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(19) **United States**(12) **Patent Application Publication**
NEMOTO et al.(10) **Pub. No.: US 2020/0046252 A1**(43) **Pub. Date: Feb. 13, 2020**(54) **INGESTIBLE SENSOR, SENSING METHOD,
AND FOOD**(71) Applicant: **Tohoku University**, Sendai-shi (JP)(72) Inventors: **Yasuhisa NEMOTO**, Miyagi (JP);
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TAKAYAMA, Utsunomiya (JP)(73) Assignee: **Tohoku University**, Sendai-shi (JP)(21) Appl. No.: **16/656,413**(22) Filed: **Oct. 17, 2019****G06Q 30/02** (2006.01)**G16H 40/67** (2006.01)**A23L 33/00** (2006.01)**A61B 5/00** (2006.01)**A61B 5/01** (2006.01)(52) **U.S. Cl.**CPC **A61B 5/073** (2013.01); **A61B 5/14503**
(2013.01); **G06Q 30/02** (2013.01); **G06Q**
30/0241 (2013.01); **G16H 40/67** (2018.01);
A23L 33/40 (2016.08); **A61B 2560/0266**
(2013.01); **A61B 5/01** (2013.01); **A61B**
5/14507 (2013.01); **A61B 5/7435** (2013.01);
A23V 2002/00 (2013.01); **A61B 5/6887**
(2013.01); **A61B 5/6861** (2013.01); **A61B**
5/0022 (2013.01)**Related U.S. Application Data**(63) Continuation of application No. 15/081,036, filed on
Mar. 25, 2016, which is a continuation of application
No. PCT/JP2014/077746, filed on Oct. 17, 2014.(30) **Foreign Application Priority Data**

Oct. 18, 2013 (JP) 2013-217826

Publication Classification(51) **Int. Cl.****A61B 5/07** (2006.01)**A61B 5/145** (2006.01)

(57)

ABSTRACT

An ingestible sensor according to an embodiment includes a sensor, a detector, and a transmitter and to be mixed with food and discharged without being digested or absorbed also when entering the inside of a body. The sensor is configured to detect a predetermined substance disposed inside the body. The detector is configured to detect whether or not the sensor has entered the inside of the body. The transmitter is configured to transmit information of the predetermined substance detected by the sensor to a communication device disposed outside the body based on a detection of an entrance of the sensor into the inside of the body that is made by the detector.

