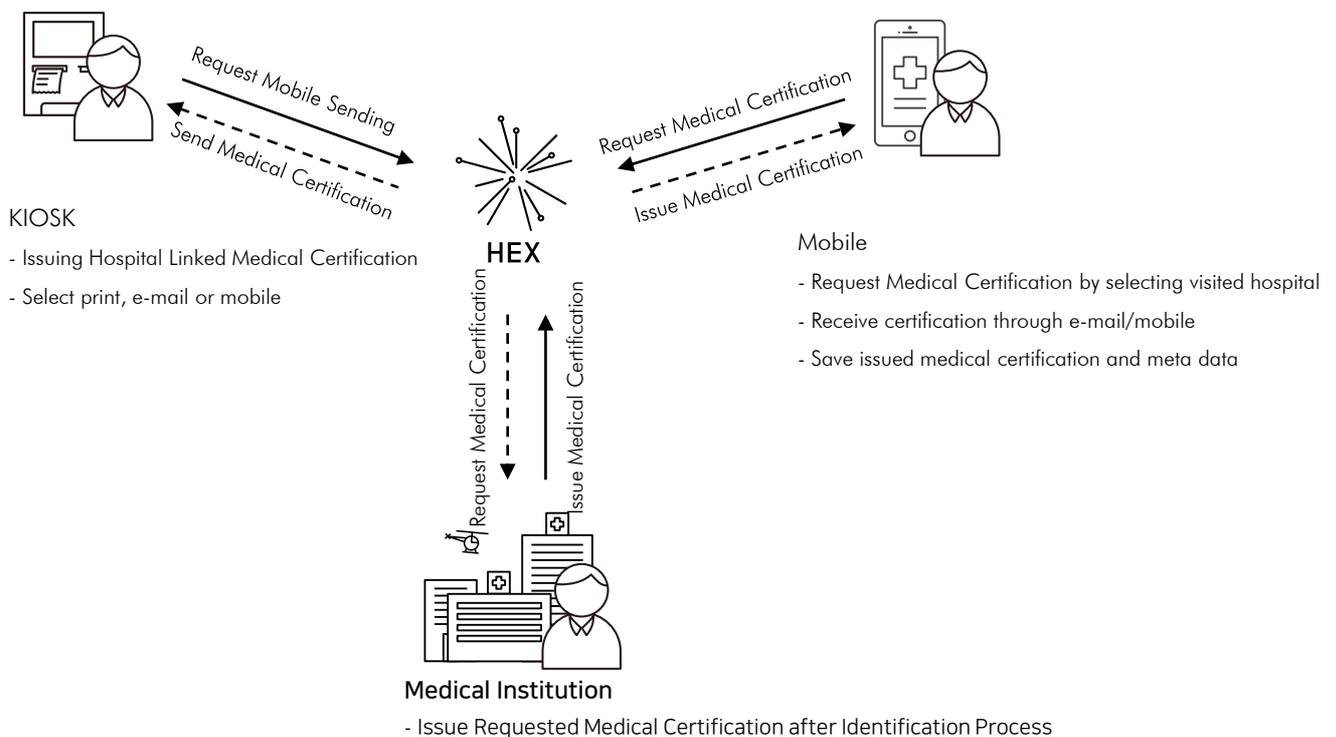


Figure 19. Medical Certification Service

## Health Data Research

In many cases, it is necessary to analyze and integrate various health information for research or new insights. HEX can support a variety of medical and health data that can be analyzed and used in various places. It also provides data to research institutes, medical institutions and pharmaceutical companies etc. that require medical data and this allows medical consumers to receive high quality healthcare services.

Once health information business ecosystem is built and vitalized while securing transparency of health information and enjoying benefits under the control of data providers, individuals will participate actively as data provider in the ecosystem. Medical researchers will provide safe and valuable medical services through accurate and precise clinical trials and new drug development based on refined data. Furthermore, it will be possible to realize predictions, prevention and precision medical services based on massive medical data.

- Collect data from medical institution, health check-up center, and IoT devices
- Retrieve and utilize de-identified data
- Provide refined data with customized information filtering
- Analyze data based on various medical and health data
- Expansion to Artificial Intelligence Medical Services

