Public Health Chain

white paper

Catalog

Health status of people's livelihood in the world

Compared with 2002, the ten global health threats released by who have changed greatly.

1.Air pollution and climate change

Nine out of ten people in the world breathe polluted air day by day.In 2019, the world health organization regards air pollution as the biggest environmental risk to health.Tiny pollutants in the air can penetrate the respiratory and circulatory systems, damaging the lungs, heart and brain.

It is estimated that air pollution causes 7 million premature deaths every year from diseases such as cancer, stroke, heart disease and lung disease.About 90 per cent of these deaths come from low - and middle-income countries, where industrial, transport and agricultural emissions are high, as well as dirty stoves and fuel in households.

The main cause of air pollution (burning fossil fuels) is also a major driver of climate change, which affects people's health in different ways.Between 2030 and 2050,
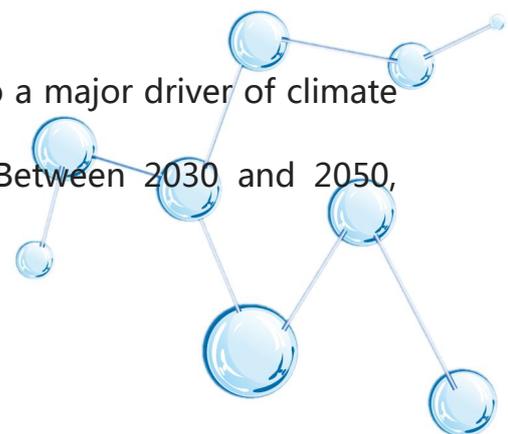
climate change is expected to cause 250000 deaths a year from malnutrition, malaria, diarrhea and heat stress.

2.Non infectious diseases

Non communicable diseases, such as diabetes, cancer and heart disease, collectively account for more than 70% of the world's deaths (41 million).This includes 15 million premature deaths between the ages of 30 and 69.More than 85 per cent of these premature deaths are in low - and middle-income countries.

The increase in such diseases is driven by five major risk factors: tobacco use, lack of physical activity, harmful use of alcohol, unhealthy diet and air pollution.

These risk factors also exacerbate mental health problems, probably from an early age: half of mental illness starts at the age of 14, but most cases are undetected and untreated, and suicide is the second leading cause of death in the population aged 15-19.

3. Global Flu Pandemic

The world will face another influenza pandemic - the only thing we don't know is when and how serious it will be.Global defense measures are the weakest link in any country's   health emergency prevention and response system.Who continues to monitor the spread of influenza viruses to identify potential pandemic strains: 153 agencies in 114 countries are involved in global monitoring and response.Every year,
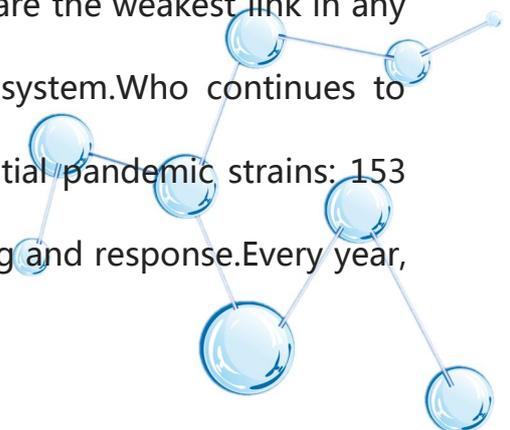
the World Health Organization recommends which strain should be included in the influenza vaccine to protect people from seasonal influenza.

To prevent the emergence of new influenza strains with pandemic potential, who has established a unique partnership with all major players to ensure effective and equitable access to diagnostics, vaccines and antiviral drugs (treatments), especially in developing countries.

4. Weak and fragile environment

Where more than 1.6 billion people (22% of the world's population) live, there are protracted crises (combined with challenges of drought, famine, conflict and population displacement), and health services are weak, making access to basic health services difficult.Almost all regions of the world have fragile environments in which half of the key targets of the sustainable development goals, including child and maternal health, remain unfulfilled.Who will continue to work in these countries to strengthen health systems, prepare for the detection and response of outbreaks, and provide quality health services, including immunization.
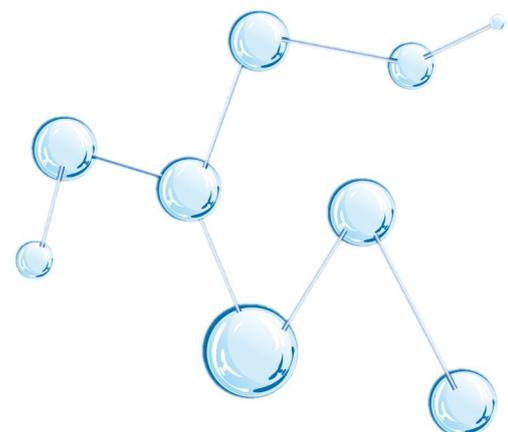
5. Antimicrobial resistance

The development of antimicrobial, antiviral and antimalarial drugs is one of the greatest successes of modern medicine.At present, there is not much time left for these drugs.

Antimicrobial resistance - the ability of bacteria, parasites, viruses, and fungi to resist these drugs may make it difficult to treat infections such as pneumonia, tuberculosis, gonorrhea, and salmonellosis easily.Failure to prevent infection can seriously affect routine procedures such as surgery and chemotherapy.Drug resistance to TB drugs is a huge obstacle in the fight against the disease, which causes about 10 million diseases and 1.6 million deaths each year.In 2017, about 600000 TB patients developed resistance to rifampicin, the most effective first-line drug, of which 82% suffered from MDR-TB.

Drug resistance is caused by overuse of antimicrobials, and also by overuse of antimicrobials in animals, especially those used for food production and the environment.Who is working with these sectors to implement a global action plan to address antimicrobial resistance by raising awareness and disseminating knowledge, reducing infections and encouraging the prudent use of antimicrobial drugs.
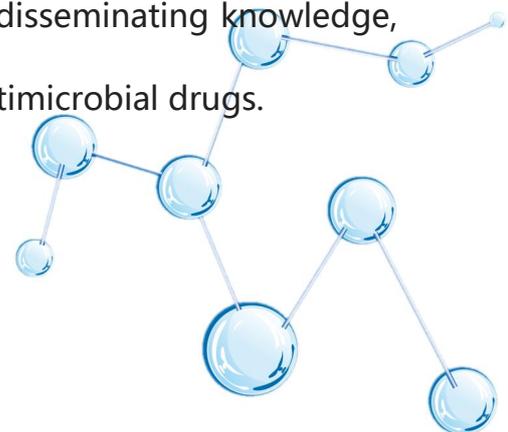
6. Ebola and other high risk pathogens

The environment for outbreaks of a high-risk pathogen, such as Ebola, is crucial, and past outbreaks in rural areas did not always apply to densely populated urban areas or conflict affected areas. At the previous conference on prevention of public health emergencies, participants from the public health, animal health, transportation and tourism sectors focused on coping with the increasingly severe challenges of urban epidemic and health emergencies. WHO's R & D blueprint identifies diseases and pathogens that may lead to public health emergencies but lack effective treatments and vaccines. This list of research and development priorities includes Ebola, several other haemorrhagic fevers, Zika, NIPA, the Middle East respiratory syndrome coronavirus and the severe acute respiratory syndrome, as well as disease x, which indicates the need to protect against unknown pathogens that can cause serious epidemics.

7. Weak primary health care

Primary health care is usually the first point of contact between people and their health care system, and it is ideal to provide comprehensive, affordable and community-based health care for life.Primary health care can meet most health needs in a person's life.A strong primary health care system should be established to achieve universal health coverage.However, primary health care facilities are
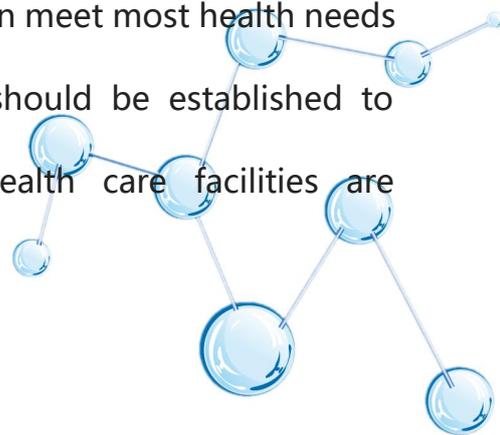
inadequate in many countries.This lack may be due to a lack of resources in low-income or middle-income countries, but it may also be due to programmes that have focused on a single disease in the past few decades.

8. Vaccine hesitation

That is, despite the availability of vaccines, the reluctance or refusal to vaccinate may reverse the progress made in responding to vaccine preventable diseases.Vaccination is one of the most cost-effective ways to avoid diseases. At present, it can prevent 2-3 million deaths every year. If the global vaccination coverage is improved, it can further avoid 1.5 million deaths.For example, measles cases have increased by 30% globally.The reason for this rise is complex, and not all of these cases are due to vaccine hesitation.However, some countries, which were close to eradicating measles, saw the disease return once again.

The reasons why people choose not to vaccinate are complex; a who Vaccine Advisory Group believes that the main reasons are complacency, inconvenience in obtaining vaccines and lack of confidence.Health workers, especially community health workers, remain the most trusted advisers and influencers in vaccination decisions, and who supports them in providing credible and reliable information about vaccines.
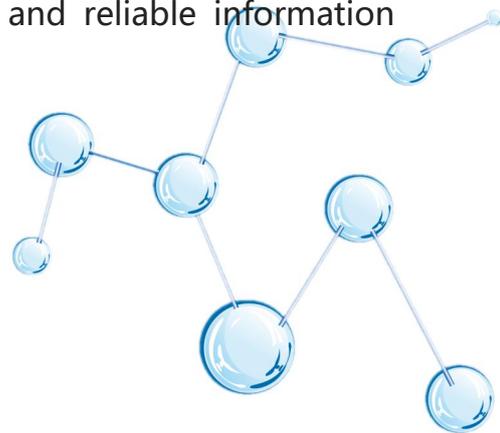
9. dengue fever

Dengue is a mosquito borne disease that causes flu like symptoms that can be fatal, killing as many as 20% of people with severe dengue fever and increasing threat for decades.Countries such as Bangladesh and India have seen a large number of cases during the rainy season.Now, its epidemic season in these countries is significantly longer (in 2018, Bangladesh saw so many deaths for the first time in nearly two decades), and the disease is spreading to countries with less tropical and temperate characteristics, such as Nepal, which has not traditionally seen the disease.

It is estimated that 40% of the world is under the risk of dengue fever, with 390 million people infected each year.

10. HIV

Great progress has been made in testing, providing antiretroviral drugs to patients (22 million are being treated), and helping people take preventive measures, such as pre exposure prevention, that is, taking antiretroviral drugs to prevent infection when people are at risk of HIV.
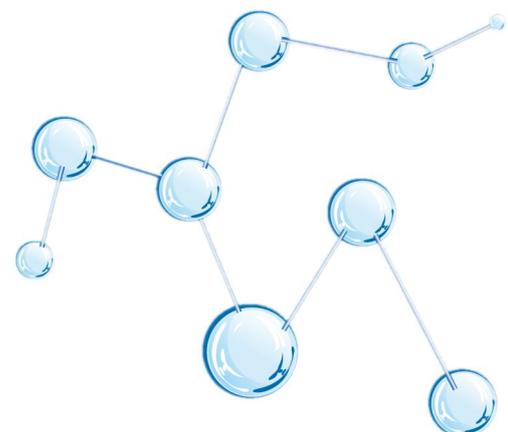
However, the epidemic continues to spread, with nearly 1 million people dying of HIV / AIDS each year.Since the outbreak of the epidemic, more than 70 million people have been infected and about 35 million have died.Today, about 37 million people around the world are living with HIV.

It should be noted that despite the continuous efforts of the government and medical institutions and enterprises, it has been improved in many aspects; however, it still faces a severe test and cannot be relaxed.

1. Reproductive, maternal, newborn and child health

Significant progress has been made in reducing child mortality globally, from 93 / 1000 live births in 1990 to 41 / 1000 live births in 2016.However, in 2016, 15000 children under the age of 5 still died every day.

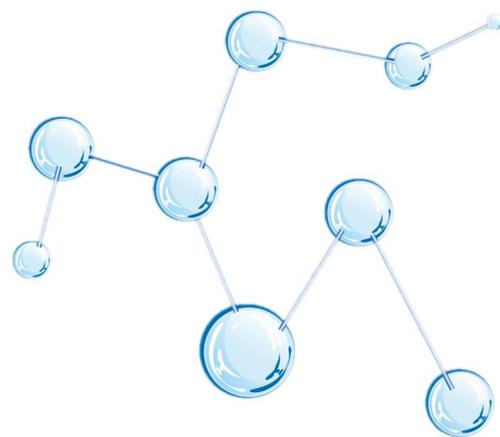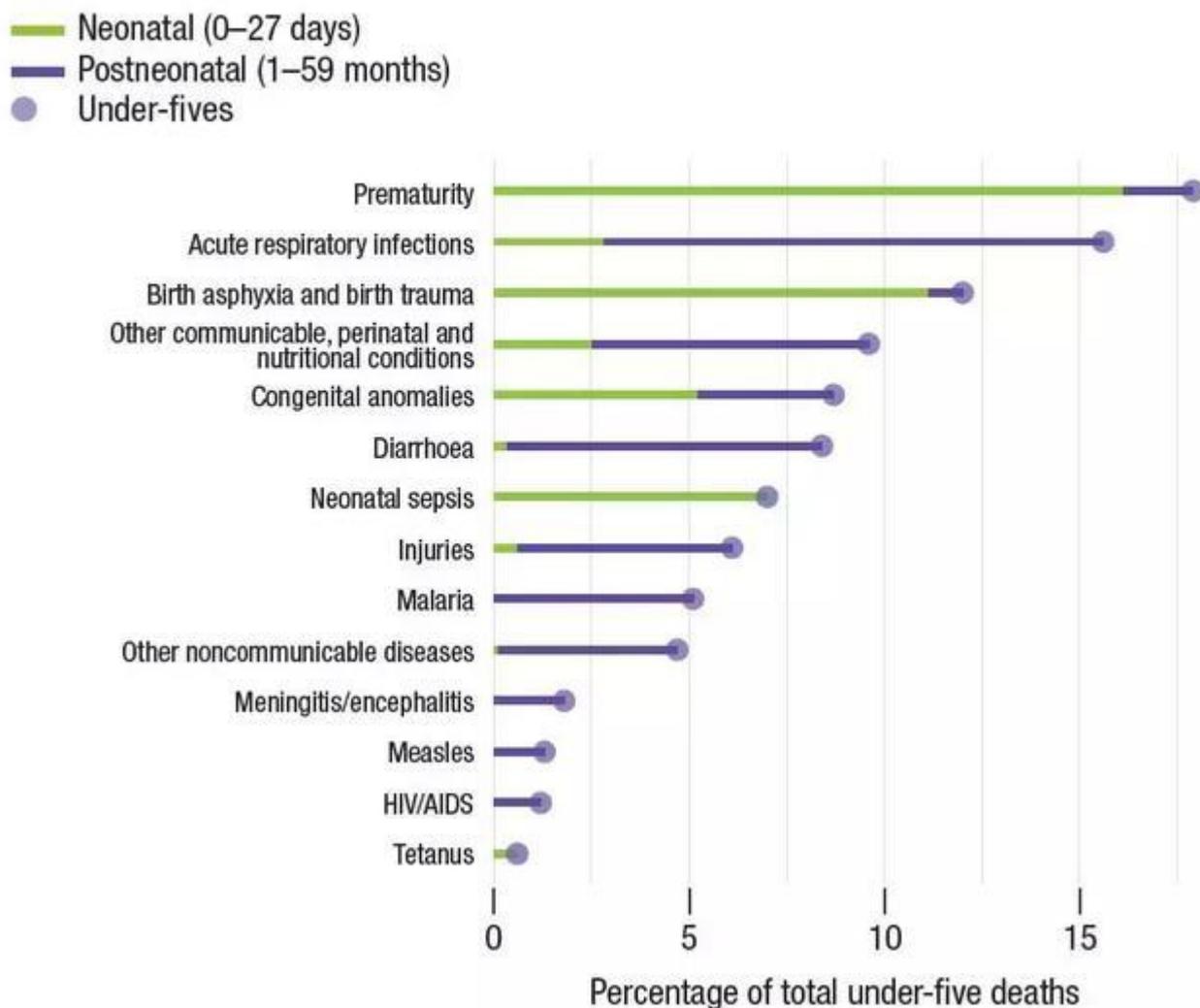2016Acute respiratory infections, diarrhoea and malaria were the leading causes of death in children aged 1-59 months.

