ABO

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MEDICAL DATA SHARING AND AI UTILIZATION PROTOCOLS

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Medical Data Sharing and AI Protocols Platform

V 0.4

Overview

In the medical care industry, profound transformations are happening in data privacy protection, social resource integration, and AI utilization. Such transformations are challenges to the industry's deep-rooted problems brought about by new technologies and ideas. New technologies make it possible to turn ideas into reality, and ideas have long been guiding the direction of technological development. The ideas include decentralization and populism, which represent people's demands for the return of certain rights and a more equitable, flattened world. The technologies include blockchains, artificial intelligence (AI), and the internet of things (IoT), none of which work independently. These technologies need to work together to allow for industrial applications and business work-flows to be restructured and reach new horizons.

In response to these changes and trends, ABO, based on its in-depth research and analysis in the medical care industry, plans to bring about the return of medical data ownership and management rights by taking advantage of distributed ledger technology. Meanwhile, ABO will promote the credibility and inter-operability of medical devices and enhance the st andardization of medical data. In this way, a secure, highly efficient, and cross-system data sharing system will be created. Finally, a credible environment will be established for services related to the use of medical data, including data acquisition, annotation, storage, transmission, computation, and other services utilizing AI.

ABO positioning: Medical data sharing and AI protocols platform.

ABO objectives: Setting up a healthier blockchain medical ecosphere and offering a better medical service.

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1. Background

The following section examines the latest rules and regulations of major economies in the medical industry, as well as the trends in the industry.

GDPR

The General Data Protection Regulation (GDPR) is a new regulation launched by the EU to protect the privacy of EU residents. It has officially been in effect since May 25, 2018.

This regulation will not only affect the enterprises that have established affiliates or branches in Europe, but also companies that regard EU customers and their business operations as business goals. On the one hand, the new regulation grants patients more rights to control the collection and usage of their personal data; on the other hand, non-compliance with the related data will lead to heavy punishment - up to a fine of 20 million euros or 4% of turnover. Strict requirements for privacy and new accounting requirements have laid a solid foundation for the implementation of new technical solutions such as those built on blockchain technology.

With the implementation of GDPR, the following major changes are to occur in the field of health care:

First, personal information is to become more secure. Medical institutions will need to learn more about methods of collecting and storing patient information.

Secondly, patient files are to be more detailed. Patient personal data is already highly dispersed as the data is collected in various ways and from various parties: from doctors performing surgery to professional medical institutions. One core part of GDPR is to ensure the availability of more information about the purposes and locations of any data collection. This means that health care institutions will need to master the management of more comprehensive and detailed information. However, according to GDPR, patients themselves can determine whether to retain their own data. To some extent, this may become an obstacle to improving diagnoses.

Thirdly, patients are to have access to more information. The health care field features highly sensitive and private information. However, medical examination results are usually widely shared for diagnostic purposes. Patients may lack a deep understanding of how the information is collected, who can access the information, and how the information is stored. GDPR provides patients access to this information and ways to tightly control the information.

Fourthly, medical data is to be more structured and standardized. GDPR has brought huge opportunities to the medical industry, an industry where large amounts of data collected by medical institutions for decades remain unstructured and inaccessible. Data structuring and integration may accelerate a generation of new treatment methods and strengthen preventive measures.

In general, the implementation of GDPR has excited the medical industry, mainly because it may stimulate the use of a large number of databases that have been gone out of use over the past decades.

Medical Treatment Combination (MTC)

The MTC framework is used for grading diagnoses and treatment. The Chinese government has proposed using this framework to address the uneven distribution of medical resources. This framework guides patents to receive initial diagnoses and rehabilitation at community clinics and

primary hospitals; to treat common diseases and minor diseases at secondary hospitals, and to treat serious diseases, intractable diseases, and acute diseases in tertiary hospitals.

However, problems in primary hospitals have been exposed in practice, such as poor first-diagnosis capabilities and insufficient incentives, confusing medical insurance settlement rules, and difficulties in the exchange of medical information. These problems seriously restrict the further advancement of this model.

Precision Medicine

In the 2015 State of the Union speech at the end of January 2015, US President Barack Obama announced the Precision Medicine Initiative, a new program in the field of life sciences. This Initiative was dedicated to curing cancer, diabetes, and other diseases, and was dedicated to allowing everyone to access personalized health information. Of the $215 million budgeted for the Initiative, $5 million flowed to the National Office of Health Information Technology Coordination (ONC). This resulted in 13 award-winning papers, most of which put emphasis on the significance of and operational plans for protecting medical data privacy and cross-system data exchange.

AI Diagnosis and Treatment

In June 2017, the US Food and Drug Administration (FDA) approved Arterys Cardio DL, which was produced by Arterys to analyze cardiac magnetic resonance images. This was the first analysis software based on cloud computing and deep learning approved by the FDA for clinical use. It is mainly used to assist doctors in heart imaging.

Technology companies such as Google, Amazon, Apple, and China's Tencent and Alibaba are striving to expand AI applications, especially in major fields such as medical care. Smart medical services improve diagnoses and treatment accuracy and decrease the uneven geographical distribution of medical resources. These smart medical services include training medical imaging AI systems, health assistant AI, and diagnosis AI.

2. Requirements and Solutions

AI technology focuses on boosting production capacity, while blockchain technology focuses on building transparent and fair "production relations". Therefore, the combination of the two can theoretically address a significant number of deeply-rooted societal problems.

2.1. "Production Relations"

"Production relations" include the form of ownership of production materials, the status of people in production, and the way products are distributed. Using this model, the problems with "production relations" in the medical industry can be mainly described with regard to aspects of ownership, distribution of benefits, and relationships of related parties in the industry.

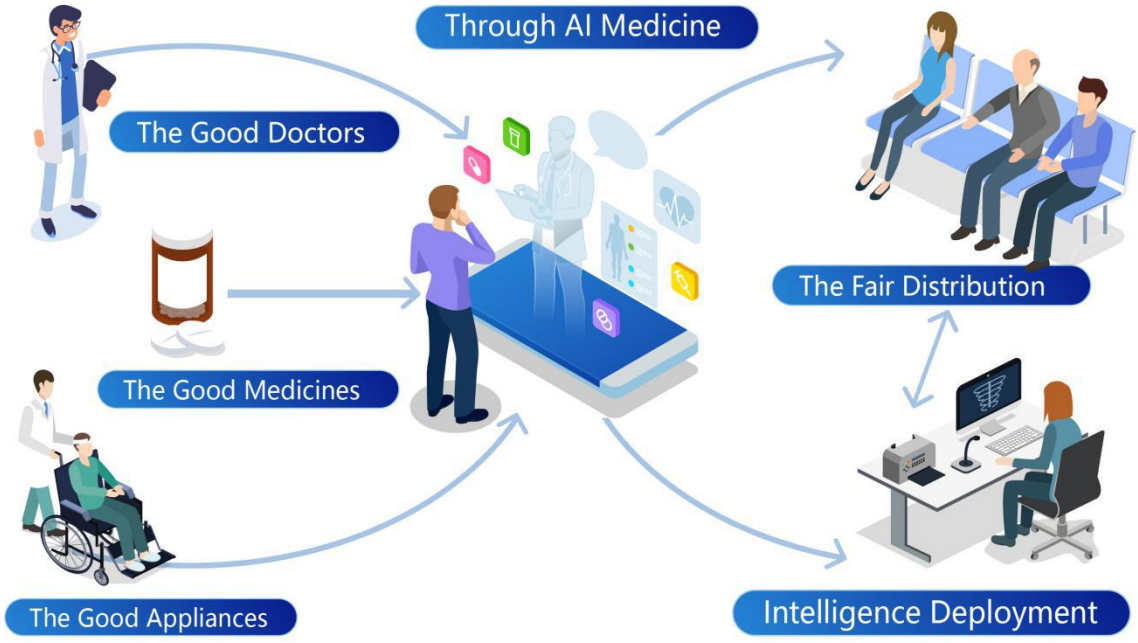
2.1.1. Medical Resource Allocation and Utilization

Medical resources mainly include doctors, medicine, and equipment. In cases where these three are fully decoupled, whether medical resources are reasonably allocated and used mainly depends on doctors.

