

CARDiQ



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Cardio Healthcare aims to create a healthy and happy society by solving the excessive financial spending problem by the government and insurance companies as a result of increases in medical expenses.

To solve this problem, Cardio Healthcare provides technology and a platform that allows you to enjoy exercising on the metaverse. Users are issued Cardiocoins, a crypto asset that allows you to trade personal exercise data to connect your workout in the metaverse and the real world.

Cardio Healthcare's token economy is a protocol economy directed at web 3.0 where the sovereignty of various data is returned to the user, and one which simultaneously pursues the growth of the company's service and the sharing of user profits.

For the rapid spread of the Cardiocoins protocol which supports user health and the economy, Cardio supplies hardware interface parts that upgrade the existing fitness equipment of fitness equipment manufacturing companies so that they can be retrofitted for use on the metaverse. Existing games from game developers can be upgraded with exercise-type metaverse content. Cardio Healthcare is creating an economy of coexistence comprised of existing economic actors by supplying APIs with

Cardio Healthcare's metaverse service. Cardio's Web 3.0-based token economy is built from AI (Artificial Intelligence)-based IOT (Internet-of-Things) sensor technology that collects validated (non-false) exercise information and on middleware technology that can control various metaverse contents.

In the future, Cardio will create the world's largest metaverse sports community that democratizes fitness data while providing 500 million global indoor bicycle and treadmill users with unlimited exercise and sports experiences in the metaverse space, all while monetizing one's own exercise data.

1. The importance of preventive healthcare

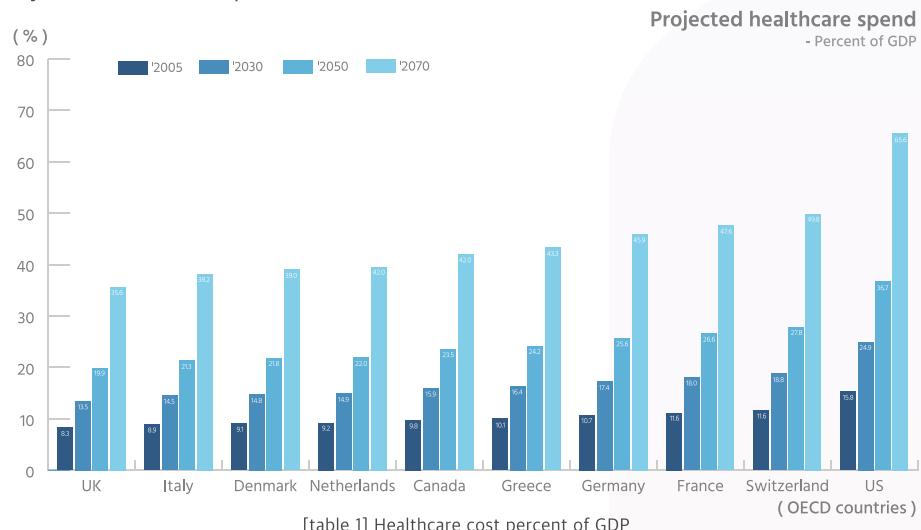
1.1 Medical expenses facing society today and in the future

1.1.1 Forecasted medical expenditure as a percentage of GDP

As in modern society, the staggering forecasted medical expenses of the (near) future have emerged as one of society's primary concerns, if not its biggest problem, especially in OECD countries. Global consulting group McKinsey references the seriousness of this issue in its report which predicts healthcare costs as a percentage of GDP in OECD countries. . [table 1]

In the case of the United States, 24.9% of the country's total GDP is expected to be used for medical expenses by 2030, and without innovative changes in the medical industry, medical expenses are expected to reach 65.6% of its GDP by 2070. This level of medical expenditure may cause the nation's financial system to collapse, potentially leading to a dysfunctional social system.

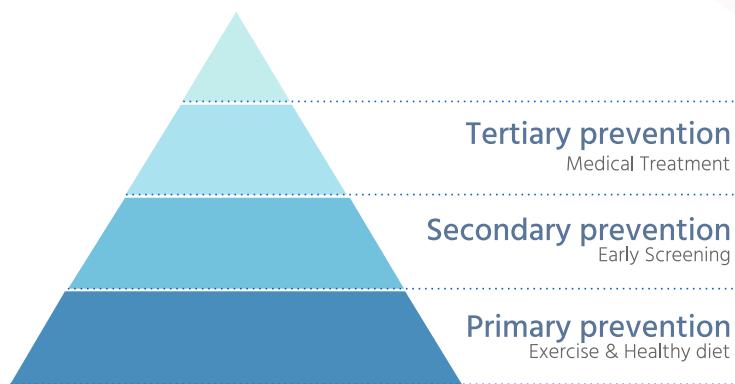
The number of people affected by obesity is expected to increase more steeply due to the increase in telecommuting as a result of COVID-19 in tandem with the growth of the metaverse society, highlighting the severity of the healthcare problem.



1.2 Preventive healthcare as a solution

1.2.1 Definition of preventive healthcare

Preventive healthcare is a concept that lowers the probability of a disease before it occurs, in contrast to the commonly known medical services of curable healthcare.



[fig. 1] Preventive healthcare Wikipedia, Graph

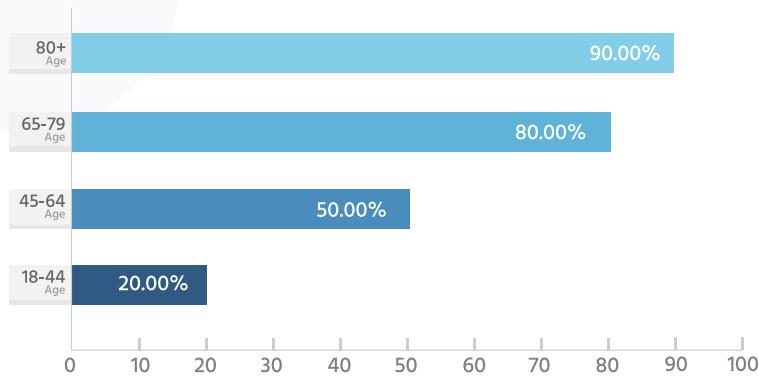
The term preventive healthcare was defined in 1940 by Hugh R. Leavell and E. Gurney Clark working at the School of Public Health at Harvard and Colombia University, and consists of Primary, Secondary, and Tertiary prevention.

Primary prevention is medical treatment which prevents disease by increasing resistance to disease and mainly includes physical exercise and dietary forms of activity. Secondary prevention refers to early detection and treatment of diseases utilizing early detection and treatment before onset. Tertiary prevention of disease includes active medical and surgical treatment to reduce disability or death.

1.2.2 Effect of preventive healthcare

Cardiovascular disease (CVD) in particular is the most expensive disease among medical costs in developed countries. CVD costs about \$1.5 billion per day in the United States as of 2017 and is expected to cost \$1,100 billion (\$1.1 trillion) per year in 2035. It is estimated that more than 50% of Americans over the age of 40 have some form of CVD. [table 2]

Prevalence of CVD by Age (2015)



[table 2] Percent of U.S Population with CVD

CVD is therefore the most burdensome disease for insurance companies and individuals alike who must pay for the consumer share of medical expenses. It is the major cause of medical bankruptcy and a disease that has a significant impact on an individual's well-being and quality of life.

Ironically, 90% of CVD which puts strenuous economic burden on individuals, companies, and society, is preventable. [fig 1] Exercise and dietary management, now known as common sense, are the most proven methods to prevent CVD, and these two methods are the most essential and basic elements of preventive healthcare.

Academia reports that even outside of cardiovascular disease (CVD) prevention, exercise is the best way to prevent all metabolic diseases and cancers and is an important factor in activating NK cells (lymphocytes) which boost the effectiveness of the human immune system.

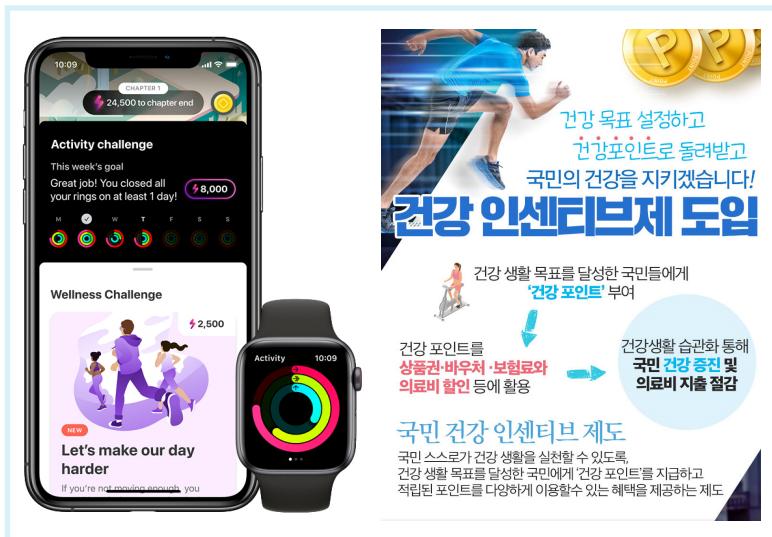
1.3 Fitness incentive program for preventive medicine

1.3.1 Government-led fitness incentive program

The federal and state governments of the United States, where obesity and metabolic disease have long been a serious problem in society, are already implementing a system that provides financial incentives to people who strive for increased health through wellness activities such as exercise. 75% of companies in the United States offer employee incentives to improve the health of their workforce.

Singapore operates a healthcare compensation program called Lumihealth in which any Singaporean citizen 17 years of age or older can participate and receive monetary incentive rewards of up to \$380 over two years by measuring one's fitness activity using an Apple watch.

The British government is running a program that gives companies a tax discount when a company installs gym facilities for the health of its employees or contracts employees' membership with a local fitness center through a system called Fitness at Work.