Fig. 2.1
Causes of death in children under 5 years of age, 2016

— Neonatal (0–27 days)
— Postneonatal (1–59 months)
● Under-fives

Figure axis: Percentage of total under-five deaths (0, 5, 10, 15)

Categories (top to bottom): Prematurity, Acute respiratory infections, Birth asphyxia and birth trauma, Other communicable, perinatal and nutritional conditions, Congenital anomalies, Diarrhoea, Neonatal sepsis, Injuries, Malaria, Other noncommunicable diseases, Meningitis/encephalitis, Measles, HIV/AIDS, Tetanus

2. Infectious diseases

Globally, the HIV infection rate was 0.40/1000 in 2005 and decreased to 0.26/1000 in 2016.In 2016, an estimated 1 million people died of HIV related diseases, of which 120000 were children under the age of 15.As of mid-2017, about 20.9 million people had received antiretroviral therapy (Art), but at the end of 2016, art still covered only 53% of the HIV infected population.
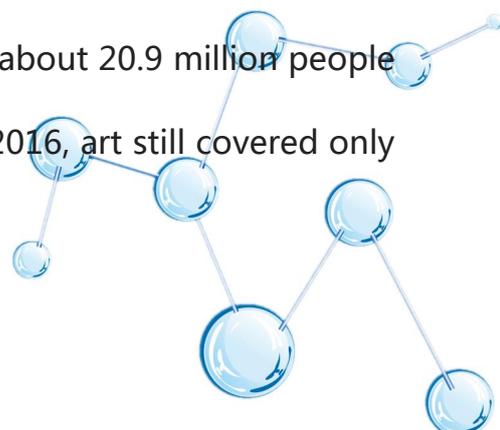
2016In 2010, it was estimated that there were 216 million malaria cases globally, 233 million in 2010 and 210 million in 2013.Hepatitis B vaccine application worldwide significantly reduced the incidence of chronic hepatitis B, and the incidence rate of hepatitis B in children under 5 years old was 4.7% in the pre vaccine age, and 1.3% in 2015.At the same time, the prevalence of hepatitis B in the general population also decreased from 4.3% to 3.5%.

Fig. 2.4
Estimated global prevalence of hepatitis B, by age, pre-vaccine era and 2015
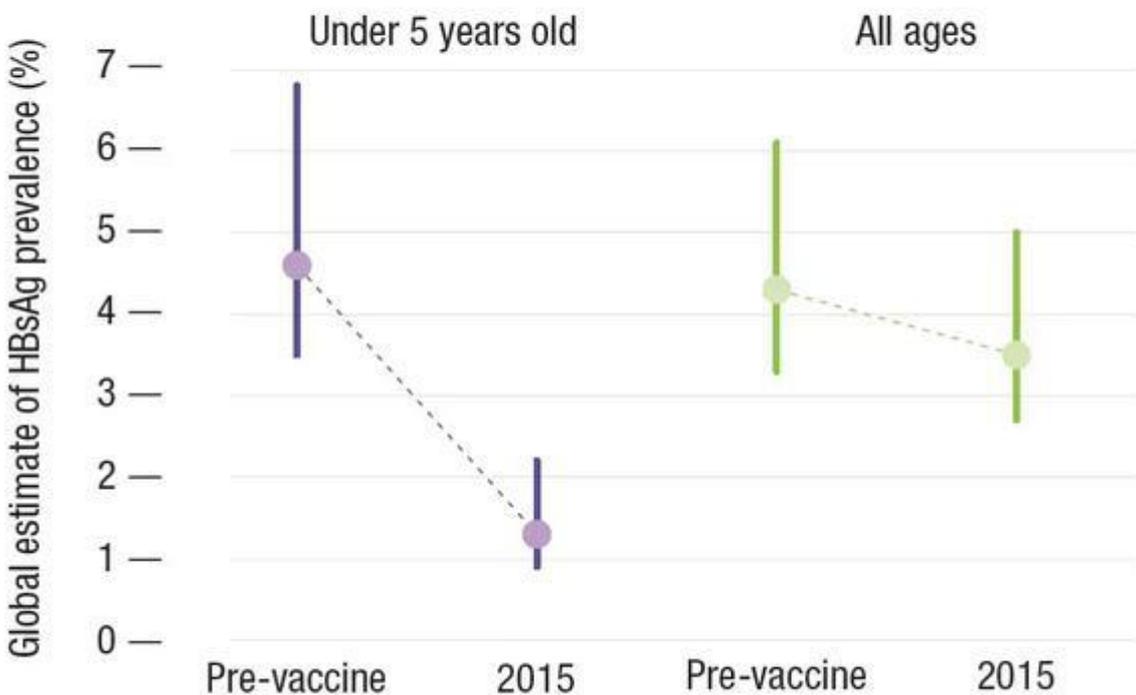
Note: Vertical lines represent 95% confidence intervals.
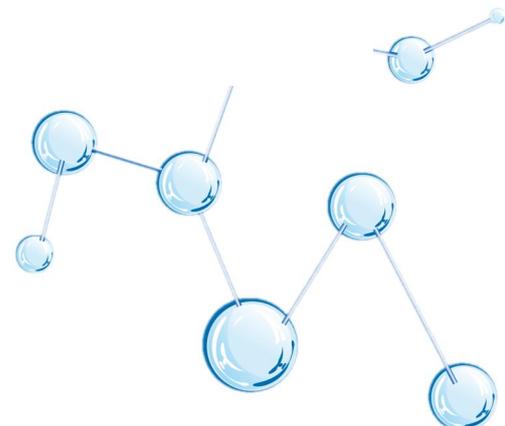
3. Non communicable diseases and mental health

2016In 1997, an estimated 41 million people died of NCDs, accounting for 71% of the total death toll (57 million).It is mainly caused by four major diseases: cardiovascular and cerebrovascular diseases, 17.9 million deaths (accounting for 44% of all NCD); cancer, 9 million deaths (22%); chronic respiratory diseases (CRD), 3.8 million deaths (9%); diabetes, 1.6 million deaths (4%).

2016In, 30-year-old men had a higher risk of dying from any of these diseases before age 70 than 30-year-old women (22% vs 15%).Low income and low-income countries have the highest adult risk (21% and 23%, respectively), almost double that of high-income countries (12%).

Smoking is a major risk factor for cardiovascular disease, cancer and chronic respiratory disease.In 2016, more than 1.1 billion people aged 15 and over smoked globally, accounting for 34% of all men and 6% of all women in this age group, respectively.

2016In, there were about 800000 suicide deaths in the world. The incidence of suicide deaths in men was higher than that in women.
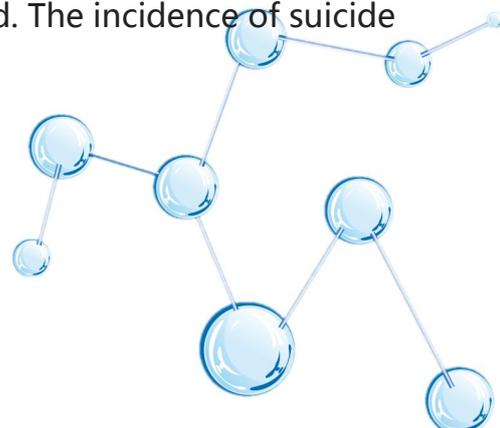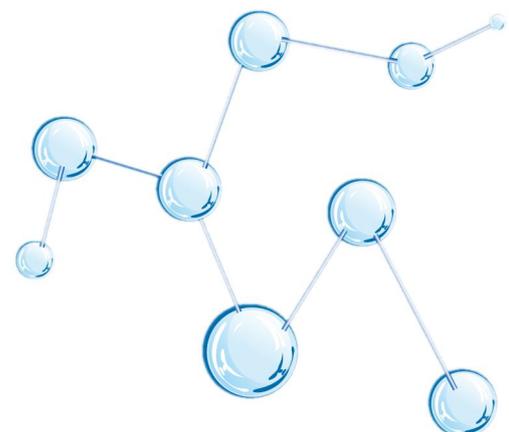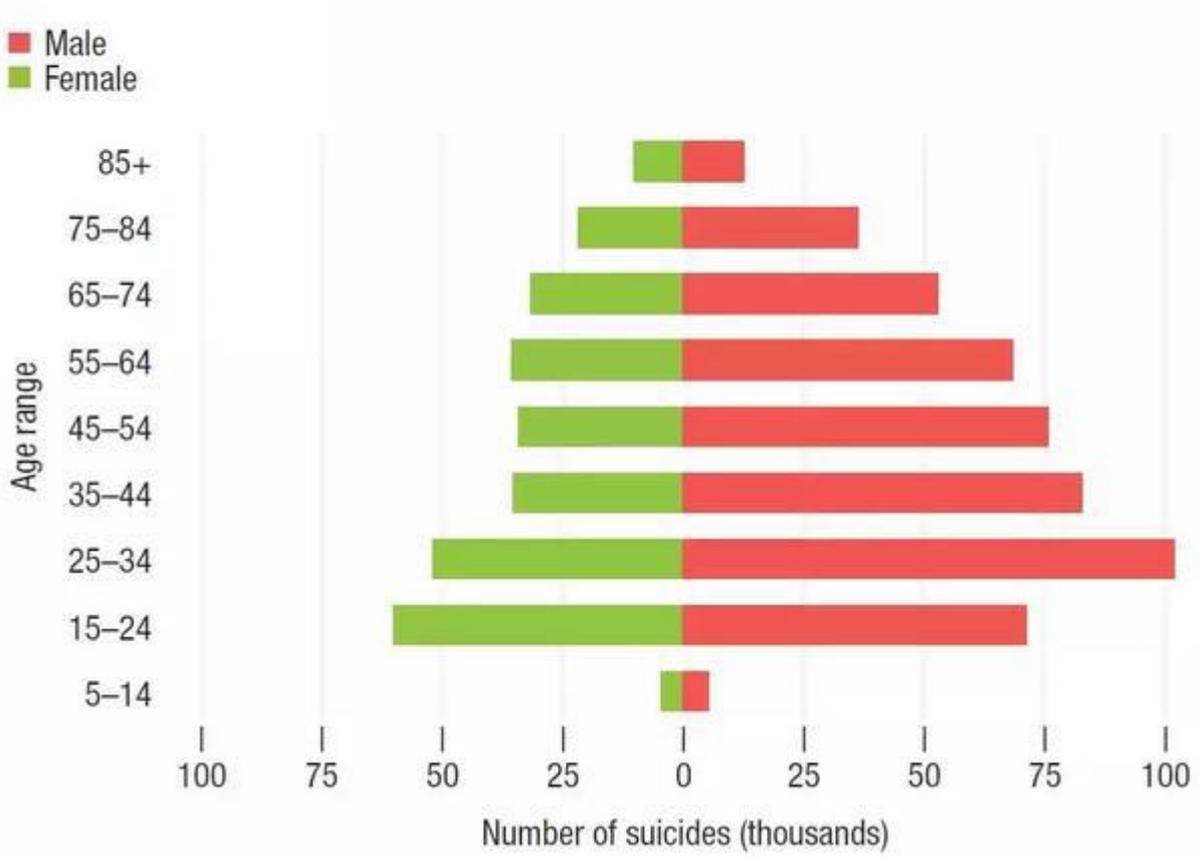
Fig. 2.6
Global suicide deaths by age and sex, 2016

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Development of medical and health industry

With the increasing demand of residents's pension and health management, the global medical and health industry has developed rapidly.It is reported that the global health market is expected to grow to 17 trillion yuan in 2022.

Development of medical and health industry

The medical and health industry aims to protect people's physical and mental health, mainly including medical services, health management, medical insurance and other related services, involving a wide range of industries and a long industrial chain, including pharmaceutical preparations, medical devices, health products, health food and fitness products, etc.With the increasing demand for elderly care and health management, it not only promotes the sustainable development of the medical field and makes major breakthroughs, but also promotes the innovation of business model and the continuous acceleration of industrial integration.In the future, people's spending on pension and medical care will increase day by day.

Medical and health industry is one of the largest and fastest-growing industries in the world.

According to frost Sullivan data, in the developed countries, the total cost of health in the United States accounted for 17.1% of GDP in 2016, while the total cost of health in Japan accounted for 10.9% of GDP in the same period.

Medical and health industry is facing pain points

With the development of Internet technology, the information and digitalization of traditional medical industry has been completed. The various business models of "Internet plus medical" have also matured and entered a stage of steady development.The process of seeking medical advice, reimbursement and payment has become more convenient and flat. The embedding of Internet technology has also solved some problems of information asymmetry. However, there are still many problems or cruxes in the industry.The following will continue to take medical services, pharmaceutical manufacturing and medical health insurance as examples to illustrate the current pain points faced by the medical industry.
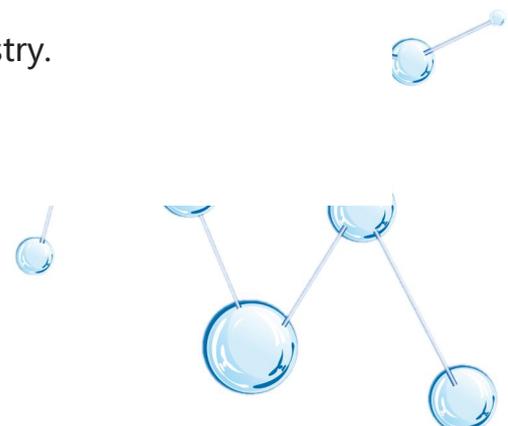
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medical service
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1.Poor medical information leads to poor medical experience

At the same time, in the legal and privacy level of user data, medical data has some particularity compared with other industry data, especially the data related to genetic and other fields is more sensitive.The phenomenon of non sharing of medical examination results and data and unequal medical information still exists, and there is no mature business cooperation process system among hospitals, which will lead to many inconveniences in the process of medical treatment. For example, in the process of transfer of patients, patients will face the dilemma of repeated examination of the same items, resulting in waste of money and time, and the failure of effective utilization of medical resources, patients have poor medical experience.