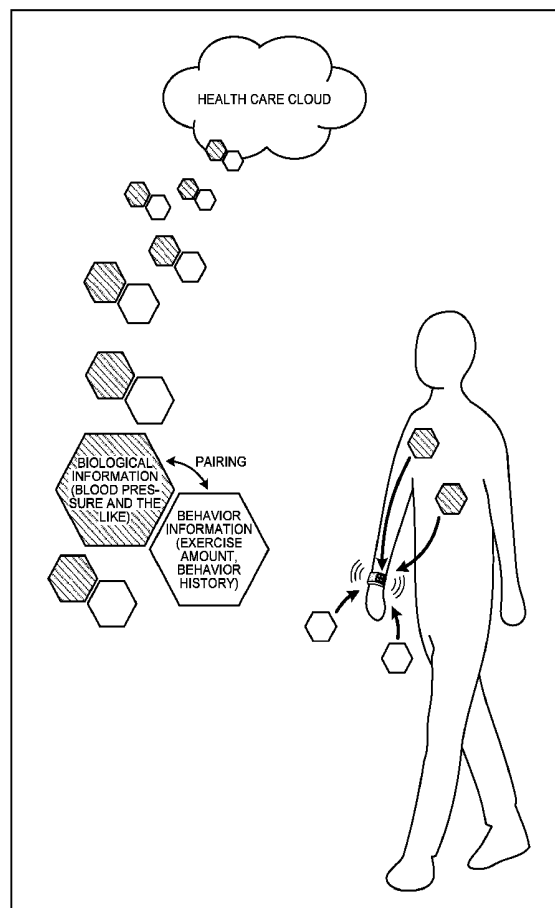


FIG. 1

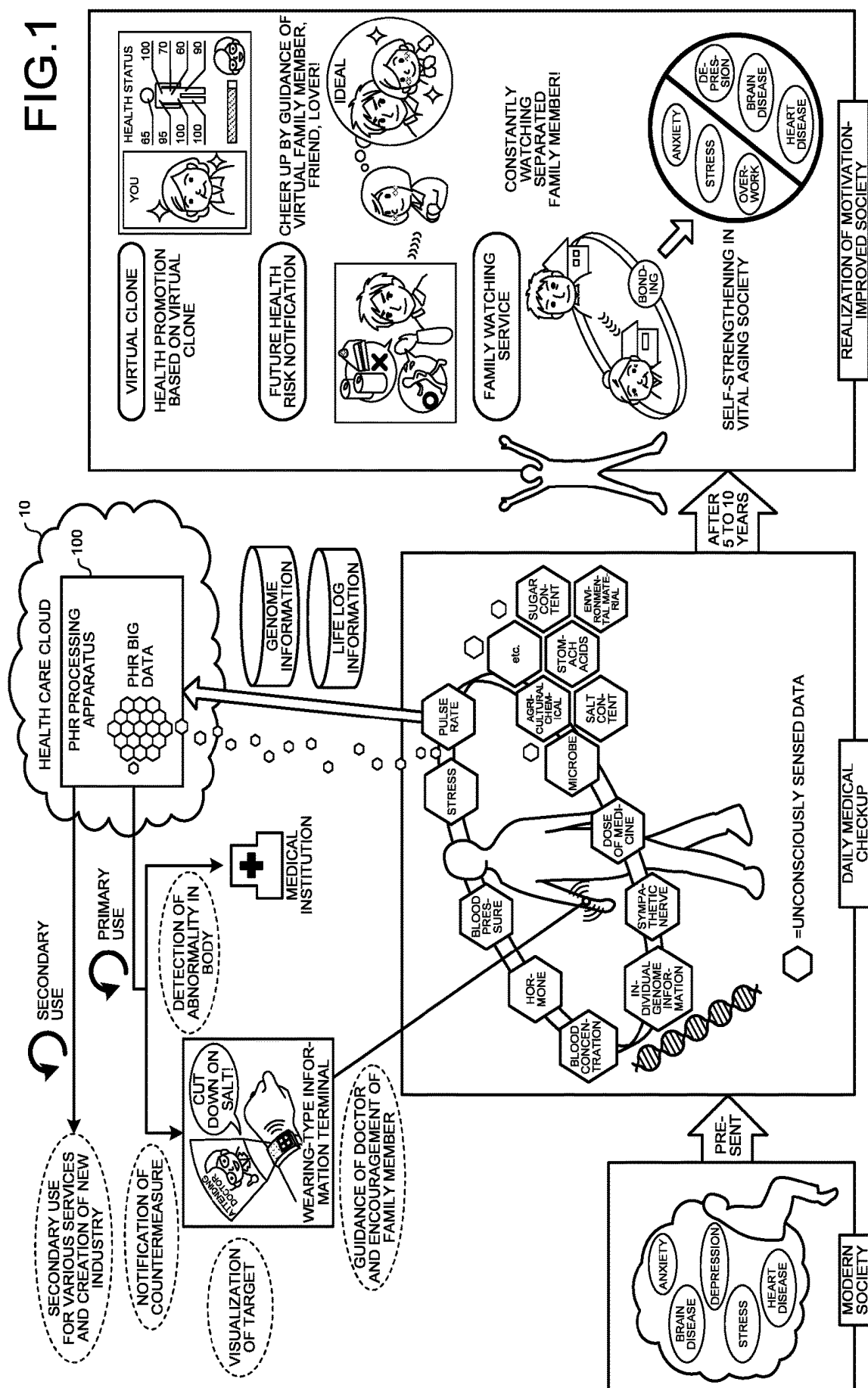


FIG. 2

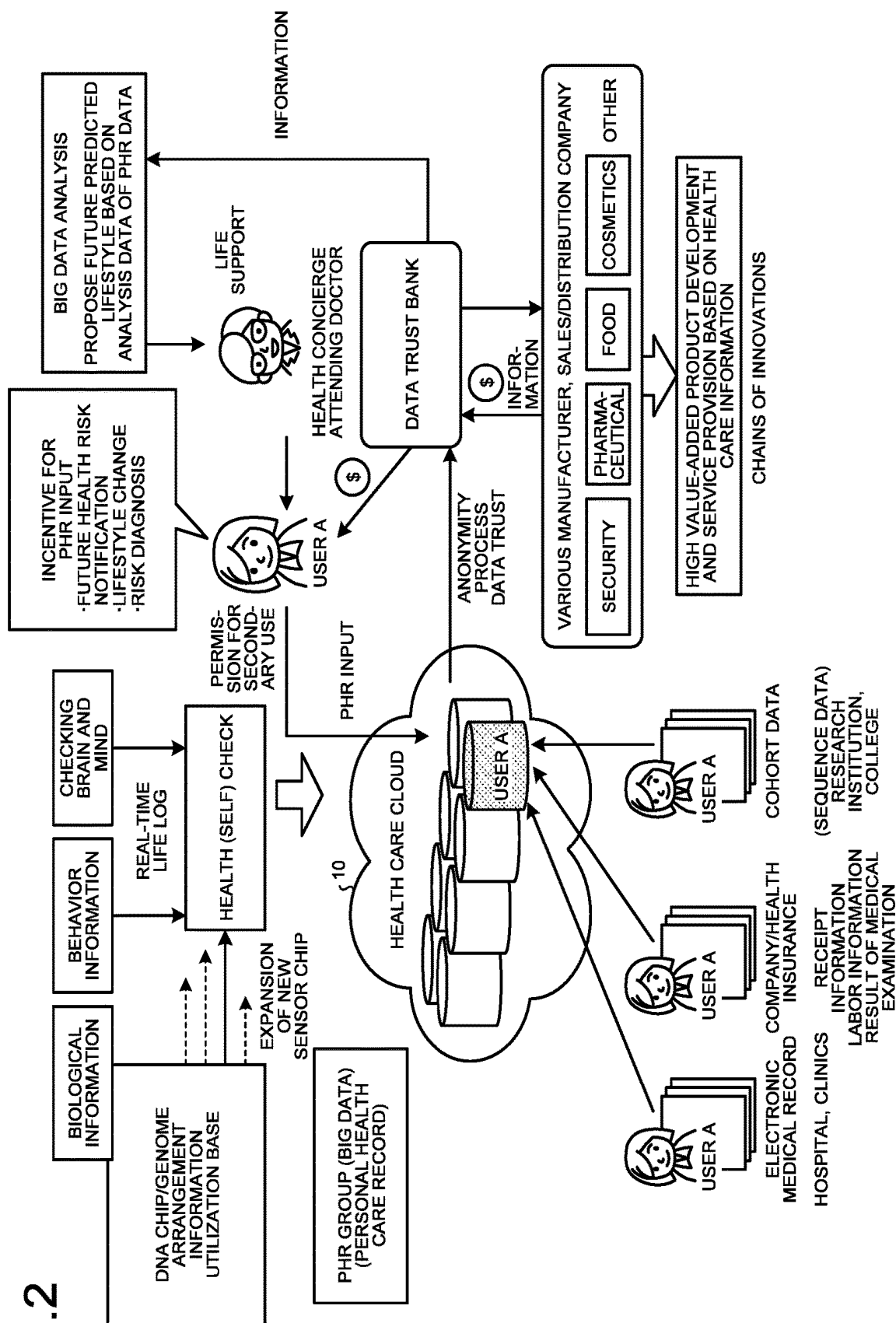


FIG.3

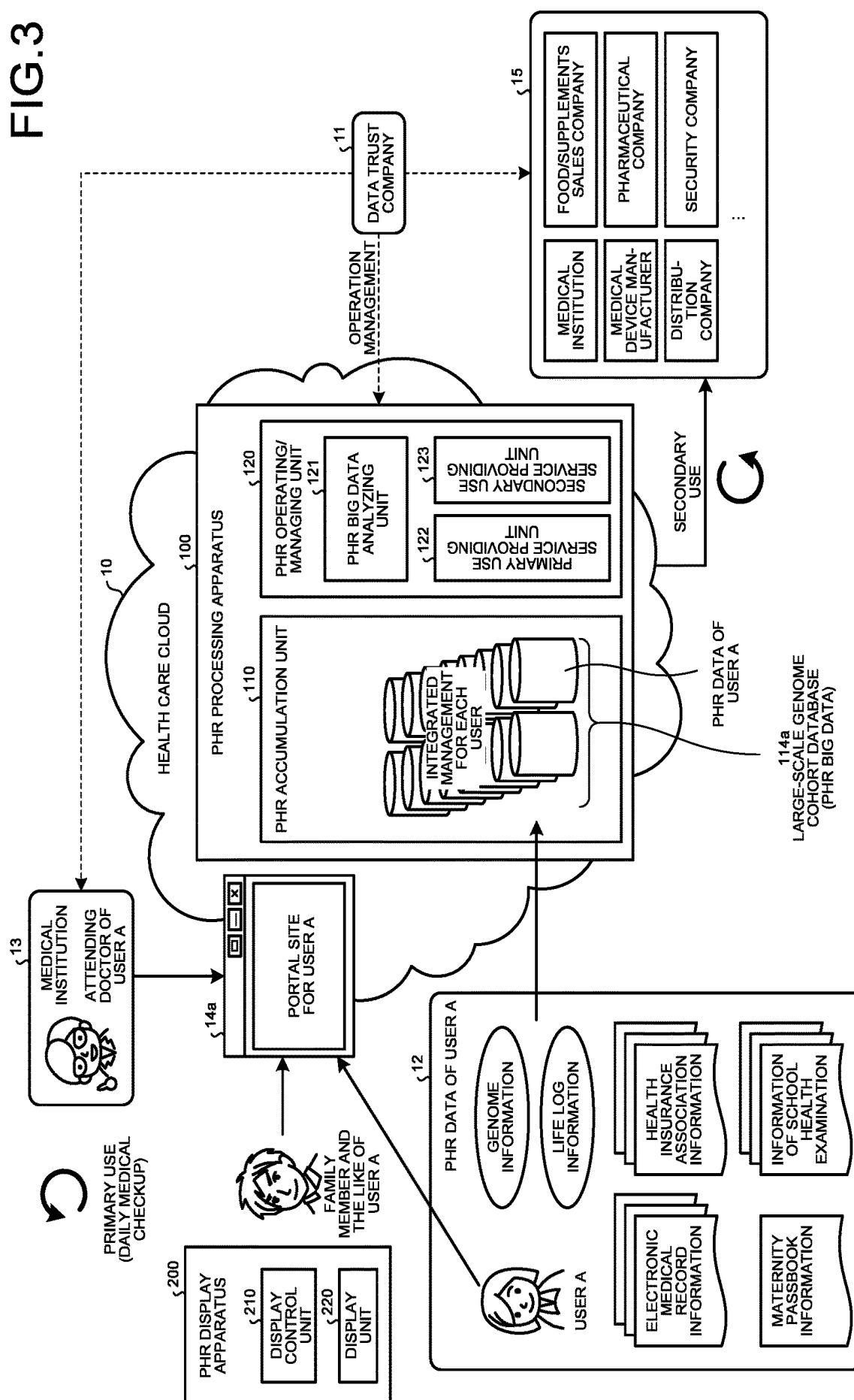


FIG. 4

=
PHR DATA
OF USER A

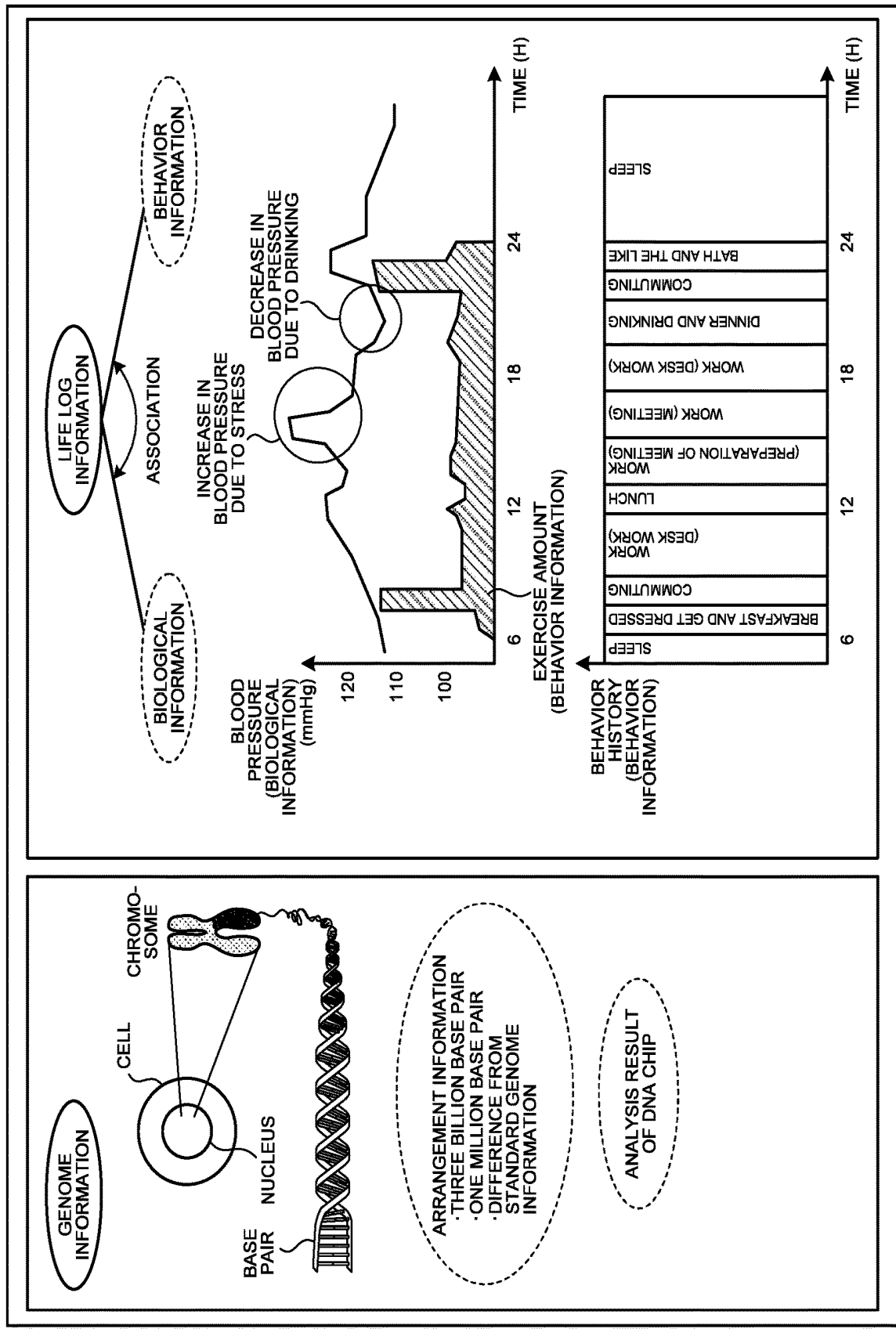


FIG.5

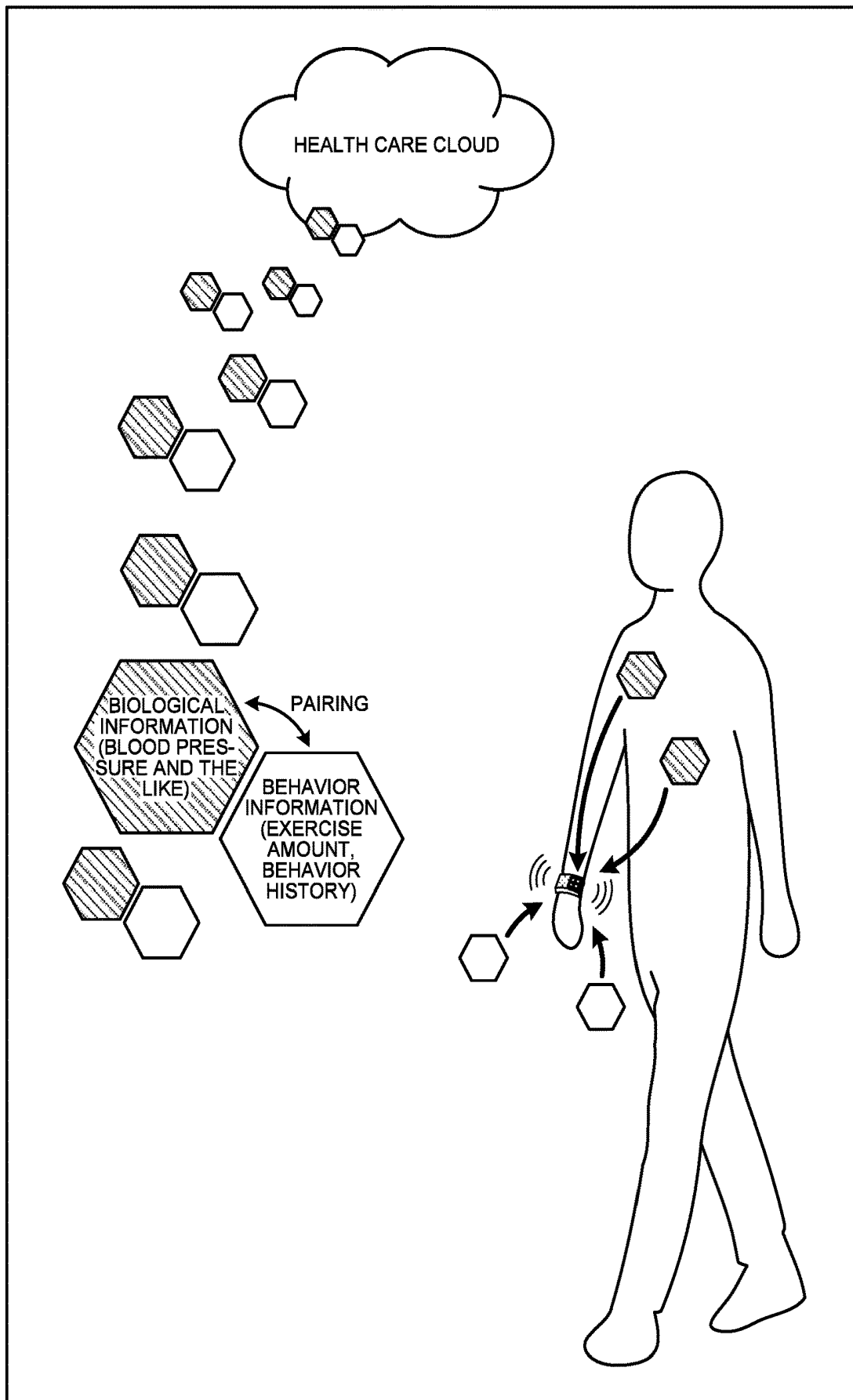


FIG. 6

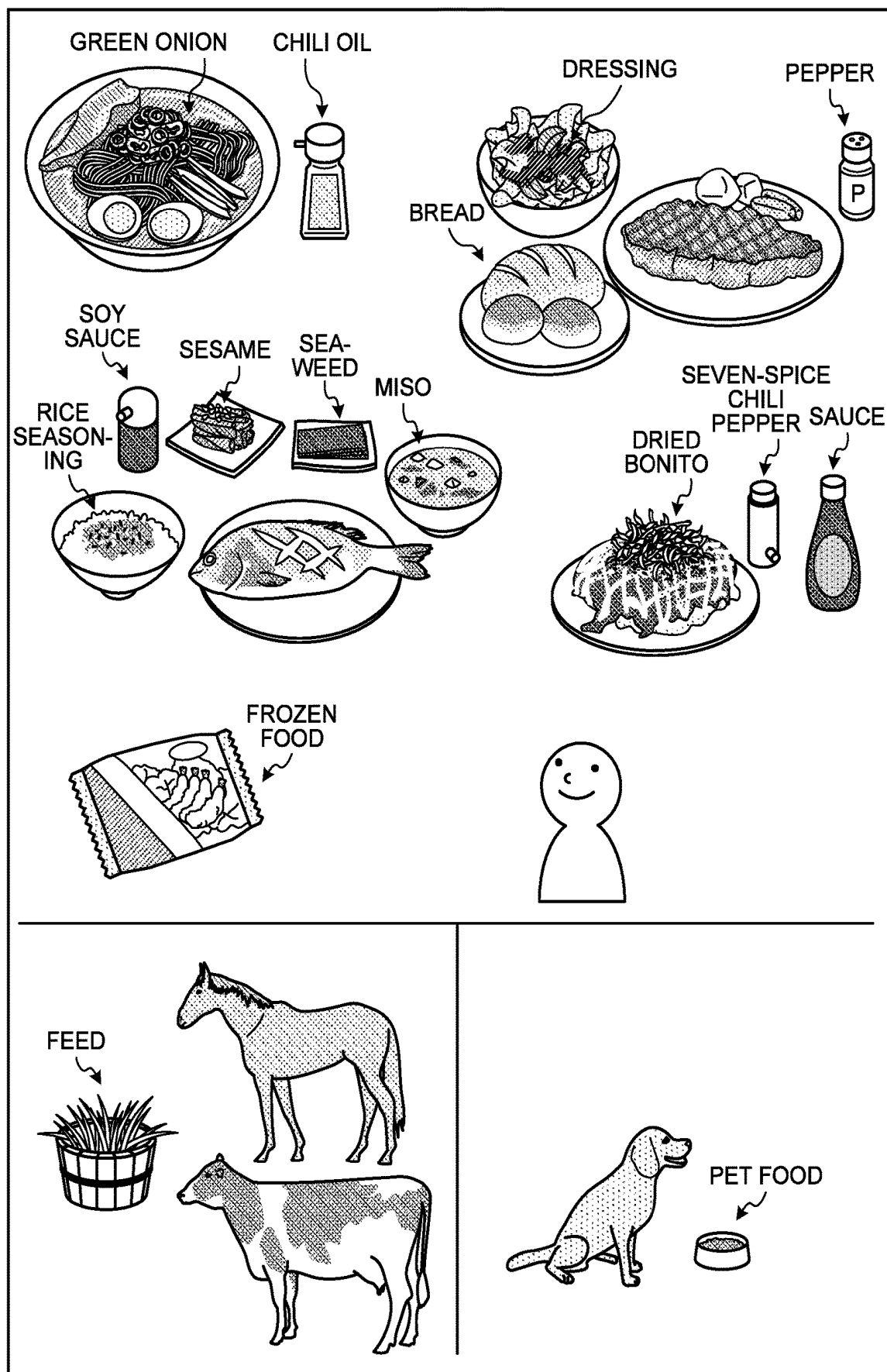


FIG.7

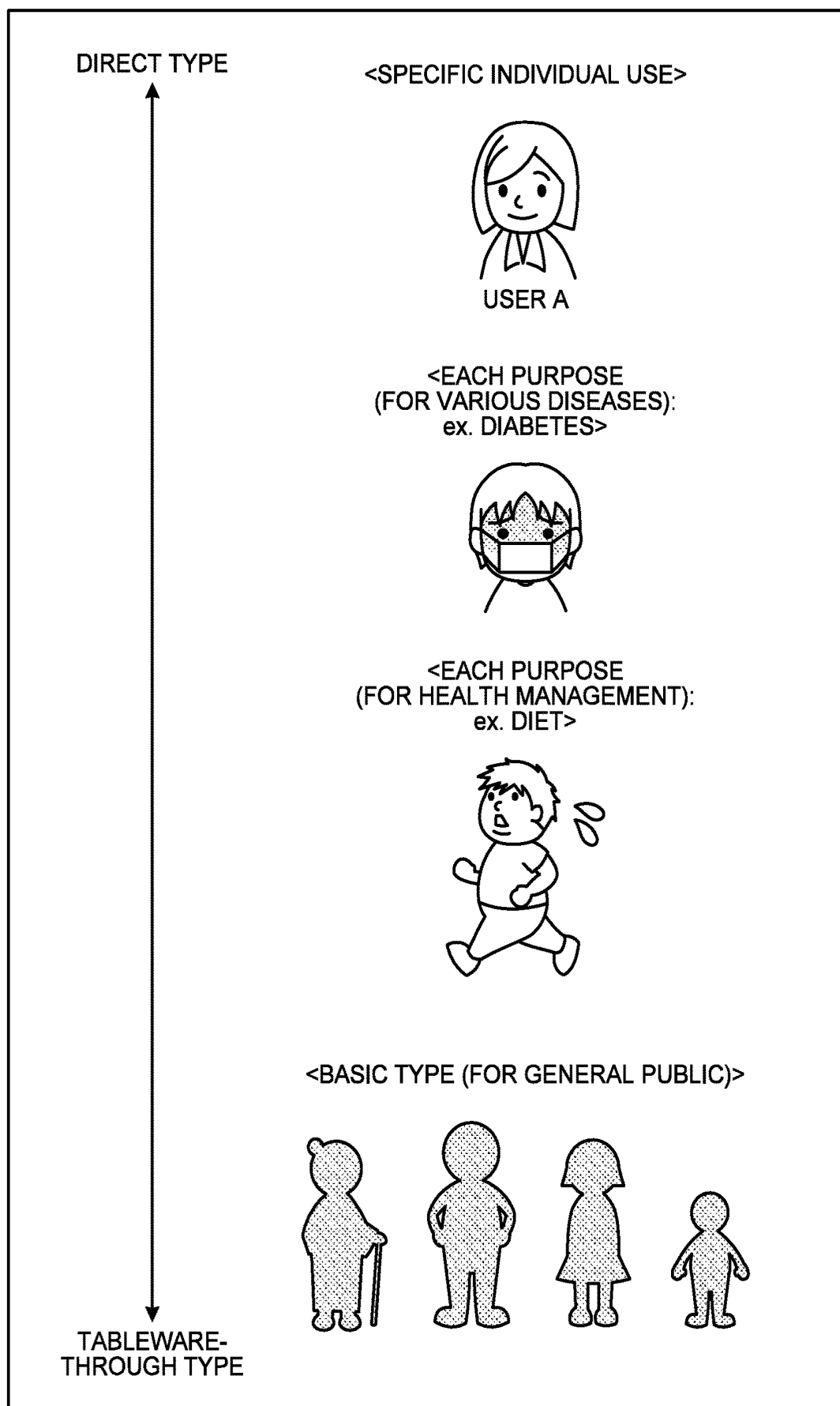


FIG.8A

[DIRECT TYPE]

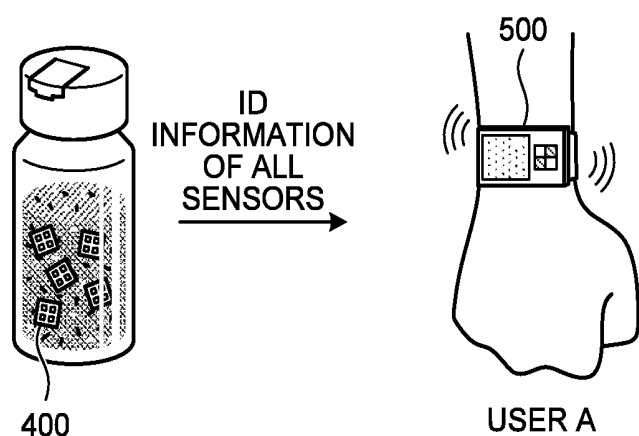


FIG.8B

[TABLEWARE-THROUGH TYPE]

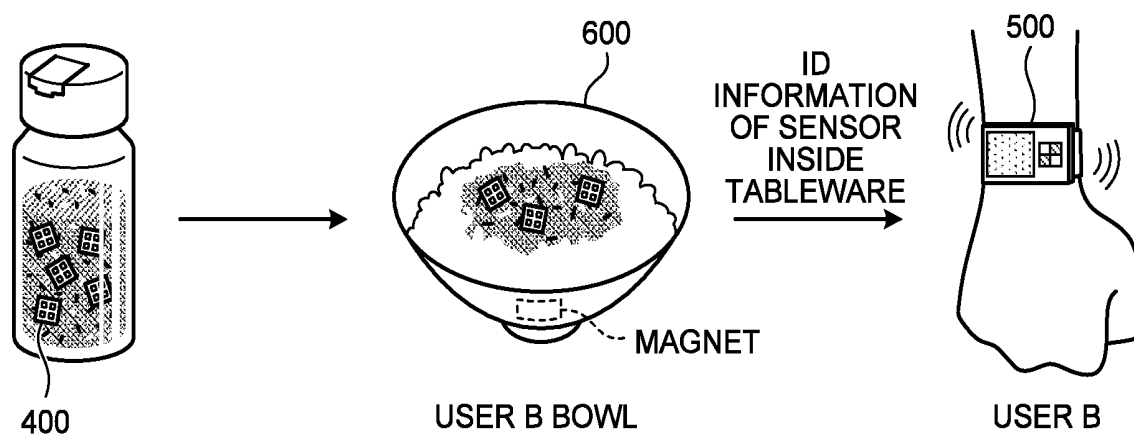
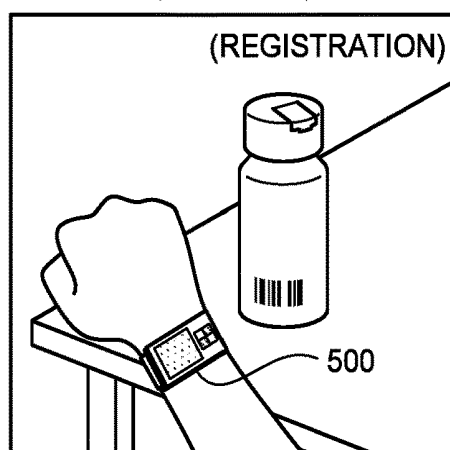


FIG.9A

(A)



(B)



(C)

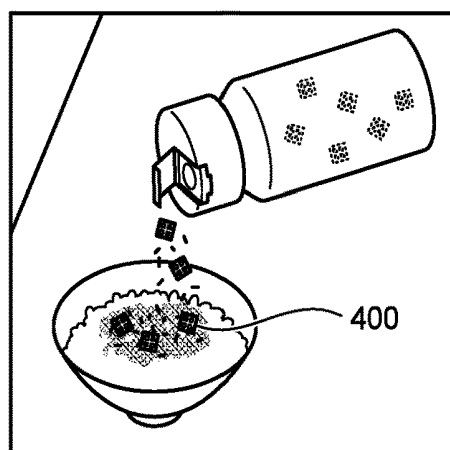


FIG.9B

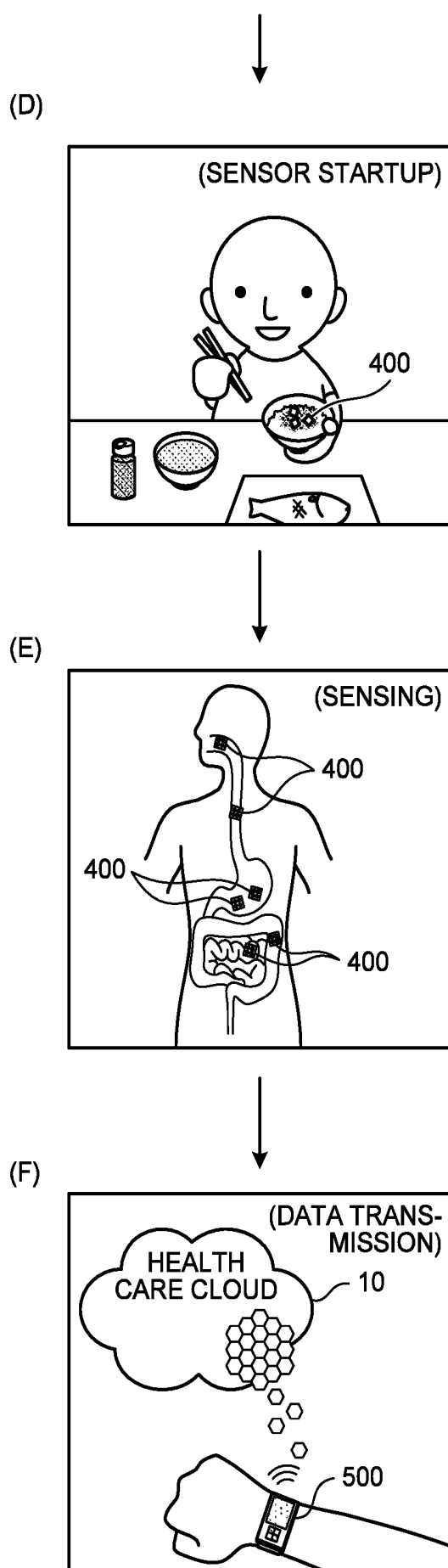


FIG.10

SENSOR ID	DATA	TIME
1	a1	20131001073015
	a2	20131001073515
	a3	20131001074015
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
2	b1	20131001073030
	b2	20131001073530
	b3	20131001074030
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
⋮		
⋮		