[fig 2] Marketing images of Singaporean and Korean governments' Health Incentive Programs

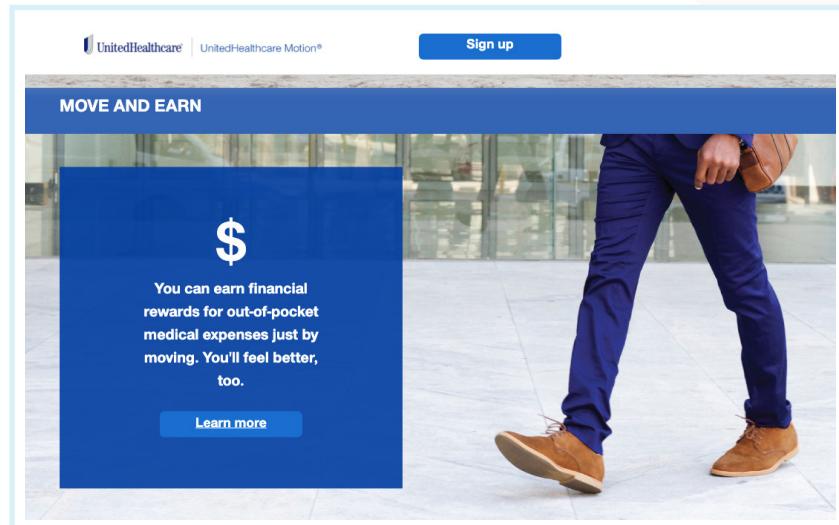
In the 2020 South Korea general elections, the ruling Democratic Party, has selected a “national health incentive system” as a pledge to give points to people who exercise and use those points to improve their health (currently operating as a pilot project in 2021).

1.3.2 Enterprise-led fitness incentive programs

As of 2021, most global insurance companies are selling products that discount insurance premiums in proportion to an individual's exercise amount and are operating healthcare services. United Healthcare, Vitality Health, Clover Health, Oscar Health, Zhongan Insurance, and Samsung Insurance, among others, are actively participating to lead insurance innovation by applying insurtech technology.

The long-term goal of operating such an incentive program is to reduce the incidence rate by improving the health of customers by using digital healthcare services or to reduce medical expenses by delaying the onset of disease. The short-term objective of insurance companies is to provide financial incentives (points) to potential customers in line with their health promotion efforts such as exercise to sell direct insurance (direct to consumer via digital means based on fitness) in return for discounting premiums with issued points.

In particular, as the method of communication between people gradually transitions more to virtual interfaces and online spaces, the existing method of distributing insurance products offline decreases as direct to consumer sales of insurance online increase, emphasizing the importance of fitness based incentive programs.



[fig 3] UnitedHealthcare website

1.4 The importance of preventive healthcare and the increase in the value of exercise data

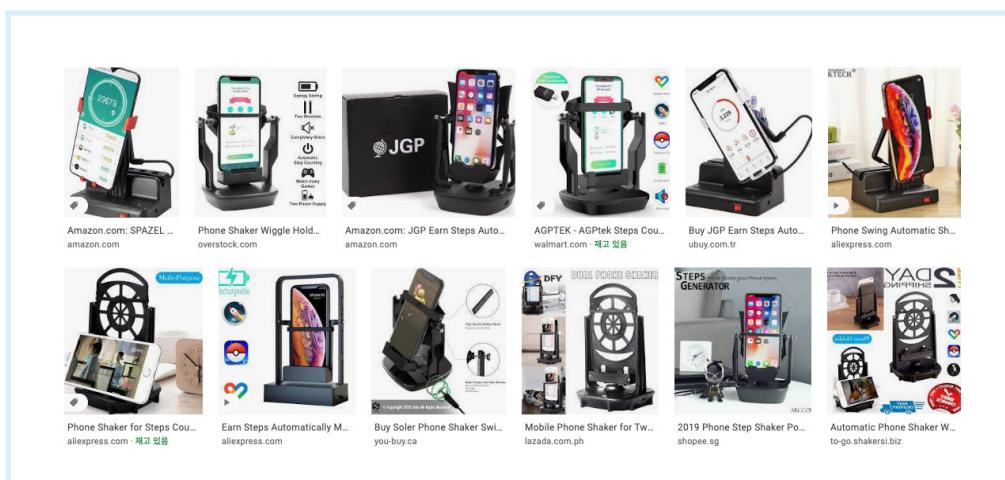
1.4.1 Development of smartphone and wearable industry

An individuals' primary internet gateway has moved from desktop PC to mobile with the advent of the smartphone enabling the tracking of individual physical activity. This important point of change in the healthcare industry has led to the emergence of numerous activity tracking smartphone applications, and the successful adoption of such applications has further led to the development of personal healthcare equipment we know today as smart watches and fitness trackers.

1.4.2 Limitations of smartphones and wearables due to false exercise information

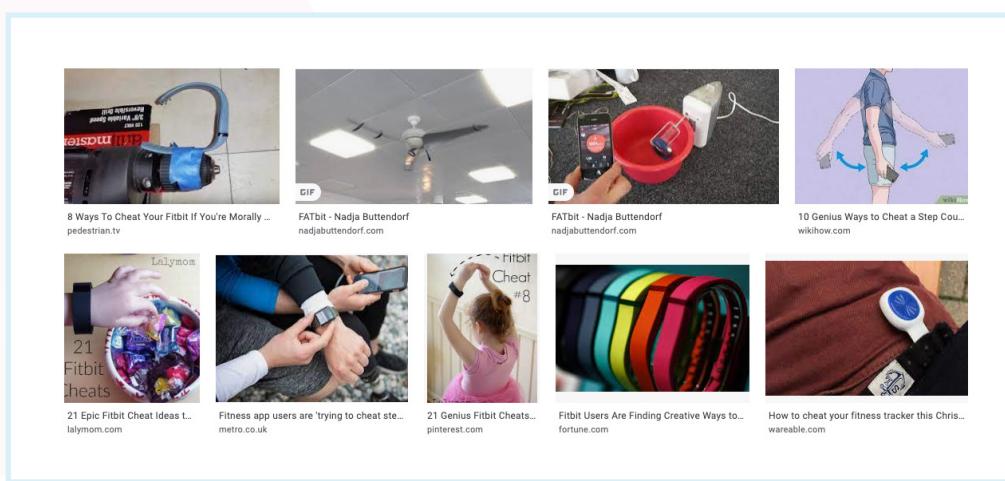
Exercise data has gained monetary value as healthcare companies continue to provide monetary incentives to users by utilizing exercise (physical activity) information from smartphones and wearables. The fact that these reward points, received through exercise, can be used to pay for insurance premiums and various other consumer payment activities has encouraged individual users to generate false fitness data to obtain points more easily. Thus, various methods and products designed to deceive smart phones and wearable devices have been created and are being sold.

The image below shows the result of searching for “phone shaker” on Google. The products depicted have functionality that automatically shakes a smartphone to increase the number of steps tracked by fitness applications running on it.



[fig 4] Google search image (Search term: phone shaker)

The image shown below is the result of searching for “fitness tracker cheat” on Google and shows methods to increase the amount of “tracked” exercise by cheating the fitness tracker in various ways.

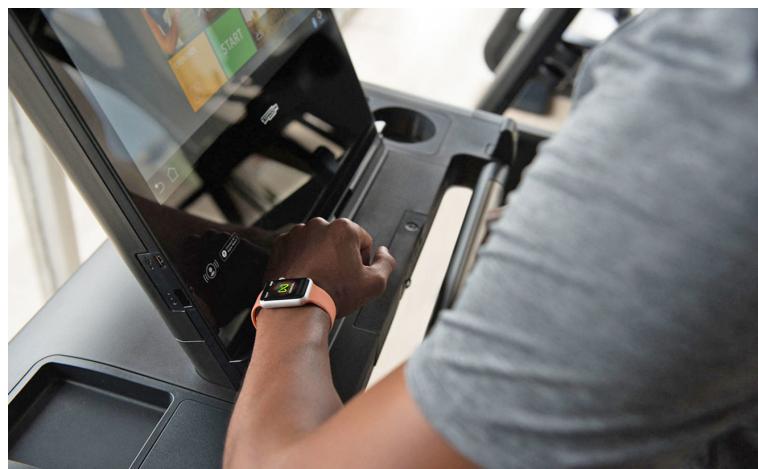


[fig 5] Google search image (Search term: fitness tracker cheat)

Methods of manipulating fitness data in such various ways have emerged and are widely disseminated, and this problem has become a critical factor in hindering the goal of realizing preventive healthcare as a hub of healthcare services through wearable devices.

1.4.3 Development direction of healthcare data towards the fitness industry

Apple released GymKit, a service that calibrates fitness data accuracy and expands its usability by linking Apple Watch with cardio fitness equipment (i.e. treadmill). This service is managed through Bluetooth as Apple Watch authenticates its connection to the OEM fitness equipment preinstalled with GymKit via NFC, pairing exercise tracking and information display.



[fig 6] Apple Gymkit image
(source: <https://appleinsider.com/articles/19/06/12/apples-gymkit-what-it-is-who-supports-it-and-where-you-can-find-it>)

2. Metaverse, a new sporting arena for mankind



[fig 7] Cardio indoor bike hiking in the Roblox metaverse platform

2.1 The relationship between the definition of sport and the metaverse

Since sports are defined by three elements, 1) exercise, 2) competition, and 3) entertainment, fitness exercises without competition and fun are not sports, and games without exercise would also be difficult to be considered sports.

Sports is one of the largest industries in terms of popularity and industry because it is essentially a fun game that promotes health. Physical restrictions for assembly are removed with the advent of the metaverse, and it is certain that this will grow into the future.

2.1.1 Why exercise is hard and why sports are fun

Because it is very difficult to run alone on the playground, it is often used as a method of self-discipline or as a penalty. And we do this unbearable exercise to be healthy. However, if you run the same playground but have a teammate who runs with you and competes, the task becomes easier. The same is true if you add a ball to that equation and add sporting rules for more teammates and more fun, which results in full-steam exercise for over 1 hour without exhaustion.

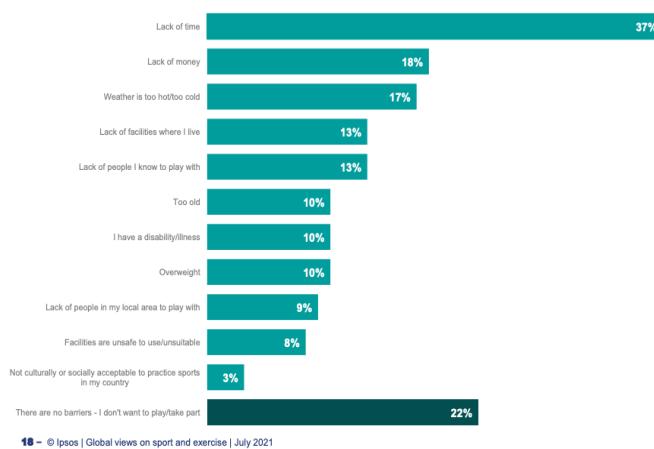


[fig 8] Image of the difference between simple exercise and sports

2.1.2 Modern society : where it's difficult to participate in sports

Sports are the most fun way to improve health while exercising, but due to lack of time, influence of weather, lack of facilities, lack of available teammates, amongst various other constraints, make sporting conditions difficult.