2.Lack of trust, resulting in Doctor-patient Conflict

Although the Internet platform can alleviate the information asymmetry in the process of seeking medical treatment to some extent, and flatten the process of seeking medical treatment, the medical service itself has a very high information asymmetry, and the scarcity of medical resources also makes this asymmetry aggravate the information opacity.In medical institutions, patients's medical data may also be wrongly entered or tampered with by attacks.At the same time, the Internet is
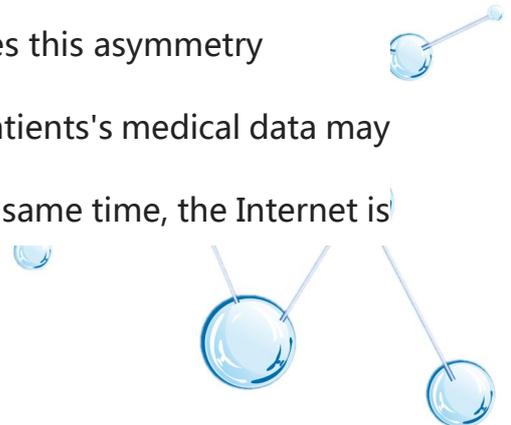
full of false information. The quality of doctors and related personnel is mixed. It is difficult for patients to identify the authenticity of information. There is a possibility of fraud. The phenomenon that doctors prescribe drugs in disorder for the benefit of patients also occurs from time to time, which will damage the interests of patients, or even endanger the life safety of patients.All of the above causes cause trust problems between medical institutions and patients, and frequent medical disturbances caused by contradictions between doctors and patients.Due to the lack or distortion of medical data behind the dispute, it is also difficult to obtain evidence in legal accountability.

3.Patient privacy data disclosure

Medical institutions have substantial control over users's medical data, ranging from personal physical examination data to highly confidential genetic data. Medical institutions may use patient data for commercial purposes to obtain economic benefits.In addition, most medical institutions collect user data to the database and upload it to the cloud in the process of operation. Because the medical institutions do not master the root of the cloud database and have limited control over data security, such behaviors are actually illegal.Patients are facing the problem of personal data disclosure, and privacy is facing challenges.
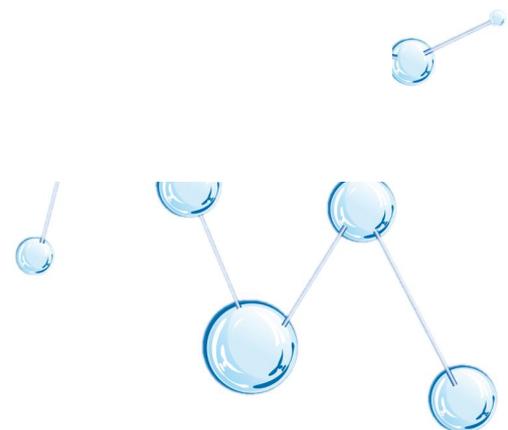
Pharmaceutical manufacturing

1. Lack of clinical data is not conducive to drug development

Clinical and trial data are very important for drug research and development. However, due to the privacy of patients involved in clinical data and the scattered state of data sources, about half of clinical trial data have not been released to the public, clinicians and managers are faced with many difficulties in integrating and analyzing data.The lack of data will not be conducive to the research and development process of drugs, but also to a certain extent increase the research and development costs of pharmaceutical enterprises.

2.It is difficult to eradicate the manufacture and sale of fake and inferior drugs

Fake medicine is a kind of medicine with incorrect dosage, false composition or wrong composition. At the same time, improper storage and other problems may also lead to unqualified drug quality.According to the who survey of low - and middle-income developing countries, more than 48000 samples of drugs were examined. It was concluded that one out of every 10 drugs sold in developing countries was fake or substandard.Drug sales in these countries can reach US $300 billion a year, which shows that the trade volume of counterfeit drugs in these

developing countries is as high as US $30 billion.These fake drugs have a great negative impact on the society.Due to the lack of an appropriate tracking mechanism, there are some irregularities in the links of drug supply chain from manufacturing, circulation, storage to sales, such as the lack of business qualification of drug sales outlets, and the substandard storage standards of drugs or vaccines, leading to the emergence of fake drugs and substandard drugs.The production and sale of fake and substandard drugs not only jeopardize the safety of life and property of drug users, but also infringe the rights of regular drug factories.

Health insurance

1.The process of insurance claim settlement is lengthy and inefficient

The health status, medical data and disease history of patients are scattered in various medical institutions. There is information asymmetry between medical insurance companies and medical institutions, which leads to the independence of insurance companies and medical institutions, and a large number of key information cannot be shared. Therefore, policyholders need to provide a lot of supporting materials in the process of insurance, claim and reimbursement, and insurance companies also need toIt is necessary to check and verify the submitted certification materials manually.On
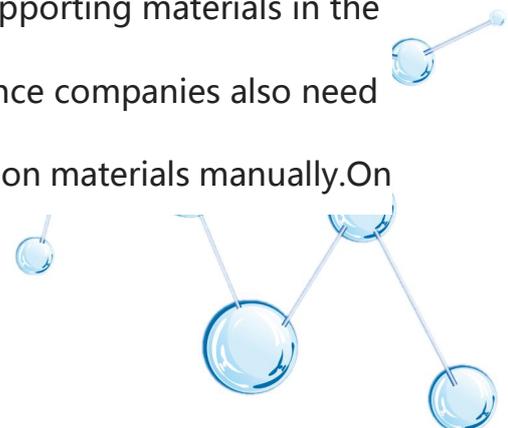
the one hand, each link is extremely time-consuming, resulting in low efficiency of the overall process and poor experience of insured patients; on the other hand, it also increases the labor cost of insurance companies.

2.Fraud and injustice in insurance

The data of patients are scattered and cannot be traced. On the one hand, the untruthfulness of the data leads to frequent insurance fraud cases and damages the interests of the insurance companies; on the other hand, the distortion of the data leads to the fact that the insurance companies are unable to customize the policies in multiple dimensions and in a fine-grained way, which results in the unfair phenomenon of the premiums of the policy holders and damages the interests of the policy holders.
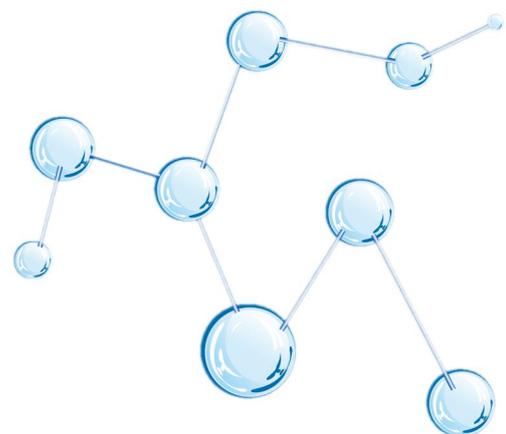
Blockchain technology application

Medical reform

The essence is three problems: the first is that the medical technology level can not solve all the medical needs; the second is that the distribution of medical resources is unbalanced; the third is that the medical information is not circulating.

The problem of medical technology level has two aspects: on the one hand, the absolute technology level of medical research can not cure all diseases of people; on the other hand, the price of newly invented medical technology is too high.

The distribution of medical resources is reflected in the fact that effective and high-quality resources cannot be enjoyed by the most needed people.All countries and regions must face this problem.

The most important and easily ignored problem is the flow of medical information.According to the current direction of medical reform in China, in the process of building a medical system based on community medical care and supported by core hospitals, the core is the circulation of medical information.

Blockchain has unique advantages in solving these problems.
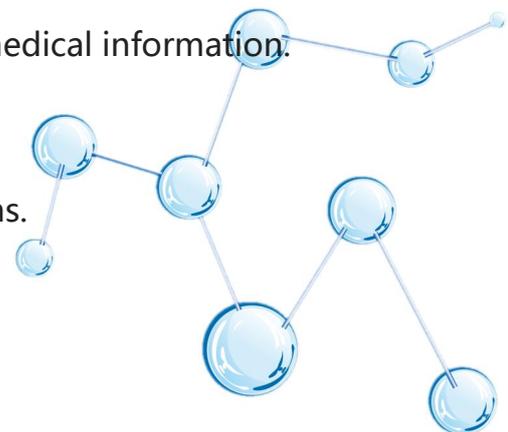
Difficulties in medical and health application

Using the characteristics of blockchain, such as distributed, tamper proof and traceable, under the premise of ensuring the privacy of patients's data, the problem of poor flow of medical information in the past has been solved, the transparency of each link has been improved, the trust relationship between all parties has been established, and the tense doctor-patient relationship has been relieved.The embedding of blockchain technology solves many current pain points in the medical industry and greatly improves the operation efficiency of the medical system. However, due to the particularity of the medical industry, the mode innovation of "blockchain + medical" faces the following difficulties in the development process:

1. Medical data standards are not unified, and information collection and circulation will be blocked1. Medical data standards are not unified, and information collection and circulation will be blocked

At present, China's medical and health data mainly includes three parts: hospital clinical data, public health data and mobile medical and health data. With the continuous progress in the field of medical science, people's medical and health needs continue to grow, and the amount of data in the field of medical and health shows explosive growth.
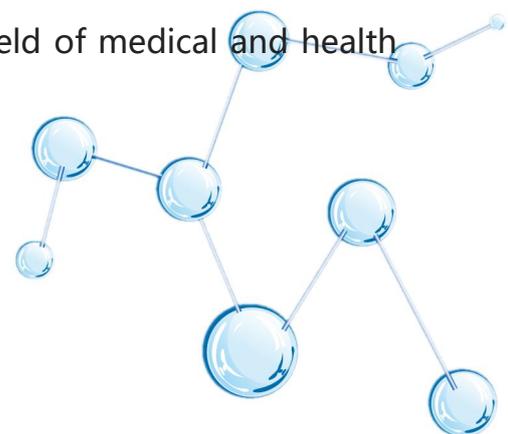
However, these data are usually very scattered and complex, so it is difficult to carry out systematic collection; secondly, the processing amount of these data is not only huge, but also some data are difficult to classify, lack of classification registration, and the valuable data like the patient's dosage, clinical diagnosis data and image data are relatively scarce, so there will be many problems when these data are aggregated, which is difficult to doForm a complete picture of the patient.What is worth discussing most is that due to the particularity of the medical and health industry, the industry involves many stakeholders, relevant policies, complex interest chain, and large differences in different regions of China, resulting in the disunity of product standards, service specifications, and the lack of uniform data standards between different medical systems, which has become an obstacle to the application of medical data in ChinaA big problem.

These isolated and decentralized, non-standard information seriously limits the potential value of medical big data, and the efficiency of medical health industry can not be improved.

Using blockchain technology, medical data is stored on the blockchain for intercommunication and sharing. The distributed node verification can only ensure that the data on the chain is authentic and not tampered with.However, the scattered and heterogeneous data from the source will not be conducive to the collection and circulation of medical information by the blockchain; the disunity of data standards
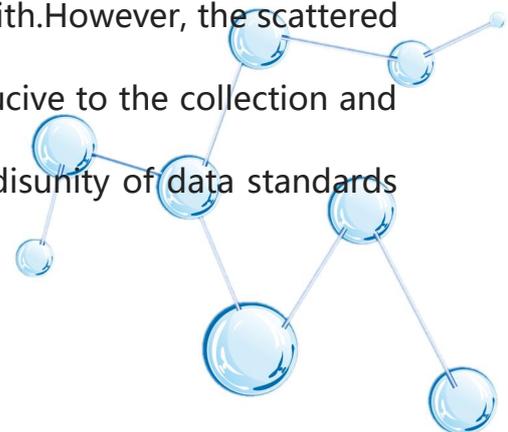
will negatively affect the quality of data sets and limit the enabling value of the blockchain to the medical and health industry; in addition, it is difficult for smart contracts to classify such data, such as automatic claims settlement and other links that need to be embedded in smart contracts will face difficulties.

At present, the problem of the disunity of medical data standards still needs to be solved by the reform of the national medical insurance units. We need to push forward the standardization of the quality, standards and dimensions of medical data, and accelerate the formation of a unified national medical standardization system.

2. The system between medical consortia is difficult to get through, and the phenomenon of data island still exists2. The system between medical consortia is difficult to get through, and the phenomenon of data island still exists

China has a vast territory, with public hospitals and private hospitals scattered all over the country.The application of blockchain technology in the field of health care is usually carried out in the form of alliance chain. Medical institutions exchange and share medical data through alliance chain. However, due to the regional dispersion of hospitals, there will be many medical associations linked by Alliance chain in the market.All major medical consortia hope to build their own medical system into a national industry standard, and have the initiative and the right to speak. There are
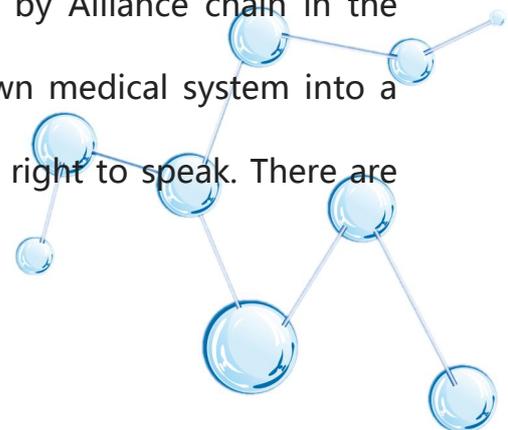
difficulties in cooperation and alliance between medical consortia due to administrative problems, executive level problems of business coordination or conflicts of interests, and there is no organization or mechanism for collaborative communication system between medical consortia. As a result, medical institutionsThe information and data can only flow in each medical association, and it is difficult to form the intersection between the data sets of each medical association. Blockchain can solve the problem of "data island" in the medical system to a certain extent, but it just makes the scattered islands gather and become a "larger island".Although the current cross chain technology can solve the problem of data exchange between alliance chains, due to the above reasons, it is difficult to realize the nationwide data flow of medical system through blockchain.

The emergence of blockchain technology will promote the development of the medical industry.

Healthy consortia from the perspective of blockchain

First of all, in terms of solving the problems of medical technology level, blockchain can really accelerate the development and popularization of medical technology.

The research of medical technology needs a lot of money and time. For example, aspirin, which we are familiar with today, once took decades to develop in Bayer
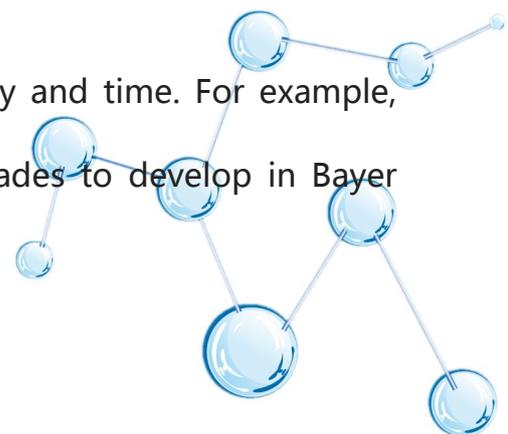
laboratory.If all the investment is borne by a commercial enterprise, the only way to recover the cost is to increase the drug price at the terminal.This is also the reason why many anticancer drugs have been developed successfully, but the public can not get universal treatment.

Blockchain can solve this problem.Through the decentralized financing mode, blockchain can encourage the society to innovate with the greatest strength. While solving the problem of single investment, it can also reduce the R & D investment of each research node.

The research and development of aspirin in Bayer laboratory has experienced nearly 200 failures, and the research team of Bayer laboratory alone has spent nearly 40 years.But if we use the blockchain model to help research and development, we may change this.In the trial stage, the research team can send the direction and projects to be tried to the research and development network with blockchain as the medium, and the project research team is composed of people from all over the world.