FIG.11

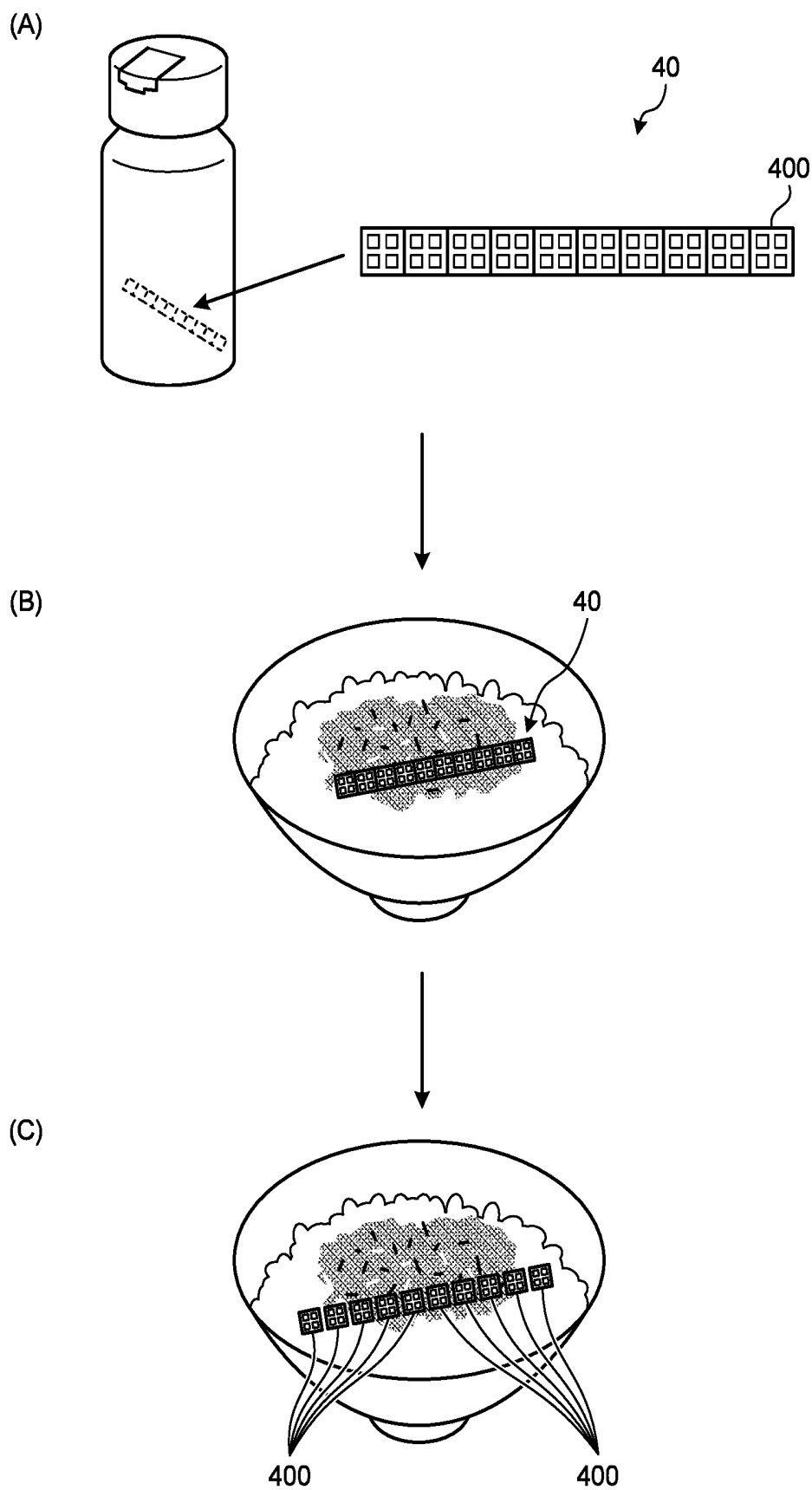


FIG.12

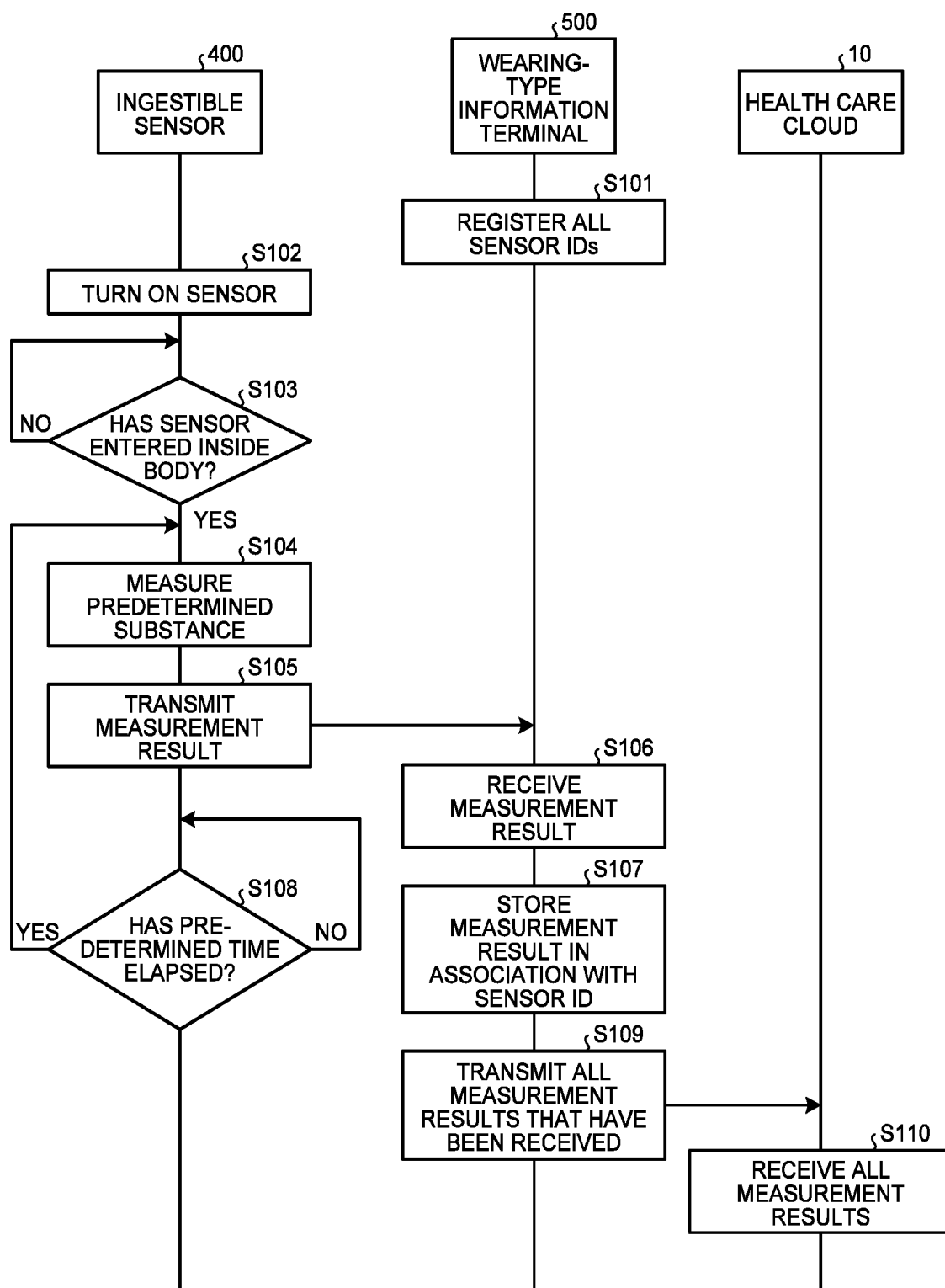


FIG.13

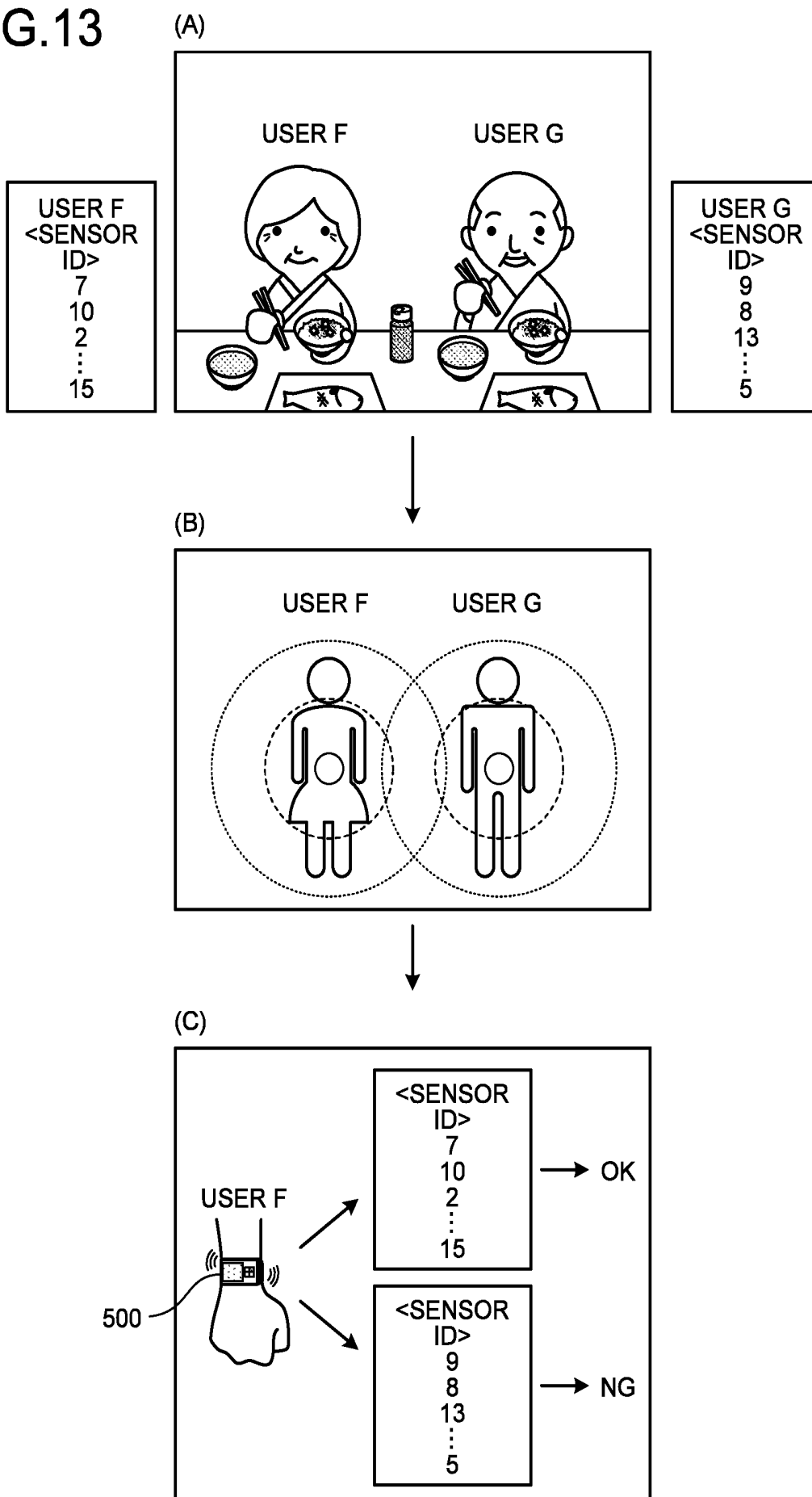


FIG. 14

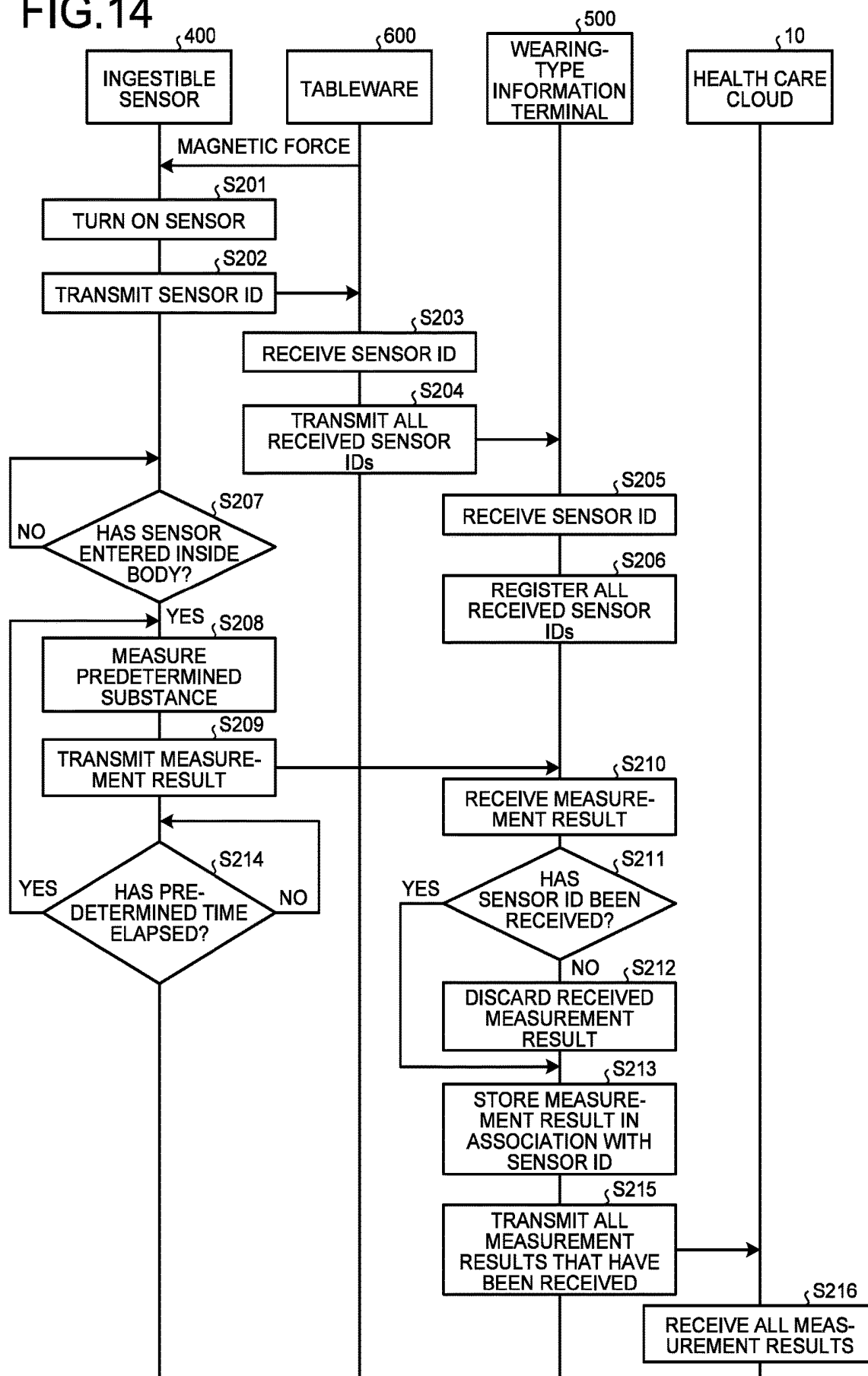


FIG.15

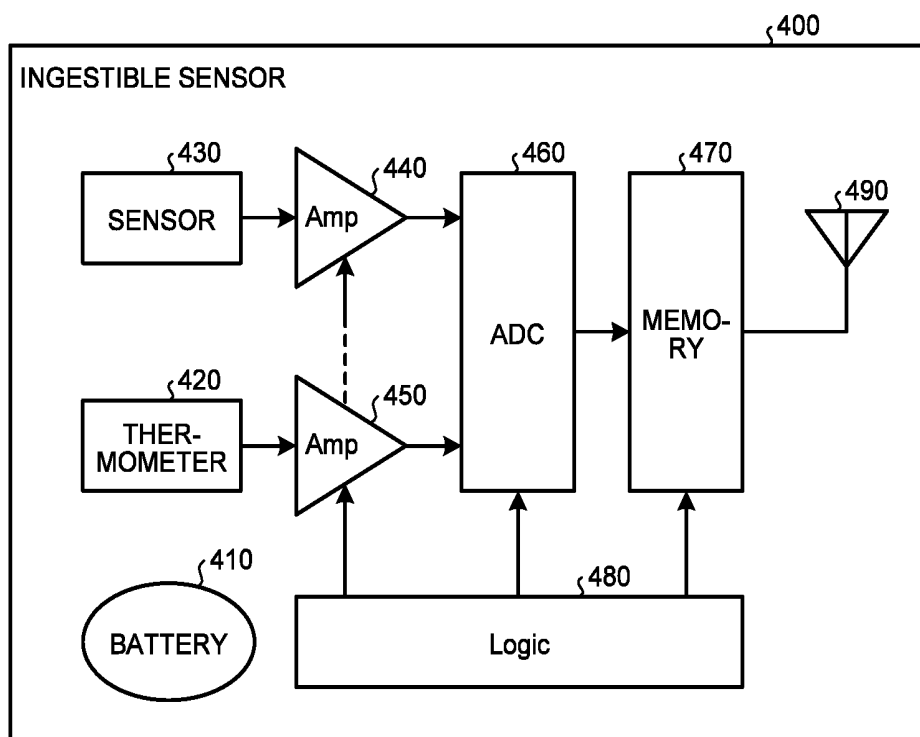


FIG.16

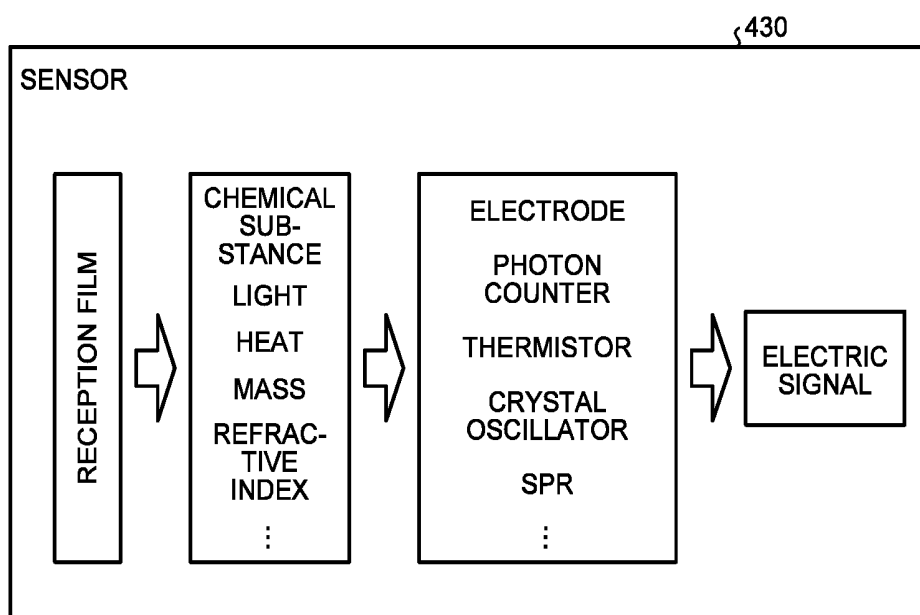


FIG.17A

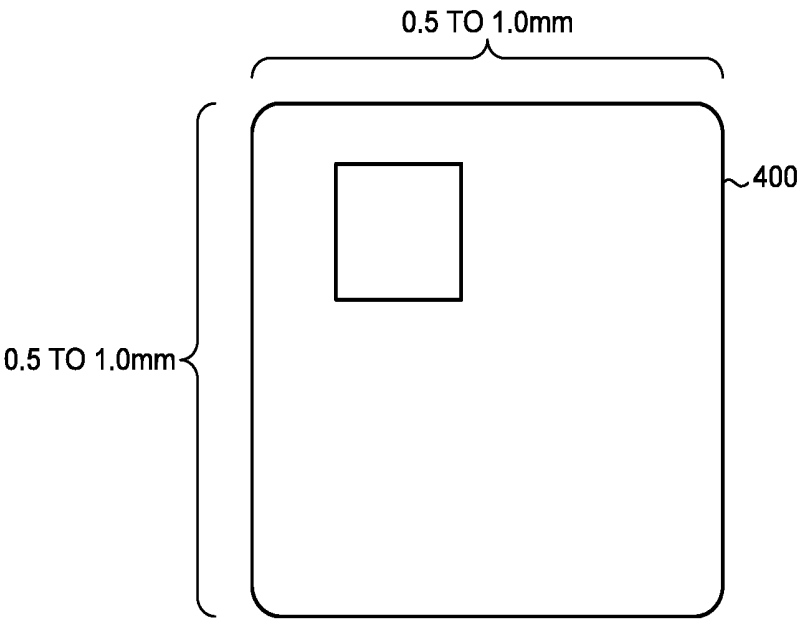


FIG.17B

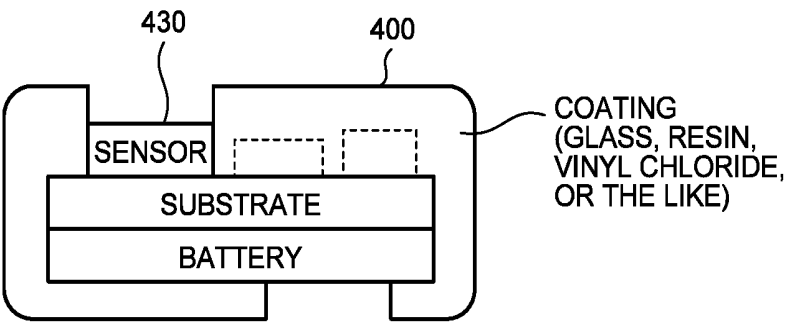


FIG.18

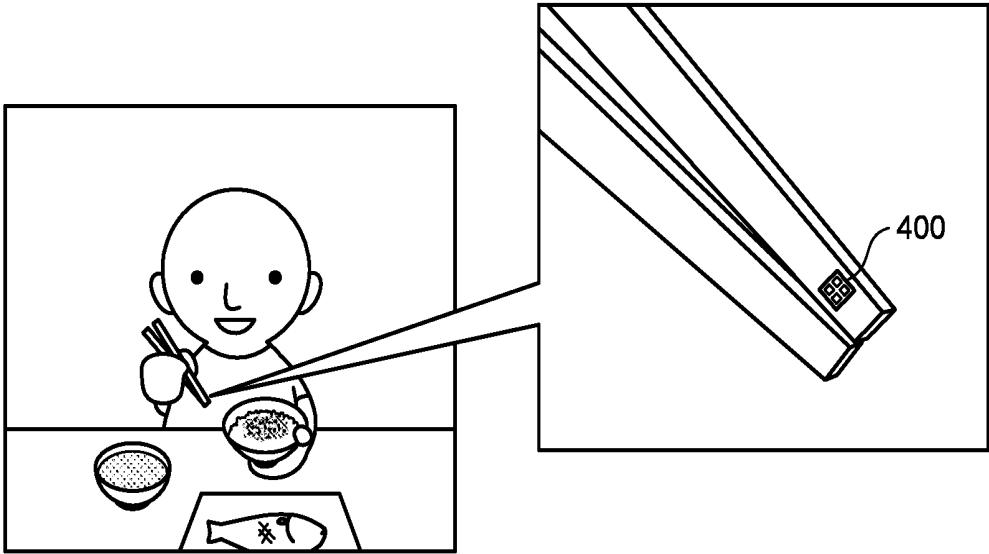


FIG.19

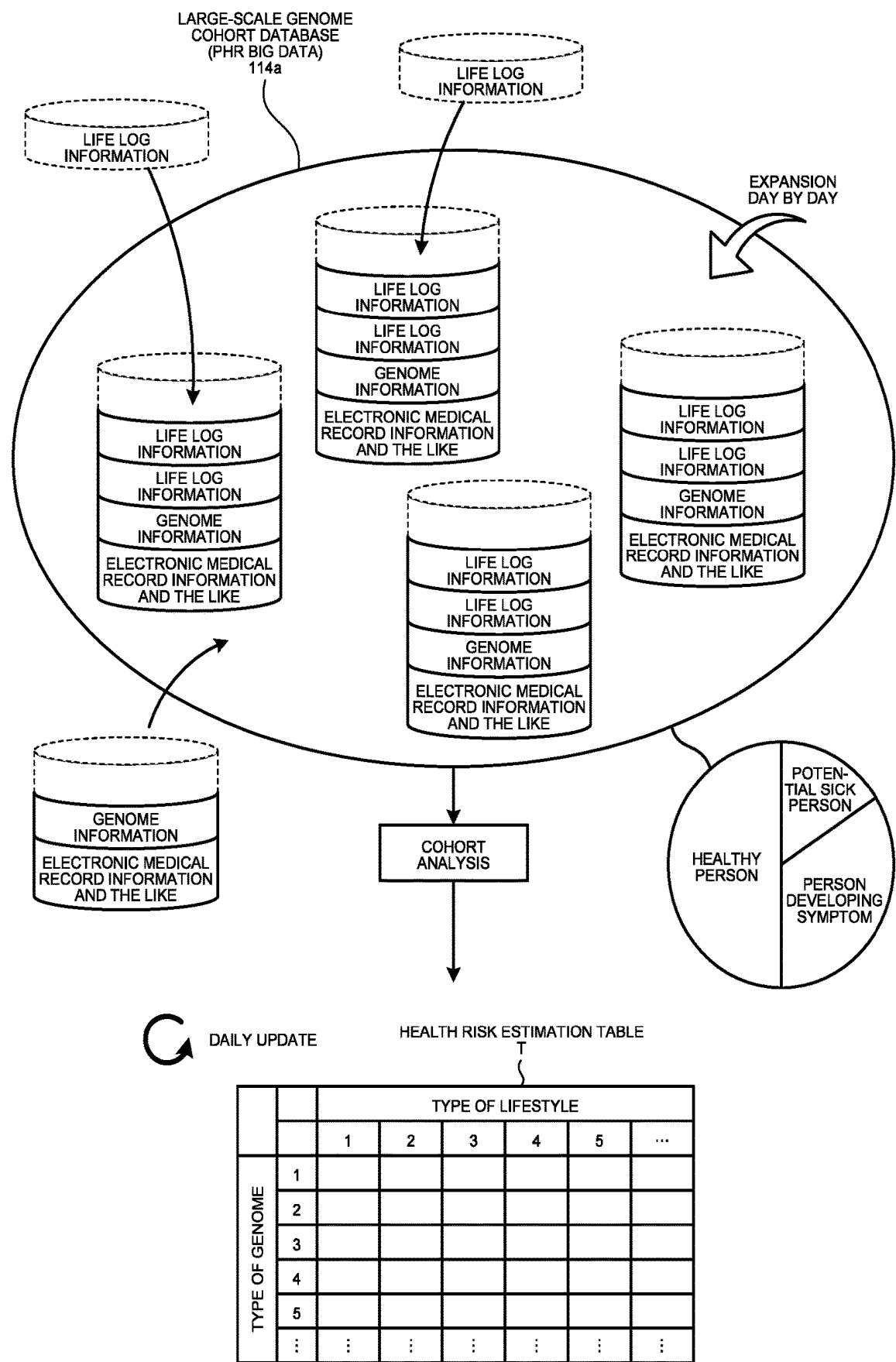
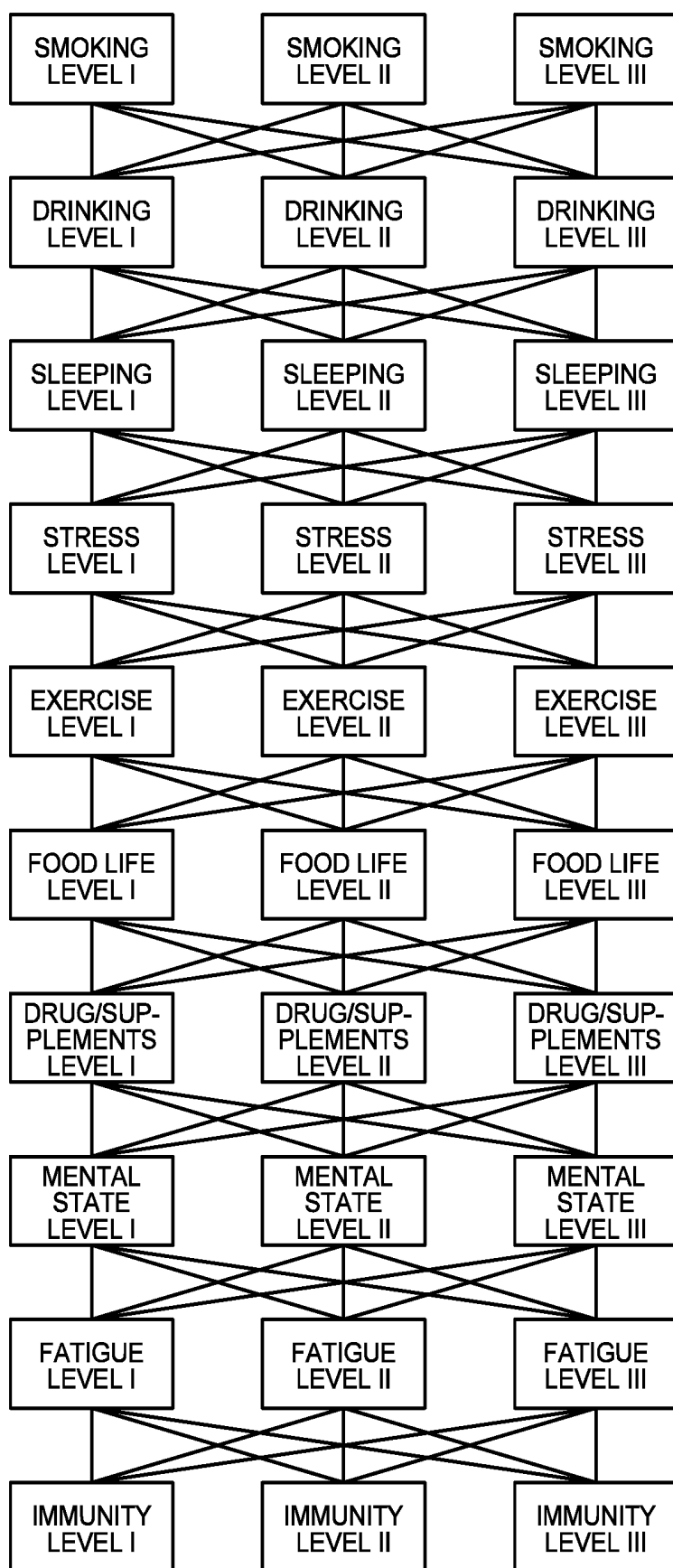
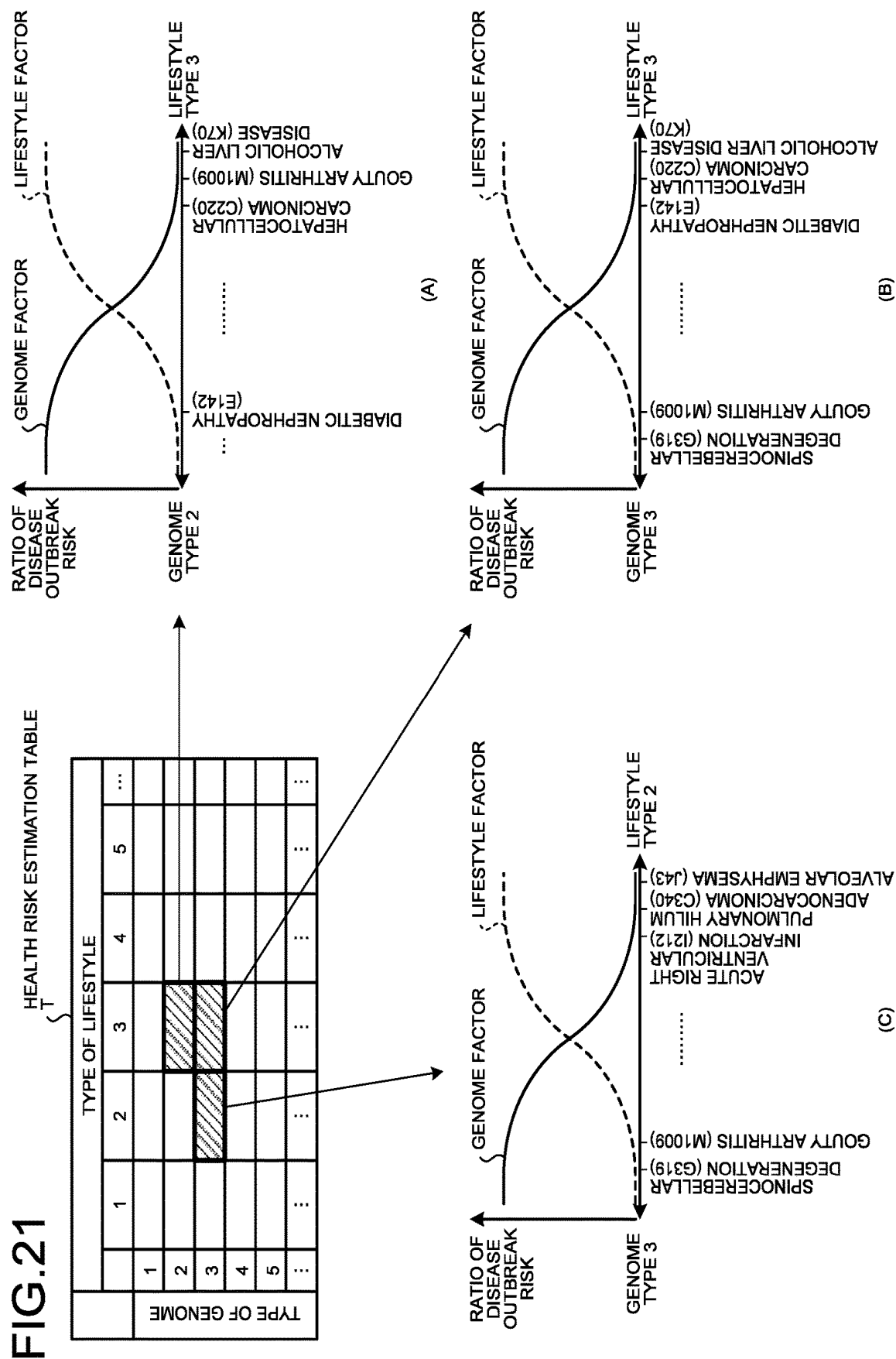