WHAT BARRIERS, IF ANY, STOP YOU FROM PRACTICING SPORTS AS MUCH AS YOU LIKE? - GLOBAL COUNTRY AVERAGE OVERVIEW



Lack of time is the most common barrier to participation in sport almost with four in ten across the 29 markets saying this stops them practicing sport as much as they would like.

One in five say there are no barriers to their participation in sport.

Base: 21,503 online adults aged 16-74 across 29 countries
Online samples in Brazil, China, Chile, Colombia, India, Malaysia, Mexico, Peru, Romania, Russia, Saudi Arabia, South Africa and Turkey tend to be more urban, educated, and/or affluent than the general population
The "Global Country Average" reflects the average result across the countries where the survey was conducted. It has not been adjusted to the population size of each country and is not intended to suggest a total result.



[table 3] Analysis of the causes of difficulty in exercising

2.2 Cardio Healthcare's Metaverse Strategy

The metaverse has risen rapidly as a space where people can gather without or with minimized restrictions of time and space. And due to the influence of the pandemic, work and gatherings on the metaverse have become quickly established parts of daily life. Since sports are also activities that must be done communally, there is no doubt that the sports space is an area in which the technical advantages of the metaverse can be fully utilized.

2.2.1 Metaverse Exercise Interface M.E.I

The physical location of the avatars in the metaverse is meaningful just like in the real world, and moving the avatar will be different from surfing on the internet. The method of transmitting the user's desired avatar movement signal will become increasingly diversified.

Interfaces operated by hand gestures such as computer mouse, keyboard, and joystick controllers are still in use, but for sports in the metaverse, an interface that controls the avatar by movement of the body is required. From a variety of interface concepts, Cardio is starting with indoor bicycles and treadmills to leverage the existing 500 million global users of these indoor exercise equipments.



[fig 9] Photo of joystick for bicycle during MEI

2.2.2 Utilization of existing metaverse platforms, games, and contents



[fig 10] Image of Roblox



[fig 11] Image of Zwift

Cardio Healthcare focuses on MEI, a data interface that links metaverse content and exercise equipment and utilizes high-quality content that has already been developed and is familiar to users. As of March 2022, a variety of



[fig 12] Image of Asphalt

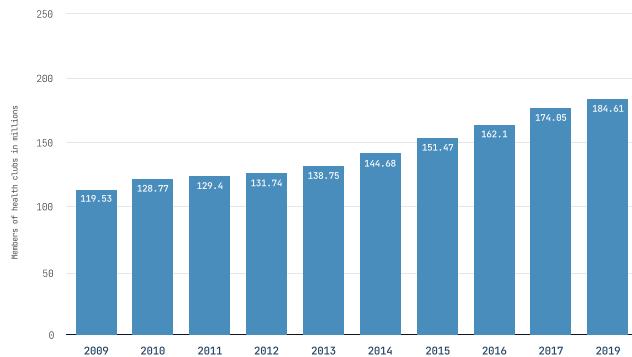
content including 50 games have been secured, and the cumulative number of downloads of the curated games totals more than 1.5 billion. Representative contents include Roblox, the world's largest metaverse platform, Asphalt, the world's best racing game, and Zwift, the world's largest bicycle simulation program.

2.3 Metaverse's potential market of 500 million users on indoor exercise equipment

2.3.1 Number of fitness clubs and its members



[table 4] Total number of health and fitness clubs worldwide 2009 to 2019 (source : statista)



[table 5] Number of members in health and fitness clubs worldwide from 2009 and 2019 (source : statista)

There were an estimated 200 thousand fitness centers globally in 2019 with the number of memberships estimated at 180 million. The number of memberships is the number of members who maintain a membership with a fitness center while these statistics have been compiled. To calculate the actual number of individual members will require adding the number of members who are taking a break from exercise (not currently enrolled as a member during the point of statistics compilation).

According to data from The Global Health and Fitness Association (IHRSA), the average retention rate of gym members in the United States stands at 60% with 40% of members estimated as taking a leave from sustained exercise. It is estimated that 72 million members globally have been members of gyms but are temporarily stopping their membership based on this data, with the total number of members estimated at 250 million people.

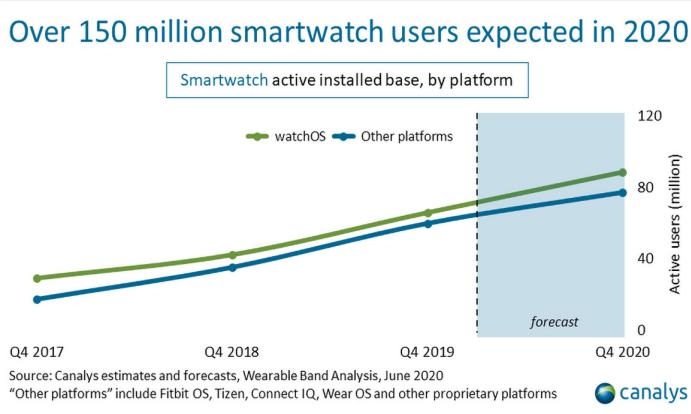
2.3.2 Estimate of home indoor bike users

Publicly available data on indoor bicycles for use at home estimate the market to be around \$1.2 billion annum, and assuming an average price of \$250, about 4.8 million units are shipped every year. Assuming an average of two users per household with a product lifespan of 5 years, an estimated 48 million people use indoor bicycles worldwide.

2.3.3 Number of active users of smartwatches

Wearable devices (for wrist) started with a simple function: to measure user exercise activity. Many companies released wearables, but most have failed to induce daily adoption and continuous usage.

The smart watch is essentially a fitness tracker that has developed into a personal healthcare device as it is equipped with hardware and software that allows for the tracking of users' heart rate, electrocardiogram, and sleeping habits. The industry is most recently being led by global tech giants such as Apple, Google, and Samsung due to the increase in the sophistication of smart watch technology and the need to reduce costs through mass production.



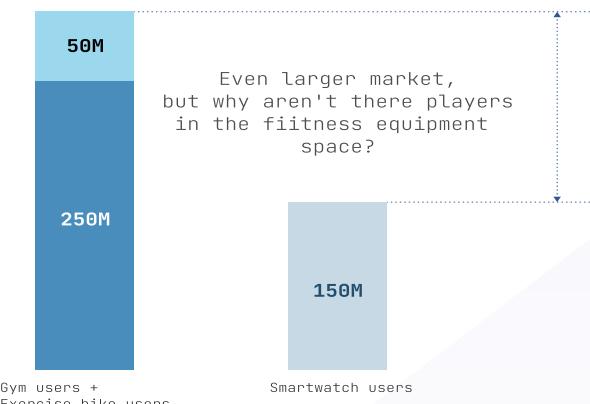
[table 6] Number of smart watch active users (source : canalys)

The number of active users of smartwatches stands at 150 million people as of 2020.

2.3.4 Indoor exercise equipment users have more users than smartwatches

The combined 300 million gym members (using treadmills) and home fitness users of indoor bicycles is much larger than the 150 million active users of smart watches worldwide, and this indoor market has a longer history and steadier growth and continues to have more adoption.

CARDIO views this as a global opportunity since there is no mass adopted, digital first service that collects verified user exercise data generated from exercise equipment and provides it for use in the healthcare industry.



[fig 13] Comparison between smart watch active users and indoor exercise equipment users

2.4 Opportunities in the metaverse and indoor sports industry

2.4.1 Prolonged COVID-19 and the advent of the metaverse

Metaverse, a term that began to be used in the novel Snow Crash in 1992, does not have an exact, global definition as of 2021, but is considered an ecosystem in which virtual reality is connected to physical reality. In the aftermath of the global outbreak of COVID-19, the establishment of an enhanced culture of meeting and collaborating with others through telecommuting and online spaces is rapidly increasing the need for and adoption of the metaverse industry.

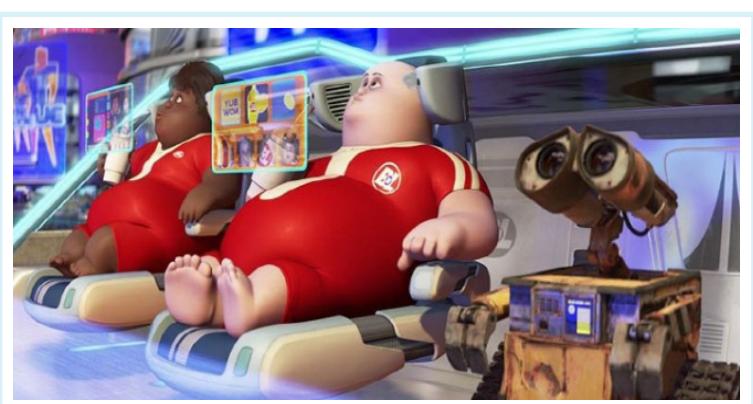
Unlike its predecessor the virtual reality industry which uses time and money in cyberspace separated from reality, the metaverse which can create real value and economic profits which translates to reality, encourages the participation of not only game users, but also that of the general user public. It is expected that the gaming industry will grow to be much larger by inducing and embracing this change.

In particular, the development and adoption of the metaverse is expected to accelerate as social consensus forms around the concept that collaboration and work in the metaverse world is a key element to a zero-carbon society. Rather than physio-spatially commuting to work and utilizing environment polluting sources of energy, the metaverse, a tangent between virtual and physical, can provide an alternative solution to a major cause of global warming.

2.4.2 Decrease in physical work (exercise) and metabolism with the advent of metaverse and AI

Physical metabolic work (exercise) is required in order to perform economic activities in the real world. Exerting physical effort to commute to and from work are a basic part of any job, for office workers as well as physical laborers.

However, the advent of the metaverse era, in which there is no need to physically move for economic activity, will sharply drop an individual's metabolism from exercise. This concept has already been popularized through novels and movies, and morbid obesity of the entire human race is treated as an insurmountable problem in the future due to the decrease in exercise metabolism depicted by the movie WALL-E in particular.



[fig 14] A scene from the movie WALL-E Google Images

2.4.3 The necessity of commuting and exercise in the metaverse

Metaverse has become an alternative for advancing a carbon-neutral era as it provides increased efficiencies to work and life. However, if a person stays at home without physical movement, obesity-related diseases such as cardiovascular disease increase and become another social problem. Therefore, a solution is required to maintain physical health by motivating exercise within the metaverse.