At present in China, it takes nearly 11 years and consumes more than $100,000 for a student to become a fully qualified doctor. These costs and time requirements make the nationally-determined allocation of available medical talent resources hard on the medical industry. Excellent doctors generally wish to be highly paid and tend to live and work in economically developed areas, but medical talent resources are also needed in less developed areas. This is one of the root causes of uneven distribution of doctor resources. The effects of using policies, even very favorable policies, to change this phenomenon is extremely limited.

The greatest significance of AI medical diagnosis and treatment is that it can be deployed in nearly unlimited amounts across time and space. The electrical and industrial revolutions allowed humanity to drastically reduce their reliance on manual labor. In the future, AI will truly bring about the unrestricted spread of information and achieve a fundamental revolution in productivity. The use of AI can significantly increase fundamental equality by enabling cheaper productivity. Once AI-driven services are extremely low cost and standardized, there will be reduced so-called resource allocation and idleness issues.

ABO supports whole life-cycle medical data AI utilization and empowers medical AI technology development and service implementation, with the goal of achieving increased achieving medical equality.



2.1.2. Data Ownership

Theoretically, medical data ownership and control and management rights should be held by patients, but have actually belonged to institutions such as hospitals, insurance companies, and

governments because users are not willing or capable to handle the data. However, as the value of big data becomes apparent in the AI age, patients' demands for data rights in terms of economy and privacy are gradually increasing. The large-scale practice of distributed and asymmetrical encryption technologies used in blockchain projects provides a readily-available combination of technical resources for patients to handle dispersed medical data. In addition to the implementation of administrative regulations such as GDPR and further public education about the use of medical information, an increasing number of patients will start to participate in the societal process of returning medical data rights to individuals.

ABO will implement the return of data rights to individuals in the following ways:

- Storing health files centrally by using blockchain distributed ledger technology to ensure mutual trust, security, transparency and traceability of data, and to bring together ownership and control rights through security keys.
- Building the infrastructure for unifying health files through a digital identity system to map system-defined user reputation and interests in both real and virtual worlds.
- Using distributed storage to securely store mass data.
- Using an authorized mechanism, enabling users to manage health and medical data in a detailed manner.

2.1.3. Multi-party Credible Data

Credible Data in Life Cycle

Blockchains can record all data flows and ensure data integrity, traceability, and transparency, but they cannot ensure the credibility of the initial data. Initial data is recorded in a blockchain using two methods. One method is that hardware or sensors record the data into a blockchain through APIs. The other method is to map centralized data sources, rules, or accounts to a blockchain through Oracle. In the second method, data credibility is uncontrolled but can be enhanced by creating randomness in multiple Oracle systems running the same service.

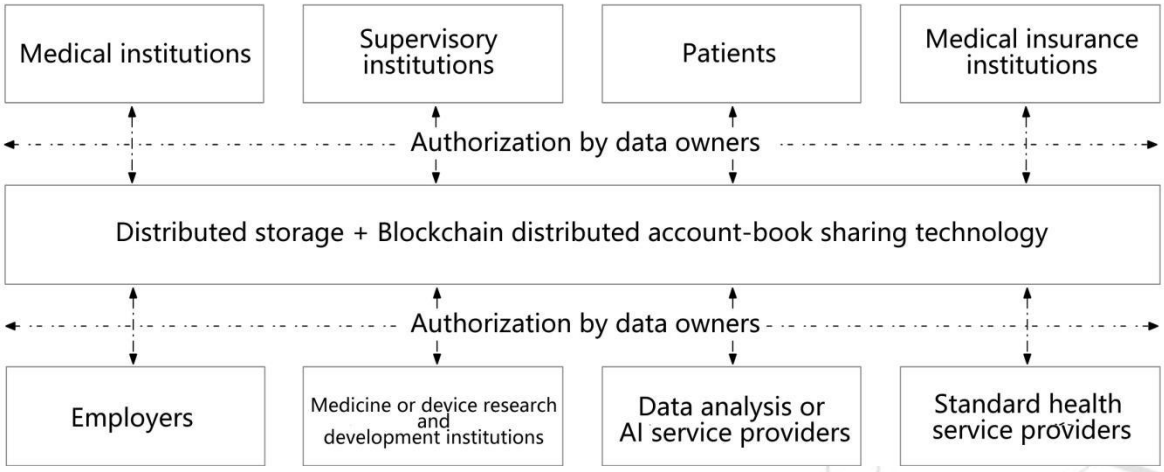
ABO ensures data credibility and correct labeling of the initial data recorded using the first method mentioned above by building hardware that preserves the credibility of the data recorded. In addition, ABO ensures transaction and storage of credible data through blockchain ledgers. In these ways, ABO ensures the use of credible data across the whole life-cycle, from generation, during recording, all the way to use.

Multi-Party Mutual Trust in Administration

At present, for the same medical event, entries are logged repeatedly by medical institutions, governmental social/medical insurance institutions, medical care institutions, and pharmacies. Multiple records give rise to mistrust among multiple parties, as well as inefficient handling of reimbursements.

Multi-Party Mutual Trust in Services

Strong coupling of doctors, medicine, and instruments in medical care can easily drive doctors to recommend unnecessary and expensive medical examinations. This is the case in China where the practice of financing medical care through the sale of medicine has existed for a long time. Misdiagnoses may also happen due to doctor negligence, insufficient competence, and incomplete information. Mutual trust in services can be achieved through the use of unchangeable health archives provided by blockchains, the introduction of multi-party diagnoses, and the use of a system-defined reputation system. These measures will increase the cost of errors and reduce their probability.



ABO Consolidate the Account Book

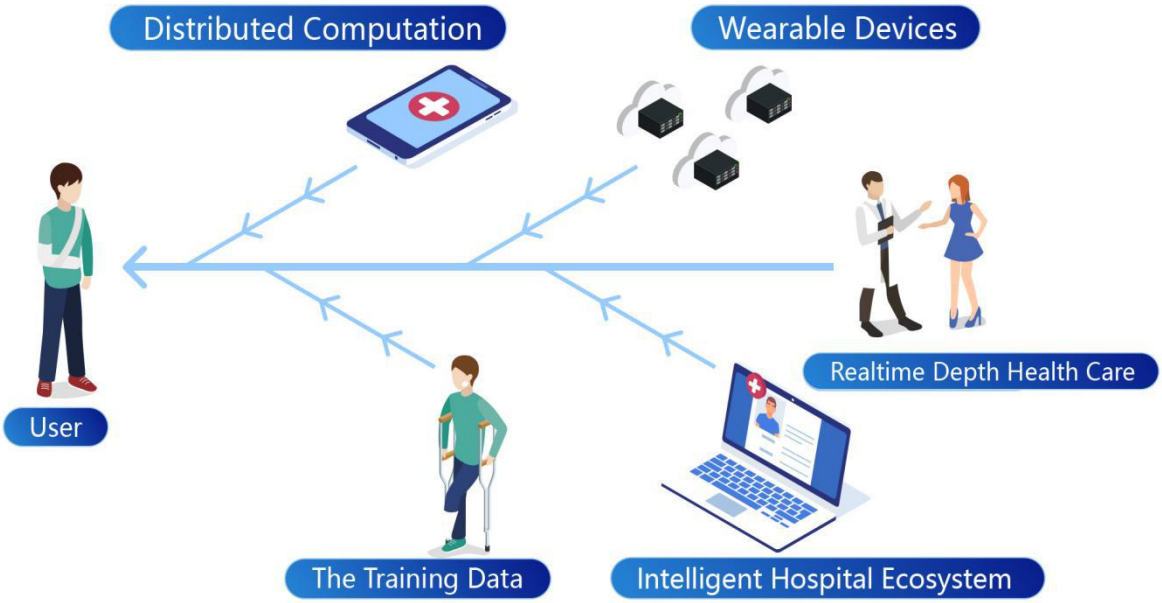
2.2. Productivity

2.2.1. Real-Time In-Depth Health Care

Superior doctors prevent disease before it appears. However, limited by cost and technology, most current diseases are treated only after patients first show signs of discomfort. For patients suffering chronic diseases or those not in good health, acquiring real-time health data is an urgent need. This can prevent medical emergencies or improve certain physical conditions through tailored physical exercise plans or diet therapies.