Because the traditional R & D mode belongs to "patent exclusive", that is, once researchers succeed, they can get all the rights and interests. Therefore, time competition pressure is great, once they are later than other project groups, it means complete failure.And blockchain redefines this logic, allowing all participants to share the final research results.In this way, more people can participate in the R & D
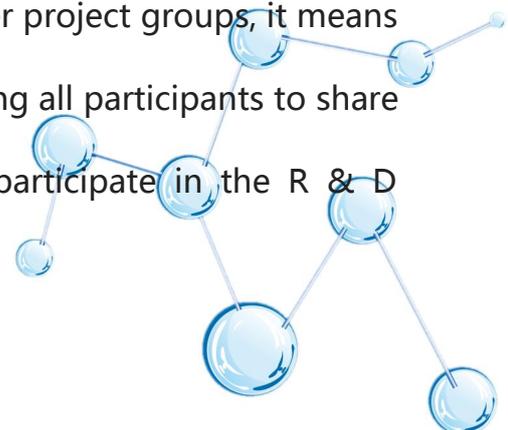
objectively, which improves the efficiency of drug R & D; and decentralized R & D also reduces the single investment.

The result is that the efficiency of medical technology research is rising rapidly, while the consumer price of the terminal is falling rapidly.

Of course, the application of blockchain technology in the field of medical technology research has just started. Due to the ethical nature of medical experiments and the sensitivity of medical and patient data, this application is not the main driving point for blockchain to solve medical problems.In terms of the balance of medical resources and the flow of data, blockchain is more flexible.

In traditional medical treatment, it is difficult to solve the problem that the information between hospitals is not exchanged, and the information of a patient can only be kept in the central database of a hospital, which brings a lot of inconvenience.

We can recall a common scene in the past: the doctor's prescription has always been a kind of "Crazy" existence.When we get the diagnosis results and handwritten prescriptions from one hospital, no one can know them. Finally, the patients have to go back to the original hospital.
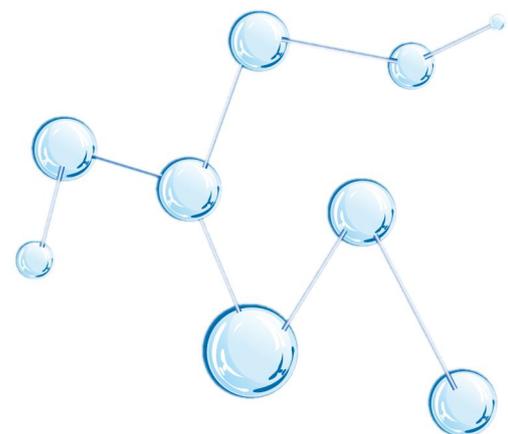
Today, the hospital's data has greatly alleviated this problem. Doctors's diagnosis and prescriptions are recorded by computer and stored in the data center of the hospital.

Although this method solves the problem that doctors can't read handwritten prescriptions, it doesn't solve the problem of data exchange between hospitals.Now that digital storage has been realized, why not let the database connect and communicate?

It's not that simple.We know that medical information is highly sensitive personal information, so every hospital manages patient information as highly confidential information.For a single hospital subject, the risk of information transmission is generally prevented by means of management, such as setting up its own confidentiality system, setting up a special authority to control the replication and dissemination, and selecting appropriate storage media such as CD-ROM, restricted hard disk, etc.Once there is a leak, the hospital can rely on its own management system for accountability and system improvement.

If hospitals are interconnected, the situation becomes very complicated.Once a patient's medical information is leaked, it will turn into a disaster in the process of verification. Hospitals will quarrel about who is responsible.This is also the fundamental reason why medical information has finally become an "island" of information.
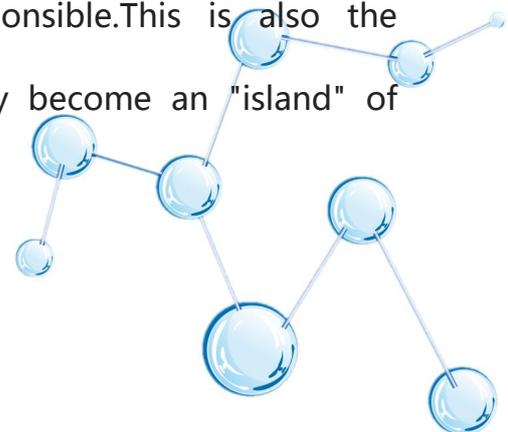
If we use blockchain to solve this problem, it will become relatively simple.One of the biggest characteristics of blockchain is decentralization. According to the logic of blockchain, information exchange between hospitals is not the current mode.

All medical information no longer exists in the specific center of a specific hospital, but randomly stored in different devices.For example, the case information of hospital a may be stored in the C computer of hospital B, but these data are relatively meaningless.For anyone who sees them, they may be just random codes and numbers. Only with the secret key can we find the real meaning of these information.And the person with the secret key is the patient himself.Only when he needs to extract his own case information or authorize his own case information to specific people, these meaningless data will become meaningful disease information.

The advantage of this is that there is no longer a centralized storage information center, nor a hospital responsible for these information.Hospitals don't have to worry about the theft and abuse of information, and disease information returns to the real owners.

On this basis, medical information is no longer bound with medical plans. Patients can choose between hospitals with their own information without worrying about
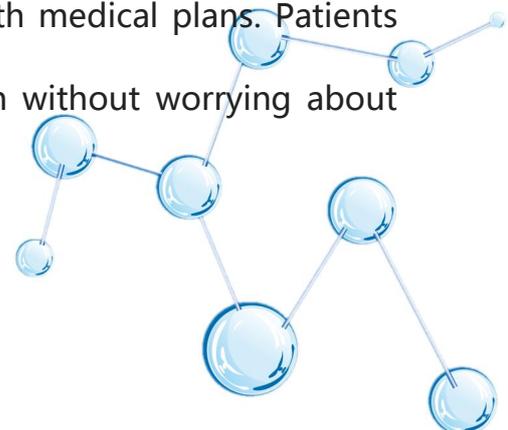
their own medical file information.In fact, it also solves the problem of patients free flow to some extent, which can relieve the pressure of large hospitals.

Blockchain technology medical data management

As an underlying infrastructure, blockchain technology can provide technical support for data sharing and trust building during epidemic prevention.Even multi-party enterprises and institutions that do not trust each other can build consensus by using blockchain technology.Blockchain technology has three characteristics: distributed, difficult to tamper with and traceable. It is sensitive to data. When applied in public health system, it can help to achieve cross regional and cross institutional trust collaboration, improve collaboration efficiency and effectively break the information island in the medical system.As more applications continue to land, blockchain technology will play a greater role in the process of optimizing the public health system in the future.

Use blockchain technology to enable Internet hospital diagnosis and treatment, realize intelligent medical scene, and achieve diagnosis and treatment, prescription, medical insurance, and drug internet medical service trace and traceability.More
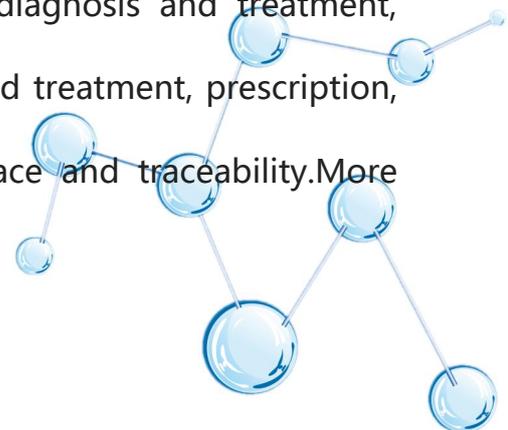
importantly, in order to ensure the data security of patients, the app uses cryptography to ensure the encryption and security of patients' online payment and data transmission.

At present, with the gradual maturity of the blockchain technology and the gradual upgrading of the blockchain industry, the focus of the transformation and upgrading of the traditional industry is increasing.As a distributed encrypted data structure, there are natural advantages in data transmission, data update and data interaction. The application of blockchain technology in supply chain, charity, insurance and other heavy data industries can effectively solve the hidden dangers and problems in these industries, such as data island, data forgery and data security.

At present, the application of blockchain in the field of health care also tends to reshape medical data.The digital transformation of medical field through blockchain technology is a huge opportunity and change for the medical and health industry.

According to the research of McKinsey big data medical report: in the U.S. region, medical big data can save 12-17% of the medical cost of the U.S. $2.6 trillion of medical expenditure, contributing nearly $450 billion in value.

With the increase of investment in primary health care and the expansion of telemedicine system, Internet plus medical treatment has improved the medical
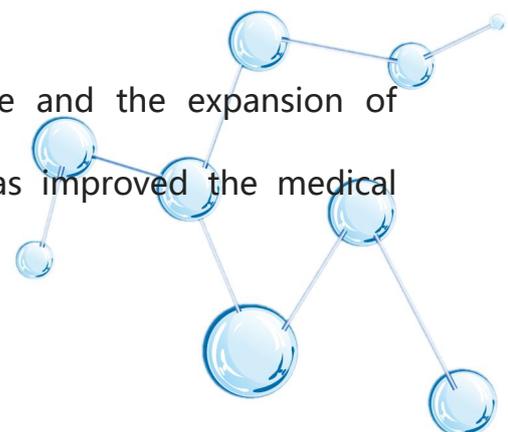
system, alleviating the problem of imbalance of medical resources to a certain extent.However, in the Internet system, patient data information and medical information are exposed in the network security hiding, which aggravates the problems of medical data leakage, data quality is not high, data loss and so on.According to the risk based security report, there are hundreds of data leakage events in one year in global healthcare.

Data generation end, data analysis storage end and data demand end form the industrial chain of the whole medical data industry.Different medical institutions have different standards for recording treatment data and information in different stages of patients. The records of hospital information, device information, doctor's diagnosis information, patient information, health information, clinical data and drug data cannot be interconnected, shared and integrated.In addition, the medical records and examination records of different medical institutions in different stages are in an independent state, which cannot form a medical data chain of personal integrity.The whole medical data industry chain falls into a disordered and invalid state, and the data value is greatly devalued.

At present, personal medical record and storage based on blockchain technology is the most important application. Through blockchain distributed encryption storage technology, electronic medical record data is encrypted, stored and updated.Each electronic medical record is a data account book. The data in the account book is
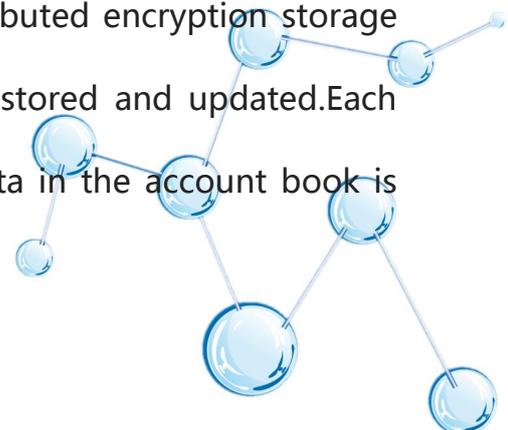
scattered in different medical institutions, and the patient has no personal medical history and data.If the patient takes the electronic medical record to other medical institutions for further treatment, the data in the electronic medical record can not be used, and the patient still needs repeated examination and treatment.

Through the smart contract technology, electronic medical record storage and access rules can be established, doctors and other medical service personnel can access and read the patient's medical record information under the authorization of patients.In different treatment stages, input the patient treatment information according to the unified standard of smart contract. If the patient needs to be transferred, the transfer application is sent to the corresponding hospital node through the chain. After the patient is transferred to the hospital, the doctor can carry out further treatment planning according to the automatically updated electronic medical record.

As a result, every hospital and medical institution can form a unified standard medical record mode, so that patients have the autonomy of medical records, and can check the historical data and medical information of patients at any time, so as to ensure the safety of medical data interaction system and prevent data tampering and distortion.

The problem of fake drugs is another "disaster" problem in the field of health care. According to industry estimates, 30% of drugs on the market in some countries are
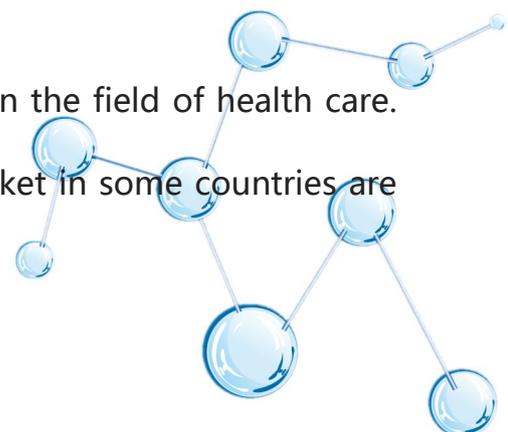
fake drugs.The data of blockchain technology is difficult to be tampered with and traceable, which is applied to drug anti-counterfeiting traceability and distribution management. The complete supply chain of drug raw material purchase, drug production and drug sales is recorded in the whole process, and the drug credible traceability system is constructed.In the article "observation of blockchain + exploration of medical supplies, building a new industry ecology", runcaijing comprehensively analyzes the application of blockchain in the supply chain of medical medicine materials, taking the production and sales of medical masks as an example.

At present, the drug Traceability Technology has been put into use. The drug packaging box has anti-counterfeiting traceback source code, which can obtain data information of drug production and sales by scanning two-dimensional code. The blockchain technology ensures the authenticity and non tamperability of the data.

PHC summary
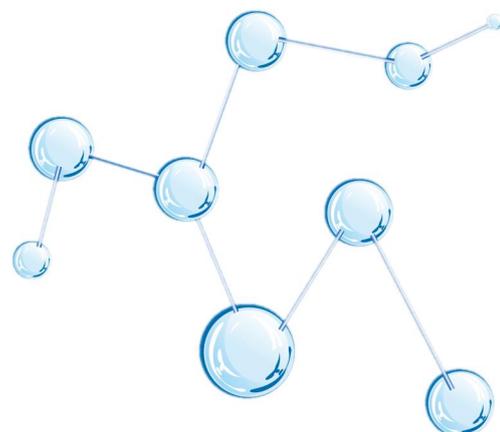
Public Health Based on blockchain as the underlying technology, chain, combined with big data, artificial intelligence, supply chain, Internet of things and other technology applications, through the exploration and research of digital identity, medical payment, health management, value medicine, clinical medicine, charity, insurance and other fields, helps enterprises, hospitals and customers coordinate their relationships, establish a trust mechanism, and provide consulting servicesTechnical support such as supervision and guidance, product development, etc., to solve the problems of medical services, accelerate the sustainable and healthy development of medical ecology, help the flow and safety of medical data, improve the value of business and scientific research, and industry efficiency.

PHC aims to make full use of the platform advantages, resource advantages, technical advantages and experience advantages in professional manufacturing and blockchain technology, and promote the development and application of blockchain technology in the fields of medicine traceability, medicine logistics, consumer safety medicine, medical insurance fee control, supply chain platform, etc.

PHC empowering healthcare industry
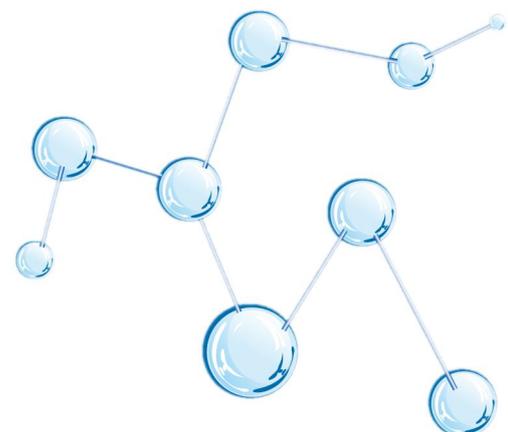
Due to the characteristics of blockchain technology, such as distributed, non tamperable, traceable, etc., PHC is able to break through the information flow of medical data, improve the status quo of mutual data island between institutions, rebuild the trust between doctors and patients, and improve the efficiency of the industry through blockchain under the premise of ensuring the privacy of patients data.