CARDIO has found a market opportunity to solve this problem by offering users monetary incentives and immersive exercise games(sports) and has developed and prepared exercise equipment and sensors as an interface that captures and transmits real fitness data.

2.5 Seizing opportunities in existing indoor exercise equipment market where data collection was difficult

2.5.1 The reason why exercise data from existing treadmill was useless

Until now, the treadmill could not measure the actual distance traveled by a user, because the treadmill has its belt driven by an electric motor which continues to rotate the belt (thereby increasing displayed distance) regardless of user input. Thus, even though there are 250 million treadmill users, the exercise distance data from treadmills could not be utilized by the healthcare industry.

2.5.2 Household indoor bicycles for which exercise data collection is not possible

Indoor bicycles can be broadly classified into two types, one for home use and one for commercial use. The technology required for the collection of exercise data from two types are different. In commercial use indoor bicycles, it is possible to collect relatively accurate movement data because it measures the amount of power generated by driving the alternator(generator) with the user's motion, but for home use products, the lower price and volume compared to commercial makes it cost prohibitive to incorporate an alternator. Therefore, almost all indoor bicycles for home use measure only the number of rotations of the pedals instead of real exercise data. Therefore, it would not be an exaggeration to say that the user exercise data is not being collected in almost all indoor bicycles for home use.



[fig 15] Electric motor image of treadmill
(Source: Google search)

3. Introduction to technology

3.1 Artificial intelligence data collection technology (patent mentioned)

3.1.1 Universal treadmill sensor technology

To collect the actual exercise information of 250 million treadmill users, CARDIO measures the raw vibration

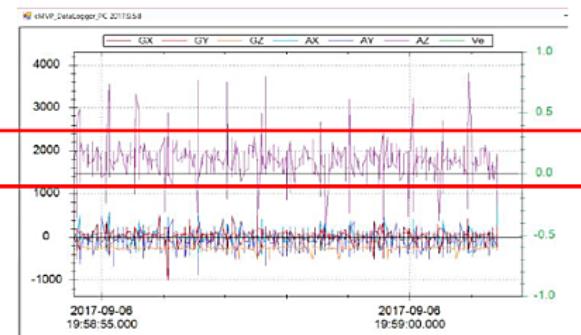
data of the treadmill and those generated by user movement during exercise and apply machine learning to the vibration patterns to determine whether the user's exercise is real or not. CARDIO has developed and patented (original technology as a patent in the United States, Korea, China, and the United Kingdom) the world's first technology that measures the distance of exercise by checking the validity of the data being generated only during actual exercise.



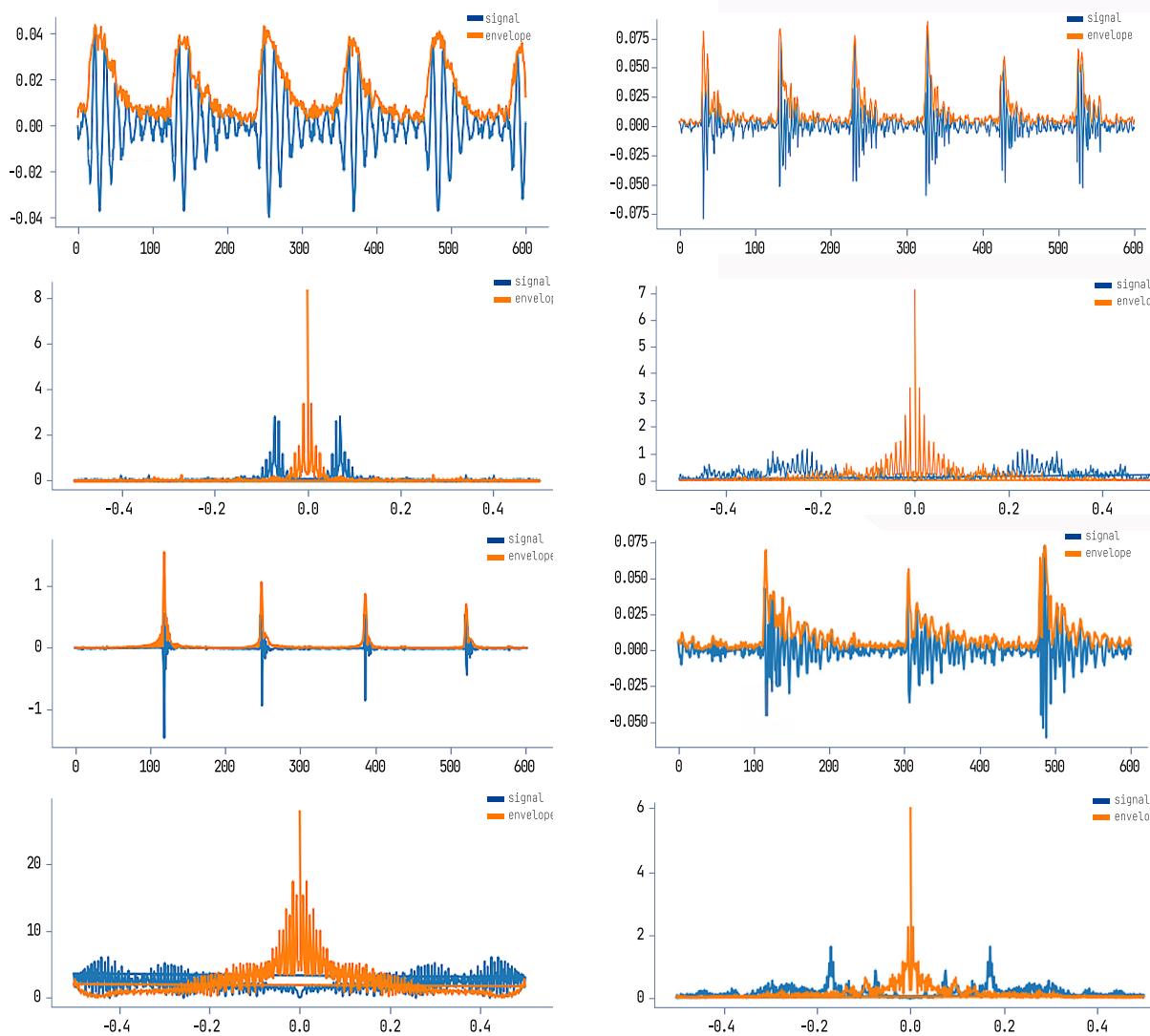
[fig 16] Cardio Treadmill Universal Sensor Image

The universal sensor that collects vibration data uses a multi-axis gyro sensor and sends information to the tablet PC which acts as a gateway through the AP using the Wi-Fi wireless protocol. The tablet PC determines whether the user is really exercising, or cheating based on the collected vibration data based on previously learned data. Cardio's server issues incentive points to the user called Cardio Points based on distanced worked out only when it is determined that the user is really exercising.

Thanks to this sensor which can be attached to any existing treadmill, it is now possible for a simple treadmill to transform into a healthcare device that collects verified user exercise data utilized in the healthcare industry.



[table 7] Vibration raw data generated from user movement



[table 8] Auto encoder analysis graph to determine the user's fake exercise

3.1.2 Cardio smart pedal (Accurate exercise data measurement on home indoor bikes)

The indoor bicycle which is used by about 50 million people worldwide, is a product expected to become used by even more people as the home fitness market grows. Indoor bicycles do not need to determine whether the user is actually exercising because distance is not measured without physical input from the user. However, this product still has problems in two respects.

The first is the problem of not being able to measure actual momentum. Existing indoor bicycles predicted distance exercised based on the user's number of pedal rotations. To be more specific, it is necessary to know not only the number of pedal rotations (angular velocity) of the user, but also how much intensity (torque) the user is applying to measure the actual physical quantity of exercise (for meaningful use in the healthcare industry).

Second, it is difficult to define the standard for data collection as many small and medium-sized enterprises (SMEs) produce various indoor bicycle products. This is because indoor bicycles do not have high technical barriers due to manufacturing, and because of their comparatively large volume and weight compared to its price, local SMEs lead this industry rather than global conglomerates.

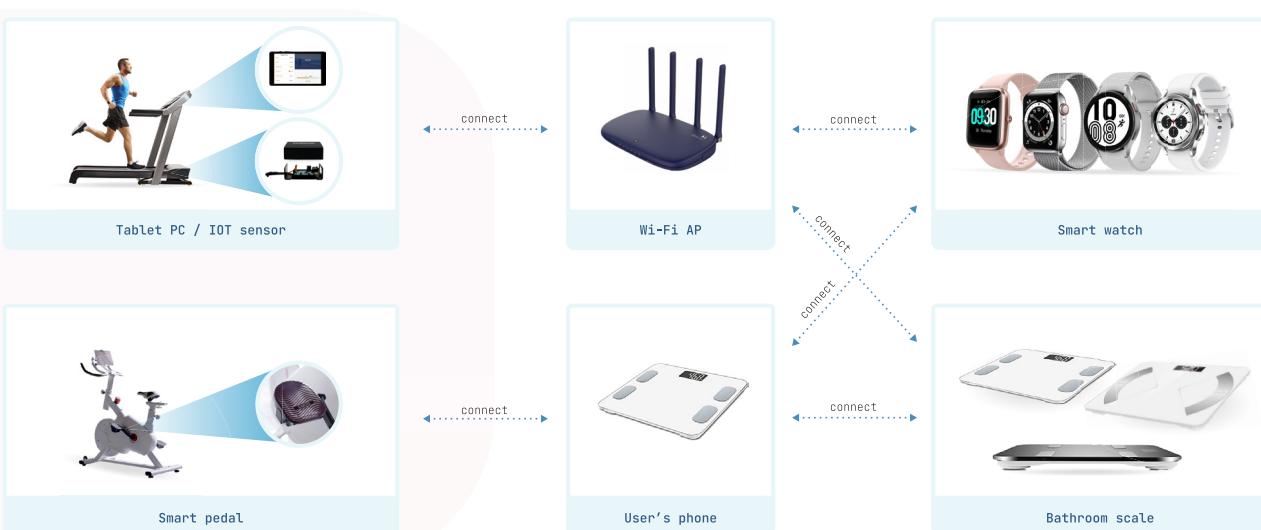
To solve these problems, CARDIO has developed a smart pedal which can be attached to any bicycle and can measure the user's exact amount of exercise.