ABO plans to develop an ecosystem of wearable medical devices, aiming to help patients access real-time health monitoring at low cost. In ABO's ecosystem, the fulfillment of this aim is dependent on the design of the following items:

- Inter-operability protocols and market adaptation for wearable devices, allowing for the construction of an open hardware ecosystem that can gather real-time data from users.
- Intelligent development frameworks, covering popular data processing libraries and deep learning libraries, facilitating AI data training carried out by developers.
- A data market and computing power market, which improve the mobility of data and computing power, as well as provide scalable distributed computing capabilities.
- A smart apps market, which allows for the construction of an open ecosystem for medical software.



2.2.2. Data Standardization

The digitization, standardization, and AI utilization of medical data is an ongoing and irresistible worldwide trend.

Digitization

Health archives are the concrete reflection of digitized medical data. These archives cover almost all past and present patient medical information. Health archives usually consist of the first page of a disease case, the records of disease development, the results of examinations, the advice of doctors, the records of surgical operations, and nurse records. These archives contain both structured information and unstructured information, such as free text, graphics, and images. With the large amounts of medical big data, medical practitioners can analyze and detect important evidence relevant to medical quality, safety, and efficacy. Such measures enhance the quality and efficiency of medical care, strengthen the safety of medical care, and promote the research and development of medical therapies and new medicines.

Standardization

Take China as an example: rich in medical data, but poor in data sharing and standardization. China is still in the transition phase from traditional physical medical imaging to electronic data. A large amount of image-based media has not been digitized yet. In addition, China's data are characterized by a variety of data sources and types, complicated structure, and inconsistent standards. Consequently, obtaining valid data of truly high quality is quite costly, consuming seemingly limitless resources.

As a result, medical device manufacturers suffer from shortages of detailed user data, difficulties with precisely locating users with the right diseases, and lengthy time periods required for the research and development and certification of medical devices. Research institutions cannot reach sufficient numbers of patients. In particular, the lack of an approach for long-term patient-data tracking and collection has significantly affected progress in research and development. Prevention and testing institutions, such as epidemic prevention and control institutions, find it difficult to rapidly track epidemic development. The shortage of detailed patient data and screening approaches has led to slow progress in the research and development of vaccines.

AI Utilization

Machine learning requires reliance on high-quality data for training and algorithm optimization in the preliminary stage, so as to ensure high accuracy. Consequently, how to acquire valid data is the obstacle that medical applications utilizing AI need to overcome from the start. High quality data means sufficient and representative data sets. Moreover, data annotations should be of high accuracy.

ABO's digitized, standardized, and AI utilizing solution covers:

- A health archive system, which is built upon open blockchain ledgers;
- A data structure of electronic medical data, which is built upon the Health Level Seven Version 3 Normative Edition (HL7 V3), Specification for Sharing Documents of Electronic Medical Record, Basic Architecture and Data Standards of Electronic Medical Data, and the implementation practices of advanced countries, such as the UK;
- Guaranteed support for the data integrity of processes utilizing AI, where experts are incentivized to annotate data professionally and in multiple dimensions to make up for the loss of critical data in health archives.
- Support for a semantic analysis library, which allows free-text data to be identified and tagged.

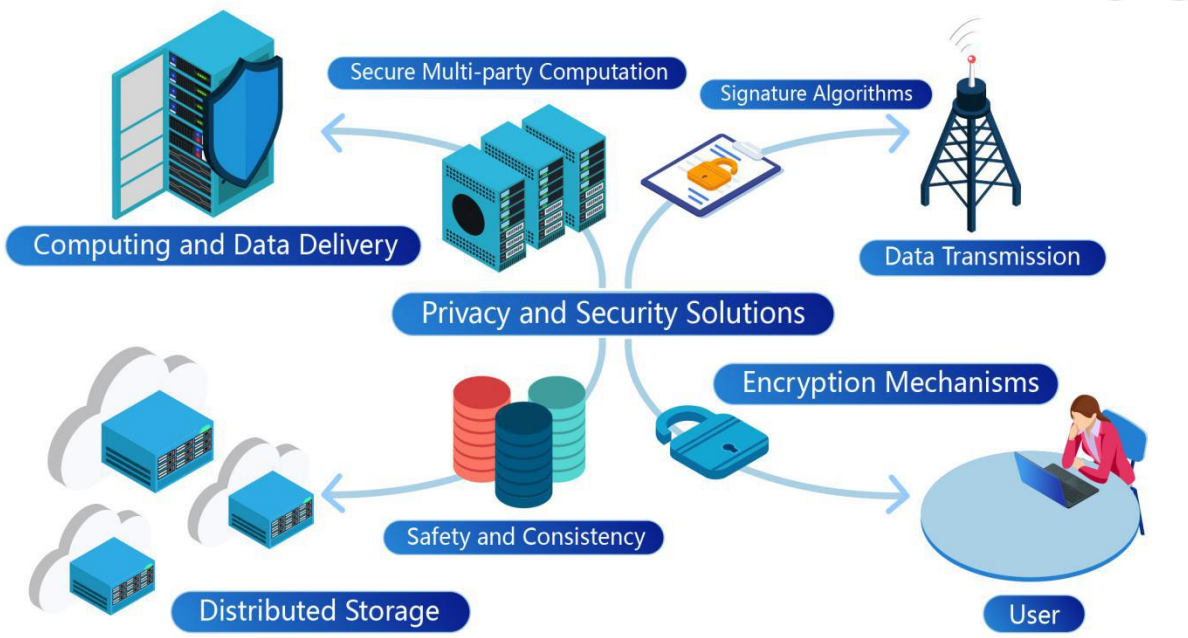
2.2.3. Privacy and Security

In 2017, Kromtech Security Researchers, a security research institution, found that about 47 GB of medical data stored in Amazon S3's online storage service by a medical service institution was accidentally left open to the public. The data included 315,363 PDF files. According to the estimation of Kromtech Security Researchers, such files involved at least 150,000 patients. The leaked information covered personal information, such as blood examination results, names, home addresses, doctor information, and doctors' notes about the management of medical cases.

As the impact of the value of big data accelerates in the AI era, the security risks related to data leakage mount. There will be more and more malicious acts targeting medical data in the future.

ABO's privacy and security solutions cover:

- Returning to individuals their data ownership and management rights through an encryption system that generally eliminates unexpected, "black swan" events, such as large scale medical data loss;
- Distributed storage, where a distributed hash algorithm is adopted to ensure the consistency and security of files;
- A signature algorithm used during data transmission that ensures the security of transmission;
- Multiple modes supported during computation and data delivery, where secure multi-party computation can be carried out without data exposure.



2.2.4. Storage, Sharing, and Trading

Generally, the data of Picture Archiving and Communication System (PACS) and genomics require GB-class physical storage space, posing challenges to the data storage capabilities required of medical institutions to allow for centralized data storage . Also, centralized data storage can obstruct the design of data trading and sharing mechanisms. Therefore, data storage, sharing, and trading should be addressed as integral issues, and the solutions implemented should have an infrastructure that is built upon sound security and privacy mechanisms.

ABO's integrated storage, trading, and sharing computation solutions:

- Data standardization that lays the foundation for trading and sharing;
- A distributed storage and access authentication mechanism that constitutes a pricing and delivery mechanism for data trading;
- A pre-processing solution, designed for large-scale image data;
- Secure multi-party computation, designed for legacy centralized data;
- A data and computing power market that supports a variety of models for data authentication, data trading and computing power trading .
- A variety of consumer devices tailored to patients, researchers, and institutions that provide good user experiences in data authentication and exchanges.

2.2.5. Analysis and AI Utilization of Big Data

Without analysis, data bear no value. Without generating intelligence or products, data analysis is pointless.