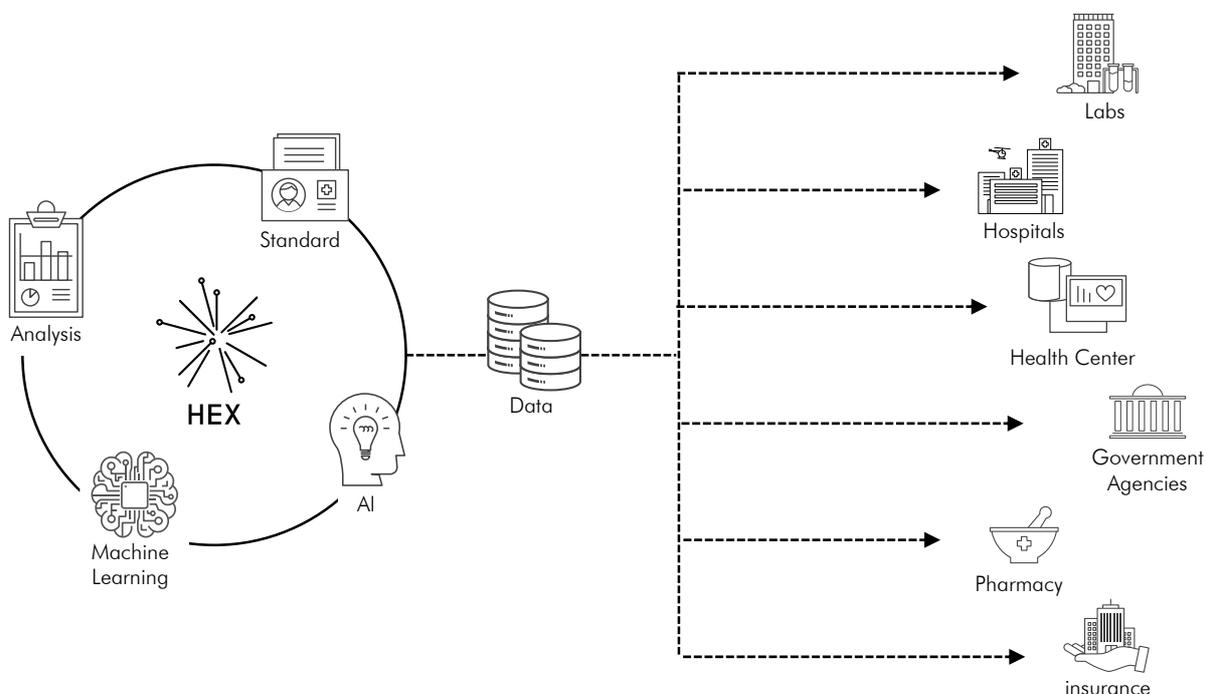


Figure 20. Health Data Research

## 5. Token Generation Plan

### Outline

Acceptable cryptocurrencies	ETH, ATX
Token price	1 ETH = 60,000 HEX / 1 ATX = 12 HEX
Number of total token	14,000,000,000 HEX
Hard Cap	100,000 ETH / 500,000,000 ATX
Soft Cap	20,000 ETH / 100,000,000 ATX

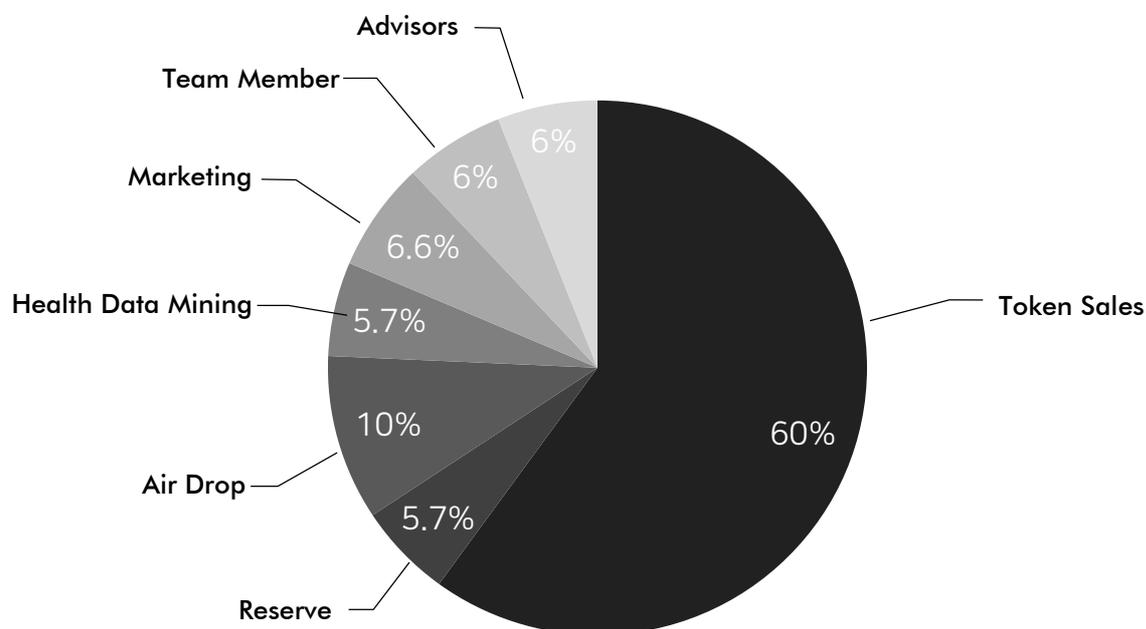
### Token Sale

Pre-Sale (30% Bonus Rate)	2018.09.01~14[* Minimum amount: 50 ETH / 250,000 ATX ]
Crowd-Sale (20% Bonus Rate)	2018.9 TBA [* Minimum amount: 0.1 ETH / 500 ATX ]

### Token Distribution

The total allocation of funds as bellow.