FIG.20





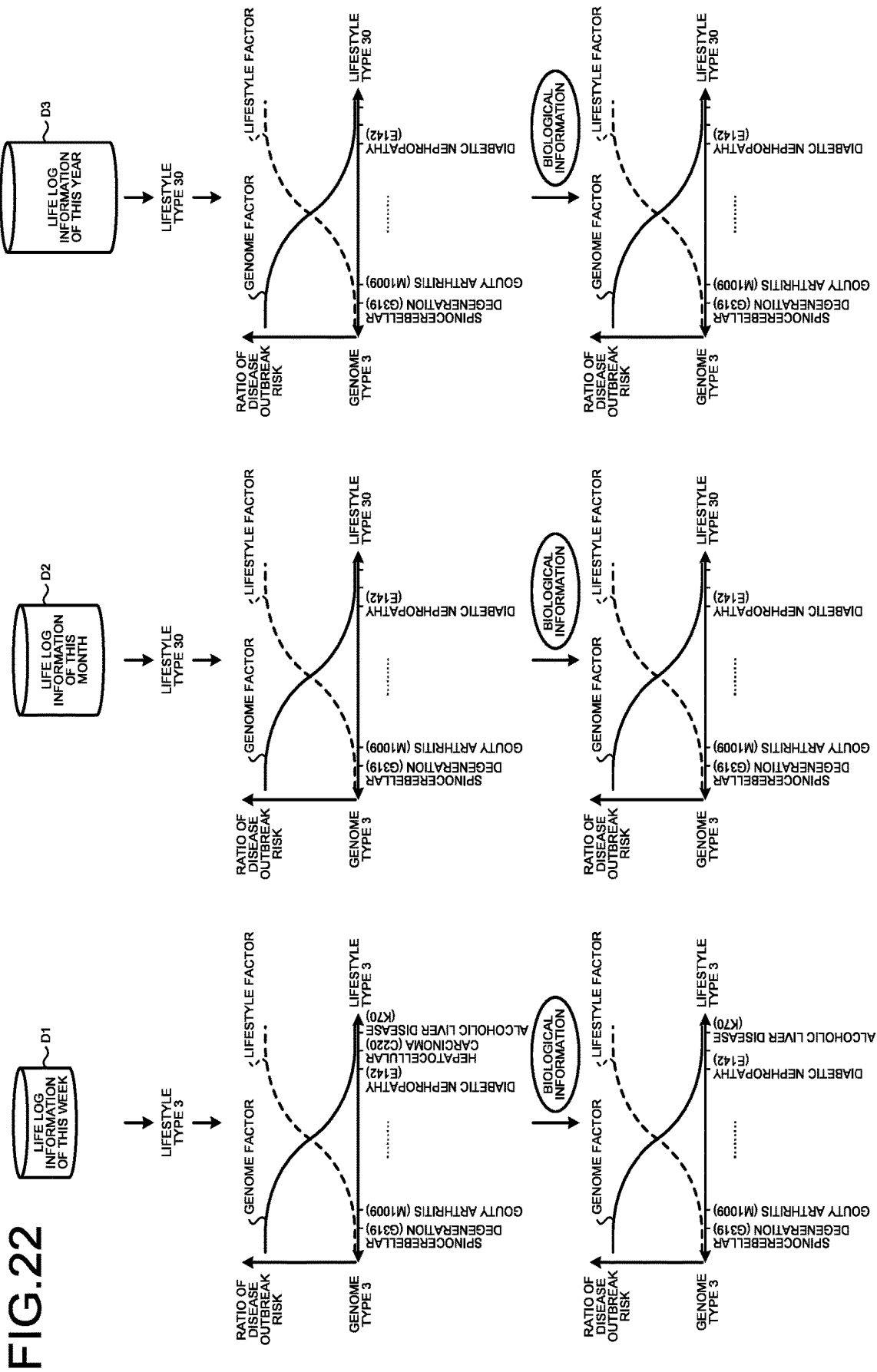


FIG.23

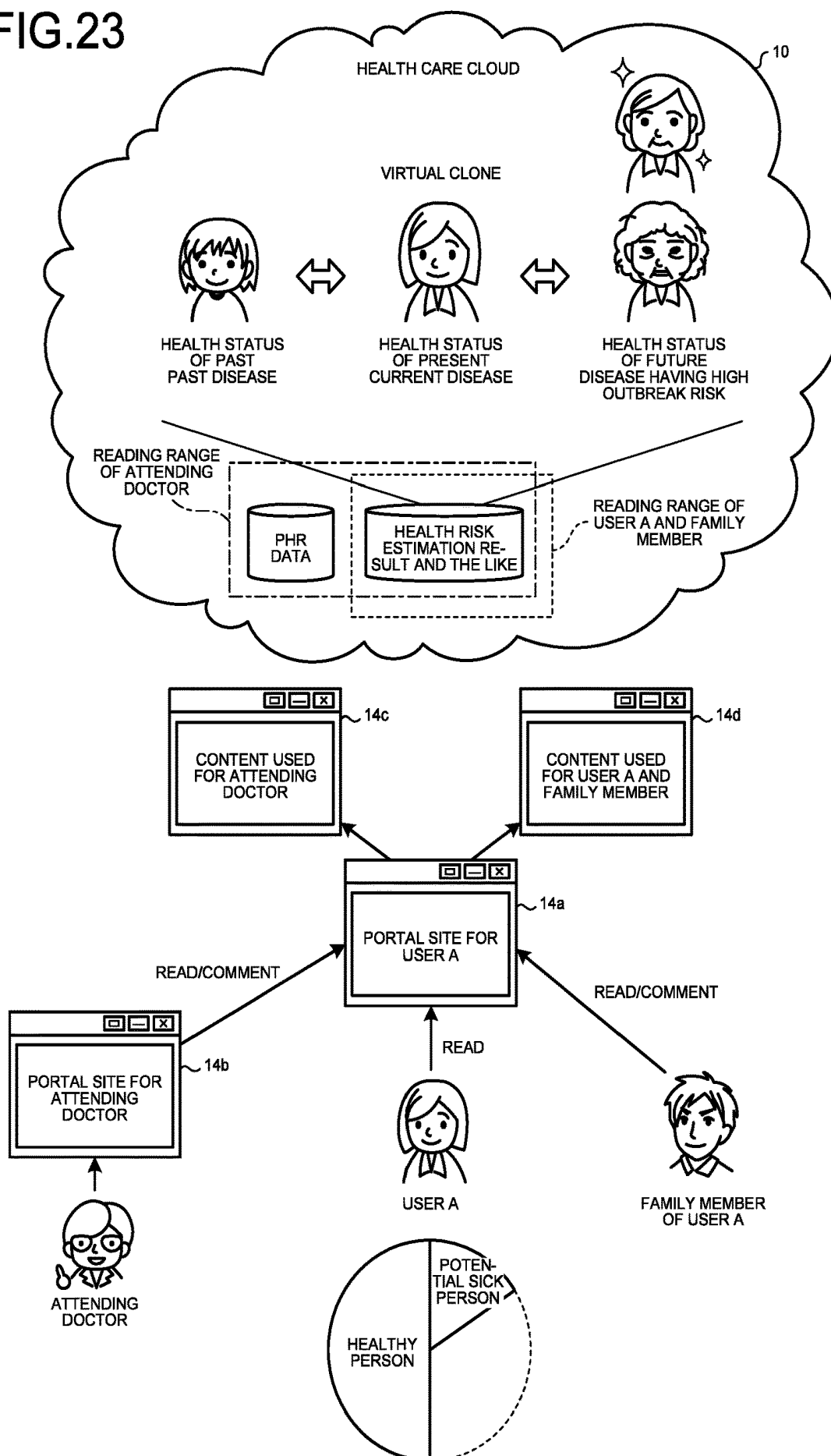


FIG.24

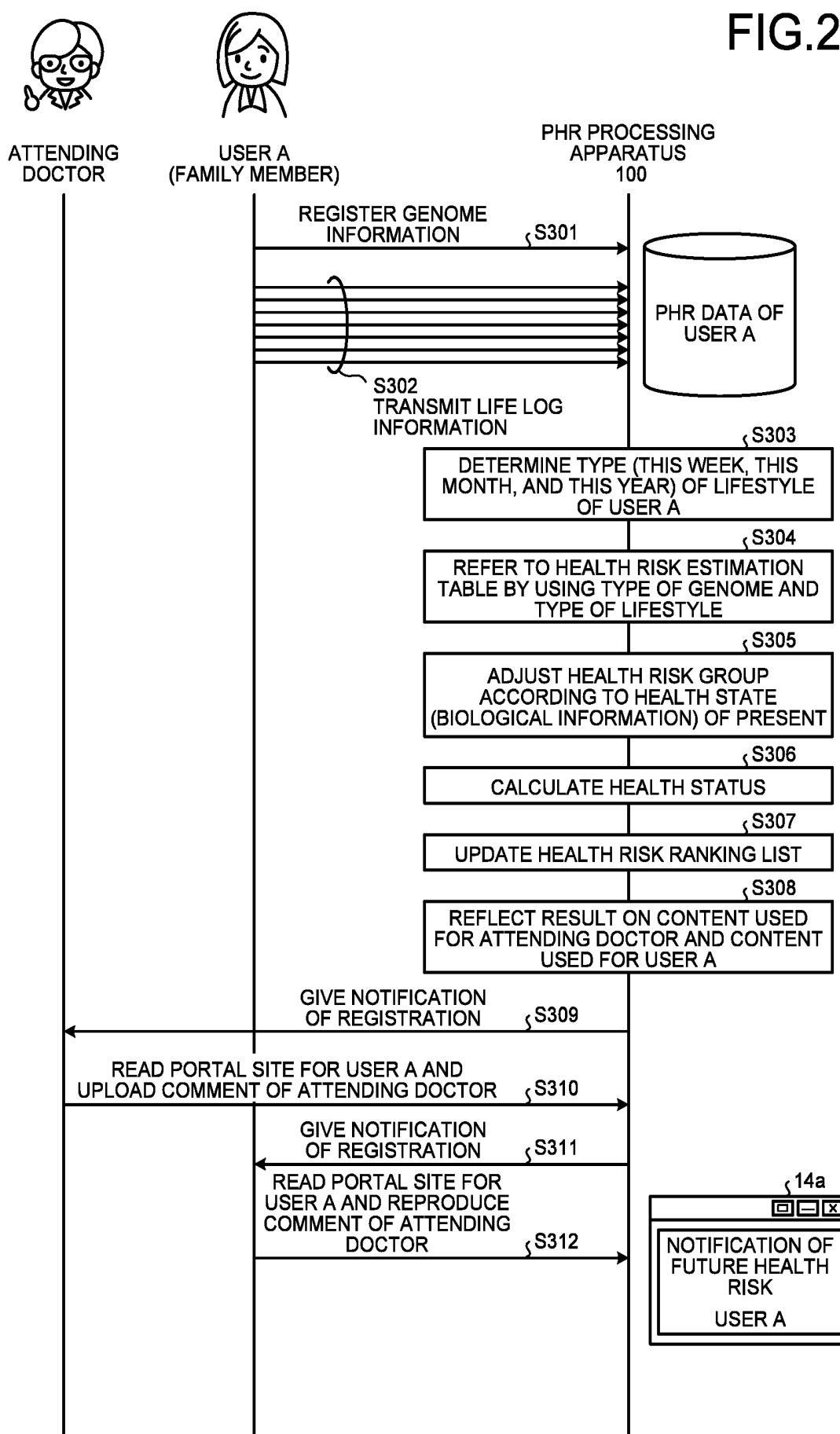


FIG.25

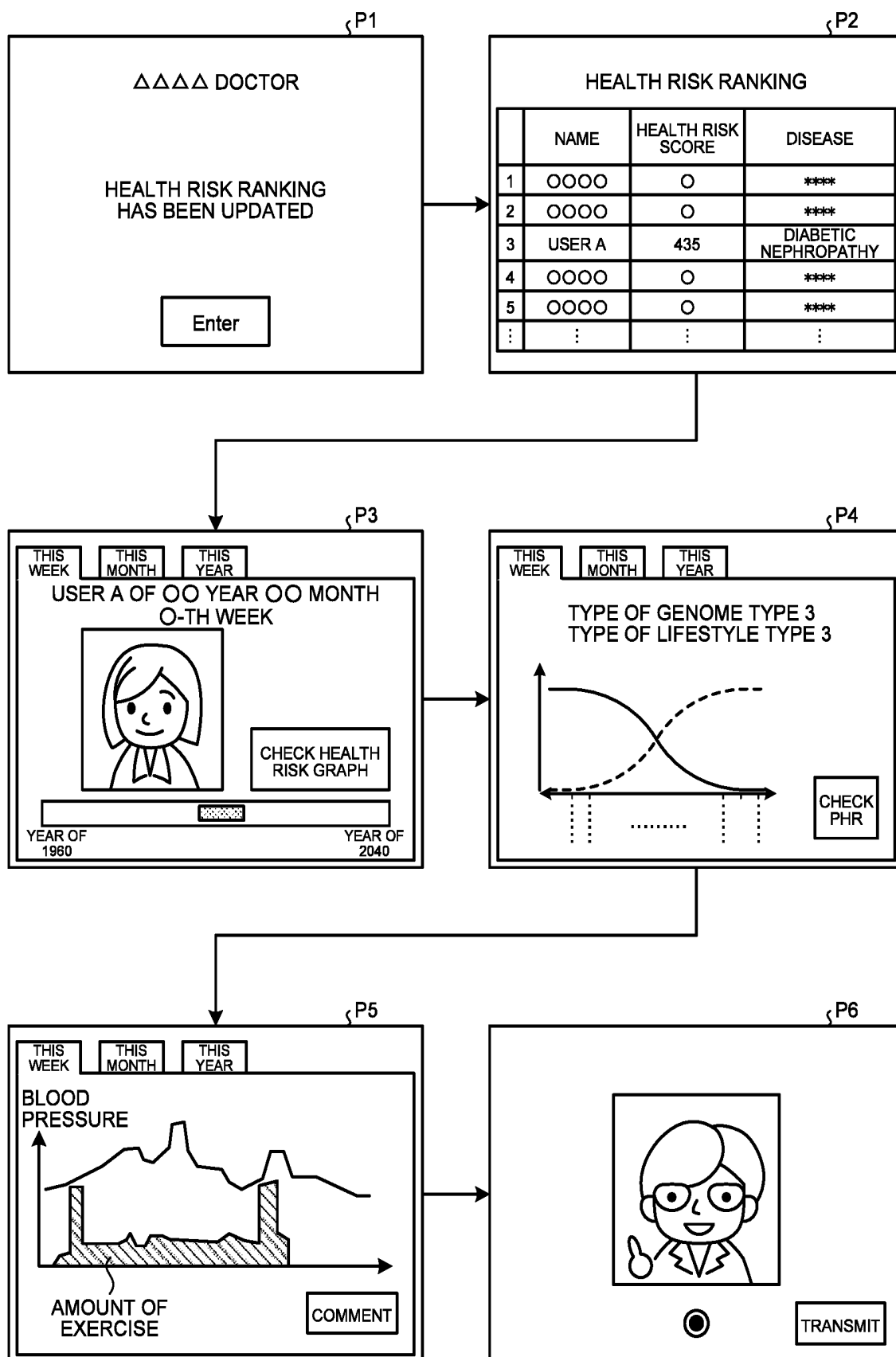
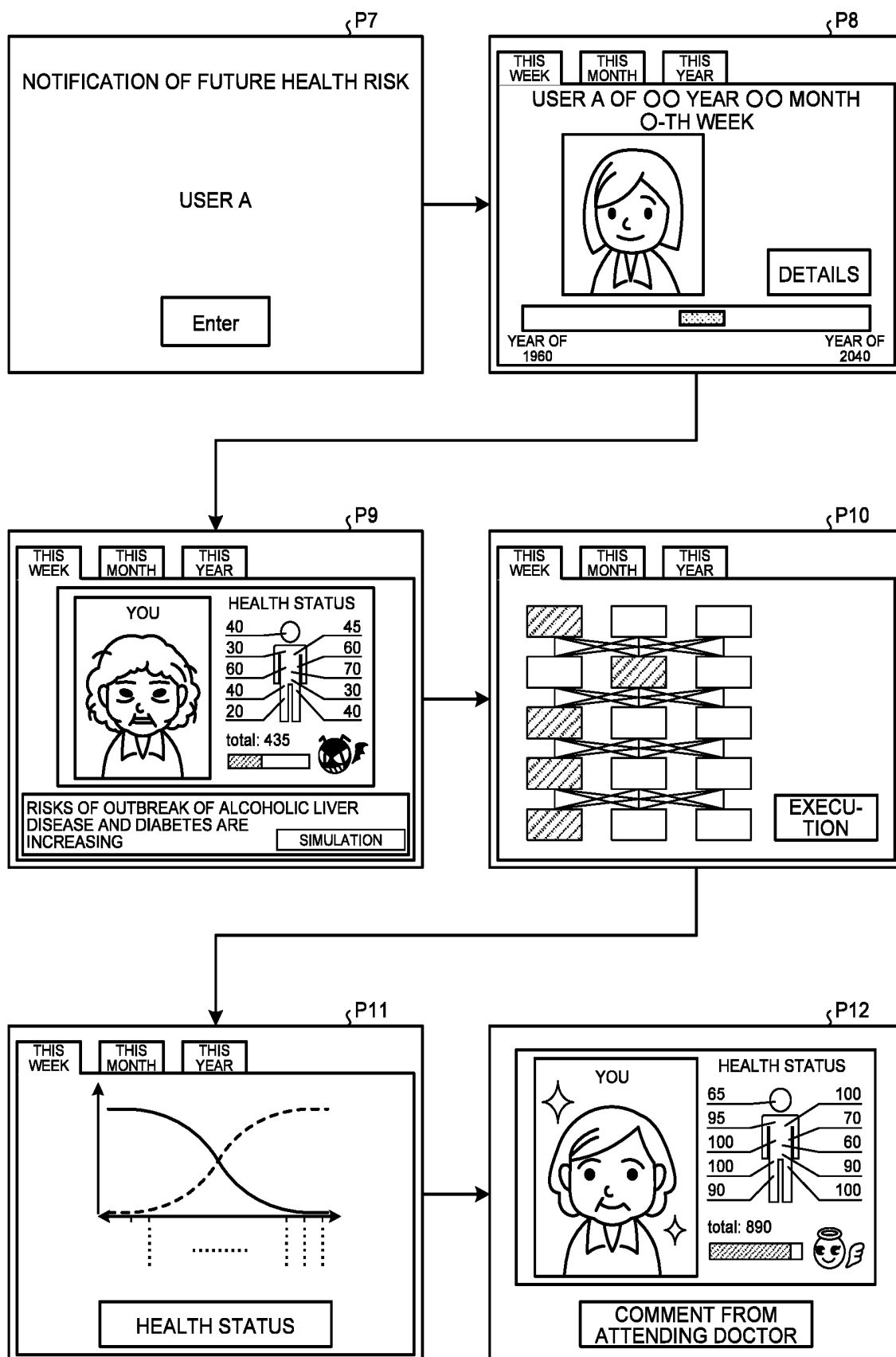


FIG.26



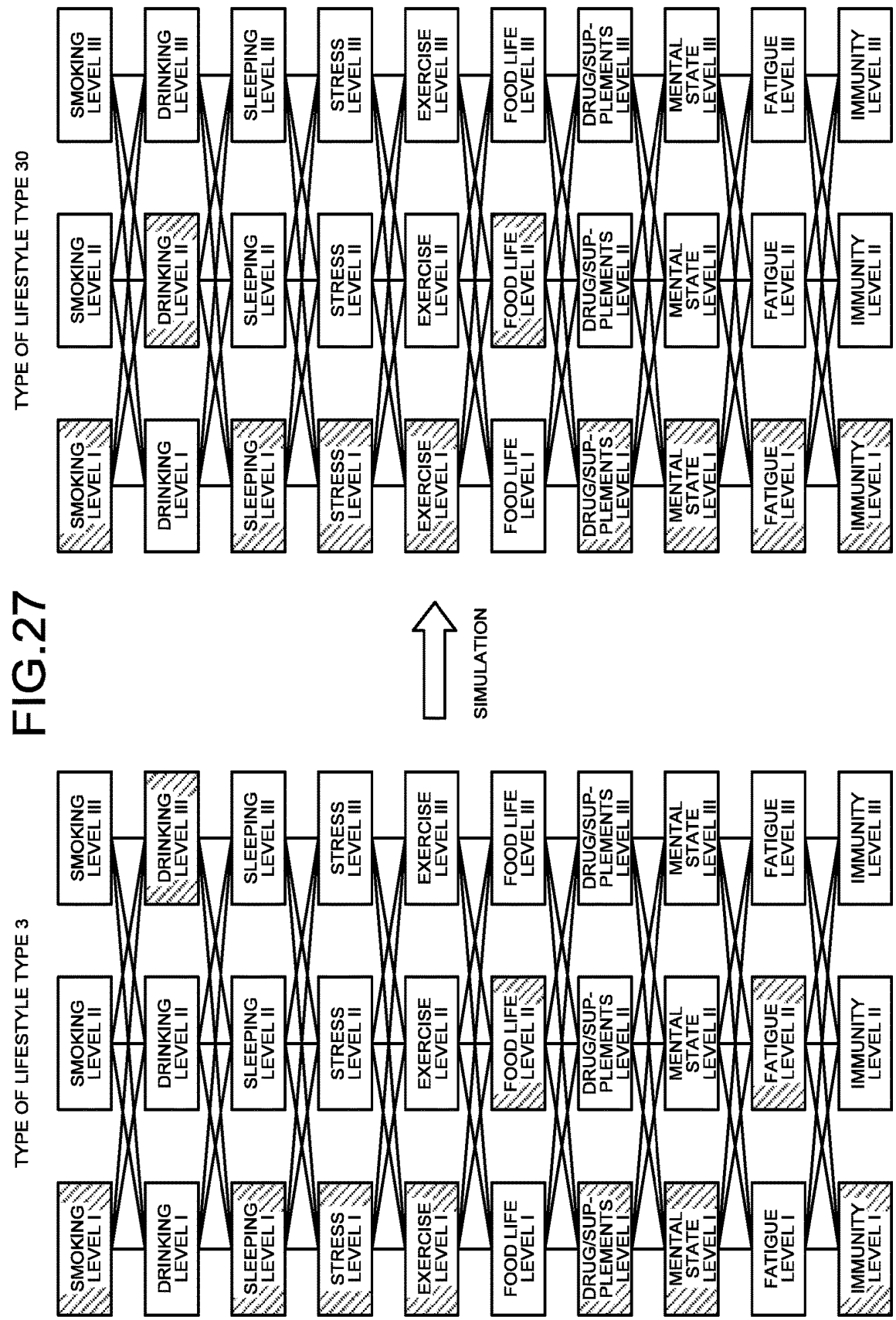


FIG.28

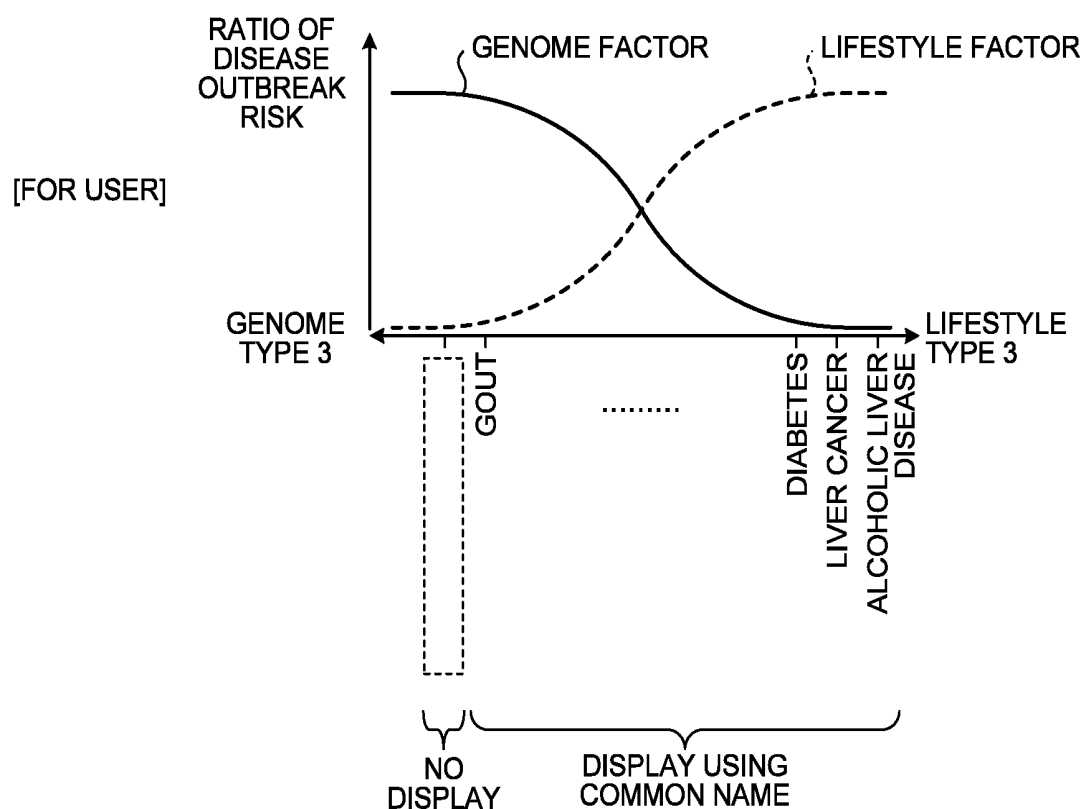
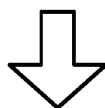
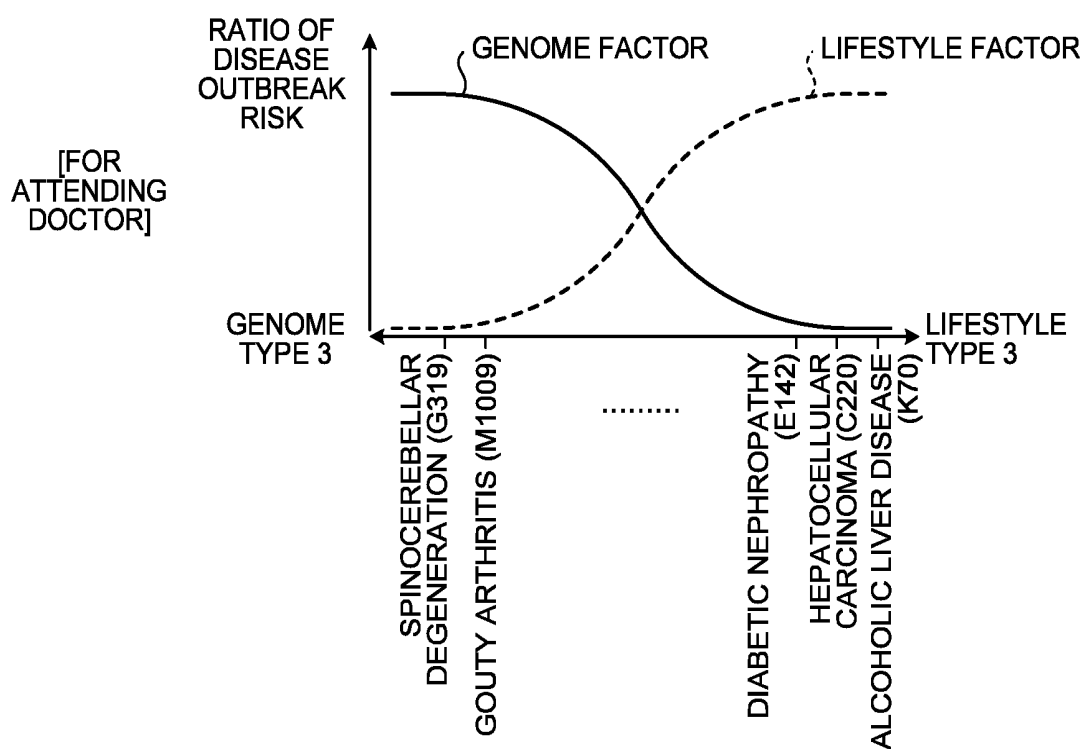