## 1. Sharing and circulation of medical data to protect patients' privacy

With the deepening of the Internet era, all kinds of network applications have gradually penetrated into all aspects of people's life, personal data is more and more exposed in the network world, and the protection of user data is imperative. In the future, more and more user data will become user assets, which can only be used after obtaining user license and paying a certain fee. In the medical field, data is of high importance, strong privacy and scattered in various institutions, so it is difficult to use and manage data. PHC is expected to build a secure and reliable data asset storage and sharing platform by building a multi-party collaborative trusted environment and using cryptography technologies such as trusted computing. PHC will unite the data owners, data providers, data users and system maintainers, and clarify the rights and responsibilities of all parties, so as to achieve efficient data circulation and sharing.
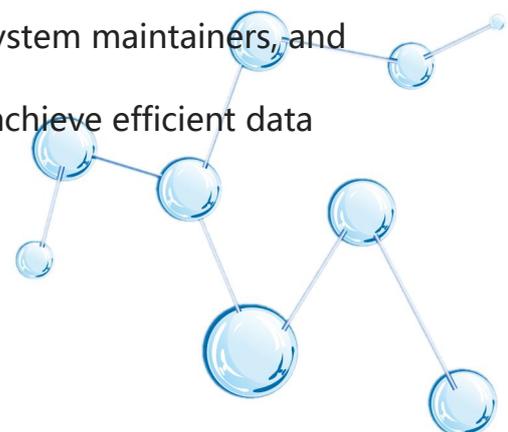
2. Link up patient data, open up information flow, and optimize medical experience2. Link up patient data, open up information flow, and optimize medical experience

In the medical diagnosis, PHC is used to build the electronic medical record database, record the patient's health status, family history, medication history and other information on the blockchain, and protect the patient's relevant information data with MPC (secure multi-party Computing), tee (trusted execution environment) and other trusted computing technologies, so as to ensure that the patient's privacy is not violated.Through the data sharing on the blockchain platform, the information channels between the medical institutions in a wider range and at different levels can be opened. Doctors and nurses can access the data of patients within their authority, master the health status of patients, and take appropriate medicine. Patients may no longer need to repeat the examination on the same diagnosis project, and the medical experience is expected to be greatly improved.

3. Improve the efficiency of medical and health insurance claim settlement, and improve the experience of policyholders3. Improve the efficiency of medical and health insurance claim settlement, and improve the experience of policyholders
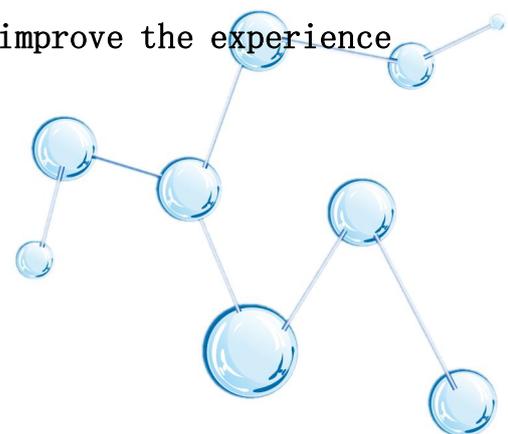
PHC records the patient's medical records, disease history, medication history, etc., by which the blockchain platform insurance company can bridge the data gap with patients, medical institutions, etc., improve the transparency of the insurance claim process, and the blockchain verification system can complete the insurance claim qualification review in a short time.Block chain based tamper proof gives data more credibility, which will reduce the burden of policyholders to provide claim materials and proof, and no longer need to go through lengthy reimbursement procedures.In the future, PHC can go on the chain from the signing of insurance contract, change of relevant data, review of claim data to payment income and expenditure and other key node information, which not only ensures the credibility of data, but also facilitates all parties to carry out on chain inspection and verification at any time, and improves the transparency and controllability of the process.Even in the future, it will be able to realize the automatic claim settlement of medical treatment, while paying for medical treatment, it will also complete the claim settlement of commercial medical insurance synchronously, and integrate the data flow of medical treatment and claim settlement into one, which will greatly speed up the claim settlement process and improve the user experience of policyholders.

4. Reduce insurance fraud and ensure the fairness and justice of insurance4. Reduce insurance fraud and ensure the fairness and justice of insurance
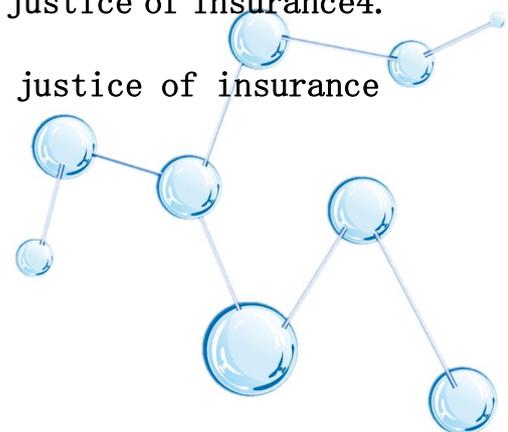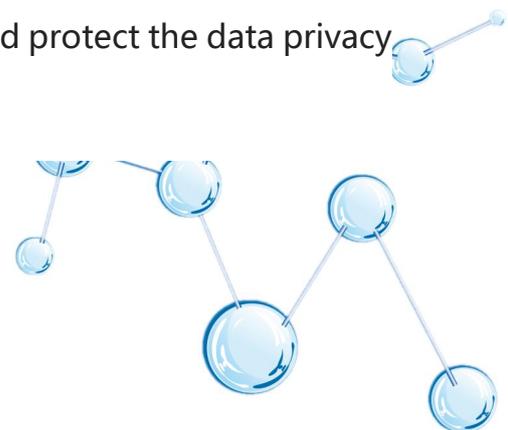
The relevant information stored by patients on the blockchain is true, accurate and cannot be tampered with, which will effectively avoid insurance fraud cases.Each insurance institution can even share reasonable data among the same industry to effectively discover and eliminate insurance fraud.Insurance companies can also customize policies for different policyholders through more authentic data, and the premium of policyholders will be more fair.

5. Clinical data circulation to help drug research and development5. Clinical data circulation to help drug research and development

Through the blockchain data platform, drug R & D institutions can conditionally obtain clinical data that were not easily disclosed in the past and extremely scattered, effectively reduce the threshold of research data acquisition, improve the quality and quantity of clinical data, and facilitate the drug R & D process.On the other hand, patients can also use their own data through authorized institutions in exchange for relevant interests, mutual benefit.

In the process of the above medical data flow, because the patient's relevant information data is encrypted on the blockchain, the third party needs to obtain the patient's private key authorization to call the data.Blockchain technology can help to establish a data sharing platform, strictly control the acquisition and use of data, to a large extent, avoid the commercial abuse of patient data, and protect the data privacy of patients.

6. Establishing trust mechanism to resolve the contradiction between doctors and patients

The blockchain not only records the data of patients on the chain, but also records the relevant information of medical institutions and medical personnel. Patients can check the data on the chain, investigate the professional qualifications of medical institutions and personnel, alleviate the trust problems caused by information asymmetry, avoid the misleading caused by false information and false advertising, and avoid the occurrence of medical fraud to the greatest extentNow, it can reduce the choice cost of patients and ensure the personal and property safety of patients.

At the same time, patients can also understand the operation records of medical personnel through the data on the chain after diagnosis, and supervise whether doctors prescribe drugs in disorder or in excess. In case of medical disputes, the data recorded on the blockchain provides a source of evidence for legal accountability, which not only protects the legitimate rights and interests of patients, but also to some extent relieves doctors from the trouble of "medical disturbance".By building a traceable and tamper proof data platform through blockchain, both doctors and patients have laws to follow and evidence to follow when solving conflicts and disputes, and the conflicts between doctors and patients that are concerned in today's society are expected to be alleviated.
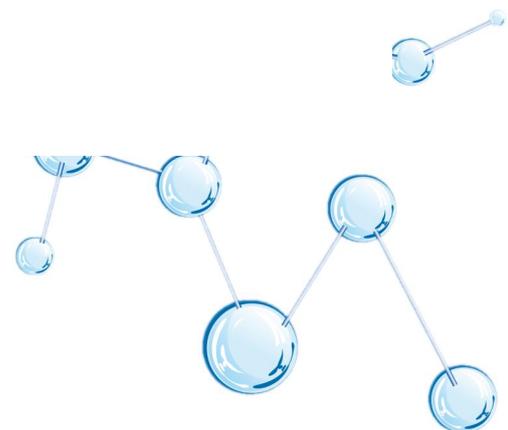
7. Traceability of drug supply chain and circulation to fight against counterfeits

The production, transportation, storage and sales of drugs have been effectively standardized and supervised. However, there is no common collaboration platform between different collaboration nodes to integrate data of all parties, complete the data chain closed-loop of the entire drug supply chain, and there are collaboration blind spots between collaboration nodes. Business collaboration is mostly based on offline paper bills, which is inefficient and easyError.The non-conforming fake drugs and inferior drugs are also likely to penetrate into the drug supply chain through this blind spot of cooperation.Moreover, if there is a collaboration platform for drug supply chain, the data on the centralized platform may also be tampered with, which still provides the possibility for the infiltration of fake drugs and substandard drugs.

1. Modern logistics professional distribution

From the pharmaceutical factory to the pharmaceutical commercial enterprise, and then from the enterprise to the pharmacy and consumers, the drugs we use are the same as the daily purchased express delivery, which need professional logistics distribution.A modern, professional and intensive medical logistics network and intelligent logistics service system have been formed to ensure the safe delivery of drugs to patients.

Since leaving the pharmaceutical factory and delivering it to the pharmaceutical commercial enterprises, the pharmaceutical industry has started its wonderful
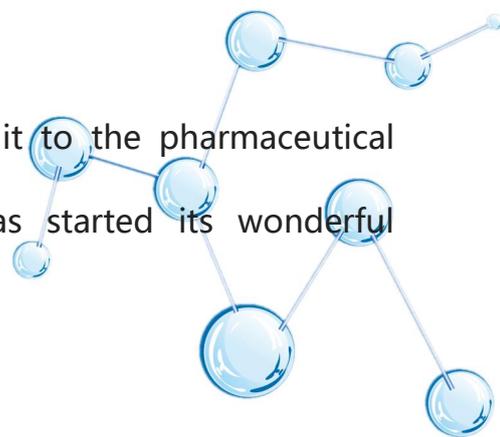
journey.In the storerooms of pharmaceutical companies, they are placed in different categories, waiting for orders from hospitals or retail pharmacies.

2. pharmaceutical warehouse of pharmaceutical commercial enterprises

When the order of the hospital or retail pharmacy is issued to the central computer room, the staff will go through the relevant approval, invoice and other procedures, and then send it to the drug storage warehouse.Different from the rooms we usually live in, the storehouse floor height is generally about 7 meters. In order to make full use of the space, the enterprise will generally set up mezzanine shelves in the storehouse to store some medicines with small inventory.

Due to the high storey height, the drug shelf is often divided into several layers, the highest layer can reach 5-6 meters, at this time, the drug taking "artifact" - picking car is needed for drug taking. By adjusting the height of the picking car, the staff can select drugs on demand.

3. the staff operate the picking car

The selected medicine will be sent to the sorting place.Only one drug of the same batch can be placed in each storage space to ensure that the drug will not be misplaced.The sorter takes the medicine according to the purchase order given by the general station. For each medicine taken, the purchase order will be automatically subtracted and a bill will be issued to ensure that the type and quantity of medicine will not be wrong.
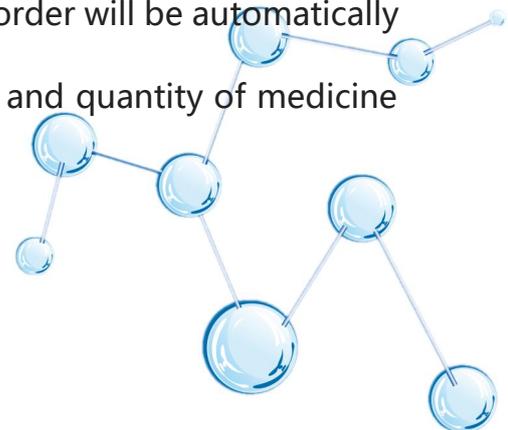
4. drug delivery vehicle

Constant temperature 3-7 degrees

SMS alarm to ensure no danger

Compared with general drugs, some special drugs need to be kept in cold storage all the time, and the temperature should be between 2 and 8 degrees.In June 2010, the cold storage of the logistics distribution center of China Resources pharmaceutical business group was put into use, becoming the first constant temperature and humidity cold storage in the field of drug circulation in China.When the cold storage temperature exceeds the range of 3-7 degrees, the early warning system will send a message to each responsible person's mobile phone to remind them to handle in time, so as to ensure the drug safety.

It is also necessary to keep a constant temperature during drug delivery.According to the size of the goods, the staff will store the drugs from the cold storage into the corresponding size of the transport refrigerated box, and then transport them to the cold chain car through the refrigerated box.There is an electronic screen on the transport refrigerated box to display the box temperature in real time. If the temperature exceeds the specified value, a short message warning will also be sent.

## 5. transportation refrigerated box
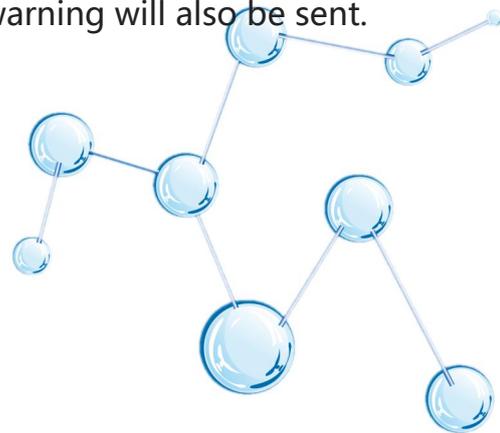
The staff on the cold chain car can scan the two-dimensional code on the transport refrigerator to confirm the type and quantity of drugs, and place an order to the central machine room at the same time. After completion, the drugs can be delivered to the hospital.Different from the ordinary transport vehicle, the cold chain car needs to be precooled before transportation to ensure the temperature is appropriate, generally about 1 hour in summer.

6. Transportation cold chain car

In addition, for example, the drug import of famous foreign pharmaceutical enterprises, from customs declaration, customs clearance, customs entry, access to the general warehouse, distribution to the logistics center, distribution terminal, the whole process is in the charge of pharmaceutical commercial enterprises.We will strictly control the quality and safety of drug distribution and make unremitting efforts to ensure drug safety.