ABO has thorough AI support in its entire design, which covers：

- Intelligent medical functions in consumer devices that provide users with real-time and precise health care as well as in-depth consultation capabilities through the computation and smart capabilities of peripheral wearable devices;
- Enhancement of the standardization of health and medical data and the credibility of smart hardware standards that provides AI with sufficient credible and usable data;
- Enhanced accuracy of data annotation, supplemental data, and more reliable remote multi-party consultation mechanisms;
- A smart app development framework that provides support for big data analysis, AI libraries, and smart app development.

2.3. Requirements and Final Features

The items required to realize the features above are listed below. After an analysis of technical feasibility, these items will work as the full feature set of ABO protocols, which cover:

- Blockchain-based secure and privacy-controllable health archives;

- Blockchain-based unified ledger for medical institutions, supervisory authorities, patients, and medical insurance institutions;
- Digital identity and system-defined reputation, built upon the blockchain-based account system;
- Distributed storage of medical data and a flexible authorization model;
- Inter-connectivity inter-operability protocols for medical devices;
- A pre-processing and standardization framework for medical data;
- Support for secure multi-party computation modes in the utilization of legacy medical data;
- Data, computing power, and smart medical app markets. Complete and multi-dimensional data delivery and payment methods;
- A smart app development framework;
- Consumer device apps, APIs, or SDKs that play different roles in the ecosystem.

3. About the Technology

The technical solutions of ABO Protocols cover all the components from data acquisition and processing, standardization, and trading and sharing, all the way to AI utilization. The difficulties lie not only in the formulation of a set of feasible technical solutions, but, to a large extent, also in the integration of societal resources related to geography and administration.

3.1. Digital Identity and System-Defined Reputation

In a blockchain, the native digital identity system is anonymous. The base digital identity is dependent on a public key and a private key that are generated based on asymmetric encryption technology. The ownership of the private key represents the full-control authority of an account, while the public key is used for the trading of digital assets and stakes.

To provide guaranteed data continuity for an account (which exists in both the real and the virtual world) and to bring about the merger of heterogeneous medical data sources in the real world, it is necessary to provide a real-name registration capability for accounts that is based on real-world information, such as Know Your Customer (KYC) and doctors' qualifications. To facilitate subsequent multi-party consultation services, it is also necessary to set a threshold for the real-world professional competency of participants, resulting in a system that reflects real-world medical professional reputation stored in blockchain ledgers.

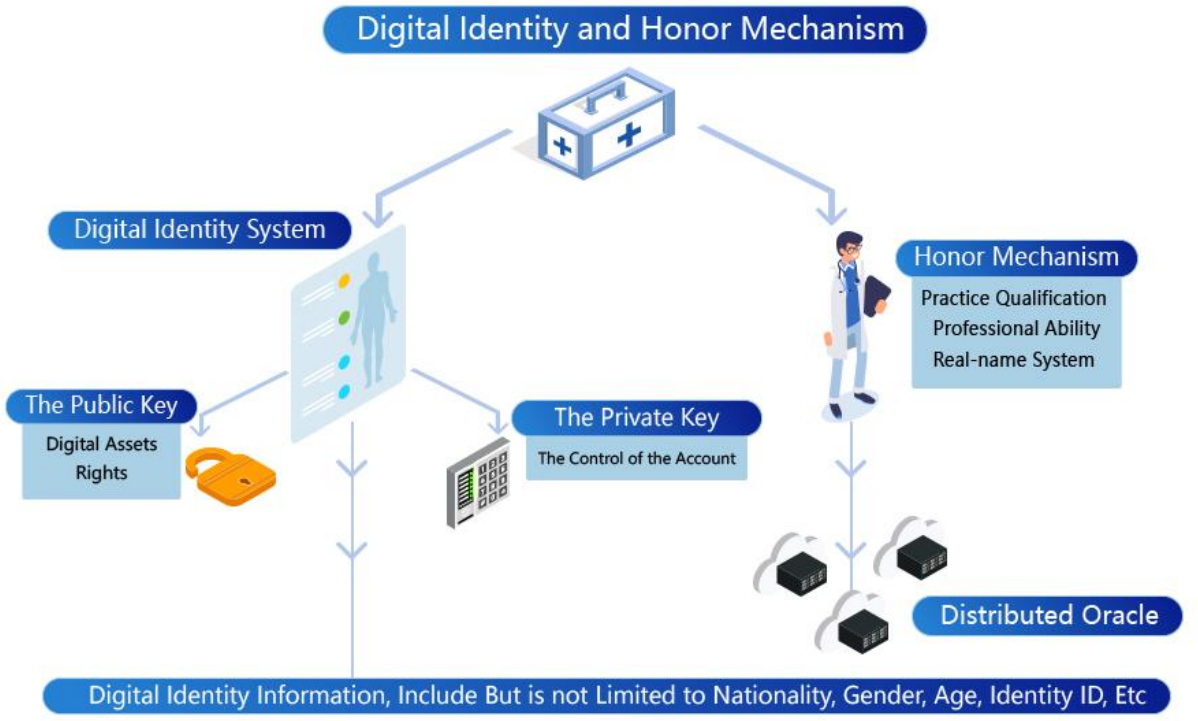
To focus on medical care services, ABO may initially adopt blockchain-based decentralized real-name authentication services provided by a third party. Later, when technical and human resources are available, ABO will carry out research projects on medical digital identity products more adapted to ABO’s needs.

In this system, patients will maintain their own digital identity information as an essential part of their medical records. This information includes but is not limited to nationality, gender, age, and personal identity information. Patients' digital identity will be be authenticated by third-party

service providers. In most cases, authentication services may be provided by national supervisory authorities or industry associations, possibly by way of secure, multi-party computation, and usually for the purpose of maintaining the truthfulness, uniqueness, and integrity of medical records.

Doctors will also maintain their own digital identities, which will be subject to authentication by doctor associations, administration committees, and other organizations. The digital identity of medical care institutions consists of institution type, qualification number, photocopied files, and other information.

Most of the authentication services can be fulfilled through Oracle's distributed model, thereby ensuring high transparency and equality of access.



3.2. Data Standardization Protocols

Data standardization brings about the adoption of uniform formats by different data sources, thus achieving the support for large-scale data analysis. Data standardization aims to build general-purpose architectures and data standards. Data standardization should take care of service usability, feasibility, and technical complexity. With the extensive scope and roles involved, data standardization is a long-term, demanding task.

A standardized multi-dimensional health data structure is provided.

- User information module: covers name, gender, date of birth, blood type, mobile phone number, nationality, personal identity information, address, Internet contact information, emergency contact, family medical history, religion, education, and other information.

- Social module: covers marital relationships, corporate relationships, organizational relationships, and other social relationship information.
- Economic module: covers social insurance, medical insurance, group insurance, and other insurance coverage information.
- Gene data: covers data about the patient's physical makeup that is unaffected by the passing of time and special data structures, such as genomics data.
- Body data: covers the time stamp-based data, such as body temperature, weight, body fat, blood sugar, pictures, psychological condition, medication, exercise habits, and records from self check-ups using smart medical devices.
- Medical care module: covers records generated from medical care events and subsidiary events, subsidiary disease developments, subsidiary hospitals, and other dimensions, including outpatient services, registration, medical examinations, medicine administration, and physical therapy.
- User-defined module: applies to rare diseases or rare medical care processes. Usually, the user-defined module uses a data type well accepted in the industry.
- Other dimensions

Data standardization protocols function throughout the whole process.

- Acquisition: covers channels, classification, data annotation rules, and privacy and authorization handling methods.
- Storage: covers the usage rules for distributed storage.
- Communication: regulates the communication mechanism and the equipment inter-operability models in a micro/macro environment .
- Security: provides encryption and signature protection for data.
- Authorization: provides privileges to operate at different levels based on the authorization at different levels .
- Exchanges: describes how data is delivered and billed and other information.

In a broad sense, data standardization also covers:

- A unique primary key, which is guaranteed through the asymmetric encryption algorithm and the hash algorithm.
- Data integrity and granularity standards, which are guaranteed through data format checks.

Standardization is promoted by markets.

Data markets allow data values to be quickly quantified. In the markets, accurately annotated structured data will be priced higher than the data not sufficiently structured and hard to utilize. In this way, markets fully drive the industry-wide structuring and accurate annotation of data.