[fig 17] Cardio smart pedal image

3.2 Data integration and interpretation technology (open data collection system using IoT hub)

3.2.1 Smart watch and scale networking using Wi-Fi



[fig 18] Wi-Fi-based IOT hub image

Cardio's technology and products use Wi-Fi as the basic communication method for easy connection with other external devices, so that it can be used as a hub for IoT systems. This is meaningful in that by collecting and linking big data such as heart rate, electrocardiogram, weight, and other data sets that match with the exercise information most frequently checked by CARDIO's users, this big data can be applied to an artificial intelligence engine down the line.

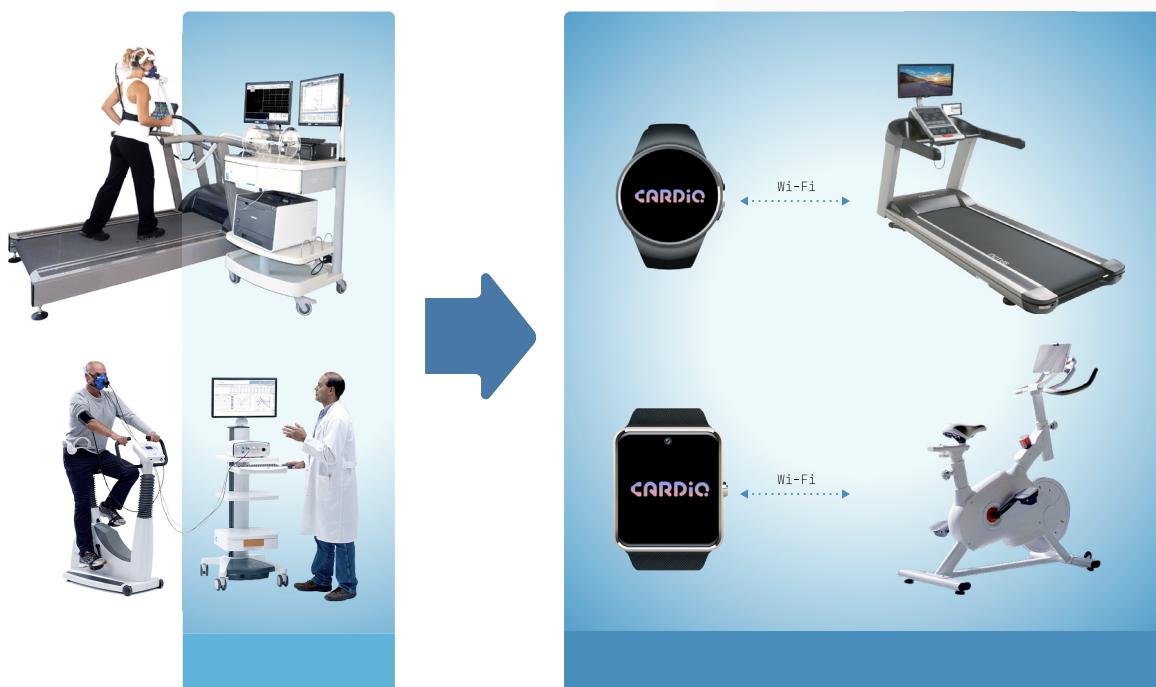
3.2.2 Artificial intelligence technology for cardiovascular disease prevention

It is very difficult to recognize the degree of progression cardiovascular disease (CVD) until the patient voluntarily perceives it. The signals from the heart may be weak and the general public, without medical expertise, tends to ignore it. Therefore, there is active development of services that use a smart watch (which is developing more so as a healthcare device) that checks the heart for abnormal reactions in daily life and provides an alarm when a certain standard is exceeded.

Since it is necessary to define what normal heart activity is to develop a preventive service detect cardiovascular disease, big data on a broad population of people's heart activity (fitness data) is essential and one of the purposes of CARDIO's technology.

When visiting a cardiovascular hospital for heart diagnosis, there is an exercise load testing device to measure an individual's heart abnormalities which basically consists of a treadmill or an ergometer (indoor bicycle that can measure the amount of exercise accurately) and an electrocardiogram device. These devices are used for diagnosing diseases by putting a certain amount of exercise load on a patient's who may be at risk for abnormal heart activity and examining the response of the heart.

CARDIO will make sure that treadmills and indoor bicycles at gyms and at homes can accurately measure the amount of exercise and can be connected with smart watches in order to enable and implement a system that conducts exercise load testing normally conducted in hospitals for patients in everyday spaces. CARDIO will have access to, in real time, the user's heart rate according to the exercise load and the change in the electrocardiogram post-workout. The cardiovascular response data according to the exercise load from the broader population of fitness users is expected to be used as key data in predicting heart disease in the future.



[fig 19] Big Data Collection Strategy Diagram for Heart Response by Exercise Load

3.3 Technology for the metaverse

3.3.1 M.E.I for Avatar Control (Metaverse Exercise Interface) Technology

The metaverse can be categorized into two types based on the method of controlling the movement of the avatar. To take the example of popular movies including Avatar, Gamer, and Surrogate for easy understanding, the first method is designed to control the metaverse avatar without physical body movement using only the user's brain signals. The other method of controlling the avatar involves bodily exercise through hardware equipment such as in the movies Ready Player One and Pacific Rim.

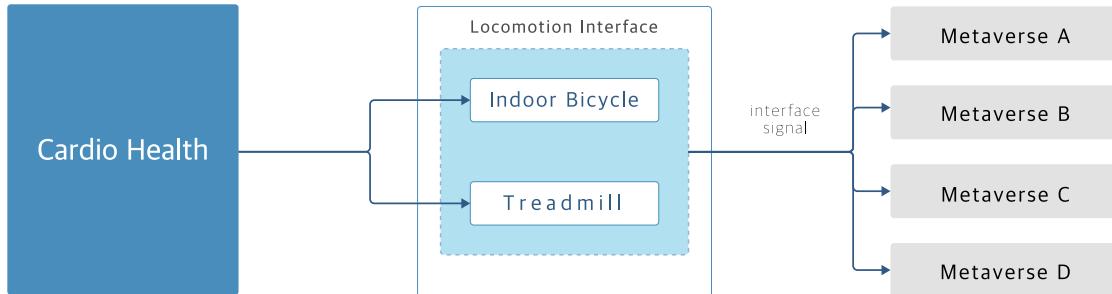
The future of metaverse will institute a coexistence of both methods, but in order to maintain users' physical health, it is expected that there will be an adoption of many cases where the method of controlling the avatar by physical human body movement. In particular, Ready Player One which realistically depicts the metaverse era of the near future, uses a treadmill that can freely move in a two-dimensional plane to control the metaverse avatar, and prototypes of similar products are under development as of 2021.



[fig 20] A scene from Ready play one. Google image search

With the development of HMD (head mounted device) and the game industry, the technical preparation to build the metaverse is prepared, but it is expected to take considerable time to introduce into reality a smooth-functioning omni-directional treadmill that accommodates locomotion like from Ready Player One. Therefore, the configuration of locomotion interfaces for metaverse using fitness equipment that can be realistically applied at home will be prioritized, Cardio Healthcare provides products and middleware that can control metaverse avatar movement by collecting user exercise data from treadmills and indoor bicycles. Additionally, Metaverse Exercise Interface, MEI, can be used on all exercise equipment.

MEI aims to generate all signals related to avatar movement, such as commuting, shopping, as well as sports and exercise in the Metaverse.



[fig 21] Role of MEI

3.3.2 MEI HID Profiling Technology

Financial incentives as well as fun & competition serve as effective motivators for exercise.

With many indoor bicycles that can facilitate body-controlled contents already, our edge will be faster procurement of already developed games and a variety of contents integrated with various forms of exercise.

Cardio Health provides HID protocol profiling technology that converts the joystick controller signals and the smart pedal's exercise distance into game signals, and if used, allows for games on smart phone, smart tv and other devices to be played on the bike while you exercise.

Profiling joystick applied to indoor bicycle used for gaming on Amazon TV.



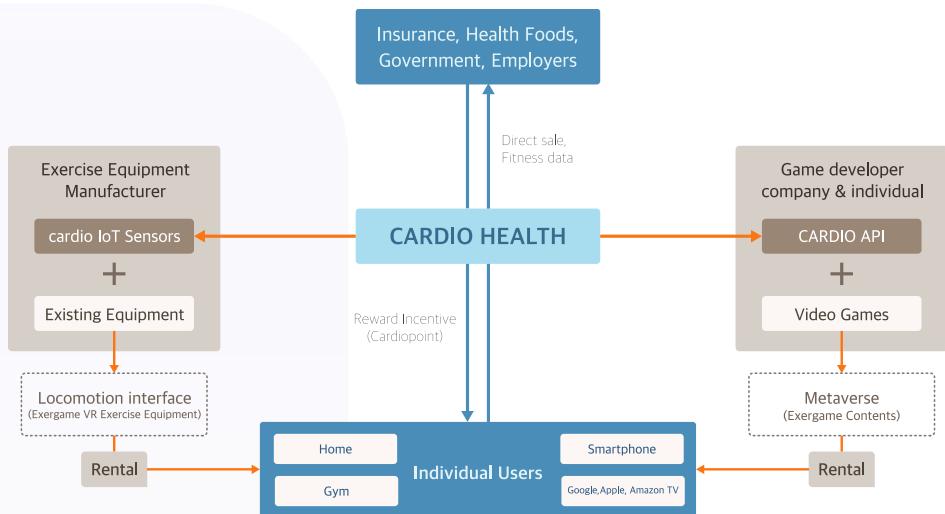
[fig 22] An image of playing a game on Amazon TV on an indoor bicycle applied with a profiling joystick

3.3.3 Universal IoT parts for exercise equipment and API for games

CARDIO has chosen methods which promote fast adoption by integrating with the existing exercise equipment (attachable IoT sensors) and game industry (exercise integrated game middleware platform) in order to quickly spread the protocol and rapidly secure many users.

CARDIO provides universally installable parts to exercise equipment manufacturers which transforms existing exercise equipment that is already produced into an upgraded virtual reality tangible exergaming (combination of exercise & gaming) equipment, and API for this exergaming equipment is provided to game companies and developers. This allows for all existing games to be uploaded to our platform and made into tangible exercise gaming content.

As such, the direction of technology pursued by CARDIO focuses on easily upgrading existing products so that they can be quickly distributed in the market to quickly secure members and take a strong first-mover advantage.