As the blockchain data has the characteristics of traceability, the drugs on the market can be traced through the transparent drug supply chain of blockchain technology.From the acquisition of drug raw materials to the production, storage, distribution and sales of drugs, proper monitoring and tracking should be carried out.Through the blockchain platform, consumers can see whether the manufacturer,
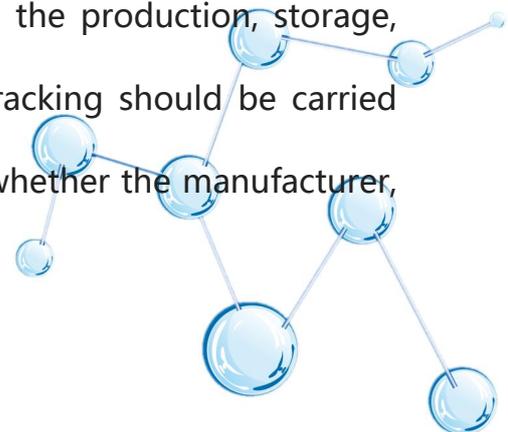
date data and circulation links of the purchased drugs meet the standards, and can also monitor the storage temperature, in and out time of the drugs or vaccines in real time through the blockchain technology in coordination with the Internet of things.To ensure the authenticity and quality safety of drugs, on the basis of the original strong supervision of GSP and GMP, we will further realize open supervision and tracking, crack down on fake and substandard drugs market, and protect the rights and interests of all parties.

PHC Technology

Proof of completeness

In this project, we use the data integrity proof method based on jump table.We define the stagnant element as existing in

S (i-1) does not exist in S (i-1) and S (I-I). High tower element is the element existing in S (i-1) and S (I-I). In addition, elem (V) is defined as the element existing in node V, down (V) is the node below node V in s (i-1); right (V) is the node on the right side of node V in S (I-I). The verification process on the hop table is designed as follows: the calculation method of tag value f (V) is as follows: definition:W = right (V), u = down (V), when right (V) = null, define f (V) = 0.Then: when u = null, i.e. V on so: a) when w is a high tower node, f (V) = H (elem (V), elem (W)); b) when w is a dead node, f (V) = H
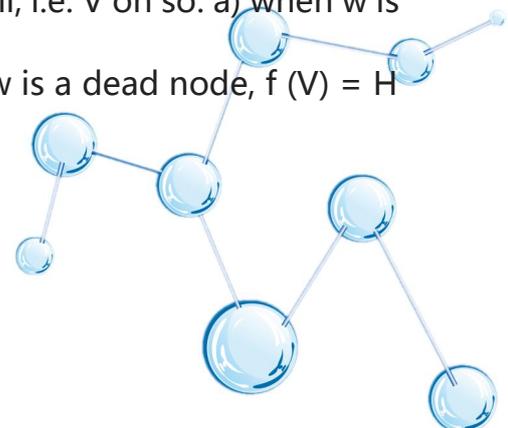
(elem (V), f (W)).When u is not equal to null: a) when w is a high tower node, f (V) = f

(U); b) when w is a dead node, f (V) = H (f (U), f (W)).

Smart contract

The smart contract based on blockchain includes transaction processing and saving

mechanism, as well as a complete state mechanism for accepting and processing

various smart contracts, and transaction saving and state processing are completed

on the blockchain.Transactions mainly contain data to be sent; events are

descriptions of these data.After the transaction and event information are transferred

into the smart contract, the resource status in the contract resource collection will be

updated, and then the smart contract will be triggered to judge the status

mechanism.If the triggering conditions of one or several actions in the automatic

state mechanism are satisfied, the state mechanism selects the contract actions to

execute automatically according to the preset information.The construction and

implementation of the smart contract based on the blockchain are divided into the

following steps:

1) Multiple users participate in the development of a smart contract;

2) Contract through P2PNetwork diffusion and storage in blockchain;

3) The smart contract built by blockchain is executed automatically;

Using PHC cloud service of blockchain technology to solve the information security,

data reliability, easy deletion and modification of traditional cloud, and through super
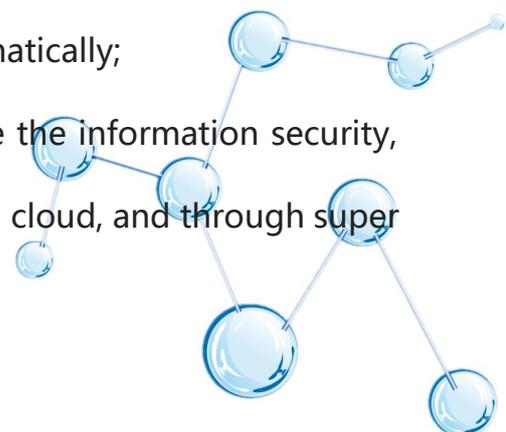
nodes to ensure the concurrent number, truly solve the security of data providers, and greatly reduce costs.

cloud storage

Different from existing cloud storage schemes, PHC is a decentralized shared storage platform, in which nodes rent storage space from each other.Because the storage space in each node is idle space, the marginal cost can be considered close to zero, and the cost of PHC shared storage is far lower than that of cloud storage.The lease of storage is based on the smart contract on PHC.By forming a smart contract, the storage provider (the node providing storage) agrees to store customer data, and periodically proves that they can continue to provide storage services until the contract expires.Storage providers can be rewarded by submitting integrity certificates, but failure to do so will result in penalties.PHC guarantees the fairness and accuracy of the smart contract. Customers do not need to verify the contract, they only need to upload data, and the rest is handed over to PHC.

Document existence certificate
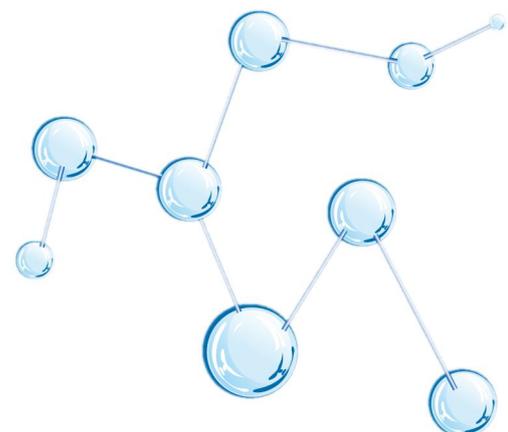
POI is the integrity certificate, which is used to prove that the storage provider completely stores the data agreed in the smart contract.POI is mainly based on hash tree construction, forming authentication tree to submit to the verification node.We divide the data submitted by customers into small data blocks and calculate the hash value of each data block.Then the two adjacent hashes are combined into a string, and the hash of the string is calculated. Each two hashes are combined to get a sub hash.In this way, the hash value will be calculated upward, and eventually an inverted tree will be formed. At the root of the tree, there will be only one root hash in this generation.The hash tree corresponding to the user data is stored in the smart contract.

erasure coding

In order to avoid that the user's data can not be acquired normally due to equipment disconnection, the stored data must be stored redundantly.But if we only deal with the data with multiple backup, according to the Xiang Nong theorem, the storage efficiency is too low, so we introduce the erasure correction code technology.In the application of erasure correction code technology to cloud storage, firstly, the user file is divided into x + 1 data segments of equal size and multiple of K (if not enough, 0 is used to make up), and then each data segment is encoded by erasure correction code. When the data block Di and check block DJ are stored after coding, they are
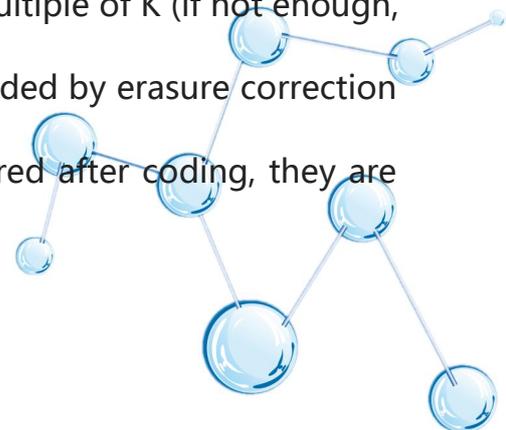
stored in different file segments according to the subscript, for example, the data block d0 of file data segment 0 is stored in segment 0,D1 is stored in slice 1, data block d0 of data segment 1 is stored in slice 0, D1 is stored in slice 1, and so on.Each file partition obtained by the partition mechanism is composed of data blocks and check blocks of different parts of the file. The file information in the partition is decentralized, that is, a single file partition will not disclose the user data information, which ensures that even if the third party including the storage node provider illegally obtains the partition stored on a single node, it cannot obtain the user file content,The privacy of data in cloud storage is guaranteed reliably.At the same time, according to the properties of vandermond matrix, in n = K + m segments, as long as K segments can be used normally, the system can completely recover the original files of users.This means that the user data will not be lost even when some segments are deleted or modified maliciously, or when one or more storage nodes fail in the system.This feature improves the fault tolerance and redundancy of cloud storage system, and guarantees the reliability and integrity of data.In addition, when RS erasure code is used to recover user files, at least k download nodes need to be connected.The fewer download nodes connected, the faster download speed, and the shorter download delay.The advantage of this algorithm is that when there is a packet loss or error in the network, the download node does not need to use the retransmission mechanism, but only needs to select another node to complete the download task
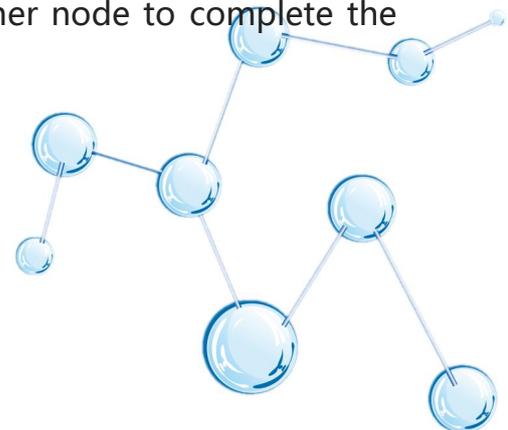
1. Combining AI big data, blockchain will promote the development of medical science and reconstruct the medical system1. Combining AI big data, blockchain will promote the development of medical science and reconstruct the medical system

To a certain extent, blockchain technology solves the dilemma that the flow of medical information data is not smooth and all parties are data islands for each other, avoiding the invariability brought by the sensitivity of medical information in the past.The real and effective data recorded on the blockchain is accumulated into a large database of higher quality. Through processing a large number of high-quality medical big data, repeated in-depth learning and algorithm optimization, the development of artificial intelligence is promoted, such as cases, images, genes, and the establishment of verifiable and repeatable medical standards.While promoting the development of medical science, artificial intelligence also enables patients to enjoy standardized medical services before, during, after, in and out of hospital.

The medical capacity of the head hospital can be enabled to the basic level medical treatment, and the auxiliary diagnosis and treatment functions can be developed for different diseases, so that the basic level hospitals can also share the medical technology of the head hospital, and finally evenly distribute the medical resources at all levels, and reconstruct the medical system.
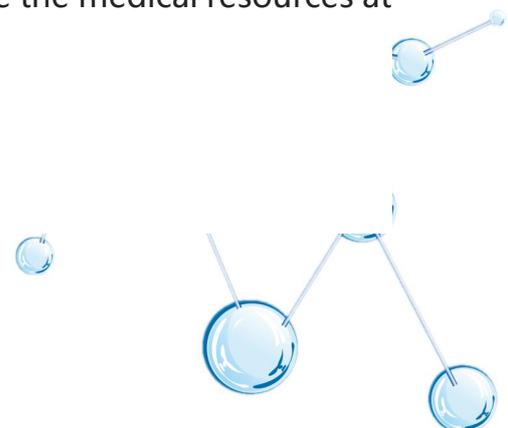
2. Promote the unification of data standards and enable blockchain to be more efficient

Because the current medical information data standards are not unified, it is difficult to share medical information big data. The key step to promote the construction of medical information is to unify the data standards. In the future, with the promotion of medical reform by the national medical insurance institutions, the current "disordered" medical information data will gradually realize standardization and unification, and be accepted by all parties. After that, the effect of blockchain on the information circulation of the medical industry will be greatly improved, the industry efficiency will be further sublimated, and the construction and development of China's medical system will be promoted.

3. Regulatory agencies and industry associations may become the driving force for the construction of medical major Alliance

After the establishment of multi-party Medical Alliance chain, in order to achieve a larger scale of collaboration, it is bound to further integrate.However, due to different systems and interests, there will be many difficulties in the process of integration, and the industry regulators or associations may be the best role to promote integration.

Taking the hospital system as an example, there are difficulties in cooperation and alliance among major medical consortia, which leads to the information and data between medical institutions can only be transferred within each medical consortia.If
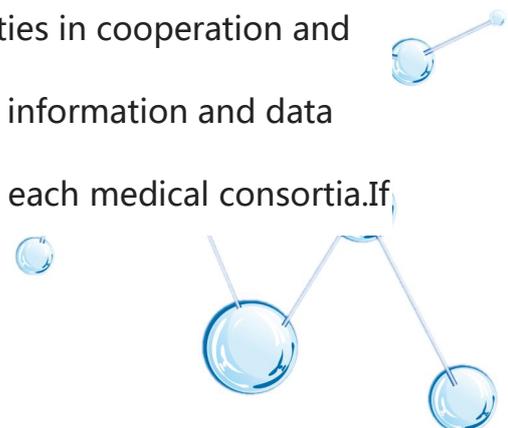
at this time, the hospital association with the right of industrial discourse initiates alliance integration, proposes unified standards, and the hospital actively cooperates to build a large-scale alliance chain across regions and systems, so as to realize a wider range of medical data sharing.After that, we will open up other institutional systems such as insurance institutions and pharmaceutical manufacturers, promote the data circulation of the whole industrial chain, and finally create a complete data sharing platform of the medical blockchain.

In view of the particularity of the medical industry, it will be a very long process to promote the integration of all parties in the industry.However, once this process is completed, the medical quality of our country will have a qualitative leap, and the increasing medical and health needs of our country will be met.

At present, the application of blockchain in medical health mainly involves patient ID certification, electronic case, clinical research and development, drug traceability, medical insurance claims, etc.In the actual cases, there are pilot projects initiated by science and technology enterprises in collaboration with traditional medical industry, as well as medical blockchain solutions independently developed by blockchain enterprises. This report combs some application cases of blockchain technology in the medical and health industry.

PHC Ecological Application
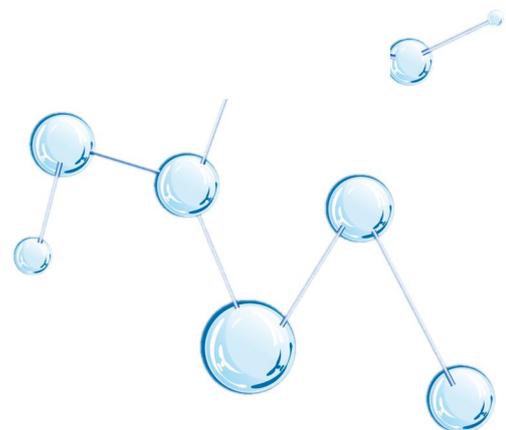
Generally speaking, blockchain technology is at the early stage of development, and it is difficult to deal with medical data with complex dimensions. Therefore, its application in the field of medical health is not mature, and only some companies or organizations have tried it in a small range.With the development of blockchain technology and the further understanding of blockchain in medical and health industry, blockchain can be widely used in the field of medical and health.

1.Medical data interconnection

In the underlying technology architecture, it solves the "information island" and data privacy security problems that have plagued medical institutions for a long time.

The data in the blockchain is encrypted, even if the data is leaked or stolen, it cannot be decrypted.Secondly, it also agreed on the access and operation authority of the upper and lower level hospitals in Changzhou Medical Association and the government management departments.Finally, the audit unit can fully understand the flow of medical sensitive data by using the block chain tamper proof and traceable technical characteristics.