FIG.29

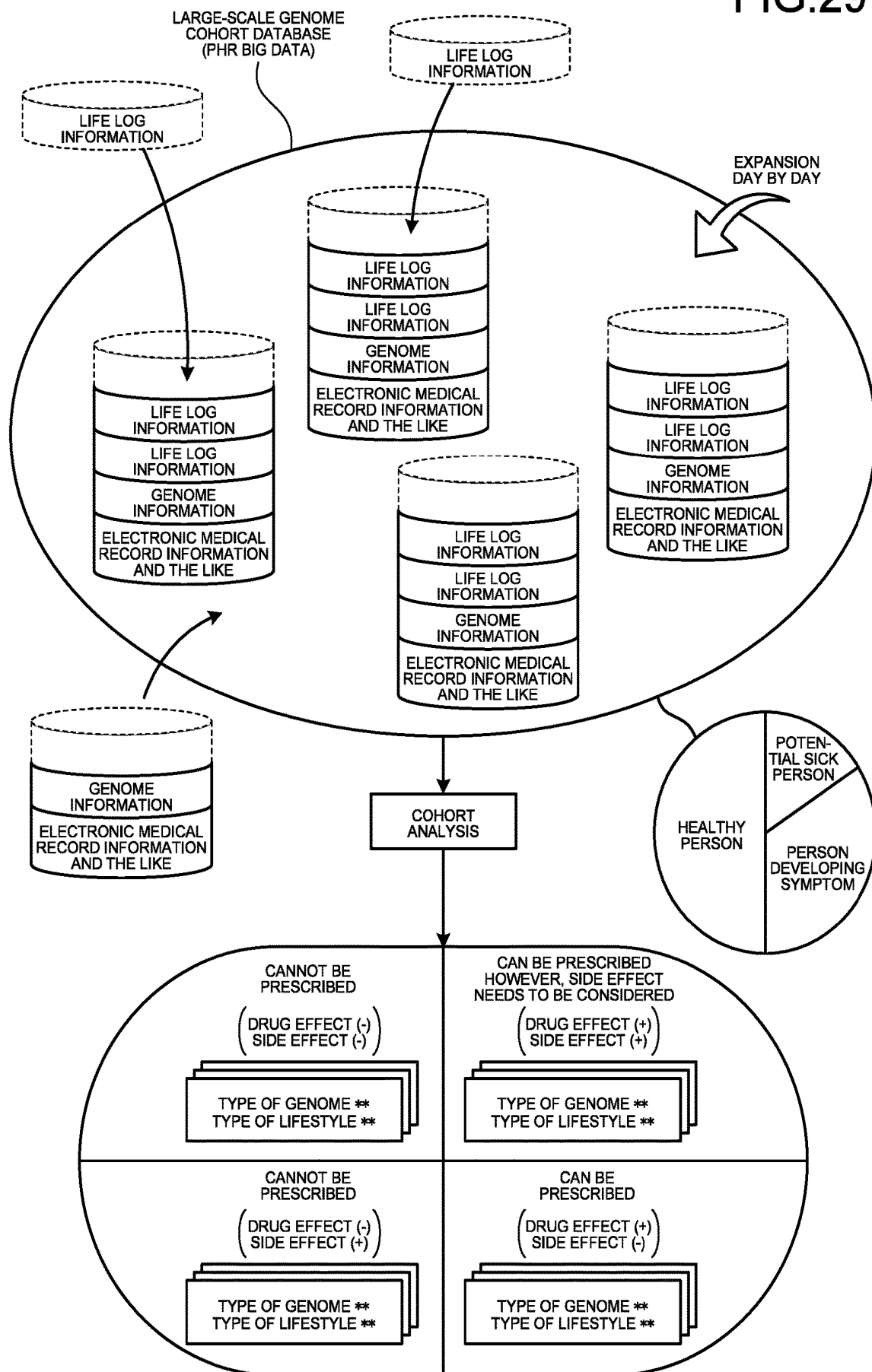


FIG.30

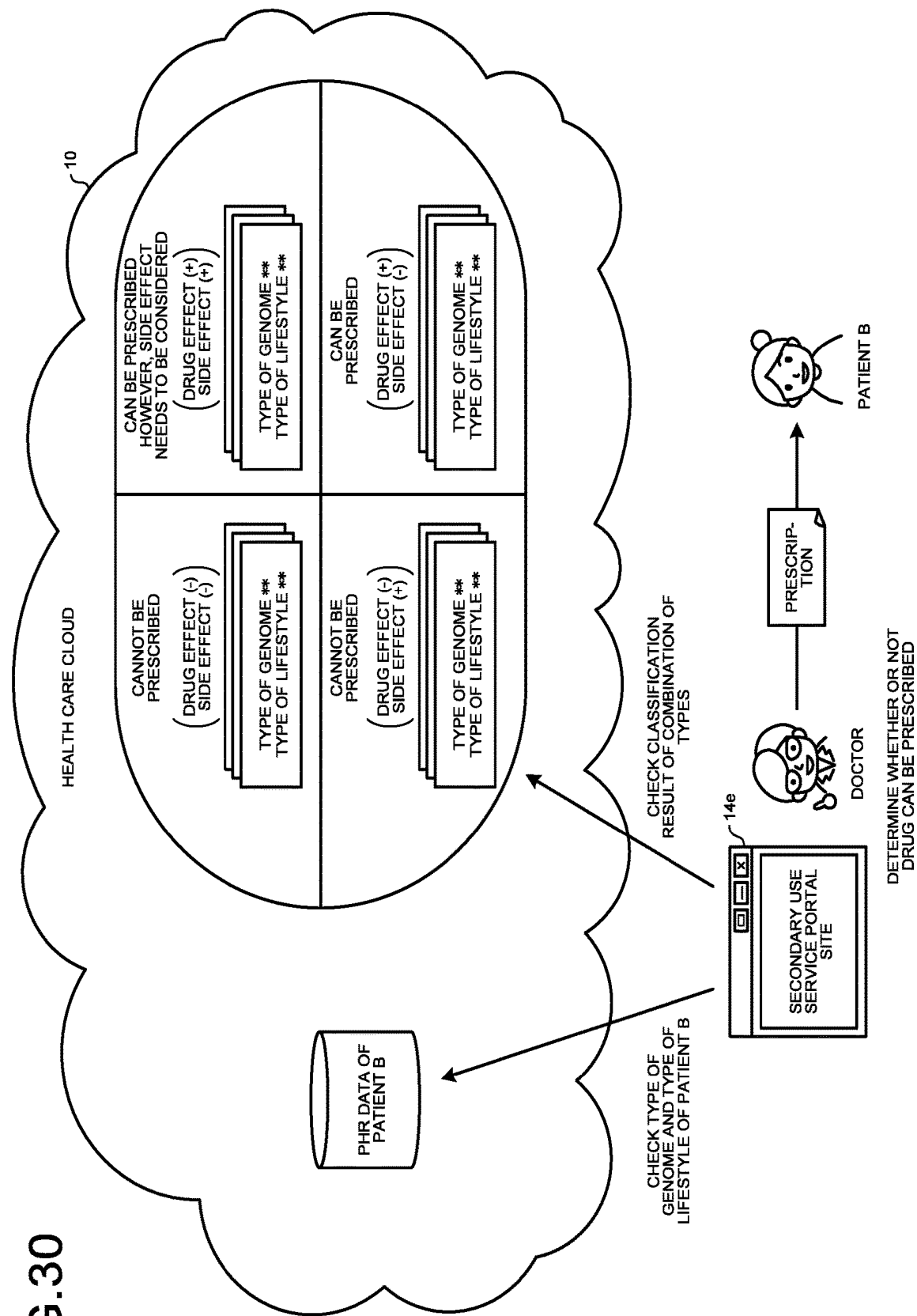


FIG.31

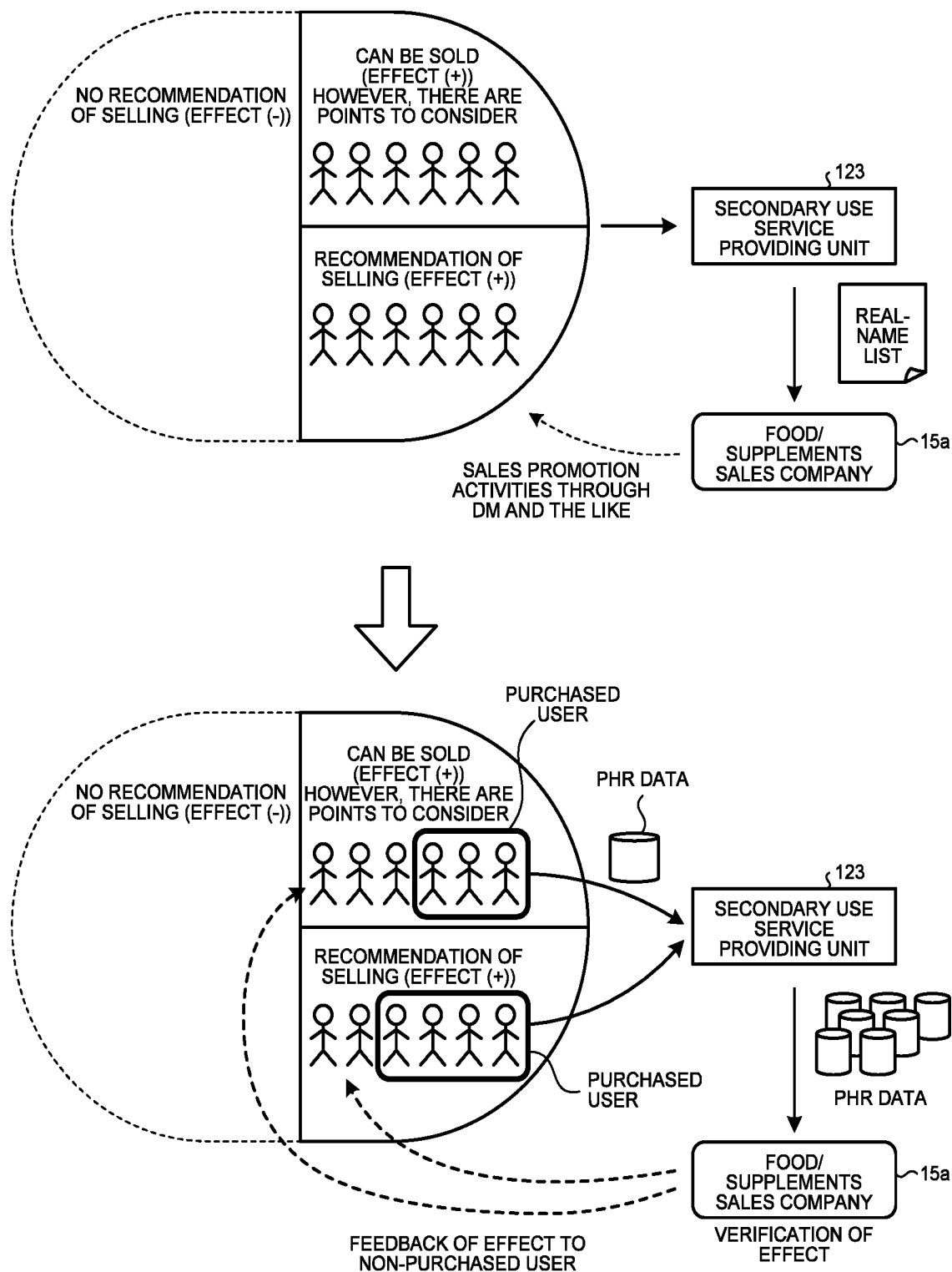


FIG.32

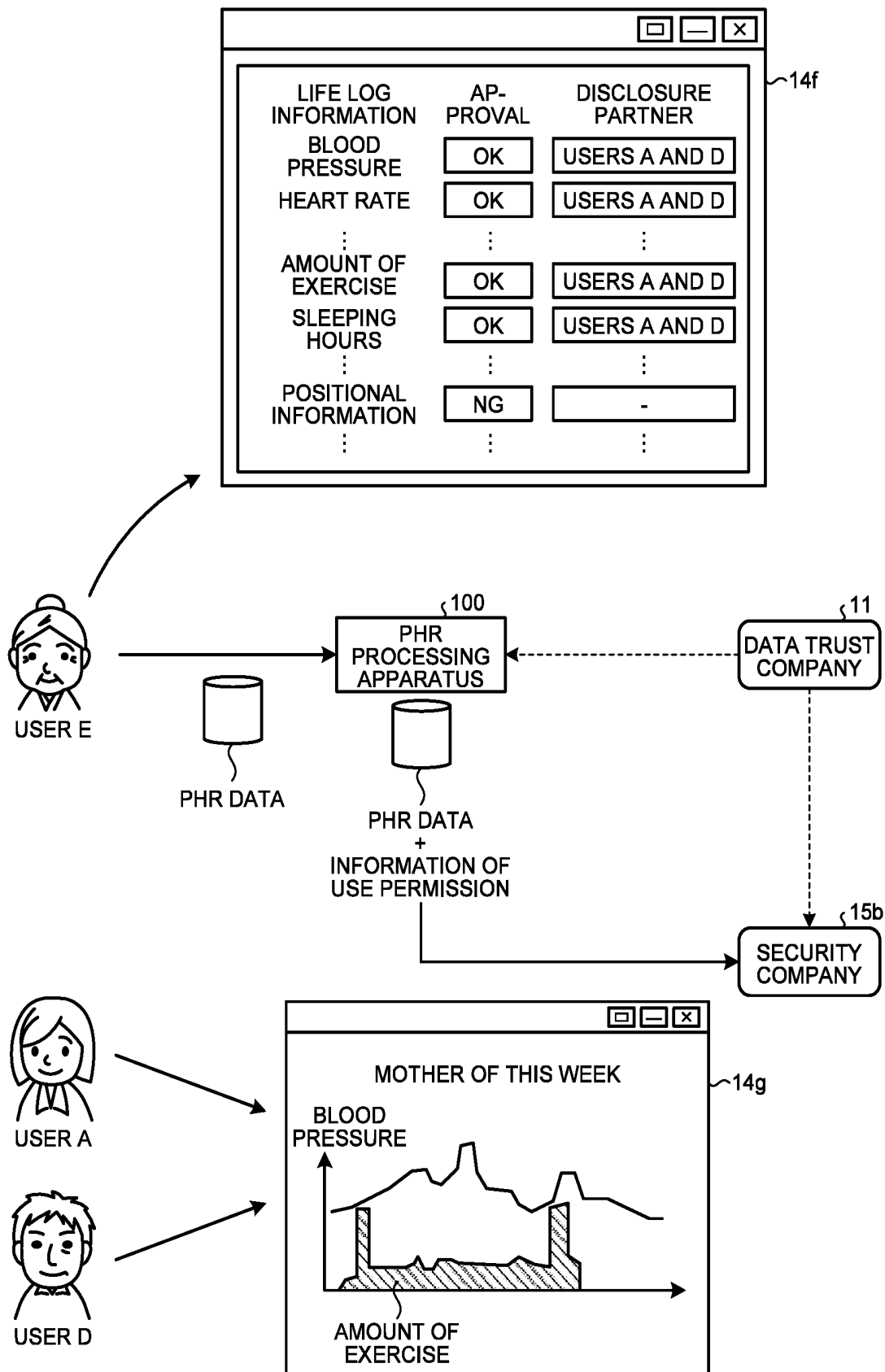


FIG.33

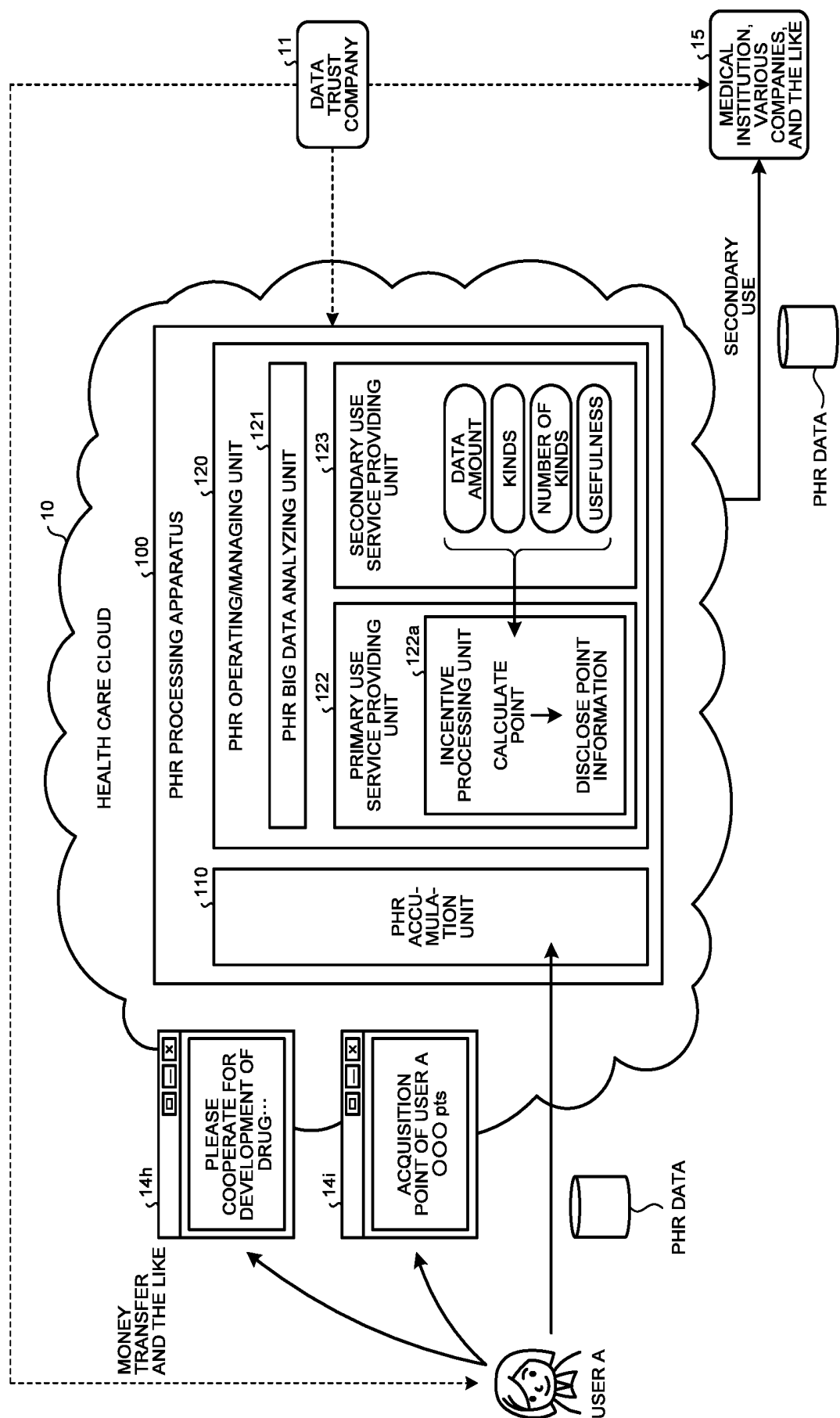


FIG.34

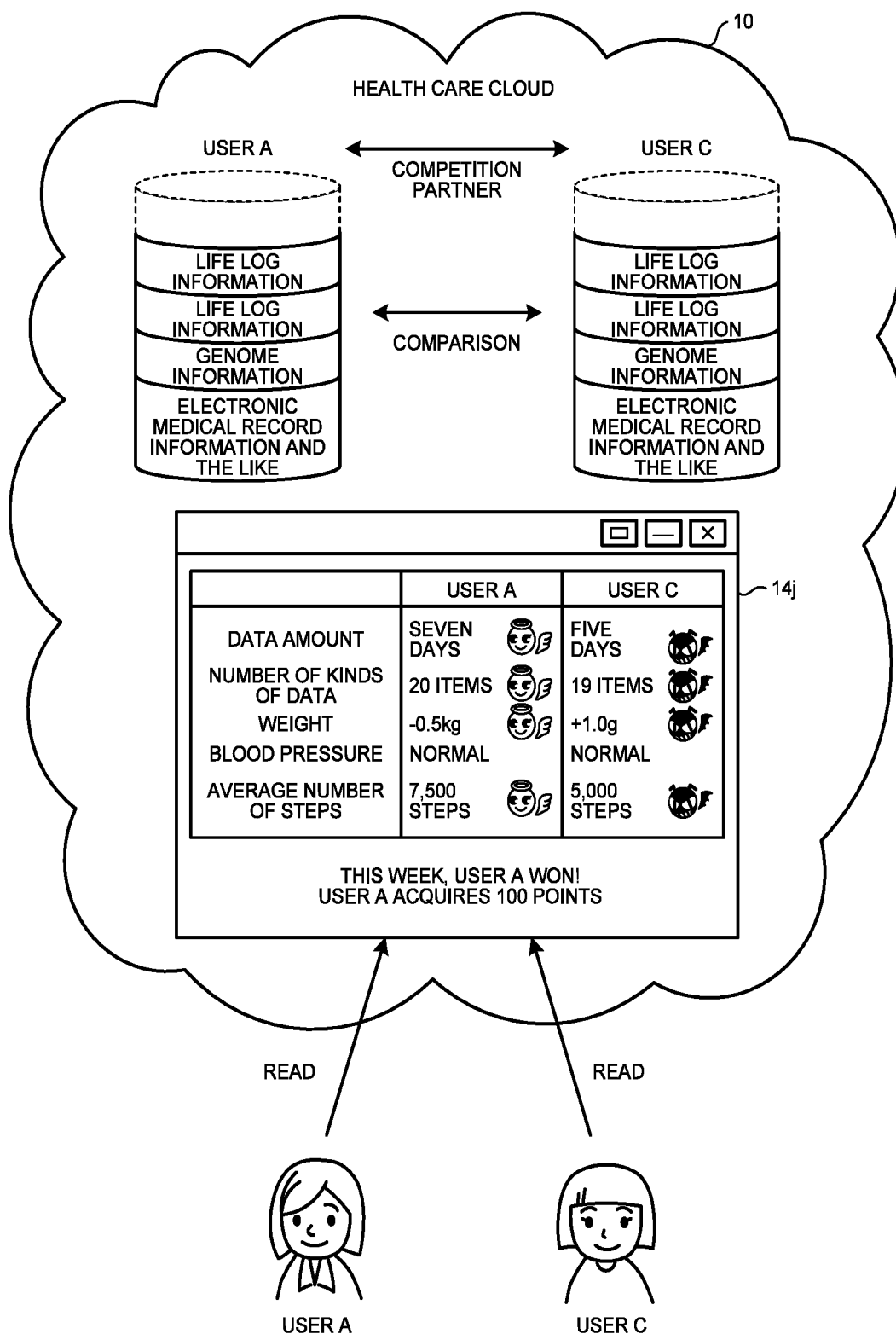


FIG.35

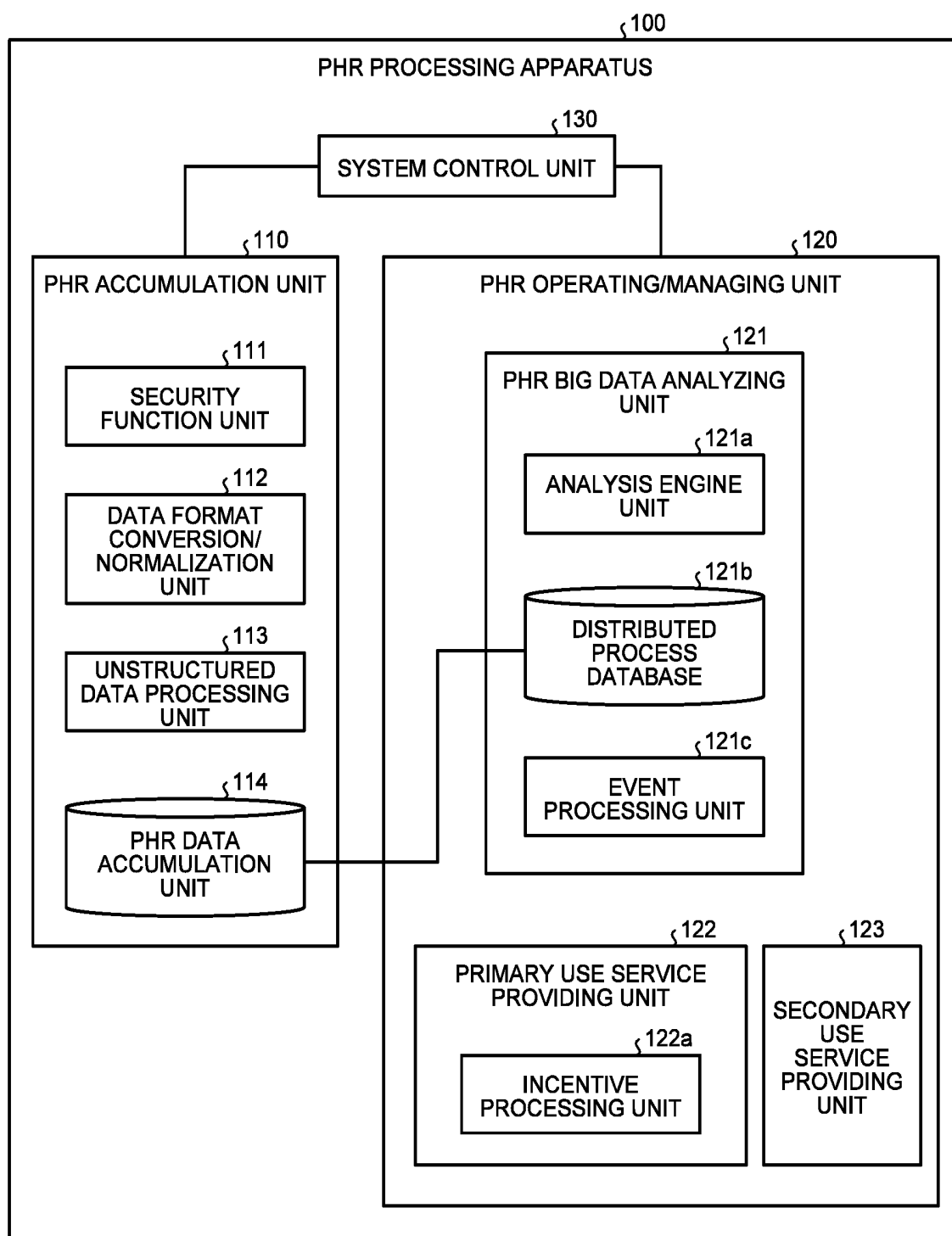
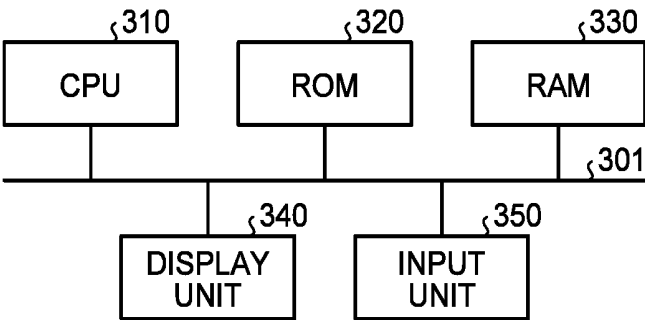


FIG.36



**INGESTIBLE SENSOR, SENSING METHOD,
AND FOOD****CROSS-REFERENCE TO RELATED
APPLICATIONS**

[0001] This application is a continuation of U.S. patent application Ser. No. 15/081,036, filed on Mar. 25, 2016, which is a continuation of International Application No. PCT/JP2014/077746, filed on Oct. 17, 2014 which claims the benefit of priority of the prior Japanese Patent Application No. 2013-217826, filed on Oct. 18, 2013, the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments described herein relate generally to an ingestible sensor, a sensing method, and food.