[fig 23] Strategies for distributing parts for exercise equipment and distributing API for exercise experience

3.3.4 Blockchain tokens as metaverse currency

Points are used globally in games, existing virtual worlds, under various names such as gold or coin. Points in the metaverse have the additional link between virtual and real in that points are characterized as having utility in both worlds.

As in the real world, Cardio Points will be paid to users based on the fitness data of the avatar's exercise or movement in the metaverse, and by converting Cardio Points into Cardiocoin, they can be converted into real fiat equivalent currencies.

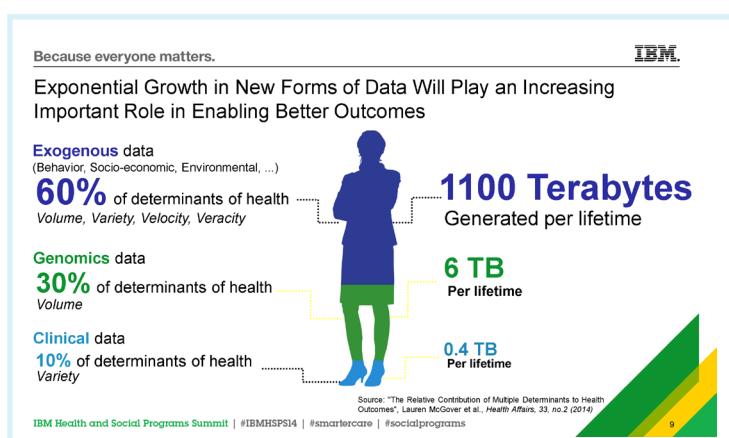
As such, Cardio Points and Cardiocoin, which have utility in both the virtual and real world, must prevent double payment and false issuance, control inflation, and maintain transparency.

4. Token Economy

4.1 The importance of cryptographic assets in preventive medicine

4.1.1 Incentive compensation based on patient experience data

Exercise and diet are the most basic methods of preventive healthcare, but since most people find it difficult to stick to them in their daily life, more and more companies and governments are trying to promote health by providing incentives based on data related to exercise and diet. Therefore, it is essential to collect objective data on individual exercise and diet. In addition, preventive medicine services such as preventive disease alarms using artificial intelligence must first teach artificial intelligence what is "normal without disease" in order to define that disease, so it becomes necessary to systematically collect analogous data from people in "normal" condition. The Cardiocoin project focuses on this area in particular, and the patient-related data for cardiovascular disease prevention described in 3.2.2 is expected to be the most valuable patient-related data.



[fig 24] Patient data slide image (Source: IBM)

4.1.2 Problems of the current system related to securing financial resources for incentive compensation and desirable solutions

Monetary incentives have been verified to be the most effective way to encourage individuals to participate in data collection for personal health promotion and early warnings of disease.

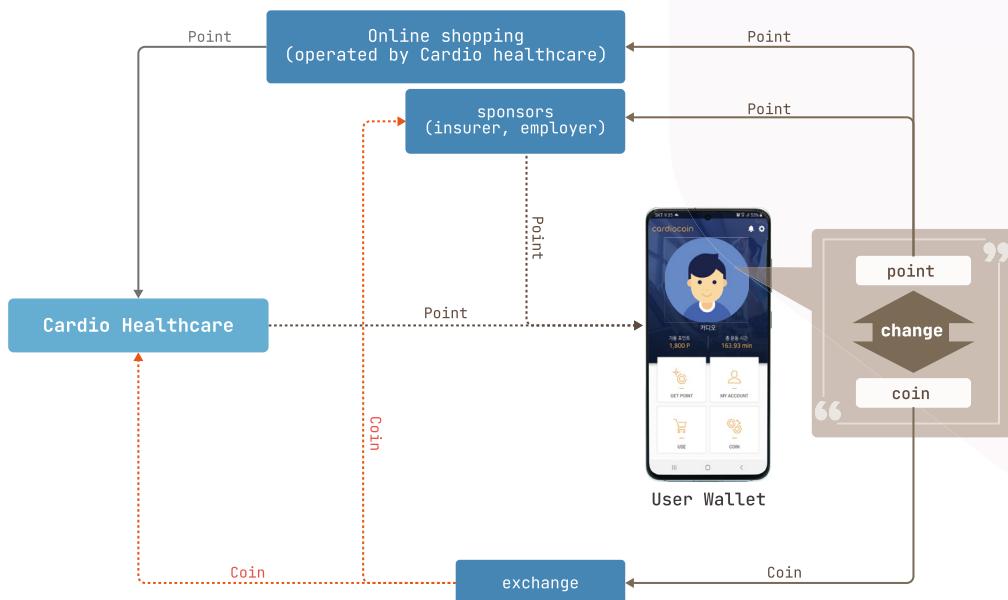
It is possible to reduce medical expenses by using financial incentives for preventive healthcare activities which will prevent incurring higher medical costs and the sustained costs associated with decreased quality of personal life. However, this can also be a significant financial burden particularly if the government issues government backed bonds to finance the issuance of these incentives. This will inevitably become a workaround for solving these ever-present problems by loading financial pressure onto future generations.

CARDIO aims to build a direct distribution platform (Direct-to-Consumer) for healthcare products and services to reduce unnecessary intermediary distribution costs to build an ecosystem that can provide these distribution costs saved by healthcare companies as the primary source of user fitness incentives.

For example, if an insurance company provides CARDIO members with Cardio Points as compensation for exercise or diet and allows the points to be used for payment of insurance premiums, users will receive incentive aligned monetary compensation in return for their health promotion activities. The company will reduce distribution costs through direct-to-consumer insurance sales, creating an ecosystem that benefits all participants in the protocol.

Preventive healthcare can be realized by utilizing this protocol economy which promotes individual health through the market economy without the heavy requirement of governments or corporations securing additional financial resources.

4.1.3 Necessity of Cardio Point



[fig 25] Relationship between cardiocoin & cardopoint

Cardio Point is a digital currency used for monetary exchange within our protocol as its value is constant compared to other legal currencies.

Cardiocoin is a blockchain token used in our protocol (issuance is limited to 12 billion CRDC). It is a digital asset that corporate participants (sponsors) must stake when issuing Cardio Points for the purpose of payment to users within the ecosystem.

As of 2021, the blockchain system is not yet a mainstream service platform making it difficult to be used in connection with various existing financial service systems. In particular, if the incentives received from exercise are limited only to blockchain tokens, the use of these tokens will be limited to a small number of blockchain services. This will decrease the scalability of the protocol and users will find less utility. In order to solve this inconvenience, CARDIO's protocol provides Cardio Points that can be used in the existing off-chain as an incentive for health promotion activities and can also be converted into crypto assets.

4.1.4 The need for Cardiocoins (CRDC)

Cardiocoins (CRDC) is a blockchain token developed as an ERC20 token based on the Ethereum protocol. Cardio Point is insufficient in and of itself as an incentive for health promotion in CARDIO's protocol and necessitates the use of Cardiocoins as an essential factor for successfully running the Cardio Protocol service as detailed below.

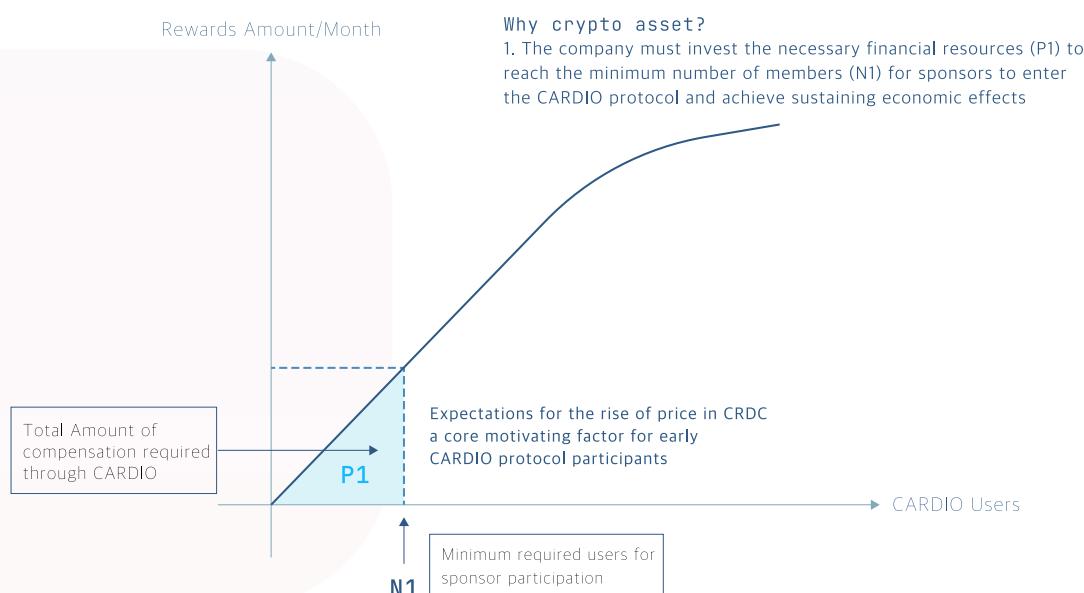
The core of Cardio Protocol is to give individual members the 'motivation for increased health.'

Type 1 is a cash equivalent point that can be used virtually immediately (like cash). Cardio Points correspond to these cash equivalent points. These cash equivalent points are a costly method in that the entity providing (sponsoring) incentives, such as governments and corporations, must immediately prepare and use cash resources to finance this service.

Type 2 is a blockchain token, with a limited issuance amount and volatility in its value. Cardiocoins (CRDC) corresponds to this type, and the expectation that the price of the asset can rise is the primary motivation for acquisition. This means that even apart from its current usefulness (utility), it can serve as an effort-driving incentive mechanism for users and lower the financial burden of governments and corporations in motivating improved health.