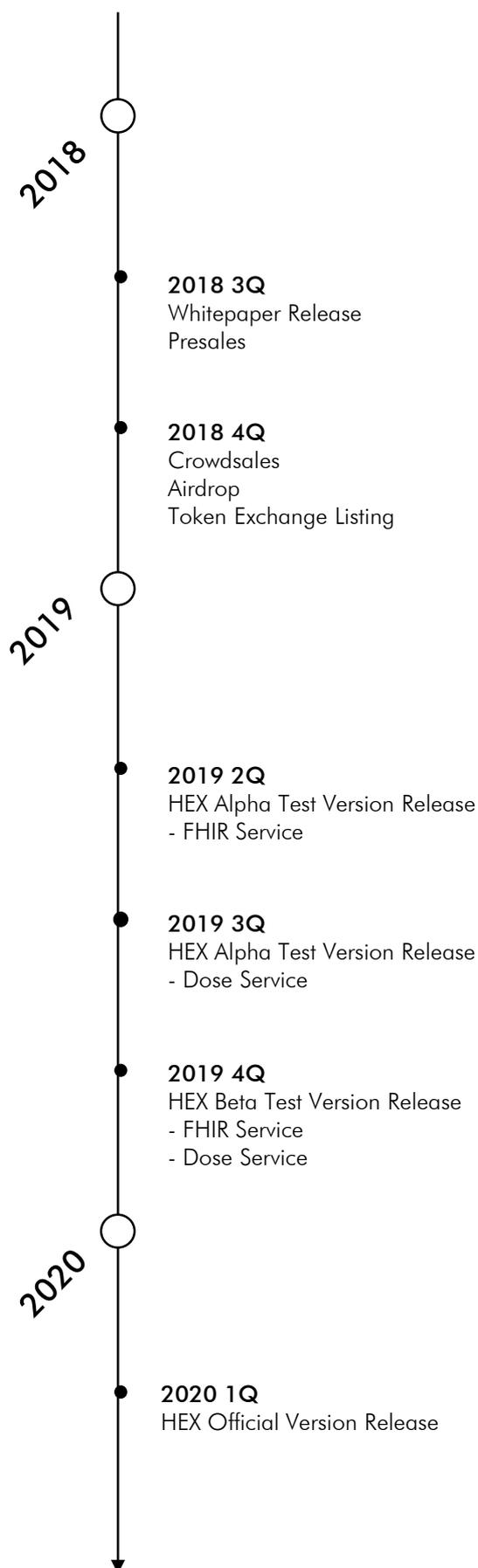
60% sales / 5.7% Reserve / 10% Airdrop for Aston token holder / 5.7% health data Mining(HEX system operation cost) / 6.6% Marketing / 6% Team Member / 6% Advisor



※ Team, Advisor Member Lock : 20%(6month) / 30%(12month) / 50%(18month)

※ Private Sale Lock : 25%(3month) / 25%(6month) / 25%(9month)/25%(12month)

## 6. Roadmap (Plan)



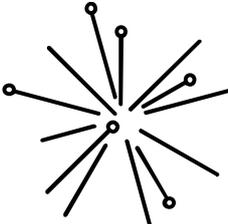
## REFERENCE

1. Systems healthcare: a holistic paradigm for tomorrow, BMC Systems Biology, 2017; 11: 142
2. Aging Population and Medical Cost, KDI Policy Study 2010-05
3. The Effect of Information Asymmetry on Consumer Driven Health Plans, Springer , Integration and Innovation Orient to E-Society Volume 1 pp. 353-362, 2007
4. Impact of an Electronic Health Record-Integrated Personal Health Record on Patient Participation in healthcare: Development and Randomized Controlled Trial of MyHealthKeeper, J Med Internet Res. 2017 Dec; 19(12): e401, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5740264/>
5. FHIR (Fast Healthcare Interoperability Resources) specification, <https://www.hl7.org/fhir/overview.html>
6. Diagnostic Reference Levels(DRLs), IAEA web site, <https://www.iaea.org/resources/rpop/health-professionals/radiology/diagnostic-reference-levels>
7. Radiation Dose Recording, DICOM web site, <https://www.dicomstandard.org/using/radiation/>
8. Aston white paper, XBC Technologies, 2018, [https://s3.amazonaws.com/aws-website-aston/za7io/aston/wp\\_english\\_180705.compressed.pdf](https://s3.amazonaws.com/aws-website-aston/za7io/aston/wp_english_180705.compressed.pdf)
9. FHIR(Fast Healthcare Interoperability Resources), <http://hl7.org/fhir/>
10. FHIR(Fast Healthcare Interoperability Resources) Data Mapping, <https://www.hl7.org/fhir/mapping-language.html>
11. HIPAA, Health Insurance Portability and Accountability Act of 1996 (HIPAA; Pub.L. 104–191, 110 Stat. 1936, enacted August 21, 1996)
12. Hybrid Encryption/Decryption Technique Using New Public Key and Symmetric Key Algorithm, Prakash Kuppuswamy, Saeed Q. Y. Al-Khalidi, MIS Review Vol. 19, No. 2, March (2014), pp. 1-13

HEX Whitepaper v1.1

September 2018

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