BACKGROUND

[0003] Conventionally, various countermeasures progress toward the realization of preemptive medicine and individualized prevention in the world. Here, the preemptive medicine represents that, before an outbreak of an illness, the illness is predicted with high accuracy or a diagnosis is made before an outbreak of the illness, and a therapeutic intervention is made at an appropriate time period before the outbreak, and the outbreak is prevented or delayed. In addition, individualized prevention represents prevention of an illness that is suitable to each individual.

[0004] However, still, it is difficult to evaluate a healthy state or make a judge of a non-illness state before the arrival at the outbreak of an illness accurately and objectively. For example, while there are many attempts for collecting a life log of an individual and making feedback to the individual, mostly, there is no association with base data necessary for the evaluation of a healthy state or a non-illness state, or individual health guidance based on the individual constitution has not been reached. In addition, regarding health management, while countermeasures for collecting a simple life log by collecting health data or life data using a measurement device such as a sensor or a body fat analyzer scale and giving feedback to a corresponding person have been attempted until now in many regions, generally, such countermeasures have not been widely used. Factors for this are as follows. For example, sensor devices that are currently available are large and have large volumes and thus, cause not good wearing feelings, and accordingly, health information is collected only in a fragmented and restricted manner and is difficult to use for long-term health maintenance. In addition, while various kinds of health data are collected by performing an inquiry hearing or a pin-point health examination, there are many cases where incorrect replies including false and pretentions are included in the inquiry hearing, and accordingly, it is difficult to acquire various situations of a living body in a pin-point health examination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a diagram that illustrates a motivation-improved society realized by this embodiment.

[0006] FIG. 2 is a diagram that illustrates an example of a solution system according to this embodiment.

[0007] FIG. 3 is a diagram that illustrates an overview of the solution system according to this embodiment.

[0008] FIG. 4 is a diagram that illustrates PHR (Personal Health Record) data according to this embodiment.

[0009] FIG. 5 is a diagram that illustrates the collection of life log information according to this embodiment.

[0010] FIG. 6 is a diagram that illustrates an example of food in which an ingestible sensor according to this embodiment is mixed.

[0011] FIG. 7 is a diagram that illustrates an example of sensing types of the ingestible sensor according to this embodiment.

[0012] FIG. 8A is a diagram that illustrates a method of identifying the ingestible sensor according to this embodiment.

[0013] FIG. 8B is a diagram that illustrates a method of identifying the ingestible sensor according to this embodiment.

[0014] FIG. 9A is a diagram that illustrates an example of the flow of the use of the ingestible sensor according to this embodiment.

[0015] FIG. 9B is a diagram that illustrates an example of the flow of the use of the ingestible sensor according to this embodiment.

[0016] FIG. 10 is a diagram that illustrates an example of a measurement result stored in a wearing-type information terminal according to this embodiment.

[0017] FIG. 11 is a diagram that illustrates an example of a sensor group of the ingestible sensors according to this embodiment.

[0018] FIG. 12 is a diagram that illustrates the processing sequence of sensing using ingestible sensors according to this embodiment.

[0019] FIG. 13 is a diagram that illustrates an example of the flow of the use of the ingestible sensor according to this embodiment.

[0020] FIG. 14 is a diagram that illustrates the processing sequence of sensing using ingestible sensors according to this embodiment.

[0021] FIG. 15 is a functional block diagram of the ingestible sensor according to this embodiment.

[0022] FIG. 16 is a diagram that illustrates an example of the process performed by the sensor according to this embodiment.

[0023] FIG. 17A is a diagram that illustrates an example of the structure of the ingestible sensor according to this embodiment.

[0024] FIG. 17B is a diagram that illustrates an example of the structure of the ingestible sensor according to this embodiment.

[0025] FIG. 18 is a diagram that illustrates an application example of the ingestible sensor according to this embodiment.

[0026] FIG. 19 is a diagram that illustrates an analysis of PHR big data according to this embodiment.

[0027] FIG. 20 is a diagram that illustrates the type of lifestyle according to this embodiment.

[0028] FIG. 21 is a diagram that illustrates a health risk estimation table T according to this embodiment.

[0029] FIG. 22 is a diagram that illustrates estimation of a health risk according to this embodiment.

[0030] FIG. 23 is a diagram that illustrates a health forecast portal site according to this embodiment.

[0031] FIG. 24 is a diagram that illustrates the processing sequence of daily medical checkup according to this embodiment.

[0032] FIG. 25 is a diagram that illustrates screen transitions at a portal site for an attending doctor according to this embodiment.

[0033] FIG. 26 is a diagram that illustrates screen transitions at a portal site for a user according to this embodiment.

[0034] FIG. 27 is a diagram that illustrates a simulation of a health risk according to this embodiment.

[0035] FIG. 28 is a diagram that illustrates health risk graphs displayed for an attending doctor and a user in this embodiment.

[0036] FIG. 29 is a diagram that illustrates an example (first example) of a secondary use service according to this embodiment.

[0037] FIG. 30 is a diagram that illustrates the example (first example) of the secondary use service according to this embodiment.

[0038] FIG. 31 is a diagram that illustrates an example (second example) of the secondary use service according to this embodiment.

[0039] FIG. 32 is a diagram that illustrates an example (third example) of the secondary use service according to this embodiment.

[0040] FIG. 33 is a diagram that illustrates a first one of incentive mechanisms according to this embodiment.

[0041] FIG. 34 is a diagram that illustrates a second one of incentive mechanisms according to this embodiment.

[0042] FIG. 35 is a functional block diagram of a PHR processing apparatus according to this embodiment.

[0043] FIG. 36 is a diagram that illustrates the hardware configuration of the PHR processing apparatus (or a PHR display apparatus) according to this embodiment.

DETAILED DESCRIPTION

[0044] According to one embodiment, an ingestible sensor to be mixed with food and discharged without being digested or absorbed also when entering the inside of a body, the ingestible sensor included a sensor, a detector and a transmitter. The sensor is configured to detect a predetermined substance disposed inside the body. The detector is configured to detect whether or not the sensor has entered the inside of the body. The transmitter is configured to transmit information of the predetermined substance detected by the sensor to a communication device disposed outside the body based on a detection of an entrance of the sensor into the inside of the body that is made by the detector.

[0045] Hereinafter, an ingestible sensor, a sensing method, and food according to an embodiment will be described with reference to the drawings. In the embodiment described below, details of the ingestible sensor will be described for an example of a motivation-improved society, in which a motivation for living is improved, realized by using the ingestible sensor according to the embodiment. Hereinafter, first, after a health information processing apparatus and a health information display apparatus realizing a motivation-improved society using sensing data collected by the ingestible sensor are described, details of the ingestible sensor will be described. In the embodiment described below, while an example will be described in which each of the health information processing apparatus and the health information display apparatus realizes a plurality of functions (for example, a primary use service, a secondary use service, and the like), the implementation of the plurality of functions is not necessarily an essential configuration. Thus, the health

information processing apparatus or the health information display apparatus may be configured to realize some of the plurality of functions.

[0046] (Motivation-Improved Society Realized by this Embodiment)

[0047] According to the embodiment described below, a motivation-improved society in which a motivation for living is increased is realized. Thus, before description of a specific configuration of the embodiment, first, the realization of the motivation-improved society proposed by us will be described.

[0048] FIG. 1 is a diagram that illustrates the motivation-improved society realized by this embodiment. Nowadays, ideally, everyone lives working and having hobbies healthily and pleasantly in the family and in the region. However, fears for a future illness, dementia, depression, loneliness, worries about separated family members, and the like threaten people in the modern society in which the decreasing birth rate and aging population progress, and a peaceful life has been eroded. In such a situation, far from a future image, even a motivation for living day by day decreases, and a strong mind is not acquired. If there is a tool that can naturally check everyday lives and mental and physical health states of a person and his family members and supports self-actualization drawn through an imagination at any time or a mechanism that raises a will toward efforts for realizing healthy and vital lives of him and his family members in the world, as a result of the self-actualization, everyone increases a motivation for living and is released from the present living, anxiety for the future, or stress and has a strong feeling of easiness and peacefulness. Thus, an economy or a society is recovered in which each individual acquiring such an ideal one's self, being backed by a strong connection with the other family members has vitality and a growing force. Thus, in embodiments described below, by collecting inventive ideas in which semiconductor, communication, energy, material, and medical technologies shine as one, a solution system for recovering a motivation for living was developed and was proposed to be implemented in the society.

[0049] As illustrated in FIG. 1, in a 'modern society', anxieties for the health or the living of the future are prevalent, and a connection with the family or the society starts to be lost. While a society of a decreasing birth rate and aging population is impending, people are worried about anxieties, loneliness, and concerns about family members such as being ill, having dementia or depression, being a lonely life, separate family members being well, and how to be confident. The reason for this is that a will or a motivation is started to be lost due to anxieties, depression, stress, a brain diseases, and a heart disease.

[0050] In such a 'modern society', everyone ideally desires to live working and having hobbies healthily and pleasantly in the family and in the society. One of means that realizes it is a 'daily medical checkup' illustrated in FIG. 1. This 'daily medical checkup' creates an ideal lifestyle based on innovative PHR (Personal Health Record) big data integrating true vital data in which biological information and behavior information are associated with each other and a constitution database acquired by analyzing genome information of individuals.

[0051] In the 'daily medical checkup', this innovative PHR data is collected by using an unconscious sensing technology. As sensing data, as illustrated in FIG. 1, for

example, there are a heart rate, stress, blood pressure, a hormone, blood concentration, a sympathetic nerve, the dose of a medicine, and the like. In addition, as the sensing data, for example, there are a sugar content, a salt content, stomach acids, an agricultural chemical, a microbe, an environmental material, and the like. As illustrated in FIG. 1, a PHR processing apparatus 100 is built on a health care cloud 10. The PHR processing apparatus 100 collects and stores biological information and behavior information of each individual with being associated with each other as life log information. Then, the PHR processing apparatus 100, as illustrated in FIG. 1, manages PHR big data acquired by integrating a large amount of the life log information collected in a time series and a constitution database that is based on genome information for a plurality of users in a unified manner on the health care cloud 10.

[0052] The PHR processing apparatus 100 analyzes such PHR big data, thereby analyzing a future disease outbreak risk based on genome information, a response and a reaction of a body for an amount of foods, an amount of exercise, or an exercise load, and the like in detail at a high degree. In addition, a design of a daily life targeted for an ideal image such as a selection of a food content, exercise, a lifestyle, and a medicine or a supplement that are optimal to an indication of a disease outbreak risk or an attack, a constitution of an individual, and a lifestyle can be made. Furthermore, the PHR processing apparatus 100, for example, applies big data mining, an integrated genome analysis, a simulation, a visualizing and quantifying technology of communication, and the like.

[0053] In this embodiment, the PHR data collected from each individual as above is used not only for a “primary use” for feeding the data back to a corresponding individual in the mechanism of the ‘daily medical checkup’ but also for a “secondary use” for various services. Thus, hereinafter, regarding the use of the PHR data, in this embodiment, an overview of health care informatics realized on the health care cloud will be described with being divided into the “primary use” and the “secondary use”.

[0054] First, the mechanism of the ‘daily medical checkup’ that is the “primary use” will be briefly described. For example, the PHR processing apparatus 100 feeds back a result of the analysis of the PHR big data to a target person by displaying the result to a wearing-type information terminal that is worn by the target person. An example of the feedback is a “future health risk notification”. The target person can acquire his future health risk based on the service of the “future health risk notification” provided on the wearing-type information terminal and have a visualized object by receiving a notification of a countermeasure thereof. In addition, the target person can receive guidance from a doctor, an encouragement from a family member (or a virtual family member), or the like on the wearing-type information terminal. For example, in FIG. 1, the target person receives guidance (“Please cut down on salt!”) from an attending doctor. In this way, the “future health risk notification” serves also as a response system using an actual person or a virtual person. Thus, according to this embodiment, each individual, based on information that is naturally collected daily with high accuracy, can acquire his health state using the wearing-type information terminal or the like and receive guidance and an encouragement from an attending doctor or a health support staff of the family. In addition,

the individual can manage the mental and physical state of him or his family members and check behaviors and lives thereof.

[0055] In addition, in the mechanism of the ‘daily medical checkup’, the PHR processing apparatus 100 may feed such information back not only to the target person but also to a medical institution. For example, a doctor recognizes a disease outbreak reserve of a high risk based on a result of the analysis that is fed back from the PHR processing apparatus 100 and responds to it as is necessary and actively accesses such a person. In addition, the sensing data transmitted from the target person may be helpful for detection of an abnormality of the target person’s body. For example, the PHR processing apparatus 100 constantly monitors the sensing data transmitted day after day for a target person of a disease outbreak reserve of a high risk and, when an abnormality is detected among the sensing data, immediately feeds the abnormality to the medical institution.

[0056] Regarding the “secondary use”, for example, the PHR processing apparatus 100 provides a result of the analysis of the PHR big data for a medical institution, various companies, or the like, thereby contributing to the secondary use for various services and the creation of a new industry. A specific example will be described later. In this way, as illustrated in FIG. 1, for example, after five to ten years, a motivation-improved society is realized. In FIG. 1, as keywords of technologies used for realizing the motivation-improved society, there are a “virtual clone”, a “future health risk notification”, and a “family watching service”. Among these, the “virtual clone” and the “future health risk notification” are examples of the “primary use”. On the other hand, the “family watching service” is an example of the “secondary use”.

[0057] For example, the PHR processing apparatus 100 sets a “virtual clone” to each target person and realizes a health promotion based on the “virtual clone”. For example, the PHR processing apparatus 100 can intuitively display a future image of each target person after X years on which the present life is influenced by presenting a self-image acquired by reflecting a characteristic look predicted from a future health state on the face or the appearance to the target person as a “virtual clone”. In addition, an ideal self-image may be set in the “virtual clone”. In this embodiment, the “virtual clone” is presented in the “future health risk notification”.

[0058] In addition, for example, the PHR processing apparatus 100 presents the “future health risk notification” to each target person. In this “future health risk notification”, a virtual family member and the virtual self-image (virtual clone) described above are projected. Furthermore, in the “future health risk notification”, the degree of a deviation from the person who is ideally designed and his future appearance of a case where the present life is continued are projected, whereby guidance for the ideal is performed. In addition, by having a conversation with a virtual person or family member, a person viewing the “future health risk notification” can receive health guidance by being constantly encouraged or cheered up, a will and vitality are enhanced, and activities and a will toward the self-realization of the ideal can be improved. In other words, a target person can raise his will by receiving guidance from a doctor, a family member (or a virtual family member), a friend (virtual friend), or a lover (virtual lover) through this “future health risk notification”. Furthermore, in the “future health risk notification”, health can be checked as well.

[0059] Furthermore, for example, in this embodiment, as an example of the secondary use service, a “family watching service” is realized. According to this “family watching service”, a separated family member can be watched at any time. Ubiquitous life log information can be used as a tool for achieving communication allowing a family member to clearly watch that a separated old person living alone and having proneness to disease has foods and takes medicine well and is in good health, thereby giving a notification of time when the person is not in good condition. As a result, it can be prevented that, since a person has unreasonable patience or performs a stouthearted behavior due to hesitation or worry about his family members, the family members do not recognize the outbreak of an illness to be ignored so as to delay the recognition thereof, and worries and concerns of the family members are also relieved. Thus, bonding with the family members and the society is strengthened, and self-strengthening is achieved in a vital aging society.

[0060] In addition, although not illustrated in FIG. 1, according to this embodiment, for example, a will can be improved toward an object of the acquisition of points based on the degree of achievement toward a target for efforts, a function of comparing with a future image of a competing friend, an opening function through an SNS (Social Networking Service) or the like, a function of assigning local currency points as a compensation, and the like. Furthermore, according to this embodiment, the condition of the disease of a person having an illness is watched over, an indication of an attack is detected, and, when the person is not in a good health or in an emergency, a helper or a first-aid staff immediately rushes to care his mind and body.

[0061] For example, in a case where anyone can use the “daily medical checkup” described above, he can check and manage the mind and body states, the behaviors, and the statuses of lives of him and his family members, and accordingly, everybody can achieve preemptive medicine and individual prevention that keeps him away from the outbreak of an illness. As a result, his ideal goal is clarified, a will is enhanced toward the realization of sound mind and body, and the feeling of achievement according to the ideal self-realization raises a motivation for the life, and each individual can be strengthened. In addition, according to the “family watching service”, the mind and body state, the behavior, and the living status of a separated family member can be acquired, and accordingly, each individual is free from anxieties and worries and constantly feels close bonding between himself and the family member, whereby a secured and peaceful society can be realized. The reason for this is that strong bonding of the family and the society is recovered by supporting daily delicate health maintenance, management of foods and a condition, watching an old person and a child that are not currently sufficient, and the realized society also represents the image of a society of a dream in which a sound, pleasant, secured, and peaceful life can be spent. When such a motivation-improved society is realized, persons are freed from anxieties, depression, stress, brain diseases, and heart diseases that prevail in the modern society.

[0062] As described above, the motivation-improved society, in which the “virtual clone”, the “future health risk notification”, the “family watching service”, and the like are provided, realized by using the “daily medical checkup” raises an individual’s motivation for living, whereby each individual can be strengthened. In addition, many people use

the “daily medical checkup” to accumulate a large amount of PHR big data, and accordingly, it is expected to lead a secondary use for various services and creation of a new industry and allow innovations to be chained in various fields. In this embodiment, a solution system of such a healthcare can be built.

[0063] FIG. 2 is a diagram that illustrates an example of a solution system according to this embodiment. As illustrated in FIG. 2, a solution system according to this embodiment performs health (self) checking based on biological information, which is based on the utilization of DNA chip/genome sequence information, behavior information that is real-time life log, checking of brain and mind, and the like, and information is integrated on the health care cloud 10. For example, for a user A, information of an electronic medical record and the like are integrated from hospitals and clinics. In addition, for user A, receipt information, labor information, results of medical examinations and the like relating to a company and health insurance are integrated. Furthermore, cohort data, sequence data, and the like are integrated from research institutions and colleges. Then, sensing data that is unconsciously collected from user A is integrated (“PHR input” illustrated in the figure).

[0064] Such a personal health record (PHR) is managed for each user (for example, user A), and a PHR group in which PHRs of a plurality of persons are integrated is managed in the health care cloud 10 as PHR big data. The PHR big data is operated and managed by a data trust bank (also called a data trust company). For example, the data trust bank enables a future prediction of each individual or a proposal for a lifestyle based on analyzed data of the PHR data by analyzing the PHR big data (big data analysis). For example, an attending doctor who is a health concierge performing a life support proposes a lifestyle based on the analyzed data of the PHR data or provides a “virtual clone” or a “future health risk notification” based on the analyzed data. In other words, for data inputting the PHR data, individual health guidance such as a health forecast on which the constitution and the lifestyle of each individual are reflected, a change in the lifestyle, and a risk diagnosis can be fed back.

[0065] Since the above-described feedback can be transferred as an incentive inputting the PHR data, a user continuously inputs the PHR data (the normalization of the PHR data input). In addition, when the user permits the secondary use of the PHR data, the data trust bank can assign a selling right or an access right for the managed PHR data or the analyzed data to various manufacturers or sellers/distributors. Here, since the PHR data and the analyzed data are personal information that requires careful handling, as illustrated in the figure, the anonymity thereof may be set.

[0066] As various manufactures or sellers/distributors provided with the PHR data or the analyzed data, for example, there are “security”, “pharmaceutical”, “food”, and “cosmetics” companies, and the various manufacturers or the sellers/distributors can perform development of high value-added products or provision of services based on health care information such as the PHR data or the analyzed data that has been provided. Here, the development of products or services, which is performed by various manufactures or the sellers/distributors, is over a very broad field including a clinical test performed for the development of medical and pharmaceutical products or approvals defined in the pharmaceutical affairs law and simple marketing for collecting

biological information appearing in the bodies from viewers of a movie or a program. The solution system of this embodiment can generate chained innovations in each field by being used in such a broad field.

[0067] In addition, as each individual uses the “daily medical checkup”, the solution system of this embodiment can build and provide a new sensor for the individual (for example, a sensor optimal to the person is provided based on the genome information or the lifestyle information of the user) or promote the development of a new DNA chip based on the analyzed data of the PHR data.

[0068] (Overview of the Solution System)

[0069] In this embodiment, first, a large-scale genome cohort database **114a** is formed by integrating the PHR data including the genome information on the health care cloud **10**, and, by setting the PHR big data accumulated in this large-scale genome cohort database **114a** as base data, a mechanism for estimating a future health risk (for example, the probability of the outbreak of each disease) with high accuracy is built. In addition, by continuously collecting the PHR data of each individual from each field and managing the collected data in a unified manner, for the individual, a mechanism (the daily medical checkup) is built which feeds back individual health guidance on which the constitution and the lifestyle of the individual is reflected. Furthermore, the mechanism of the secondary use (a use for the other people or a commercial use) of the PHR big data integrated on the health care cloud **10**.

[0070] FIG. 3 is a diagram that illustrates an overview of the solution system according to this embodiment. As illustrated in FIG. 3, in the overview of the solution system according to this embodiment, the PHR processing apparatus **100** (also referred to as a “health information processing apparatus”) is built on the health care cloud **10**, and the PHR processing apparatus **100** realizes the various mechanisms described above. In addition, as illustrated in FIG. 3, a health care cloud service including the operation of the PHR processing apparatus **100** is operated and managed by a data trust company **11**. For example, the data trust company **11** performs various procedures for providing services in an online or offline mode for a user and a medical institution **13** provided with the primary use service (the daily medical checkup) and a medical institution and various companies **15** provided with the secondary use service (see a dotted line illustrated in FIG. 3).

[0071] The PHR processing apparatus **100** includes: a PHR accumulation unit **110** that collects and accumulates PHR data; and a PHR operating/managing unit **120** that operates and manages the PHR data accumulated in the PHR accumulation unit **110**.

[0072] The PHR accumulation unit **110** collects PHR data (the PHR data **12** illustrated in FIG. 2B) relating to an individual from not only individuals but also from a research institution, a medical institution, a company, and the like, integrates the collected data as the PHR data of each individual, and individually manages the integrated data in a unified manner. For example, as the PHR data, in addition to information of a life log that is continuously collected from an individual, there are genome information of the individual that is acquired from a research institution, electronic medical record information that is acquired from a medical institution, health insurance association information (receipt information, labor information, and examination notebook information) acquired from a company or a health

insurance association, maternity passbook information, information of a school health examination, and the like. In other words, the PHR data is collected not only from an individual but also from various organizations as information relating to the health of the individual, and the kind thereof is not particularly limited. In addition, the PHR accumulation unit **110** collects such PHR data in a large scale (for example, a scale of 150,000 persons) and forms a large-scale genome cohort database **114a**. In the large-scale genome cohort database **114a**, the scale is enlarged by accumulating new information on a daily basis for each individual, and the scale is enlarged by enlarging the range of collection targets. Hereinafter, in a case where the entire PHR data of the large-scale genome cohort database **114a** is to be represented, it will be referred to as “PHR big data” so as to be discriminated from the PHR data of each individual. The PHR data may be also referred to as “health information”.

[0073] The PHR operating/managing unit **120** includes: a PHR big data analyzing unit **121**; a primary use service providing unit **122** (also referred to as an “estimation unit”); and a secondary use service providing unit **123** (also referred to as an “output unit”). The PHR big data analyzing unit **121** analyzes the PHR big data accumulated in the large-scale genome cohort database **114a** according to a predetermined object, thereby deriving relevance among the genome information, the lifestyle, and the health risk. Then, the PHR big data analyzing unit **121** acquires an analysis result in which specific relevance with a combination of the constitution of an individual and a combination of lifestyles is represented.

[0074] For example, the PHR big data analyzing unit **121** performs a cohort analysis of the PHR big data as a target, thereby deriving relevance between a combination of the type of genome and the type of lifestyle and a risk (it will be referred to as a “disease outbreak risk”) of a disease that may be developed in the future. Then, the primary use service providing unit **122** applies the relevance derived by the PHR big data analyzing unit **121** to the PHR data of each individual, thereby calculating a disease outbreak risk according to the constitution of the individual and the lifestyle. Then, the primary use service providing unit **122** performs registration of information of the calculated disease outbreak risk in a portal site **14a** of the user or the like, thereby feeding the information back to the user. This portal site **14a** can be read by not only the corresponding individual but also his family members and attending doctor, and communication with a third party can be achieved through the portal site **14a**. This is the overview of the “daily medical checkup” according to this embodiment. The “daily medical checkup” will be described later in detail.

[0075] In addition, the PHR big data analyzing unit **121** performs the cohort analysis of the PHR big data as a target, thereby deriving an analysis result for the secondary use service. In addition, the secondary use service providing unit **123** outputs the analysis result derived by the PHR big data analyzing unit **121**, thereby providing the analysis result for various companies (a medical institution, a food/supplements seller, a pharmaceutical company, a medical device manufacturer, a distribution company, a security company, or the like). A specific example of the secondary use service will be described later.