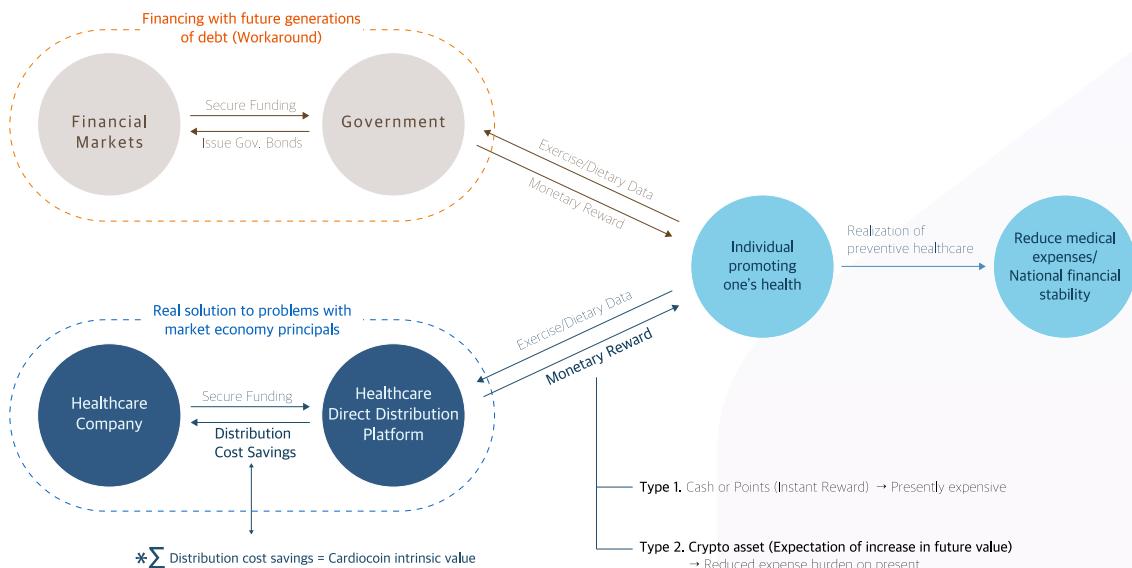
To highlight again, the difference is that Cardio Point, the driving force that moves people as a motive for health promotion, is ***the current usefulness***, and Cardiocoins is ***the expectation of future value***. In other words, when incentives are provided to the same number of people under the same conditions over the same period, the usage of Cardiocoins in that protocol allows savings on the overall cost of financial resources invested for the motivation of improved health.

Cardiopoint : Cardiocoins = Current usefulness : Expectation of future value



[fig 26] Graph of CardioCoin Necessities for Initial Service Settlement

For the same reason, Cardiocoin is essential for the initial service settlement of the protocol. CARDIO's protocol aims to realize autonomous preventive medicine by utilizing the market economy rather than relying on the government's deficit financing. Therefore, this protocol must satisfy the minimum number of participating users (N_1) that can make it attractive enough for participating sponsors to provide the required monetary incentives (P_1). Thus, if members are recruited up to N_1 by replacing P_1 of financial resources with expectations of future value (Cardiocoin), the protocol can be expected to autonomously operate stably as the number of participants (sponsors) increases.



[fig 27] Strategic diagram for realizing preventive medicine through market economy rather than tax

4.2 Protocol configuration

4.2.1 Members as data providers

Data in our protocol means all data generated from individual users that have made efforts to improve their health, and particularly with emphasis on data that can be trusted by utilizing CARDIO technology. This includes personal fitness data that is legal to collect, such as exercise distance, exercise time, exercise frequency, body weight, heart rate, electrocardiogram, and BMI, as well as diet-related data such as the type of health foods purchased including but not limited to the price and types of health foods purchased. The providers of this data which are generated from efforts to promote health are compensated by the demanders of this data through Cardio Points which can be used for additional consumer spending on the platform or exchanged for price equivalent Cardiocoin (CRDC).

CARDIO users, data providers, can be divided into B2B users such as gym members and B2C home fitness users who exercise with exercise equipment or smart watch.

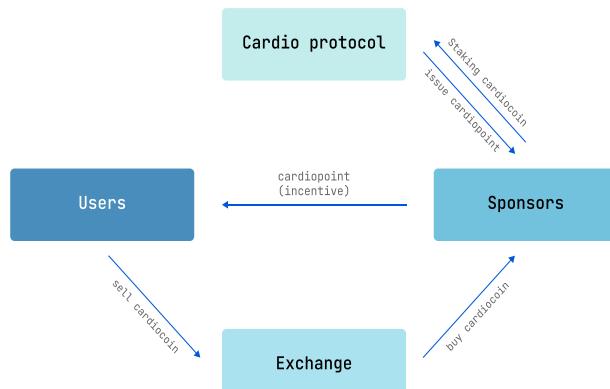
4.2.2 Sponsors as data consumers

Data consumers in our protocol include entities such as governments, insurance companies, and employers who benefit financially when the health of its members are improved and entities such as healthcare & health food companies, medical clinics & hospitals, and fitness goods companies who utilize the data for direct-to-consumer marketing efforts (often through digital channels). Thus, those who demand data from and offer incentives in the form of Cardio Points to users are labeled as sponsors in CARDIO's protocol.

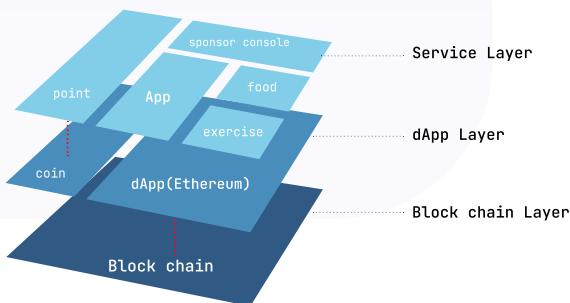
4.2.3 The role of each subject composing the protocol

Individual users can convert Cardio Points received for exercise into Cardiocoin and trade them at cryptocurrency exchanges to "cash" their earnings while sponsors can stake their Cardiocoin through specified

wallets and swapping for Cardio Points to provide as incentives to target users on the CARDIO platform. The conversion standard for Cardiocoin and Cardio Point will be based on trading price of a CRDC trading pair on select exchange(s) to be selected by the CARDIO protocol.



5. Blockchain configuration



[fig 29] Blockchain and off-chain configurations

[fig 28] Roles of the subjects of the Cardio Health Protocol

5.1 Ethereum

Among the data generated by the CARDIO protocol, all data related to the issuance and burning of Cardio Points and the transfer of Cardiocoin are monetary data, and blockchain is used to manage the data in a clean and transparent way.

CARDIO protocol decided to utilize Ethereum, a blockchain platform, rather than developing its own blockchain main net to manage the above data. As a startup company with limited resources CARDIO chose to utilize its resources for stably operating and expanding the protocol more quickly.

Ethereum is a public blockchain platform created by Vitalik Buterin [7] on July 30, 2015. It provides extensibility to transparently operate various applications such as voting. In other words, it is a platform that allows anyone to create and use decentralized applications called dApp (DApp) for monetary transactions as well as other purposes. It supports most major programming languages such as C++, Java, Python, Go, etc.

5.2 App

CARDIO protocol's App is the top layer of all services and consists of Android and iOS interfaces for individual users as well as for enterprise consoles used by sponsors.

5.3 dApp

In the CARDIO protocol, dApps have a total of three unique functions.

The first(1st) is the function of exchanging Cardiocoin with Cardio Points, the second(2nd) is sharing and managing the information of staked Cardiocoin, and the third(3rd) is the sharing and management of information of all issued or burned Cardio Points.

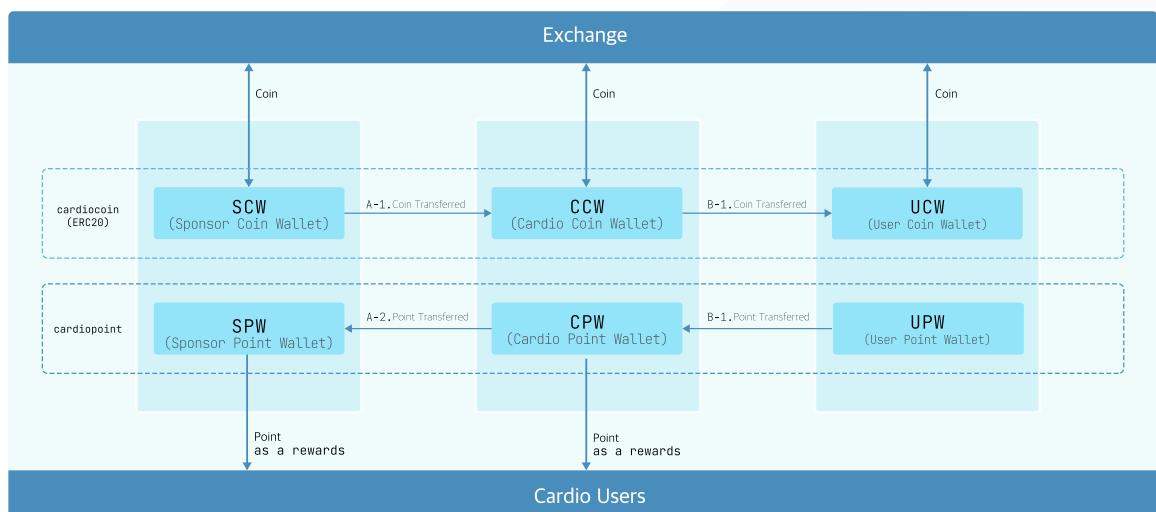
Individual users that have Cardio Points have proven physical effort in order to promote one's health and can use Cardio Points, received from exercising on the CARDIO protocol, for the purchase of various goods and services as well as the purchase of Cardiocoin.

Conversely, sponsors can receive Cardio Points by purchasing Cardiocoin from designated exchanges and

staking them in specified wallets of the CARDIO protocol. At this time, the exchange rate of Cardiocoins and Cardio Points is based on market exchange pricing. This can be compared to the relationship between gold and fiat currency in the gold standard system, where Cardiocoins represent gold and Cardio Points represent fiat currency in this example.

The exchange of Cardio Point and Cardiocoins of each participating entity (individual user, sponsor) is automatically performed through smart contracts and oracles for off-chain and on-chain data, and the corresponding data is stored in blocks in the CARDIO protocol. All data related to monetary transactions will be managed transparently with blockchain.

When sponsors stake in a specific cryptocurrency wallet (CCW) of the CARDIO protocol, the Cardiocoins deposited into the wallet are locked-up for up to 24 months, and Cardio Points are deposited into the sponsor's wallet (SCW) based on the exchange price at the time of deposit. When the 24-month lockup period is over and Cardio Points are deposited into the specific Cardio Point wallet (CPW), the Cardiocoins staked at the exchange standard price ratio at the time of the deposit transaction are deposited back into the sponsor's SCW.