After the introduction of PHC blockchain technology, medical data interconnection can be realized in the Medical Association, which optimizes the experience of doctors and patients, and ensures the implementation of hierarchical diagnosis and treatment
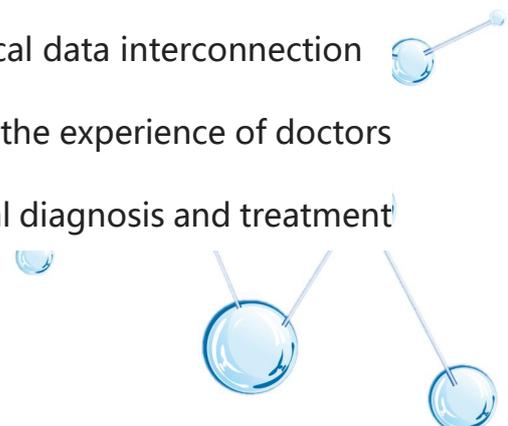
and two-way referral.Through the blockchain network, community residents can have the ownership of health data, and through authorization, realize the data flow between the community and the hospital. Doctors at all levels of hospitals in the medical association can obtain the medical information of patients under authorization, understand the past medical history and relevant information of patients, patients do not need to do repeated inspection, reduce the money paid for this in a timely mannerRoom.

Blockchain technology realizes the information interconnection between hospitals, which will reduce the number of patients' examinations, correspondingly reduce the hospital's income and personnel costs, and may violate the interests of relevant parties.Therefore, such technology application needs the government to take the lead in pilot, implement from top to bottom, and launch a new business model to encourage other hospitals to join the ecosystem, so that the ecosystem as a whole can operate healthily and sustainably.

2. Blockchain medical whole process solution

Healthcare blockchain operating system:
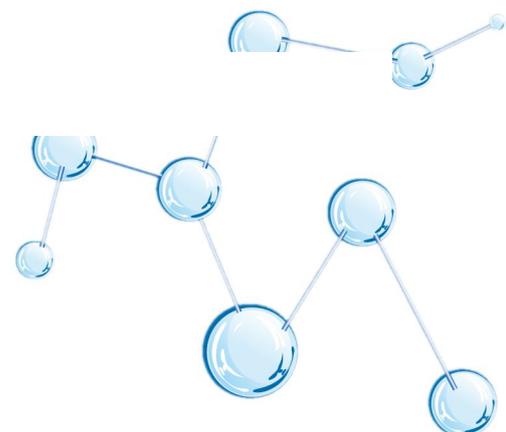
PHC is the first hospital wide blockchain integration project in the world, which can fully share and exchange health data and ensure data privacy, so as to accelerate cooperation in the healthcare industry.

The data on the system includes images and various information about the patient's condition.Doctors and patients themselves can access this information through mobile device software.It also enhances the security of medical information through distributed ledger Technology (DLT).

The main applications of PHC are as follows:

(1) Patient intelligence ID

1.Anonymous digital identity for patients' resumes to realize patient identification and identity management

2.Support patient data writing and query, including hospital care and drug management

3.Track patient health records

(2) Intelligent medical chain
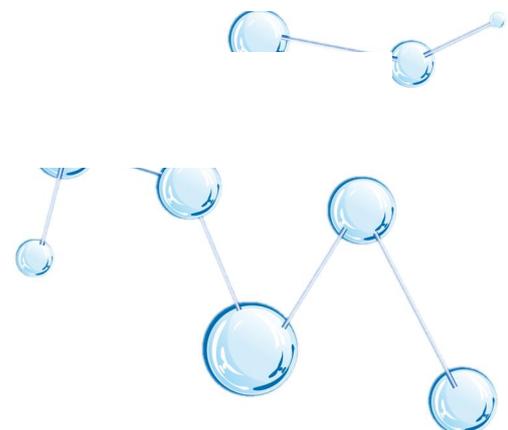
It improves the efficiency of medical data exchange, patient medical record data security and privacy protection by promoting medical data sharing between medical institutions and patients.

(3) Electronic signature of smart contract

Smart contract can be applied to clinical trials, simplify the management of patient electronic documents, and improve the efficiency of patient recruitment process in clinical trials.

(4) Automatic insurance

It involves the authorization of medical data sharing among patients, hospitals and insurance companies. The data includes time stamps and medical records. All authorized data files have digital signatures. No third-party service is required to resolve any dispute and audit anytime and anywhere.

(5) Healthcare data market

Connect the data trading platform of patients, doctors and pharmaceutical companies to speed up the process of new drug development.Researchers can obtain
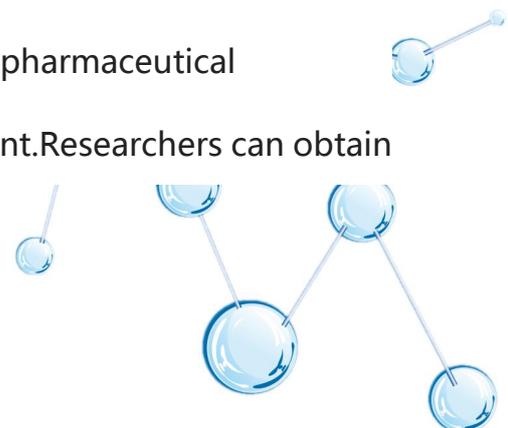
medical data directly from patients for academic research, and data analysis companies can obtain data for their reports and research.

PHC provides services of software, analysis, network solutions and technical support to help create a more powerful and collaborative healthcare collaboration system.Using blockchain technology, the relevant organizations in the medical chain can track the status of claim submission and payment in the whole claim process, improve the transparency, auditability, traceability and credibility of the whole claim chain, and better manage the income cycle.The blockchain makes the whole process patient-centered, more simple and flat, and stimulates more innovative products and cooperation.

PHC is used to process clinical and payment data among various stakeholders in the healthcare industry, such as hospitals, doctors, companies, governments and other providers.

Through the blockchain network, the further optimization and expansion of the solution and technical framework, the platform performance is expected to significantly improve.

PHC provides API interface for developers, allows users to search PHC supplier directory, and provides basic services such as online store, reservation, payment and insurance for enterprises.At the same time, PHC also provides app interfaces for
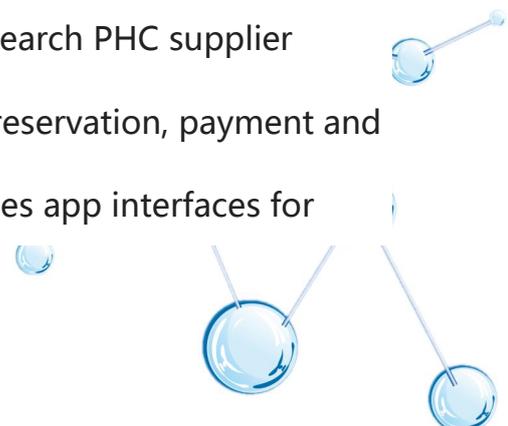
third-party developers such as payment companies, public health systems and

medical and health companies. Developers can easily use the software framework

including payment processing, insurance company qualification review, referral,

insurance claim payment, patient identity management and supplier search functions

on the platform.

PHC's medical blockchain solution can provide identity management to verify the

multi-party information of medical transactions. After successful information

verification, the transactions will be automatically executed according to the

established contract.Applying it to medical claims will greatly improve the efficiency

of compensation.In addition, PHC can also be used to verify the medical supply chain.

For example, the information of doctors' prescriptions will be recorded on the

blockchain, and the drug price will be more open and transparent, which will also

have a profound impact on the inventory and order management of medical

supplies.The application of PHC will effectively alleviate the current situation of

information asymmetry in the medical industry, improve the trust of each node, avoid

the occurrence of medical fraud, and effectively protect the privacy of patients.

(1) Identity authentication

PHC will build an interstate medical license platform in the United States, which

allows medical institutions, health plans and other organizations to verify the identity
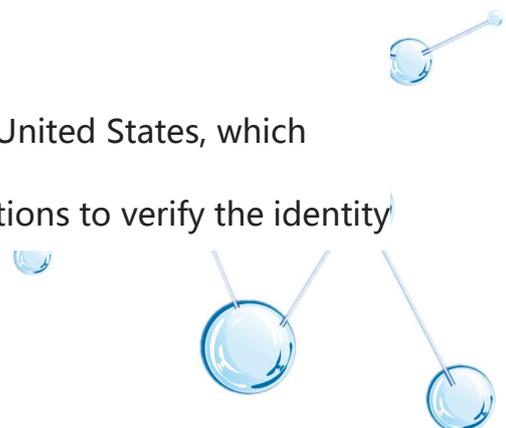
and qualification of medical personnel by combining the distributed trust layer of blockchain.

(2) Medical payment

PHC is trying to design a new healthcare payment ecosystem to help consumers make the most rational choice in healthcare.

(3) Health management

By building a health management platform based on blockchain, users can monitor their health status through wearable devices or other monitoring devices, and collect personal health data for chain storage.Combined with smart contract, it can provide users with timely health feedback. For example, in case of emergency, the platform will automatically transmit appropriate information to medical staff and family members in the first time, grasp the golden time of rescue, and ensure users' life safety.At the same time, the smart contract can also use health prevention resources to create a locally accessible health community project.

PHC's health management platform will bring many benefits to users. Intelligent health devices are used to track users' health status, so as to develop personalized preventive medical care plans; manage acute and chronic disease care plans; timely monitoring and management of the health status of the elderly, dealing with urgent matters, and improving emergency care.

(4) Value medicine

PHC team is limited by trust, transparency and incentives in the value medical model. PHC's blockchain solution will be applied in value payment, contract signing and revenue design.

(5) Clinical trials

PHC is currently working with a number of pharmaceutical companies and government consultants to explore "decentralized IRB (institutional review committee)" management, using blockchain technology to help IRB review and manage the experimental results of multiple test sites and patients, and reduce the high test cost caused by decentralized data.

(6) Supply chain management

PHC's supply chain use cases include tracking and tracing, contract signing, master data management and equipment life cycle planning.

The above medical whole process solution aims to realize the data flow of multiple scenarios such as medical treatment, digital payment, health management, clinical research, medical insurance and supply chain management through blockchain technology, while ensuring data privacy, complete the data interaction and process closed-loop between application nodes, improve industrial efficiency and optimize user experience.

However, in the actual application, due to the large number of business links and business subjects involved in the solution, the data structure and format of all parties
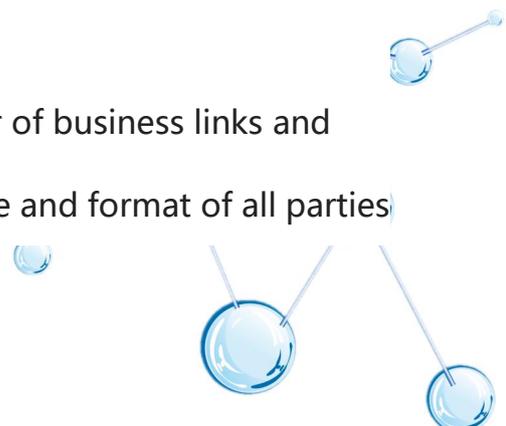
may be inconsistent, and there are difficulties in the application promotion process, so only small-scale attempts can be made with limited partners.In addition, it is very important to design a reasonable incentive scheme to expand the alliance ecology. The more members of the alliance are, the more data they share, the more comprehensive the service and the better the user experience.

3. Blockchain insurance application

Through the innovative business model of "science and technology innovation + insurance", we can provide an intelligent, transparent and safe health insurance system.

As the first health insurance product that applies blockchain technology to the whole insurance industry chain, PHC has opened many links such as front-end channels, middle-end underwriting, claims settlement and back-end reinsurance through blockchain to improve the transparency and efficiency of Internet insurance.

Finally, PHC promotes the circulation of data among all links, and improves the flexibility of insurance companies and reinsurance companies to adjust the annual renewal rate and the ability of risk management.The embedding of blockchain technology improves the operating efficiency of direct insurance companies and re insurance companies, and the cost of insurance products has been significantly reduced, laying the foundation for insurance mode and ecological innovation.
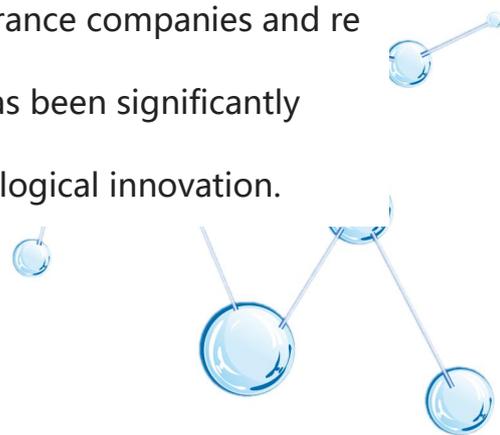
As the first enterprise to apply blockchain technology to health insurance, easypool's easypool products are user-centered. From the perspective of users, they can master user data, understand user attributes and product demands through clear user portraits, so as to develop exclusive and accurate health insurance for different customers.

As a leading enterprise of domestic health insurance, the layout of easy financing in blockchain field provides a new idea and development direction for the whole industry.PHC uses blockchain technology to solve the problem of poor information in the industrial chain, open up front-end channels, middle-end underwriting and back-end re insurance, reconstruct the insurance ecology and improve the efficiency of Internet insurance.The organic combination of blockchain and Internet insurance has changed the way of data exchange and sharing. At the same time, with the characteristics of openness, transparency and non tamperability of blockchain, it has put a credible label on the data.

PHC organizes and builds blockchain Alliance for medical institutions, insurance companies, health information platforms and other institutions, and uses blockchain to drive the implementation of "intelligent + insurance" scenario.

Through blockchain technology, the data flow of all organizations in the alliance can be opened, and the digital certificate information can be stored safely and efficiently. On the basis of ensuring the security of medical data, the real interconnection of medical, insurance and other information security can be realized, and efficient and
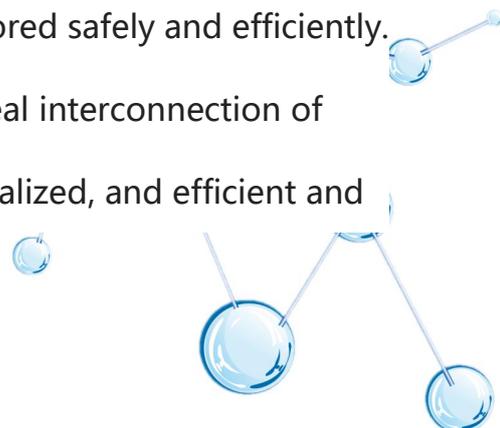
safe insurance guarantee products and medical health services can be provided for users.

"Blockchain + insurance", on the one hand, helps to share and circulate information in various links such as medical institutions, insurance companies, policy holders and supervision, and improves the control of risks and costs in addition to improving the efficiency of claims settlement process.On the other hand, through the smart contract to achieve automatic underwriting and automatic claims settlement, reduce management costs.