[0076] In addition, as illustrated in FIG. 3, the user, related persons such as user’s family members, and the user’s attending doctor, for example, read the portal site **14a**

provided by the primary use service providing unit 122 by using a PHR display apparatus 200 (also referred to as a “health information display device”). The PHR display apparatus 200 is a smartphone, a PC (Personal Computer), an Internet TV, a wearable information terminal, or the like. The PHR display apparatus 200 includes a display control unit 210 and a display unit 220. The display control unit 210 displays the future health risk of the user on the display unit 220.

[0077] (PHR Data)

[0078] Next, FIG. 4 is a diagram that illustrates the PHR data according to this embodiment. As described above, the PHR data is collected not only from an individual but also from various organizations as information relating to the health of the individual, and the type thereof is not particularly limited. Thus, in this embodiment, information to be collected as the PHR data is considered to be different for each individual. As will be described below, the “daily medical checkup” according to this embodiment calculates the type of lifestyle of an individual based on the PHR data of the individual. In this embodiment, the type of lifestyle is calculated by evaluating ten items (smoking, drinking, sleep, stress, exercise, a food life, a medicine/supplement, a mental state, fatigue, and immunity). Accordingly, in this embodiment, it is assumed that the PHR data from which the ten items can be evaluated is collected from each individual. In FIG. 3, among the PHR data of user A, only the genome information and the life log information will be conceptually illustrated.

[0079] First, the genome information is genetic information of user A. As illustrated in FIG. 4, inside a nucleus of a cell, a chromosome is present, and a material composing this chromosome called deoxyribonucleic acid is DNA. DNA has a double helical structure, in which nucleotides that are constitutional units thereof are bonded in a chained pattern, formed by two chains. In addition, a gene is a partition on the DNA. In the nucleotide, deoxyribose sugar is connected using phosphoric acid, and one of four kinds of bases is combined with the deoxyribose sugar. Between the two chains, a base pair of adenine (A) and thymine (T) and a base pair of guanine (G) and cytosine (C) are combined. Human genome information is composed by about three billion base pairs.

[0080] In this embodiment, the genome information is arrangement information of these base pairs of about three billion or arrangement information of about one million base pairs determining the individuality. In addition, the PHR accumulation unit 110 may directly store the arrangement information of the base pairs or may store the arrangement information in the form of a difference from standard genome information (for example, an SNP (Single Nucleotide Polymorphism) of a Japanese person). For example, in a case where a user A provides his blood to a research institution, and all the base arrangements (arrangement information) of the genome extracted from user A are specified in the research institution, the arrangement information is handled as the genome information of user A.

[0081] In addition, the genome information is not limited to the above-described arrangement information but also includes an analysis result according to various techniques such as a DNA chip and the like. For example, in a case where user A provides his blood to a research institution, and the research institution analyzes the blood using the DNA chip, the analysis result thereof is handled as the genome

information of user A. For example, in a case where the type of gene relating to a specific disease (for example, hypertension, hyperlipidemia, obesity, diabetes, or the like), metabolism of a specific medicine, or the type of gene relating to alcohol decomposition is determined, for example, through an SNP analysis using a DNA chip, a CNV (Copy Number Variation) analysis, a micro satellite analysis, an epigenome analysis, a gene expression level analysis, or the like, the analysis result thereof is the genome information of user A.

[0082] Next, the life log information is information that represents the lifestyle (mode of life) of user A. As illustrated in FIG. 4, in this embodiment, the biological information and the behavior information will be referred altogether to as the life log information, and both are associated with each other as is necessary, whereby accurate life log information can be acquired.

[0083] Here, the acquisition of accurate life log information, which is acquired by associating the “blood pressure” that is the biological information and the “amount of exercise” and a “behavior history” that are the behavior information will be described with reference to FIG. 4. For example, it is assumed that user A wears a biological sensor and an acceleration sensor. Such sensors may be provided in a wearing-type information terminal to be described later or may be installed (for example, attached) to user A separated from the wearing-type information terminal. The biological sensor, for example, detects a change in the blood flow of a peripheral blood vessel of a finger, a wrist, an ear, or the like and acquires blood pressure, a pulse rate, a pulse count, and the like based on the detected change in the blood flow. On the other hand, the acceleration sensor detects the user’s posture based on a DC component and identifies a user’s operation (walking, running, riding on a bicycle, moving on a vehicle, moving by subway, or the like) based on an AC component. Then, the acceleration sensor acquires the amount of user’s exercise based on the user’s posture and the user’s operation. In addition, the behavior history is acquired from schedule information that is input from a wearing-type information terminal or an information terminal such as a smartphone or a PC.

[0084] Then, in this embodiment, the biological information acquired from the biological sensor and the behavior information acquired from the acceleration sensor and the other information terminals are associated with each other by using time information included in each information or are associated with each other by being recorded in the same record. By referring back to FIG. 4, for example, while the blood pressure that is the biological information temporarily rises during the day, by referring to the behavior history associated with the biological information, this rise is determined to be caused by stress due to meetings. In addition, while the same blood pressure falls after the evening, by referring to the behavior history associated with the biological information, this fall is determined to be caused by drinking. Furthermore, relevance between the blood pressure and the amount of exercise becomes clear.

[0085] As above, in this embodiment, the biological information and the behavior information are basically handled with being associated with each other. In addition, in this embodiment, the PHR processing apparatus 100 appropriately selects the type of lifestyle and information required for evaluating the health state of the present as biological information and behavior information to be selected. For

example, the biological information is information of various numerical values representing the health state of the present and information representing the amount of a component taken into the body and presence/no-presence of a material. For example, the biological information is blood pressure, a heart rate, a pulse count, a body temperature, a body component, ions, pH concentration, and the like. In addition, for example, the biological information is the amounts of components such as sugar, salt, and the like, the concentration of gastric acid, presence/no-presence of agro-chemical, an environmental material, and a food additive, the intake amounts of alcohol, nicotine, and a medicament component, and the like. Furthermore, the behavior information is an amount of exercise, sleeping hours, schedule information, positional information of a GPS (Global Positioning System) or the like, and the like. In this embodiment, the whole or a part of such life log information is collected from sensors or various information terminals. In addition, for example, information acquired by a smartphone (a motor system application, a scheduling application, or the like), an SNS, an electronic receipt, or the like may be used.

[0086] FIG. 5 is a diagram that illustrates the collection of the life log information according to this embodiment. In this embodiment, as an example, it is assumed that a user wears a wearing-type information terminal. As the wearing-type information terminal, for example, a wrist watch type, a glass type, a ring type, or the like may be considered. This wearing-type information terminal has a function of a sensor and can collect biological information. In addition, this wearing-type information terminal also has a function of a so-called information terminal and can collect behavior information. Thus, the wearing-type information terminal achieves the role of a dock of the life log information and, as illustrated in FIG. 5, associates (pairs) the biological information and the behavior information, which have been individually collected from a user, with each other and uploads the life log information after the pairing into the health care cloud 10. While the biological information and the behavior information, which are individually collected, are collected regularly or irregularly during one day, the upload thereof into the health care cloud 10, for example, is performed at the frequency of once per day. In addition, this wearing-type information terminal may receive the biological information and the behavior information from a sensor or an information terminal that is worn by the user separately from the wearing-type information terminal. Also in such a case, the wearing-type information terminal associates (pairing) the biological information and the behavior information, which are individually collected from the user, with each other and uploads the life log information after the pairing into the health care cloud 10. In addition, the pairing process may be performed not on the side of the wearing-type information terminal but on the side of the health care cloud 10.

[0087] In addition, in this embodiment, the wearing-type information terminal performs personal authentication. In other words, the wearing-type information terminal performs personal authentication for checking whether or not a person wearing the terminal is reliably authenticated. For example, in the case of the wrist watch type, the wearing-type information terminal performs personal authentication through vein authentication. In addition, for example, in a case where a camera is included, the wearing-type information terminal performs personal authentication through face

authentication. Furthermore, for example, in the case of the glass type, the wearing-type information terminal performs personal authentication through retina authentication or iris authentication. In addition, for example, in the case of a ring type, the wearing-type information terminal performs personal authentication through vein authentication of the finger. Here, a technique used for the personal authentication is not limited to the techniques described above. In this embodiment, while the technique for uploading the life log information from the wearing-type information terminal has been described, the embodiment is not limited thereto. For example, the life log information may be uploaded from a mobile-type information terminal or an installation-type information terminal.

Overview of this Embodiment

[0088] Hereinafter, an ingestible sensor according to this embodiment will be described. As described above, in this embodiment, by performing non-conscious sensing allowing individuals to be non-conscious of a sensor, true data of the individuals is collected effectively and continuously. Here, the ingestible sensor according to this embodiment is an ultra-small autonomous driving-type high-performance sensor, is mixed with food, and is discharged without being digested or absorbed also when entering a body, thereby sensing biological information in a non-conscious manner. For example, the ingestible sensor is mixed into various foods (a fresh food, a processed food, condiment, a beverage, and the like) that are taken in everyday, is taken into the inside the body together with the foods, and collects biological information of the body.

[0089] FIG. 6 is a diagram that illustrates an example of food in which the ingestible sensor according to this embodiment is mixed. For example, the ingestible sensor according to this embodiment, as illustrated in FIG. 6, is mixed into a fresh food such as a green onion, a processed food such as bread, a rice seasoning, a sesame, a seaweed, dried bonito, or a frozen food, a seasoning such as chili oil, a dressing, pepper, a soy sauce, miso, seven-spice chili pepper, or a sauce, a beverage such as tea or water, or the like, and is swallowed into the body together with the food described above. Here, the ingestible sensor, for example, is mixed into a fresh food at the time of cooking and is mixed into a processed food and a seasoning at the time of manufacturing. Then, as a user takes one of the foods into which the ingestible sensor is mixed into the body as a meal, the ingestible sensor collects the biological information of the inside of the body.

[0090] Here, according to the ingestible sensor of this embodiment, one ingestible sensor senses a single substance so as to decrease the size of the sensor. For example, as the ingestible sensor, a sensor measuring a salt content, a sensor measuring a sugar content, a sensor measuring PH, a sensor measuring an enzyme, a sensor measuring a virus, a sensor measuring a germ, a sensor measuring alcohol, a sensor measuring a specific substance of a cigarette such as tar or nicotine, a sensor measuring blood, a sensor measuring a specific medical component, a sensor measuring a lipid, a sensor measuring an iron content, a sensor measuring calcium, a sensor measuring a fiber, a sensor detecting vitamin, and the like are respectively built.

[0091] In addition, for the enzyme, the virus, the germ, the specific medical component, the vitamin, and the like, ingestible sensors of each of various enzymes, each virus,

each germ, each medical component, and each vitamin are respectively built. In other words, in a case where an ingestible sensor is mixed into a rice seasoning, a plurality of ingestible sensors respectively targeting substances are mixed into the rice seasoning, are applied to rice, and are respectively swallowed into a user's body. Then, each ingestible sensor measures a predetermined substance included in a user's body and transmits a result of the measurement to each communication device disposed outside the body.

[0092] Here, the ingestible sensor is built such that, under a specific environment, the power becomes in the On state, and the ingestible sensor communicates with a communication device disposed outside the body and transmits a measurement result. For example, in the case of detecting moisture, being exposed to predetermined temperature, detecting an enzyme inside the body, detecting magnetism, or the like, the ingestible sensor is built such that the power becomes in the On state, and the ingestible sensor starts communication with a wearing-type information terminal that is mounted by a user. The start of the communication of the ingestible sensor will be described later in detail. The kinds of sensors and the kinds of foods described above are merely examples, and embodiments are not limited thereto. For example, as the other sensors, sensors having an agricultural chemical, an environment substance, a food additive, and the like as sensing targets may be used. In addition, for example, as the other foods, confectionary such as chocolates and cookies may be used. The ingestible sensor and the food may be mixed in an arbitrary manner and, for example, the ingestible sensor may be simply mixed or be embedded in the food.

[0093] The ingestible sensor according to this embodiment may be targeted for sensing not only a person but also a pet, a domestic animal, or the like. In such a case, for example, as illustrated in FIG. 6, the ingestible sensor may be given to a domestic animal with being mixed into fodder or may be given to a pet with being mixed into a pet food. In this way, various substances disposed inside the body of the domestic animal or the pet can be sensed.

[0094] Next, the type of sensing of the ingestible sensor and a method of identifying each ingestible sensor will be described. Hereinafter, a case will be described as an example in which the ingestible sensor is swallowed by a person. While the ingestible sensor is mixed with food and is swallowed together with the food and collects information of each substance disposed inside the body, a sensing target may be variously changed by a user using the ingestible sensor. For example, in a case where the ingestible sensor is mixed into a rice seasoning, a sensing target substance may be arbitrarily combined by the user.

[0095] FIG. 7 is a diagram that illustrates an example of the sensing types of the ingestible sensor according to this embodiment. For example, as illustrated in FIG. 7, as the types of the ingestible sensor, there are a "specific individual use", "each purpose (for various diseases): for example, diabetes", "each purpose" (for health management): for example, diet", a "basic type (for general public)", and the like. Here, an ingestible sensor of the "specific individual use" is a combination of sensing targets with the specific individual use. For example, there is a combination of ingestible sensors sensing substances that are determined to be preferably observed with focused thereon, while a user A utilizes daily medical checkup.

[0096] In addition, ingestible sensors of "each purpose (for various diseases): for example, diabetes" are a combination of sensing targets for various diseases. For example, as illustrated in FIG. 7, the ingestible sensors are a combination of ingestible sensors sensing substances that are preferably observed with a focus for a diabetic. In addition, the ingestible sensors of "each purpose (for health management): for example, diet" are a combination of sensing targets for health management. For example, as illustrated in FIG. 7, the ingestible sensors are a combination of ingestible sensors sensing substances that are preferably observed with a focus for a user having the purpose of diet. Furthermore, the ingestible sensors of the "basic type (for general public)", as illustrated in FIG. 7, is a combination of ingestible sensors targeted for general public and, for example, include ingestible sensors of all the types. As a user using the ingestible sensors of the basic type, for example, there is a user who has no particular purpose and desires to utilize daily health checkup and the like.

[0097] As above, a different combination of ingestible sensors is used according to the sensing type. For example, there are the above-described four types of rice seasonings in which the ingestible sensors are mixed, and a user using the ingestible sensor uses a rice seasoning by selecting the type thereof. Here, in the four types described above, while users of the ingestible sensors of the "specific individual use" or the "each purpose (for various diseases)" are limited, there is a high probability that users of the ingestible sensors of "each purpose (for health management)" or the "basic type (for general public)" are unlimited. For example, while rice seasonings in which the ingestible sensors of the "specific individual use" or the "each purpose (for various diseases)" are used for specific users, there is a high probability that rice seasonings in which the ingestible sensors of "each purpose (for health management)" or the "basic type (for general public)" are used by a plurality of users (for example, by all the family members or the like). Accordingly, in the ingestible sensor according to this embodiment, a structure for identifying that a measurement result transmitted from the ingestible sensor received inside the body is a measurement result of a user swallowing the ingestible sensor is built.

[0098] For example, in the ingestible sensors according to this embodiment, as illustrated in FIG. 7, most of the ingestible sensors of the "specific individual use" and the "each purpose (for various diseases)" are identified as direct types, and most of the ingestible sensors of the "each purpose" (for health management)" and the "basic type (for general public)" are identified as tableware-through types. Hereinafter, the identification of the direct type and the identification of the tableware-through type will be described with reference to FIGS. 8A and 8B. FIGS. 8A and 8B are diagrams that illustrate methods of identifying ingestible sensors according to this embodiment. In FIGS. 8A and 8B, a case will be described in which the ingestible sensor is mixed into a rice seasoning.

[0099] For example, in the case of the identification of the direct type, as illustrated in FIG. 8A, by registering information of all the sensor IDs of ingestible sensors 400 included in a bin of the rice seasoning in a wearing-type information terminal 500 of a user A, it is identified that a measurement result transmitted from an ingestible sensor 400 is a measurement result of a user who has swallowed the ingestible sensor 400. In other words, in the case of an

ingestible sensor of the “specific individual use” or the “each purpose (for various diseases), the user is limited, and a user eating the rice seasoning is limited to the user A. Thus, before the rice seasoning is eaten, first, by only registering the information of the sensor IDs of all the sensors mixed into the rice seasoning in the wearing-type information terminal 500 of the user A, it can be identified that measurement results transmitted from all the ingestible sensors 400 mixed into the rice seasoning is a measurement result of the user A.

[0100] On the other hand, in the case of the identification of the tableware-through type, by using tableware dedicatedly used for a user, a measurement result is identified. For example, as illustrated in FIG. 8B, a user B bowl 600 that is dedicatedly used for a user B is used. Here, the user B bowl 600 can communicate only with a wearing-type information terminal 500 of the user B and transmits information of the sensor ID of an ingestible sensor 400 that has entered the user B bowl 600 among ingestible sensors 400 mixed into the rice seasoning to the wearing-type information terminal 500 of the user B so as to be registered therein. Also in a case where the same rice seasoning is eaten by a plurality of users, as described above, by using a bowl dedicatedly used for each user and transmitting a sensor ID of the ingestible sensor 400 that has entered the bowl to a wearing-type information terminal 500 of a corresponding user so as to be registered therein, a measurement result of each user can be correctly identified. In other words, it can be identified that the user B has eaten the ingestible sensor 400 disposed inside the user B bowl 600, and a measurement result transmitted by the ingestible sensor 400 disposed inside the body of the user B is the measurement result of the user B.

[0101] Here, the power of the ingestible sensor 400 is in the Off state until the ingestible sensor is eaten by a user. Then, as described above, the power of the ingestible sensor is in the On state in the case of being under a specific environment. For example, in case of the tableware-through type, as illustrated in FIG. 8B, the power is built to become On according to a magnetic force generated by a magnet embedded in tableware (for example, the user B bowl 600). In other words, when a rice seasoning is applied to rice disposed inside the user B bowl 600, the power of the ingestible sensor 400 becomes On according to a magnetic force. Then, the ingestible sensor 400 transmits a sensor ID to the user B bowl 600. The user B bowl 600 transmits information of the received sensor ID to the wearing-type information terminal 500 of the user B, thereby registering only the sensor ID of the ingestible sensor 400 that has entered the inside of the user B bowl 600.

[0102] In the embodiment described above, while a case has been described in which the identification of the direct type or the identification of the tableware-through type is properly used according to the sensing type, a case may be employed in which the direct type or the tableware-through type is properly used according to food in which the ingestible sensor 400 is mixed. For example, in the case of food that is sub-divided for personal uses, an ingestible sensor of the “basic type (for general public)” may be identified as the direct type as well.

[0103] Next, a series of flows of using the ingestible sensor 400 of the direct type will be described with reference to FIGS. 9A and 9B. FIGS. 9A and 9B are diagrams that illustrate an example of the flow of using the ingestible sensor 400 according to this embodiment. For example, in

the case of an ingestible sensor 400 of the “basic type (for general public)” of the “each purpose” (for health management) of which the users are not limited, the ingestible sensor 400 is mixed in advance at the time of manufacturing food (for example, a rice seasoning or the like) and, as illustrated in a left diagram in (A) of FIG. 9A is sold at a drugstore, a supermarket, or the like. On the other hand, in the case of an ingestible sensor 400 of the “specific individual use” or the “each purpose (for various diseases)” of which the user is limited, as illustrated in the right diagram in (A) of FIG. 9A, based on a doctor’s prescription, a combination of sensors is customized for each user at a drugstore or the like and is mixed into food (for example, a rice seasoning or the like) and is sold.

[0104] In the rice seasoning purchased in this way, for example, as illustrated in (B) of FIG. 9A, a barcode used for registering the ingestible sensor 400 in the bin is written. Here, the barcode written in the bin includes information of a sensor ID used for uniquely specifying each of all the ingestible sensors 400 disposed inside the bin. The user reads the barcode using the wearing-type information terminal 500, thereby registering the sensor IDs of all the ingestible sensors 400 mixed into the rice seasoning in the wearing-type information terminal 500.

[0105] Then, as illustrated in (C) of FIG. 9A, the ingestible sensor 400 can be applied to rice together with the rice seasoning and, as illustrated in (D) of FIG. 9B, is eaten by the user. Here, the power of the ingestible sensors 400 becomes in the On state under a specific environment. For example, the ingestible sensor 400 can be loaded on rice and, in a case where the ingestible sensor becomes a predetermined temperature or becomes humid according to saliva or the like, the power thereof becomes the On state and can communicate with the user’s wearing-type information terminal 500. In addition, the ingestible sensor 400 detects that the sensor enters the inside of the user’s body. For example, in the case of being exposed to a temperature of the inside of the mouth, detecting amylase contained in saliva, detecting lipase contained in gastric acid, not detecting light, or the like, the ingestible sensor 400 detects that the sensor enters the inside of the user’s body. In addition, a same condition may be used as the condition for causing the power of the ingestible sensor 400 to be in the On state and the condition for detecting that the ingestible sensor 400 enters the inside of the user’s body. For example, in a case where the ingestible sensor 400 is exposed to a predetermined temperature, it may be configured such that the power is caused to be in the On state, and the sensor is determined to have entered the inside of the body.

[0106] Then, when the ingestible sensor 400 detects that the sensor has entered the inside of the user’s body, the sensor starts sensing by operating a sensor function and continuously measures substances until the sensor is discharged. For example, the ingestible sensor 400, as illustrated in (E) of FIG. 9B, senses substances targeted for the inside of the mouth, the inside of the esophagus, the inside of the stomach, the inside of the intestine, or the like. For example, the ingestible sensor 400 measures the presence/absence and the density of each of a salt content, a sugar content, a lipid, an iron content, calcium, a fiber, a component amount of each vitamin, PH, each enzyme, each virus, each germ, each medical component, and alcohol inside the stomach, the presence/absence of a specific substance of a cigarette such as tar or nicotine, the presence/absence of

blood according to bleeding inside the body, and the like and transmits measurement results to the wearing-type information terminal **500** in association with the sensor ID of the sensor.

[0107] Here, the ingestible sensor **400** performs sensing at a predetermined frequency according to the staying time inside the body. Generally, food entering from the mouth passes through the mouth to the esophagus after about 30 seconds to 60 seconds in case of a solid and after about one to six seconds in case of a liquid and stays at the stomach for about four hours, stays at the small intestine for about seven to nine hours, and stays at the large intestine for about 25 to 30 hours. Thus, the ingestible sensor **400**, for example, is built such that the frequency of the sensing operation is decreased in a stepped manner from the initial stage at which the sensor function is operated. For example, after the sensor function is operated, and substances are instantly measured, the ingestible sensor **400** measures substances for every five minutes. Then, after the elapse of a time (for example, four hours or more) for which substances are considered to pass through the stomach, the ingestible sensor **400** measures the substances for every 20 minutes. In addition, the ingestible sensor **400** decreases the sensing frequency in a stepped manner in consideration of the staying times at the small intestine and the large intestine.

[0108] Here, every time when a substance is measured inside the body, the ingestible sensor **400** transmits a measurement result to the wearing-type information terminal **500**. FIG. 10 is a diagram that illustrates an example of the measurement result stored in the wearing-type information terminal **500** according to this embodiment. For example, the wearing-type information terminal **500**, as illustrated in FIG. 10, stores biological information in which “data” and “time” are associated with each “sensor ID”. Here, a “sensor ID” represents the sensor ID of the ingestible sensor **400** that has been registered in advance. In addition, “data” represents a measurement result received from the ingestible sensor **400**. Furthermore, “time” represents date and time at which a measurement result is received and is assigned by the wearing-type information terminal **500**.

[0109] For example, the wearing-type information terminal **500**, as illustrated in FIG. 10, stores biological information “sensor ID: 1, data: a1, and time: 20131001073015”. Such information represents that a measurement result “a1” measured by the ingestible sensor **400** of which the “sensor ID” is “1” was received by the wearing-type information terminal **500** at “7:30:15 on Oct. 1, 2013”. Similarly, the wearing-type information terminal **500** stores a received measurement result and a reception time in association with each other for each sensor ID. For example, as illustrated in FIG. 10, the wearing-type information terminal **500** stores biological information in which a measurement result received every five minutes is associated with reception time for each sensor ID.

[0110] In this way, the ingestible sensor **400** senses substances until the ingestible sensor is discharged after being swallowed into the inside of the body and transmits measurement results to the wearing-type information terminal **500**. Here, the ingestible sensor **400** can detect that it has been discharged to the outside of the body and cause the power thereof to be in the Off state. For example, the ingestible sensor **400** determines that the sensor has been discharged to the outside of the body by detecting a change in temperature, a change in PH, light, an elapse of a

predetermined time after the power becomes On, or the like and causes the power of the sensor to be in the Off state.