AI is utilized in the standardization process.

Raw data are certainly important to unstructured, high-volume medical imaging data. However, as images recorded at a certain time become less useful over time, image data will have decreased utilization and significance as time goes by. It is necessary to design algorithms to carry out data compression within defined time frames. The convolutional neural network (CNN) approach of deep learning technology can be adopted for such compression to allow for controllable compression and recovery of large pictures.

For unstructured free text, the natural language processing of AI can be adopted to carry out word segmentation, part of speech annotation, tagging, keyword extraction and other processing work. Then, further case analysis and solution forecasting can be provided for the data.

All the aforementioned intelligent processing approaches are used for legacy data. For health records entered by users in actual use cases, or for medical data created by doctors through mobile devices, ABO provides more diverse input methods, including voice input, image recognition and input, and input based on self-defined templates.

3.2.1. Data Sources

ABO supports the recording of a variety of health and medical data sources on the blockchain and is capable of extensively working with business partners and medical care ecosystems. These data sources can include data like the following examples: body monitoring data provided by wearable devices, data provided by hospital information systems (HIS), data provided by partners' comprehensive health care apps, digitized data from paper medical records provided through image recognition technology, and voice recording data from psychological treatments.

The data are generated based on the rules that meet ABO's standard data architecture. The data are usually pushed from an external data source to a blockchain through Oracle services, or are transmitted from a blockchain to a centralized database through API invocation. During data import and export, data fusion can be achieved with mobile phone numbers, personal identity ID information, or a public key address used as the primary key.

3.2.2. Distributed Storage

With distributed storage, files are separately stored in multiple machines. This process involves the consistency of files and the redundancy management of duplicates. ABO supports distributed storage services, such as InterPlanetary File System (IPFS). In ABO's ledger, the only recorded storage transaction objects are the hash values generated during the distributed storage of files.

3.2.3. Security, Privacy, and Authorization

Security

For data, ABO has adopted the native asymmetric encryption and signature algorithm of the lower-layer blockchain.

Privacy

Medical data and personal identity data are stored in distributed storage. The blockchain itself will not be able to display any personal private medical data. Privacy protection is fulfilled by distributed storage services. For centralized data, privacy protection is accomplished through secure multi-party computation.

Authorization

Once patients allow researchers to access their data, the data should be open to the researchers. Meanwhile, data owners can also define the scope of authorization as needed:

- Scope of permissions: defines the basic permissions to view, add, delete, and change data.
- Scope of time: defines the authorization time period.
- Scope of frequency: defines how many times an API can be invoked.
- Scope of account: defines whether to assign the permissions to a group user or an individual user.

Each patient needs to process the data requests he/she receives. As the number of requests increases, it will be burdensome for patients to process the requests one by one. In such cases, rules can be set for patients to automatically select whether to receive or decline a request, or intervene manually. In the consumer app, the rules can be set through the "Authorization Manager" function.

3.3. Smart Medical Device Protocols

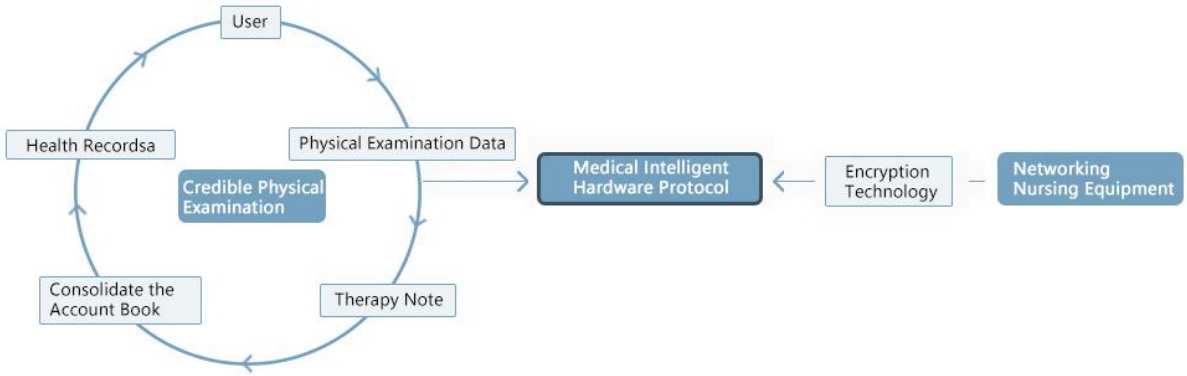
According to the future health index data, 57% of patients will monitor their various health indices through networked nursing care equipment. Therefore, it is necessary to ensure that such data will not be copied or stolen from source devices by the device manufacturers.

ABO has created a brand-new concept, that is, a medical care environment where all data is guaranteed to be private and credible. Encryption technology ensures that users' health data is stored in user-controlled distributed storage accounts, instead of in the servers of medical

examination operators or wearable device manufacturers. Users are entitled to have full data management rights.

ABO's Private Medical Examination is the embodiment of this credible, private medical care environment. As an open offline organization, a Private Medical Examination environment can be operated by any party as long as the organization can provide equipment fully compliant with ABO's credible data hardware standards. The examination or medical care devices will not store users' medical data, but pre-process and standardize the data for storage in the distributed storage service. Credible Protocol is a kind of device inter-connectivity protocol similar to the Google Weave protocol. Compliant devices can interact with each other, with interaction data stored in distributed ledgers or associated distributed storage.

Credible Experience provides a business model for the hospital-light future, helping users command their data ownership rights. The process will not involve the conflict of interest that exists in current centralized institutions. With the expansion of the ABO ecosystem and the gradual decoupling of examination and medical care, the medical data owned by users will become a prerequisite for the downstream medical care phase. This data will provide incentives for a unified ledger, driving the formation of an industry practice that adopts a unified ledger and medical records.



3.3.1. Use Case-Based Classification of Medical Devices

Under different use cases, health or medical care devices play different roles. Based on user cases, ABO has classified devices into three types. Adaptations are made accordingly in the design and selection of communication protocols, data storage, and computation models.

Body class

Wearable devices mainly apply to the real-time monitoring of vital signs. With wearable medical devices, non-intrusive sensor technologies are integrated into garments and decorative accessories, allowing 24 hours of monitoring services to be provided for vital signs. Wearable devices have been successfully used for chronic illness monitoring, family nursing and care, and sleep therapy monitoring. The development of wearable medical devices is now aimed at low cost, high performance, long running times, and small sizes.

Initially, the ABO ecosystem will cover but be limited to the following wearable device families:

- Blood pressure monitoring: an arm-worn monitor for dynamic blood pressure measurement.

- Continuous glucose monitoring system (CGMS): monitors the glucose concentration of subcutaneous interstitial fluid.
- Blood oxygen saturation: uses a finger cuff-type approach or other approaches and is of obvious significance to the routine monitoring of patients suffering cardiopulmonary dysfunction.
- Portable electrocardiographic (ECG) monitoring: uses mature SMD LED technology.
- Monitoring devices for exercise and health data, such as body temperature, number of steps, calorie consumption, and step length.

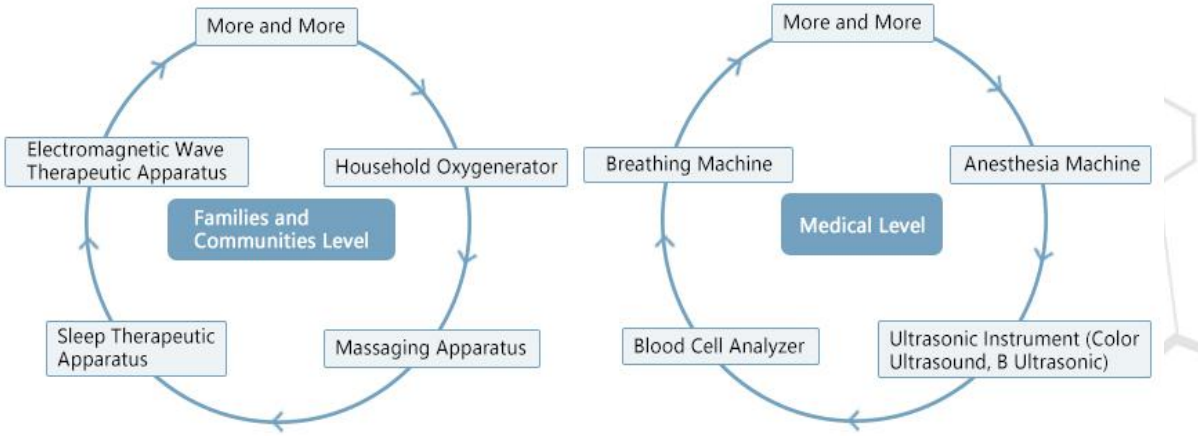
Finally, sensor suites based on use cases and user detailed segmentation will be developed. Such sensor suites can be integrated into garments and decorative accessories, satisfying both health care and practical needs.