Blockchain combines with medical insurance to achieve a qualitative leap in the efficiency of claim settlement process, optimize the experience of policyholders, and achieve the purpose of cost reduction and efficiency improvement for insurance companies.In the future, more medical institutions, insurance companies and regional platforms (regulators) will join the insurance and medical industry ecological alliance built by blockchain technology, and realize the insurance direct compensation mode of blockchain in the form of alliance chain.
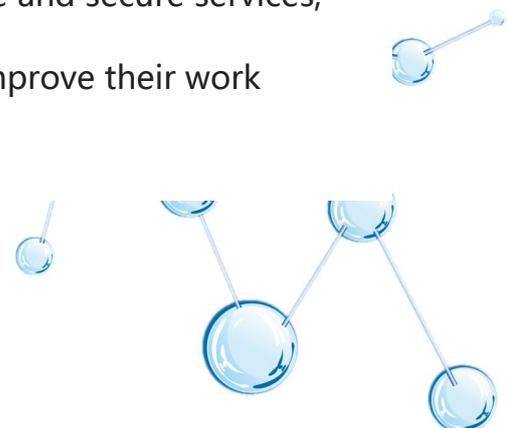
4. Traceability of drug circulation

PHC launched a blockchain based medicine traceability platform, through which it provides intelligent vaccine management software and hardware solutions to ensure the transparent flow of information in the whole process of vaccine production,
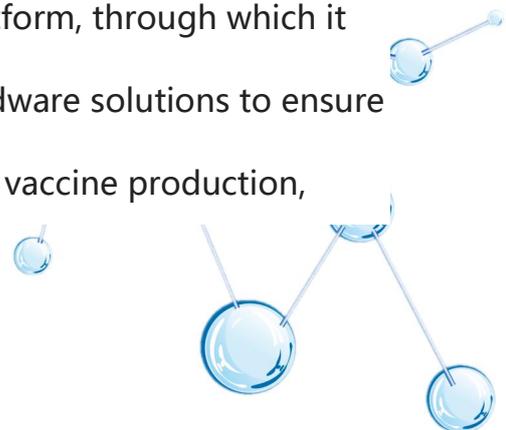
circulation and use, record the data of each vaccine, trace its source, ensure the quality and safety of the vaccine, make the terminal vaccination safer, and ensure the medical safety of consumersEscort.

Launch blockchain vaccine traceability solution products and apply them to vaccination sites at all levels of cities.Through the blockchain technology, we can solve the drawbacks brought by the current vaccine data manual recording, such as easy to be tampered with, data lag, etc., to ensure the authenticity and security of vaccine monitoring, and solve the problem of vaccine traceability.

In the traditional vaccine circulation process, there are many pain points, such as many circulation links, opaque information, low efficiency of terminal inventory management, time-consuming and laborious vaccination statistics.Through blockchain technology, PHC has opened up the information flow of vaccine from production center, cold chain logistics, disease center, vaccination station and other links, and can complete the final vaccination situation and even response of information feedback.In addition, the intelligent freezer is applied to the terminal vaccination station, providing management functions such as vaccine in and out of storage, temperature control early warning, automatic inventory, out of stock early warning, retroactive code scanning, etc.Through digital vaccine information and blockchain technology, we can provide consumers with safe and secure services, greatly reduce the labor cost of vaccination stations, and improve their work efficiency.

Through the smart vaccine traceability management system, consumers can learn the real circulation information of vaccinated vaccine through mobile phones when vaccinating, and can receive the feedback of vaccinated results in time, which is more reliable.

In addition to the cooperation with Hisense medical cold chain, PHC's anti-counterfeiting traceability platform in the field of medicine is gradually expanding its influence, and proposes a solution for vaccine traceability of block chain in the region.Through the blockchain network, drug manufacturers, wholesalers, hospitals and other nodes in the drug supply chain can record drug delivery data on the blockchain. Drugstores and hospitals can benefit from full-automatic and timely real response, without the need to handle the process involving telephone and email manually. Drug manufacturers can also safely request and respond to drug validation requests.In every step of the drug delivery process, blockchain network can prove the origin and authenticity of drugs, making it extremely difficult to steal drugs and trade fake for real.At the same time, only authorized companies can include products in the product catalog.

At present, the blockchain has been applied in many scenarios in the traceability field. In the medical field, the blockchain can not only monitor the drug flow process for all parties, but also eliminate false drug sources.At the same time, as vaccines are such
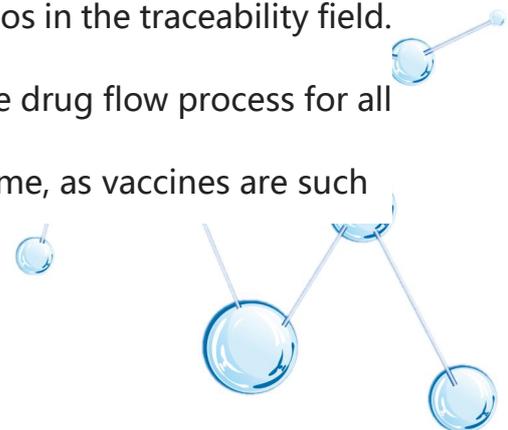
perishable and perishable special commodities, the blockchain can monitor the

multi-dimensional data such as the time, temperature, humidity, etc. of vaccine in and

out of the warehouse by combining the Internet of things devices, so as to ensure the

quality and timeliness of vaccine drugs.

In the future, in addition to the drug supply chain traceability scheme for enterprises,

as consumers also have great trust problems in purchasing drugs online, it is

expected that a large number of pharmaceutical e-commerce companies will explore

the application of blockchain technology in drug traceability, increase consumers'

trust in the platform and products, ensure safety, facilitate and rest assured.
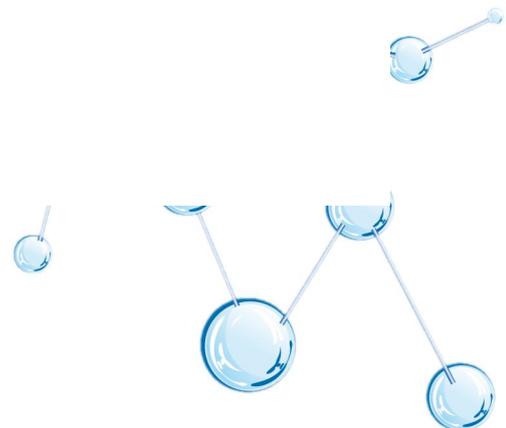
5. Drug clinical research and development

PHC serves clinical trial institutions and eliminates site-based clinical trial operation delay by developing software.

Through the leading digital management scheme, simplify the workflow of clinical trial site and improve work efficiency.The research start-up time of institutions is 20% faster on average, and the time cycle of documents is reduced by 40%. Researchers can complete more research content in the same time, with higher quality and efficiency.

PHC has built a bridge between clinical research institutions and pharmaceutical enterprises, saved the start-up time of research, reduced the cost of communication between them, accelerated the process of new drugs from research and development, clinical to final market, and guaranteed the health of more patients.

The average R & D time of new drugs is more than 10 years, and the R & D cost is amazing. The greatest value of PHC products lies in reducing the R & D cycle and improving the efficiency of the R & D process.

PHC has developed an open source blockchain application jointly with several Internet data companies to manage patient and clinical trial data.

Through the block chain technology to encrypt the patient data on the chain, while protecting the privacy of patient data, promoting the flow of clinical data among
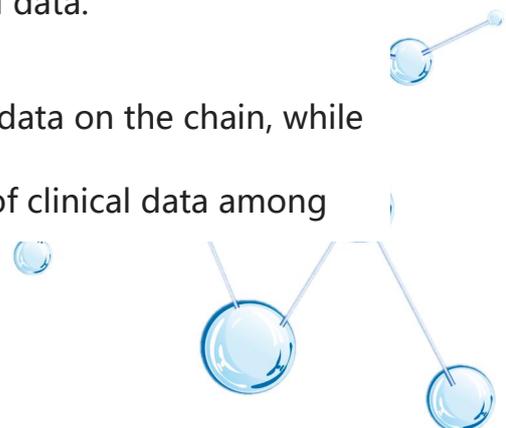
various institutions, making the lengthy drug research and development process caused by the lack of clinical data in the past shorten in time and improve the efficiency of drug research and development.With the circulation and sharing of clinical data, we can expect that in the future, the launch of new drugs to cure various difficult and miscellaneous diseases will be more frequent, because the increase of clinical research data samples, the research and development process of drugs is more scientific, and the cure effect of new drugs will be more obvious.PHC development promotes the application of medical blockchain in medical and clinical research.
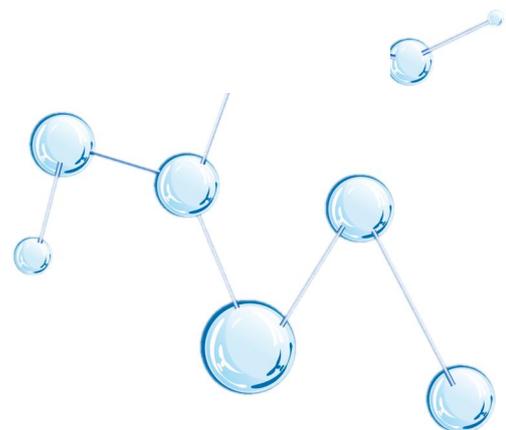
PHC token distribution

700 million There are seven continents on earth, representing boundless public health
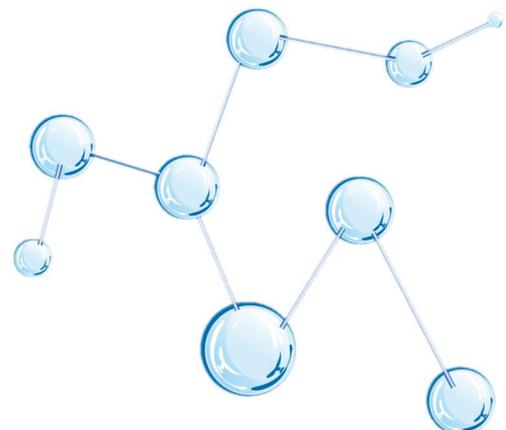
Token proportional distribution:

1.The PHC team has reserved 30 million pieces and released 10% on World Health Day on April 7 every year. As the expansion and construction of the global public health and medical team, it has released 4 times since April 7, 2017, that is 12 million pieces, that is, the current circulation;

2. 70 million global health and medical contribution funds are used to reward those who have made outstanding contributions to public health;
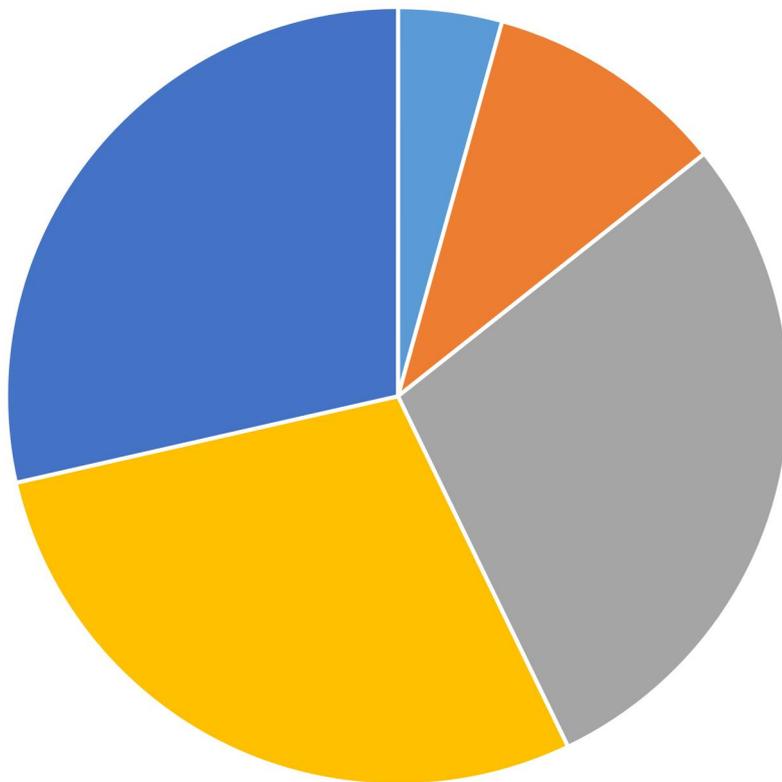
3. The global medical ecological assistance and construction reserve is 200 million, which is mainly used for emergent public health events;

4. 200 million rewards for global citizens' behaviors in the chain of medical and health filing;

5. There are 200 million foundations, the global public health and medical public welfare fund. Each use needs to be publicized by the foundation and recognized by 51% of the community's coin holders.

Distribution proportion

■ PHC team reservation
■ Global health care contribution fund
■ Global medical ecological assistance and construction reserve
■ Behavior reward of global citizens in the chain of medical and health filing
■ Foundation
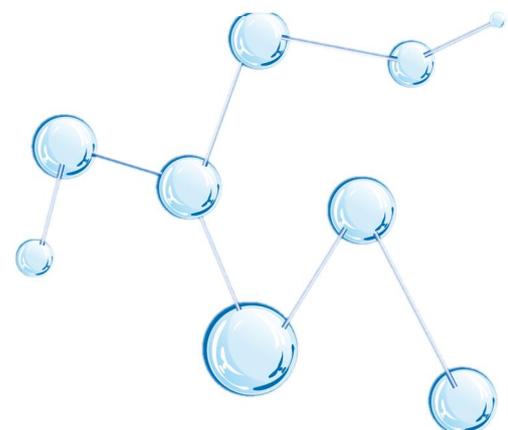
PHC team

Jackie Sharp, Graduated from Stanford University School of medicine, he used to work for Roche, a Swiss pharmaceutical company. Roche is the second largest pharmaceutical company in the world. He is mainly responsible for establishing a technical team to participate in the later product development and online work. He has set up a technical team to participate in the development of many key indications of innovative drugs and clinical applications of later equipment, and has been focusing on new drug development and application.

Robin Wright, Graduated from Cambridge, Pfizer, one of the top ten pharmaceutical companies in the world, once served as the chief pharmaceutical business consultant, and served as a technical consultant in a number of pharmaceutical companies. The research-based company has a variety of product portfolios, covering treatment
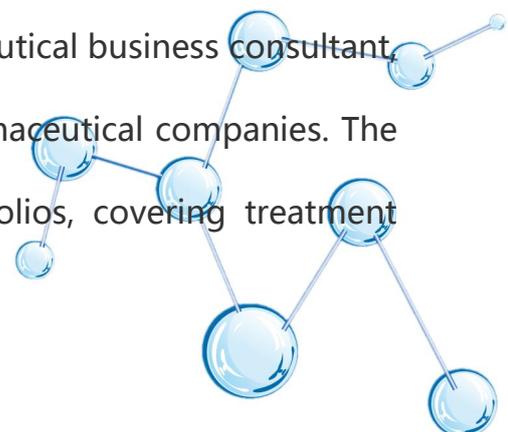
fields including immunology, oncology, neuroscience and rare diseases, especially in oncology.

Doug Stamper, Graduated from the University of Munich, he has super understanding in medicine. After graduation, he worked in Merck clinical drug research and development, participated in cancer immunotherapy, HPV vaccine Gardasil and clinical application of diabetes drug januvia.

Heather Dunbar, Graduated from Stanford University School of medicine and worked for Merck, an American pharmaceutical company. His main research direction was to develop new drugs, vaccines and biological agents in the fields of cardiovascular science and oncology.

PHC development line

2017May 2006: set up a start-up team

2017June 2006: project preparation started

2017July 2007: white paper release

2017December 2006: technical team designs technical framework

2018March, 2004: public chain development started

2018June 2006: prototype construction of cloud health system framework

2018October 2010: building of exclusive distributed server

2019September 2009: global market layout

2020June 2006: online exchange

2020October 2010: distributed server goes online

2020December 2006: cloud health system internal test

2021February 2006: cloud health system officially launched

2021June 2006: public chain internal test

2021August 2008: public chain Online

2022Year: continuous improvement of Ecological Application