[fig 30] Cardiohealth protocol dApp definition

6. Roadmap

6.1 Business Development Road map

2Q21 Launch service in Korean fitness centers

4Q21 30k active users

1Q22 Metaverse exercise equipment interface (MEI) release

1Q22 Playability for famous metaverse contents & exercise integrated gaming

2Q22 Start sales of Metabike (metaverse home fitness bicycle)

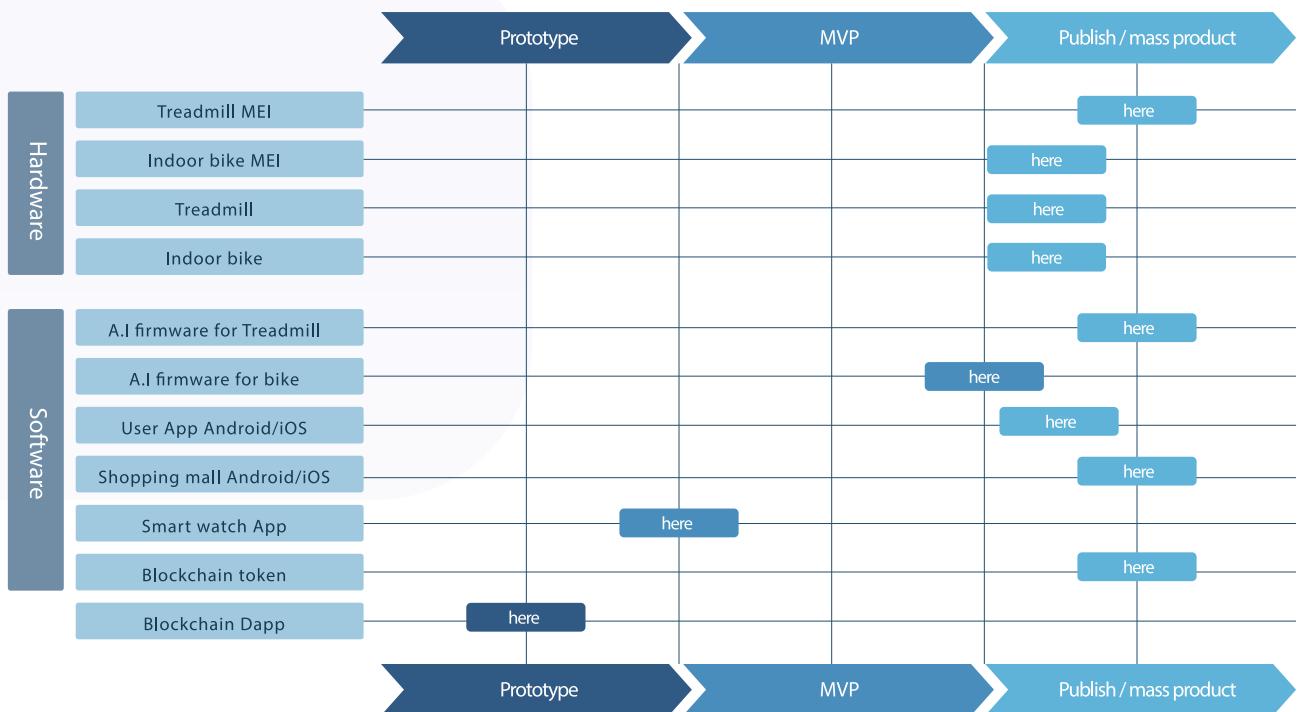
2Q22 reveal new equipment IOT component and metaverse API

3Q22 Metabike North American launch

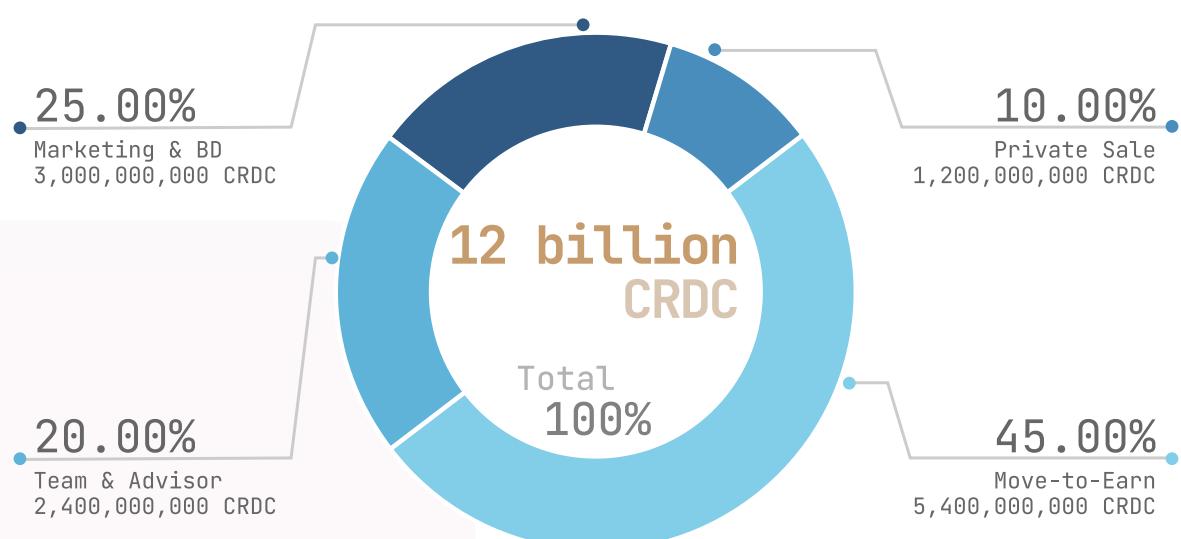
4Q22 Launch service in US fitness centers

2Q23 200k MAU

6.2 R&D Road map



6.3 Token allocation



[fig 31] Token allocation

6.4 Token Lock-up Schedule

12 billion Cardiocoins (contract address: 0xF81421fc15300c5a8CCa9aFE12F5CBAd502Fa756) have been minted and the lockup schedule is as follows :

Private Sale : 1.2 billion tokens have been issued and sold to early investors, 50% of which will be unlocked upon listing and remaining 50% of the remaining tokens will begin unlocking at 20% per month for 5 months 12 months after initial listing.

Move-to-Earn : 5.4 billion tokens are used only as a reward for users of Cardio's service for promoting their health through means such as exercising on Cardio's systems or purchasing of health foods. 2% of these tokens are unlocked monthly starting on the 12th month after token minting.

Marketing & BD : 3.0 billion tokens are used for necessary business development & marketing cooperation, such as for insurance companies that are affiliated with our service launch. 10% of tokens are unlocked upon minting and the remaining tokens unlock at 2.78% per month for 36 months, 21 months after minting.

Team & Advisor : 2.4 billion tokens are provided to Cardio's team & advisors who work hard to develop, launch and expand Cardio's service in the market. These tokens are all locked up for 20 months after listing and will unlock at 2.5% for 40 months thereafter.

7. Team & Advisor



Daniel joined the Daedeok Research Complex as a Researcher after receiving recognition for a patent he applied for while attending at Sogang University for his bachelor's in chemical engineering. He has since been a serial entrepreneur in Korea and Silicon Valley and has experience in healthcare, IoT data, and AR/VR industries. He oversees development and management of the Cardio Health team as the Founder & CEO. He is an active member of Mensa.



Michael applied his experience in finance at investment banks and venture investment firms in San Francisco after graduating from UC Berkeley with a bachelor's in economics. He oversaw investment diligence and supported on secondary transactions while in the Bay Area before co-founding the US-based accelerator's Korean office in 2017. Michael is responsible for operations and business development as Co-founder & COO at Cardio Health.



Before starting a FINRA registered broker-dealer and venture investment firm in Silicon Valley, Kevin served as Attorney at Davis Polk & Wardwell, Principal at Barclays Global Investors and most recently Director at BlackRock, the world's largest asset manager. His depth of experience as a legal, finance and business officer spans the Americas, Europe as well as Asia. He brings his talents to the Cardio Health team as General Counsel by advising on legal, financial and strategy matters and supporting global business development. He received his JD from Stanford Law School, MA from UC Berkeley, and his BA from Vanderbilt University



Grant was formerly a petrochemicals trader before starting a cross-border investment firm that specializes in US-KR and blockchain. He has invested into various early-stage companies on both sides and has supported some of the largest blockchain companies with their entry into and growth in the Korean market. He currently supports Cardio Health through his role as director and head of blockchain. He received his BS and MBA from UCLA.



Sanghwa is specialized in big data and artificial intelligence and has experience working at Samsung Electronics. His specialties are applied well at Cardio Health which mines large amounts of user data to identify exercise behavioral patterns and filters for intentional deception. Sanghwa graduated from Hanyang University in Computer Science and has received awards including the BIGDATA x A.I competition organized by the Center for Creative Economy and Innovation (government).



Kyungsoon is responsible for designing the overall architecture of software development and managing the project as a full stack software engineer and Head of Engineering at Cardio Health. He has a deep interest in robotics and previously worked at LG Electronics after graduating from Korea Advanced Institute of Science and Technology (KAIST) with a degree in electrical engineering.



As a Ph.D. in Economics from Syracuse University, he is a scholar and career administrator who designed the foundation for and contributed to Korea's macroeconomic development. He served as director of four national research institutes, including the Korea Development Institute (KDI), is the founding chairman of the Incheon Global Campus, and supports Cardio Health on the public sector (B2G) and advises on economic structuring. He received his bachelors from Seoul National University.



Jeongwook previously served at Korea Development Institute (KDI) and Korea Telecom, and is currently a professor in the Department of Business Administration at Sejong University. He has advised public Korean companies as well as blockchain projects and supports on the development of Cardio Health with academia and private sector relationships. He received his PhD from the Korea Advanced Institute of Science and Technology (KAIST).



As a medical doctor and having a PhD in computer science with experience at Samsung Medical Center, Jaehwan specializes in medical data, particularly in EMR (Electronic Medical Records). He advises on interpretation of sensitive medical and personal data for Cardio Health supports on architecting the data schema that Cardio Health targets. He graduated from Seoul National University and Kyungpook National University.



Yungmin has a found success in broad range of experiences including finance, distribution, technology development after graduating with a degree in electrical engineering. He has a wide global network of business development in China, Africa, and ASEAN in particular. Yungmin supports Cardio's domestic and global business development efforts.

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Graph reference

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[fig 27] Strategic diagram for realizing preventive medicine through market economy rather than tax

[fig 28] Roles of the subjects of the Cardio Health Protocol

[fig 29] Blockchain and off-chain configurations

[fig 30] Cardiohealth protocol dApp definition

[fig 31] Token allocation