Family and community class

This class covers medical devices that mainly apply to disease prevention and rehabilitation. This product family covers electromagnetic therapeutic instruments, household oxygen making machines, massage instruments, sleep therapy instruments, and other appliances and instruments.

Medical care class

This class covers mainstream examination equipment for hospitals, which mainly applies to in-depth acquisition and tracking of medical data.



3.3.2. Smart Medical Device Market

In this market, all the protocol-compliant medical devices can be sold off-the-shelf based on the above three use-case classes. A decentralized approach should be adopted for getting devices to the market, sales, logistics and dispute resolution.

3.3.3. Health Stations

In the era of AI utilization, everyone can participate in this comprehensive health care ecosystem. With smart devices (usually of the community class or higher) procured from the Smart Medical Device Market, offline services can be set up to provide frequent and routine extensive medical check-ups and rehabilitation therapy. Such services can be offered in “Health Stations” which could provide medical examination services for college entrance examinations, military service, employee recruitment, civil servant recruitment, people prior to marriage and pregnancy, seniors, and employees in firms and institutions. More importantly, “Health Stations” can satisfy, in terms of cost and efficiency, the demands for highly frequent routine health monitoring services. Users can carry out in-depth daily or weekly medical examinations.
“Health Stations” will be able to act as a supplement to community hospitals, with private health diagnoses and treatments provided through AI-based medical apps and smart devices.

3.4. Data and Computing Power Market

A prerequisite for the apps market is ABO token-based data exchanges and computing power provided by a data and computing power market. Data and computing power are two prerequisites for effective AI training.

3.4.1. Data Market

The data market provides parties demanding or supplying data with the venue and basic mechanisms for data exchanges. ABO does not exclude the possibility of charging for data exchanges in the future.

Supply-demand inter-connectivity

To design the data market, the first task is to deal with the identity of two parties who want to exchange data. The two parties can be individuals or enterprises. Data descriptions and data structure examples are the metadata to be provided by the party supplying data during a data exchange.

The second task is data pricing, which is addressed through a complete market mechanism. To promote the efficacy of the market mechanism, ABO will design a concept called “Similar Data Set”.

The next task is data filtering. Users can select data from personal accounts in batches, or data sets from centralized enterprises. Users can also locate matched data through searching the blockchain, or make offers for the provision of desired data.

Payment method

The payment method is related to the delivery method. ABO supports payment through pooling funds. Medical and social insurance accounts can be imported at one a time through the relevant service providers' Oracle services (a way to push data from the real world to blockchains instead of Oracle's database). After this, all the transactions are accessible through ABO-based processing and retrieval. Generally, the result of data importing will be regarded as generating

ERC20 tokens. The flexible payment through pooling funds can bring about a scalable system for the exchange of credible data between multiple parties in the medical industry.

Delivery method

The data delivery method is actually an extension of the authorization model. See the description in the previous section.

3.4.2. AI Training and Computing Power Market

AI training refers to the process where AI models are generated based on deep learning algorithms. For supervised or unsupervised learning cases, the training process will raise different requirements for whether to annotate data and the data volume. The adaptability of algorithm will vary.

Distributed training

Huge computation volume is a significant problem for the training of deep learning models. For example, it takes nearly half a year for an Inception-v3 model to attain the accuracy of 78% through training on a single unit and a single card. This training speed is unable to meet the needs of ABO's expected actual system operations. To speed up the training process, it is necessary to utilize distributed computing power to accelerate idea verification and service realization.

Incremental training

Incremental learning means that a learning system can constantly learn new knowledge from new samples, and retain most of its previously learned knowledge. Incremental learning is quite similar to the learning model used by the human brain.

In the medical care industry, data is constantly generated day after day. In particular, as data standardization gradually increases, incremental learning becomes increasingly suitable to AI training within the medical care industry. Meanwhile, with no need to store historical data, incremental learning can decrease the space and cost of distributed storage to some extent. Moreover, with historical training results fully utilized in the current sample training, incremental learning can significantly reduce subsequent training time.

Secure multi-party training

This is a solution that integrates secure multi-party computation (SMPC) and AI training. This solution is capable of satisfying data sharing demands while allowing multiple participants to keep their data confidential. In use cases where data is provided by multiple parties, the stakes of the final AI model can be allocated among community users based on the amount of data contributed.

Computing power market

ABO supports the computing power market. Here, "computing power" is not the computation that is carried out to maintain the consistency in the Proof-of-Work (POW) consensus mechanism, but rather "computing power" is the computation done for the distributed training of AI models. However, in the computation architecture, these two kinds of computation can be unified. That is, a machine can be simultaneously used for the distributed training of AI models and POW.

Therefore, users can participate in the collection, computation, and fulfilling offers for computing power tasks by easily configuring their POW machines.

3.5. Medical App Development

Whether in businesses or technology, ABO's app ecosystem is open. Whether for medical and health care apps currently in use, for Dapps to be developed in the future based on the Ethereum or other public blockchains, or for Dapps developed based on the ABO protocols, the same data structure can be utilized to achieve interconnectivity in the lower data layer through the Oracle push service or API invocation.

The medical apps developed based on the ABO protocols and deployed in the ABO app market will become ABO's native apps. Usually, such apps will cover standard medical care apps, which are simple and involve basic data logic computation and contracts for programming, as well as smart medical apps, which are more complicated in terms of data requirements and processes.

3.5.1. Standard Medical Apps

With standard medical apps, Solidity and other programming languages are utilized to develop smart contracts based on the Ethereum or other public blockchains that support smart contracts and virtual machines, while the decentralized apps are provided by relevant decentralized service APIs.

3.5.2. Smart Medical Apps

In most cases, the to-be-trained and trained AI service models are retained in decentralized storage. The service models are assigned different service characteristics based on variations in AI training modes, such as variations in supervised training and incremental training. The AI models based on supervised learning and training can provide services as standard medical apps, while contracts are deployed at times based on trained models. The AI models based on incremental training evolve quickly and should be stored in a distributed storage account affixed with multiple signatures and controlled by smart contracts. For the AI models, version iteration is realized through trust voting or direct voting by AI users.

In ABO, the general workflow for developing a smart medical service is as follows:

- Data set and annotation, addressed through data markets and standardization;
- Algorithm and model design;
- Training, which is addressed through distributed training, secure multi-party training, incremental training, and the computing power market;
- AI service stake allocation.

The algorithm is the metadata contained when an AI training task is released. The algorithm data is stored in distributed storage, whose hash values are stored in blockchains. Algorithms can be self-developed or optimized based on open-source algorithms, confidential or open. However, with open-source algorithms, data owners have the right to absolute control.

The allocation of stakes related to the AI service is mandatory. This will probably be the most extensively used business model for future AI services. This allocation is determined as the result of the interactions of multiple stakeholders, such as data providers and data model providers. AI service stake allocation can be regarded as a system where an AI service provider issues a secure token and holders of that currency share the AI service revenue. It is highly likely that AI service stake allocation will in reality become the process of requesting data authorization and releasing algorithm tasks.

4. Product Lines

ABO's products serve to provide users the services based on new-encryption-key accounts by integrating various technologies. ABO's products also lay foundation for eco-friendly and replicable development.

4.1. User Apps

General-purpose apps for consumer devices, suitable for patients and computing power providers

The app front-end adopts a hybrid mobile development framework, which speeds up product development and iteration, with performance and usability guaranteed. App back-end services are developed based on smart contracts under different lower-layer public blockchains. Therefore, ABO takes into consideration the performance, security, and decentralization of public blockchains. Meanwhile, ABO will expand product functionality and its service ecosystem through iteration by adopting a parallel development model for business and public blockchains.

In general, ABO's use cases for common users are built upon the architecture for crypto-currency wallets. The next sections will elaborate on the basic functions of consumer apps.

4.1.1. Account and Identity Management

For blockchains, the asymmetric encryption algorithm and hash algorithm of Bitcoin Improvement Proposal 39 (BIP-39) are usually adopted to create user account systems. It is necessary to provide users with the training about basic security information and practices related to blockchains.

Account management

Users can create, switch to, back up, and activate new accounts. The accounts are created based on lower-layer public key protocols through private keys, mnemonic phrases, keystore files, and other approaches.

Digital identity

Users can perform real-name identity verification and record information about real-world professional reputations to the blockchain through third-party Oracle services.

4.1.2. Asset Management

Transfer

This function covers transfers from ABO to other accounts or the acceptance of transfers from ABO.

Query

This function covers queries about blockchains transfer records or browser functionality.

4.1.3. Data Management

View

Users can check their health and medical care data by switching to a view sorted by time, data source, doctor, device, or classification. The data missing or not standardized are highlighted red, so as to facilitate the completion of data.

Management

Users can maintain data annotations and personal health records.

Authorization

Users can enable automatic authorization, with all data assigned a price.

Users can trigger a free-of-charge authorization for a certain ABO address to obtain specified data.

Users can be allotted different privileges according to the authorization rules.

Users can cancel and edit authorizations.

Users can enable the linking of health data from comprehensive health care apps.

4.1.4. Storage Management

Storage management is used for distributed storage services, including account activation and file checking and management.

4.1.5. Hardware Management

Device linking management

Linking with smart wearable devices can be enabled if the device is compliant with ABO's device standards.

Inter-operability management

Operating a smart medical device can be enabled. For example, when data is stored on a medical device for the first time, such as by a "Health Station", a request for user authorization will be issued. Such requests will be issued to users through smart contracts. After user authorization, relevant data storage requests will be fulfilled.

4.1.6. Markets

Markets are of extremely high significance for the distributed businesses built by the community. In ABO's long-term plan, all the resources can be allocated through markets.

Data market

Users can check data request offers, and get the offer by authorizing the offer provider to get their data.

Device market

Users can purchase smart wearable devices that are compliant with ABO's security and privacy standards.

Computing power market

Users can collect computing power tasks, and link their POW machines to complete distributed training tasks and get rewards.

Apps market

Some higher-layer smart medical apps can be developed based on the basic principle that users have direct control over private data.. For such apps, contract codes can be checked on mobile phones.

4.1.7. Examples of Medical Care Applications

"Medical Records"

To use the service, users need to grant the contract the permission to access to all their medical data. The contract can only analyze, re-consolidate, and re-organize the medical data, with no changes or backups made.

"Data Doctor"

After undergoing a medical examination in a "Health Station", users can utilize the service to analyze the data from their medical examination. Users can also authorize a "Data Doctor" to access the data collected from their wearable devices, so as to obtain from the "Data Doctor" the data analysis results and in-depth health and diet suggestions.

"Digital Hospital"

Each physical hospital can register as an real-world instance of a digital hospital that uses ABO’s systems. These hospitals will digitize as many documents as possible, such as consent forms for operations, consent forms for anesthesia, information and consent forms for transfusion therapy, consent forms for special examinations, critical condition reports, doctors' prognosis and

treatment records, and reports on auxiliary examinations. Additionally, patients' medical care processes can be digitized to reach teams at higher levels. Moreover, all the records are traceable.

"Recovery Expert"

The app can provide personalized recovery training solutions and monitor the implementation of the solutions using data that is always available from smart physical therapy facilities in open "Health Stations" and from the analysis of wearable device data .

Medical insurance reimbursements

With the Oracle services provided by ABO and medical insurance institutions, users can reimburse their expenses for seeing a doctor and medical care. In the app, users can link third-party accounts and the record information about medical insurance assets to the blockchain by themselves.

AI-aided medical image analysis

Image recognition technology is quite mature and has been widely applied in medical image recognition. Users can grant the medical image analysis application access rights to their medical image data to obtain professional diagnoses.

AI-aided sleep

In 2017, the Nobel Prize for Medicine was awarded to three scientists who had discovered the biorhythms describing how daytime temperature difference, daylight intake, and other parameters can influence sleep quality. With data collected by wearable devices around the clock, personalized analysis and suggestions can be provided for sleep quality.

Health trends

By joining national health statistics plans and allowing their own medical data accessible to contracts for statistics purposes, those granting access permissions to their data can check nationwide epidemic developments, and obtain suggestions on medicine to be carried during travel, or other health recommendations.

Gene analysis

Sooner or later, all people will be allowed to fully control all of their genomics data. As long as privacy protections are guaranteed, the data can be used to analyze susceptibility to diseases and the allergens.

4.2. Doctor Apps

Suitable for doctors

Doctor apps have the same asset and account management functions as user apps. Doctor apps play a big role in providing remote consultation services.

Remote consultation

Doctors will receive a request for consultation, and provide multi-party anonymous/real-time diagnoses based on accessible medical data as authorized by patients.

Health archive management

With user authorization, doctors can use a mobile device to check patient medical data. Meanwhile, doctors can enter new medical records through voice input, image uploads, and manual input.

4.3. Service Provider Apps

Suitable for big-data analysis service providers and AI service providers

AI service providers need to request data authorization from users, release distributed training tasks, and carry out AI service stake allocation. Some of this work may be carried out through APIs. However, ABO will also provide some auxiliary functions on mobile devices in order to enable some routine financial reporting functions and message notification functions.

4.4. Health Station Operations System

Suitable for hospitals and Health Station operators in compliance with ABO's standards

Ideally, it is necessary to decouple the process of examination and the process of medical care. In this way, data is prevented from staying in a single process for a long time and threatening data privacy.

The Health Station operations system is usually monitored and operated remotely. Its basic functions cover: displaying basic operational status in the operations panel, hardware management and status monitoring, financial management, and system configuration.

5. Technology, Product, and Ecosystem Road Map

2018/07 Project initiation phase

- Introduction of an official website and a white paper
- Basic international operations
- The KYC pre-sale is based on ERC2.0 token.

2018/08 Project organization phase

- Completion of the team setup for ecosystem operations
- Feasibility analysis of technologies and products
- Draft scheme for technology planning and draft scheme for product development planning

2018/09-2018/10

- Technology
    - Research on laws and regulations and the electronic medical record systems in different countries; Formulation of the draft scheme I for data standardization

  - Research on Homekit and Weave protocols; Formulation of the draft scheme I for hardware and software interfaces
  - Smart contract sets based on Ethereum development contents
- Product
  - Requirements analysis and consumer app concept design
  - Community testing of product prototypes and problem review
- Ecosystem
  - Ecosystem development plans for the developers of smart health and medical care software
  - Integration of organization resources, such as medical institutions, industry associations, and governmental development authorities
  - Concept design for health care organizations and business model design

2018/11-2018/12

- Technology
  - Integration of distributed storage technologies
  - Data structure design for the data market
  - Model design for secure multi-party computation
- Product
  - High-fidelity prototype design for multiple consumer devices
- Ecosystem
  - Select medicine, medical care, and medical examination providers for pilot projects

2019/01-2019/03

- Development of apps for consumers and doctors
- ABO's smart contracts and API testing

2019/04

- ABO Version 1 should go live on ETH with support for health archives, user-controlled privacy and data markets.
- The test reports on ecosystem pilot projects and analysis on the next steps should be available.
- The first versions of apps for consumers and doctors should be released.

2019/05

- The ETH version should go live on the EOS platform, with token mapping completed.

6. Token Economy

A token is a kind of tradable encrypted digital proof of stakes. Token can be used to represent, trade, and record all the real-world proofs of a stake, including shareholders' rights, creditors' rights, bonus points and notes. Tokens can work in the same way as the real-world cash and equities. In blockchains, tokens play a highly important role in community-based business models.

In most cases, ABO's system serves as a trading tool, supporting the establishment of free markets for various data, computing power, and services. Also, ABO's system works as a kind of pathway for game theory and mechanism design.

ABO will have a fixed issuance of five billion tokens, which will be first deployed within the ETH ecosystem and follow the ERC20 standards.

6.1 Token Functions

Common users

- Spend ABO tokens by subscribing to smart medical care services ;
- Spend ABO tokens by utilizing medical examination services provided by participating health stations;
- Earn ABO tokens by authorizing institutions and others to access their data ;
- Earn ABO tokens by leasing computing power.

AI researchers, hardware researchers, and medical institutions

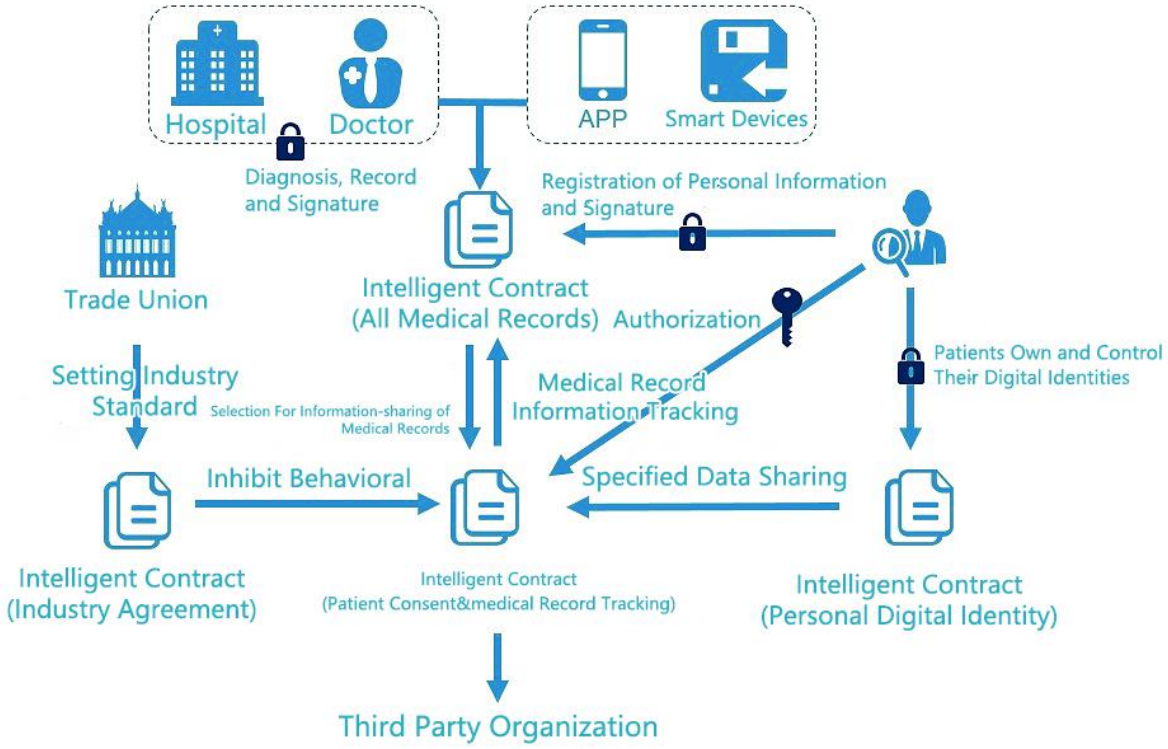
- Spend ABO tokens to release smart medical apps in the apps market;
- Spend ABO tokens to bring to market ABO devices that are compliant with ABO's inter-connectivity standards;
- Spend ABO tokens to obtain users' authorization for access to their medical data;
- Earn ABO tokens by providing users with smart medical app services.
- Spend ABO tokens to rent network computing power and storage.

Doctors

- Earn ABO tokens by providing remote consultation services.

Health Station operators

- Earn ABO tokens by providing health and medical examination services.



6.2 Token distribution

In view of the high complexity of the medical industry, more consideration will be given to providing more resources for ecological development when token distribution is distributed.

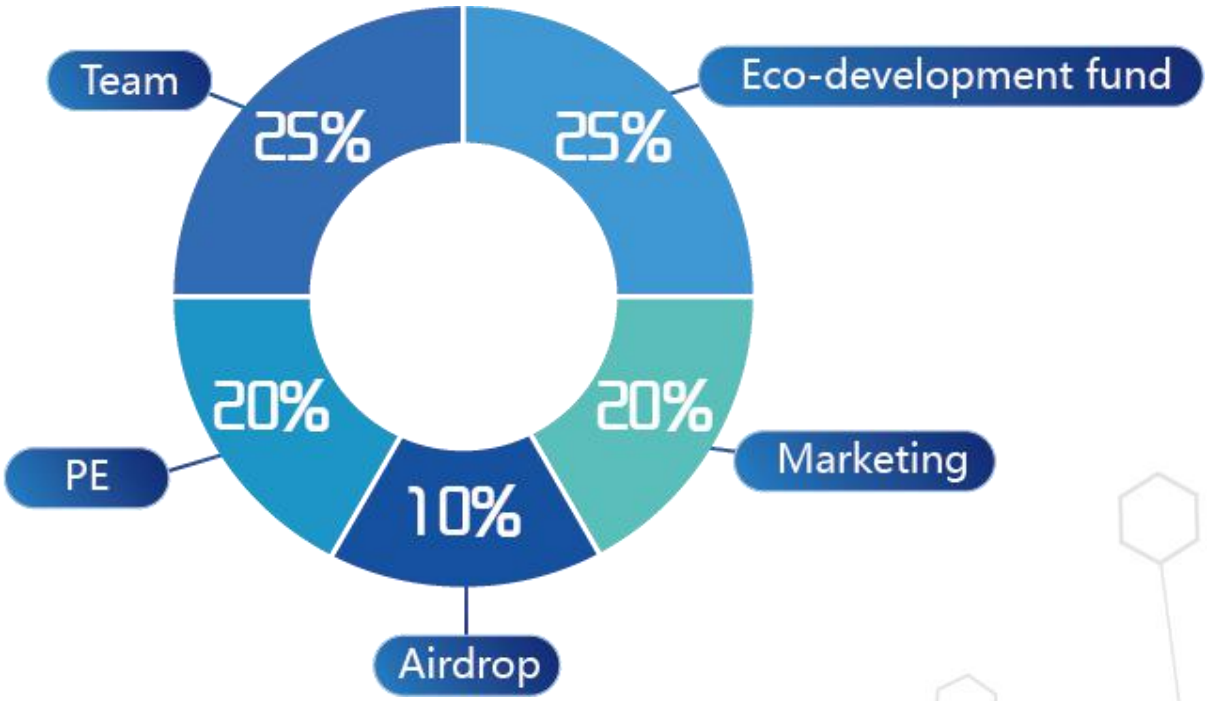
•25% Eco-development fund

• 25% Team

• 20% PE

• 20% Marketing

• 10% Airdrop



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8. Conclusion

Returning data ownership to patients is a response to demands for privacy protection. In a deeper sense, it also represents many people's thoughts about and precautions against the possible hegemony brought about by the combination of big-data and AI in the future. Once data and algorithms are in place, AI can almost completely replace all current production tools with zero cost. In a sense, returning data ownership to patients at least sets limits to possible AI hegemony.

In general, how to protect user privacy without affecting AI development are issues that should be tackled seriously by the domains of sociology, blockchain, and AI.

ABO provides a development model to simultaneously guarantee the privacy of medical data and the provision of intelligent services. The relevant objectives and methods have been clearly defined from the lower-layer data architecture to the realization of future smart medical care cases, complete with implementation feasibility and a vision of the future as seen by science and technology. Driven by data protection laws and regulations, such as GDPR, ABO is certain to contribute to the rapid development of products and their related ecosystems. These new technologies and ideas will be reasonably and extensively applied in health and medical care applications.

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