[0111] Referring back to FIG. 9B, the wearing-type information terminal **500**, as illustrated in (F) of FIG. 9B, receives measurement results from the ingestible sensor **400**, performs pairing between the stored biological information and behavior information, and loads (transmits data of) life log information after the pairing to the health care cloud **10**. Here, the upload of the life log information to the health care cloud **10**, for example, is performed at the frequency of one per day. For example, the wearing-type information terminal **500** uploads life log information in which behavior information is associated with biological information illustrated in FIG. 10 to the health care cloud **10**. In the health care cloud **10**, various PHR big data analyses are made using the uploaded life log information. Here, based on the information collected by the ingestible sensor **400**, not only the presence/absence and the density of each substance are analyzed, but also a passage time for the inside of the body from each substance entering the mouth to the substance being discharged can be calculated. For example, measurement results acquired by the ingestible sensor **400** detecting PH are analyzed in a time series, and, based on two time points at which PH is markedly changed (a time point at which PH is changed according to the entrance of a substance into the mouth and a time point at which PH is changed according to the discharge of the substance to the outside of the body), the passage time for the inside of the body can be calculated. In this way, the ingestible sensor **400** measures various substances disposed inside the body, thereby being able to analyze various kinds of information.

[0112] As described above, while the ingestible sensor **400** is mixed into food and is swallowed into the inside of a user's body and senses predetermined substances disposed inside the body, it is preferable that, in order to cause one sensor to sense a single substance, ingestible sensors **400** corresponding to all the substances that are measurement targets for one meal are swallowed into the inside of the body. Here, for example, in the case of a rice seasoning as illustrated in (C) of FIG. 9A, it is difficult to determine whether or not ingestible sensors **400** corresponding to all the substances that are measurement targets for one meal are applied on rice. Thus, the ingestible sensors **400** corresponding to all the substances that are measurement targets can be built as one sensor group.

[0113] FIG. 11 is a diagram that illustrates an example of a sensor group of the ingestible sensors **400** according to this embodiment. For example, as illustrated in (A) of FIG. 11, one sensor group **40** is formed by connecting all the kinds of ingestible sensors **400** corresponding to substances that are measurement targets and is put into a rice seasoning bin. Here, all the kinds of ingestible sensors **400**, for example, may be connected as one sensor group **40** by using edible paste having a low melting point or the like. Accordingly, as illustrated in (B) of FIG. 11, when the sensor group **40** is loaded on rice together with a rice seasoning, as illustrated in (C) of FIG. 11, the edible paste connecting the ingestible sensors **400** is melt, and the ingestible sensors **400** come apart. In this way, the size decreases, and it becomes easy for a user to swallow the ingestible sensors **400**.

[0114] Next, the flow of the process of direct-type sensing using ingestible sensors **400** will be described. FIG. 12 is a diagram that illustrates the processing sequence of sensing using ingestible sensors **400** according to this embodiment.

As illustrated in FIG. 12, in the direct-type sensing, first, the wearing-type information terminal 500 reads a barcode attached to a package of food, thereby registering sensor IDs of all the sensors disposed inside the package (Step S101).

[0115] Then, when the power of an ingestible sensor 400 becomes the On state under a specific environment (Step S102), it is determined whether or not the sensor has entered the inside of a user's body (Step S103). Here, in a case where the sensor is determined to have entered the inside of the body (Yes in Step S103), the ingestible sensor 400 measures a predetermined substance (Step S104) and transmits a measurement result to the wearing-type information terminal 500 (Step S105). On the other hand, the ingestible sensor 400 is in a standby state until the sensor enters the inside of the user's body (No in Step S103).

[0116] Thereafter, when the measurement result is received (Step S106), the wearing-type information terminal 500 stores the measurement result and time in association with the sensor ID of the ingestible sensor 400 that has transmitted the measurement result (Step S107). When the measurement result is transmitted, the ingestible sensor 400 determines whether or not a predetermined time has elapsed (Step S108). Here, in a case where it is determined that the predetermined time has elapsed (Yes in Step S108), the ingestible sensor 400 returns the process to Step S104 and measures a predetermined substance again.

[0117] After pairing all the measurement results that have been received with behavior information, the wearing-type information terminal 500 transmits all the measurement results to the health care cloud 10 at a predetermined frequency (Step S109). The health care cloud 10 receives all the measurement results (Step S110) and stores the measurement results as PHR data. In the processing sequence described above, a case has been illustrated in which, after the sensor is determined to have entered the inside of the body, a predetermined substance is measured, and a measurement result is transmitted. However, the embodiment is not limited thereto. Thus, for example, a case may be employed in which, before the sensor is determined to have entered the inside of the body, a predetermined substance is measured, and a measurement result is transmitted from the wearing-type information terminal 500. In such a case, a measurement result acquired after determining that the sensor has entered the inside of the body is transmitted to the wearing-type information terminal 500 with a flag being set. Accordingly, the wearing-type information terminal 500 can identify measurement results before and after the entrance of the sensor into the inside of the body, and only measurement results after the entrance of the sensor into the inside of the body can be used.

[0118] Next, a series of flows of using the ingestible sensor 400 of the tableware-through type will be described with reference to FIG. 13. FIG. 13 is a diagram that illustrates the flow of using the ingestible sensor 400 according to this embodiment. As described above, the tableware-through type accurately identifies a measurement result acquired by the ingestible sensor 400, which is simultaneously used by a plurality of users, by using tableware that is dedicated used for each user. For example, as illustrated in (A) of FIG. 13, it is assumed that a user F and a user G have a meal at the same table and use a seasoning in which an ingestible sensor 400 of the "basic type (for general public)" is mixed.

[0119] In such a case, by using the ingestible sensor 400 of the tableware-through type, for example, sensor IDs "7,

10, 2, . . . , 15" of the ingestible sensors 400 inserted into a bowl of the user F are registered in a wearing-type information terminal 500 of the user F in advance. Similarly, sensor IDs "9, 8, 13, . . . , 5" of the ingestible sensors 400 inserted into a bowl of the user G are registered in a wearing-type information terminal 500 of the user G in advance. Then, when the user F and the user G swallow the ingestible sensors 400 together with the rice seasoning, measurement results of substances are transmitted from the swallowed ingestible sensors 400 to the wearing-type information terminals 500 disposed outside the body.

[0120] Here, for example, in a case where a meal is taken at the same table, the transmission ranges of the measurement results acquired by the ingestible sensors 400, as illustrated in (B) of FIG. 13, overlap each other between the user F and the user G. In such a situation, as one user further comes near another neighboring user, the user enters the transmission range of measurement results acquired by the ingestible sensors 400 of the neighboring user, and the wearing-type information terminal 500 receives measurement results of the neighboring user. However, by using ingestible sensors 400 of the tableware-through type, measurement results other than those acquired by the ingestible sensors 400 inserted into the tableware of the user can be controlled to be discarded. For example, as illustrated in (C) of FIG. 13, the wearing-type information terminal 500 of the user F performs control such that measurement results acquired from sensors having the sensor IDs "7, 10, 2, . . . , 15" registered in advance are set to "OK" and sets measurement results acquired from sensors of the user G having sensor IDs "9, 8, 13, . . . , 5", which are not registered, to "NG" so as to be discarded. Also the wearing-type information terminal 500 of the user G is controlled as such.

[0121] Also in the sensing process using the ingestible sensors 400 of the tableware-through type, the process performed thereafter is similar to that using the ingestible sensors 400 of the direct type, and the wearing-type information terminal 500 of each user uploads (transmits data of) life log information in which the biological information received from the ingestible sensor 400 and behavior information are paired to the health care cloud 10. In the tableware-through type described above, while a case has been described in which a bowl is used as an example, the embodiment is not limited thereto, but any other tableware such as a dish may be used.

[0122] Hereinafter, the flow of the sensing process of the tableware-through type using the ingestible sensors 400 will be described. FIG. 14 is a diagram that illustrates the processing sequence of sensing using ingestible sensors 400 according to this embodiment. As illustrated in FIG. 14, in the sensing process of the tableware-through type, for example, when the power of an ingestible sensor 400 becomes the On state in accordance with a magnetic force generated from a magnet built in tableware 600 (Step S201), the ingestible sensor 400 transmits the sensor ID to the tableware 600 (Step S202).

[0123] When sensor IDs are received from the ingestible sensors 400 (Step S203), the tableware 600 transmits all the sensor IDs that have been received to the wearing-type information terminals 500 of corresponding users (Step S204). The wearing-type information terminal 500 receives the sensor IDs (Step S205) and registers all the sensor IDs that have been received (Step S206).

[0124] Then, the ingestible sensor 400 determines whether or not the sensor has entered the inside of the user's body (Step S207). Here, in a case where it is determined that the sensor has entered the inside of the body (Yes in Step S207), the ingestible sensor 400 measures a predetermined substance (Step S208) and transmits a measurement result to the wearing-type information terminal 500 (Step S209). On the other hand, the ingestible sensor 400 is in a standby state until the sensor enters the inside of the user's body (No in Step S207).

[0125] Thereafter, when a measurement result is received (Step S210), the wearing-type information terminal 500 determines whether or not the sensor ID of the received measurement result is a registered sensor ID (Step S211). Here, in a case where the sensor ID of the measurement result is not a registered sensor ID (No in Step S211), the wearing-type information terminal 500 discards the received measurement result (Step S212). On the other hand, in a case where the sensor ID of the measurement result is a registered sensor ID (Yes in Step S211), the wearing-type information terminal 500 stores the measurement result and time in association with the sensor ID of the ingestible sensor 400 that has transmitted the measurement result (Step S213).

[0126] When the measurement result is transmitted, the ingestible sensor 400 determines whether or not a predetermined time has elapsed (Step S214). Here, in a case where it is determined that the predetermined time has elapsed (Yes in Step S214), the ingestible sensor 400 returns the process to Step S208 and measures a predetermined substance again. After pairing all the measurement results that have been received with behavior information, the wearing-type information terminal 500 transmits all the measurement results to the health care cloud 10 at a predetermined frequency (Step S215). The health care cloud 10 receives all the measurement results (Step S216) and stores the measurement results as PHR data. In the processing sequence described above, a case has been illustrated in which, after the sensor is determined to have entered the inside of the body, a predetermined substance is measured, and a measurement result is transmitted. However, the embodiment is not limited thereto. Thus, for example, a case may be employed in which, before the sensor is determined to have entered the inside of the body, a predetermined substance is measured, and a measurement result is transmitted from the wearing-type information terminal 500. In such a case, a measurement result acquired after determining that the sensor has entered the inside of the body is transmitted to the wearing-type information terminal 500 with a flag being set. Accordingly, the wearing-type information terminal 500 can identify measurement results before and after the entrance of the sensor into the inside of the body, and only measurement results after the entrance of the sensor into the inside of the body can be used.

[0127] (Configuration of Ingestible Sensor)

[0128] Next, the configuration of the ingestible sensor 400 will be described. FIG. 15 is a functional block diagram of the ingestible sensor according to this embodiment. As illustrated in FIG. 15, the ingestible sensor 400 includes: a battery 410; a thermometer 420; a sensor 430; an Amp (Amplifier) 440; an Amp 450; an ADC (analog to digital converter) 460; a memory 470; a logic 480; and an antenna 490.

[0129] The battery 410 is an ultra-small compound battery that serves as the power supply of the ingestible sensors 400.

For example, the battery 410 is a battery acquired by combining an electric double layer capacitor operating under a wet environment and a battery (for example, a chemical battery, a vibration battery, a thermal battery, or the like). Accordingly, for example, the battery 410 can be built as a battery starting the operation in the case of being inserted into the mouth and humidified according to saliva. For example, the battery 410 has an ultra-thin film (for example, about 10 nanometers) sandwich structure of an electrode part and polymer electrolyte starting the function by being humidified.

[0130] The thermometer 420 measures the temperature of the inside of the body based on a change in the resistance of a metal joint (for example, a p-n junction). The sensor 430 is a sensor that detects a predetermined substance disposed inside the body and, for example, is configured by electrodes, a photosensitive element (photon counter), and the like. FIG. 16 is a diagram that illustrates an example of the process performed by the sensor 430 according to this embodiment. For example, the sensor includes a reception film used for receiving a predetermined substance disposed inside the body. The reception film of the sensor 430 changes the reception of a predetermined substance, for example, into a chemical substance, light, heat, a mass, a refractive index, or the like. Then, in a case where the reception film changes the reception of a predetermined substance into a chemical substance, the sensor 430 is configured to detect the chemical substance using the electrodes and output the detection as an electric signal. In a case where the reception film changes the reception of a predetermined substance into light, the sensor 430 is configured to detect the light using the photon counter and output the detection as an electric signal. In a case where the reception film changes the reception of a predetermined substance into heat, the sensor 430 is configured to detect the heat using a thermistor and output the detection as an electric signal. In addition, in a case where the reception film changes the reception of a predetermined substance into a mass, the sensor 430 is configured to detect the mass using a crystal oscillator and output the detection as an electric signal. In a case where the reception film changes the reception of a predetermined substance into a refractive index, the sensor 430 is configured to detect the refractive index using an SPR (Surface Plasmon Resonance) and output the detection as an electric signal.

[0131] In this way, for each substance (for example, a salt content, a sugar content, a lipid, an iron content, calcium, a fiber, each vitamin, PH, each enzyme, each virus, each germ, each medical component, alcohol, a specific substance of a cigarette such as tar or nicotine, blood, an ion such as Na⁺ or Cl⁻, or the like) to be received, the sensor 430 detects the substance using an optimal detection method and outputs the detection as an electric signal. Here, the reception film of the sensor 430 may fix an antibody for each substance so as to output specificity with the substance to be received. Here, the output of an electric signal is merely an example, and an optical signal may be output.

[0132] Referring back to FIG. 15, the Amp 440 amplifies an electric signal or an optical signal output from the sensor 430. The Amp 450 amplifies a signal used for applying a feedback correction in accordance with a temperature measured by the thermometer 420. The ADC 460 converts a signal (an electric signal, an optical signal, or the like) output from the sensor 430 into digital data. The memory 470 stores

the digital data converted by the ADC 460. The logic 480 is an integrated circuit controlling the ingestible sensors 400. For example, the logic 480 controls sensing using the sensor 430, temperature measurement using the thermometer 420, conversion of analog data into digital using the ADC 460, recording of digital data into the memory 470, transmission of data to the wearing-type information terminal 500 through the antenna 490, and the like.

[0133] Here, the ingestible sensor 400 according to this embodiment detects whether or not the sensor 430 has entered the inside of the body and, after detecting that the sensor 430 has entered the inside of the body, transmits information of a substance detected by the sensor 430 to a communication device disposed outside the body. In other words, based on the detection of the entrance of the sensor 430 into the inside of the body, the logic 480 performs control so as to transmit digital data of the detected substance written in the memory 470 to the antenna 490.

[0134] For example, the ingestible sensor 400, in accordance with a temperature measured by the thermometer 420, determines whether or not the sensor has entered the inside of the body. For example, the ingestible sensor 400 detects a case where the temperature measured by the thermometer 420 is stabilized to a predetermined temperature, a case where the temperature markedly changes, or the like as a case where the sensor 430 has entered the inside of the body. In addition, it may be configured such that another sensor not illustrated in the drawing is further included, and whether or not the sensor has entered the inside of the body is determined by using the another sensor. For example, the ingestible sensor 400 further includes a sensor detecting amylase contained in saliva and detects that the sensor 430 has entered the inside of the body in a case where the sensor detects amylase. In addition, as a determination using an enzyme, any other enzyme disposed inside the body may be used. Furthermore, not a sensor detecting an enzyme but a sensor detecting PH may be used. In such a case, in a case where PH markedly changes, it may be determined that the sensor 430 has entered the inside of the body. In addition, a sensor measuring light may be used. In such a case, in a case where light is not detected, it may be determined that the sensor 430 has entered the inside of the body. Each process described above is performed under the control of the logic 480.

[0135] The ingestible sensor 400 performs the transmission of the digital data (measurement result) through the antenna 490 at a predetermined frequency. For example, the logic 480 is built such that the frequency of the sensing process using the sensor 430 and the transmission of the digital data through the antenna 490 is changed in a stepped manner in accordance with the elapse time after the determination of the entrance of the sensor 430 into the inside of the body. For example, the logic 480 is built so as to detect a predetermined substance disposed inside the body and transmit digital data while decreasing the frequency in a stepped manner in accordance with an elapse of time after being entered the inside of the body.

[0136] Then, the ingestible sensor 400 detects whether or not the sensor 430 has come to the outside of the body and can turn off the power in a case where the sensor 430 is detected to have come to the outside of the body. For example, the ingestible sensor 400 determines whether or not the sensor has come to the outside of the body in accordance with a temperature measured by the thermom-

eter 420. For example, in a case where a temperature measured by the thermometer 420 markedly changes or the like, the ingestible sensor 400 detects that the sensor 430 has come to the outside of the body. In addition, it may be determined whether or not the sensor has come to the outside of the body by using another sensor not illustrated in the drawing. For example, in a case where a sensor measuring PH detects a marked change in PH, the ingestible sensor 400 may determine that the sensor 430 has come to the outside of the body. In addition, in a case where a sensor measuring light, after no detection of light, detects light again it may be determined that the sensor 430 has come to the outside of the body. Then, in a case where the sensor 430 is determined to have come to the outside of the body, the ingestible sensor 400 can perform control to turn off the power of the sensor. Each process described is performed under the control of the logic 480.

[0137] FIGS. 17A and 17B are diagrams that illustrate an example of the structure of the ingestible sensor according to this embodiment. Here, in FIGS. 17A and 17B, FIG. 17A illustrates a top view of the ingestible sensor 400, and FIG. 17B illustrates a cross-sectional view of the ingestible sensor 400. The ingestible sensor 400 is built in a size that can be swallowed by a person without feeling discomfort. For example, as illustrated in FIG. 17A, the ingestible sensor 400 is built in a size of "vertical: 0.5 to 1.0 mm" and "horizontal: 0.5 to 1.0 mm". Then, in the ingestible sensor 400, as illustrated in FIG. 17B, a substrate on which a circuit such as the sensor 430 is integrated and a battery overlap each other, and the ingestible sensor 400 is coated with glass, a resin, vinyl chloride, or the like so as not to be digested or absorbed inside the body. Here, the material used for the coating is not limited to glass, a resin, or vinyl chloride, but any material that is easily formed, has resistance against heat, gastric acid, each digestion enzyme, and the like, and has no influence on the human body may be used.

[0138] The ingestible sensor 400, as illustrated in FIG. 17B, has a structure in which a part or the whole of the surface of the sensor is exposed. In other words, the sensor 430 is exposed such that a predetermined substance disposed inside the body can be brought into contact with the sensor 430. In a case where the battery is started to function under a wet environment, the ingestible sensor 400, as illustrated in FIG. 17B, has a structure in which a part of the battery is exposed. On the other hand, in a case where the battery is not caused to function under a wet function, the whole battery is coated. In addition, in a case where On/Off of the power is detected using temperature, light, or the like, the surface of each sensor is exposed.

[0139] In the embodiment described above, a case has been described in which one ingestible sensor 400 senses a single substance. However, the embodiment is not limited thereto, and thus, for example, one ingestible sensor 400 may senses two or more substances. In such a case, one ingestible sensor 400 includes a plurality of sensors 430. In addition, the form of the ingestible sensor 400 is not limited to the structure illustrated in FIGS. 17A and 17B but, for example, may have an oval shape or a sphere shape. In such a case, for example, the size of the major axis of the oval is in the range of "0.5 mm to 1.0 mm".

[0140] As described above, the ingestible sensor 400 that is mixed with food and is discharged without being digested or absorbed also when entering the inside of the body

includes: the sensor **430** that detects a predetermined substance disposed inside the body; the thermometer **420** or a sensor detecting whether or not the sensor **430** has entered the inside of the body; and the logic **480** that transmits information of a substance detected by the sensor **430** to the wearing-type information terminal **500** disposed outside the body based on the detection of the entrance of the sensor **430** to the inside of the body according to the thermometer **420** or any other sensor and is swallowed together with the food. Accordingly, the ingestible sensor **400** can accurately sense a substance disposed inside the body in a non-conscious manner and enables effective and continuous collection of true data of individuals.

[0141] In addition, the sensor **430** detects a predetermined substance disposed inside the body at a predetermined frequency, and the logic **480** transmits information of a detected substance to the wearing-type information terminal **500** disposed outside the body every time when the substance is detected by the sensor **430**. In this way, the ingestible sensor **400** enables the size of the battery to be decreased by suppressing the waste of the battery **410**.

[0142] In addition, the sensor **430**, in accordance with an elapse time after the entrance into the inside of the body, changes the predetermined frequency in a stepped manner and detects a predetermined substance disposed inside the body. Accordingly, the ingestible sensor **400** can enable a sensing process performed in consideration of a staying time inside the body.

[0143] The sensor **430**, after entering the inside of the body, detects a predetermined substance disposed inside the body while decreasing the frequency in a stepped manner in accordance with an elapse of the time. Accordingly, the ingestible sensor **400** can set a sensing interval based on the passage time that is different for each part of the inside of the body and enables effective collection of true data of individuals by suppressing unnecessary sensing.

[0144] The thermometer **420** detects whether or not the sensor **430** has entered the inside of the body based on at least one of the temperature, the hydrogen ion exponent, and a predetermined enzyme. Accordingly, the ingestible sensor **400** enables an accurate determination of whether or not the sensor **430** has entered the inside of the body.

[0145] The ingestible sensor **400** is formed to one millimeter squares or less. Accordingly, the ingestible sensor **400** can be swallowed without any discomfort.

[0146] The surface of the ingestible sensor **400** is coated with a substance having resistance against digestion and absorption inside the body. Accordingly, the sensing process can be performed accurately without having any influence on the human body.

[0147] The logic **480**, under the condition that the sensor has been inserted into tableware that is associated with each user and communicates with the wearing-type information terminal **500** of the user, transmits the identifier of the sensor to the tableware and registers the identifier of the sensor in the wearing-type information terminal **500** through the tableware. Accordingly, also in a case where one food is shared and eaten by a plurality of users, the ingestible sensor **400** can accurately identify a measurement result.

[0148] The food is a fresh food, a processed food, condiment, a beverage, or the like. Accordingly, the ingestible sensor **400** enables adaptation to meals of various variations.

[0149] As described above, while the ingestible sensor **400** according to this embodiment is mixed into food and is

swallowed and measures a predetermined substance disposed inside the body, the embodiment is not limited thereto, and thus, the ingestible sensor **400** may be built in tableware. FIG. **18** is an application example of the ingestible sensor according to this embodiment. For example, the ingestible sensor **400**, as illustrated in FIG. **18**, may be built in the tip end of a chopstick and sense a substance disposed inside the mouth.

[0150] As above, the ingestible sensor **400** according to this embodiment has been described. Hereinafter, the analysis of PHR big data including the life log information collected by the ingestible sensor **400** described above will be described.

[0151] (Analysis of PHR Big Data and Estimation of Health Risk Using Analysis Result)

[0152] Subsequently, the cohort analysis that is performed for the PHR big data of the large-scale genome cohort database **114a** as a target will be described. Here, as described above, in this embodiment, in order to perform the evaluation of the health state and the estimation of the health risk with high accuracy, the large-scale genome cohort database **114a** is formed, and the database is set as base data. For example, in the cohort analysis to be described later, the PHR big data analyzing unit **121**, in lifetime PHR data from birth to death, associates the outbreak of a disease to a clinical outcome with information of the life and the environment at that time. In addition, in the cohort analysis to be described later, for example, the PHR big data analyzing unit **121** performs a long-term follow-up survey for a cohort of a specific region, performs a comparative analysis with a cohort of another region, and reviews a difference between regions. Such an analysis can be realized by having the large-scale genome cohort database **114a** as its target, and, in the case of a small-scale database, the analysis cannot be realized and is limited to an analysis having a specific disease or the like as its target. In addition, in this embodiment, since the life log information included in the PHR big data is collected by using a sensing technology or the like, an accurate and precise analysis can be performed differently from a reply in a conventional interview. Furthermore, by forming the large-scale genome cohort database **114a**, a low-frequency allele of a Japanese can be acquired, a comprehensive Japanese original standard SNP database can be built, and a typing array can be standardized.

[0153] In this embodiment, the PHR big data analyzing unit **121** performs a cohort analysis of the PHR big data accumulated in the large-scale genome cohort database **114a** as its target and derives relevance between a combination of the type of genome and the type of lifestyle and a health risk (in other words, a disease outbreak risk).

[0154] Here, in this embodiment, the cohort analysis is a technique for deriving relevance between a factor (a group matching a specific combination of a type of genome and a type of lifestyle) and a disease outbreak by tracking a group (a group matching a specific combination of a type of genome and a type of lifestyle) exposed to a specific factor and a group (a group not matching the combination) not exposed to the factor for a predetermined period and comparing outbreak probabilities of a specific disease with each other. For example, the PHR big data analyzing unit **121** classifies in patterns standard data of a healthy person that is stored in the large-scale genome cohort database **114a**, deviation data between a healthy person and a potential sick person, deviation data between a healthy person and a

person developing a symptom, an abnormality sign in the life log information, and the like and clarifies relevance with the type of genome. Here, the technique used for the analysis by the PHR big data analyzing unit 121 is not limited to the cohort analysis described above, but any other technique may be used.

[0155] FIG. 19 is a diagram that illustrates the analysis of PHR big data according to this embodiment. As illustrated in FIG. 19, in the large-scale genome cohort database 114a, the life log information that is the PHR data of each individual and the like are newly accumulated day by day, and the PHR data of a new individual is accumulated as a new operating/managing target, whereby the scale of the large-scale genome cohort database 114a increases day by day. In addition, in this large-scale genome cohort database 114a, for example, since the PHR data of the lifetime of each individual is accumulated, from a different viewpoint, the PHR data of healthy persons, potential sick persons, and persons developing symptoms is accumulated.

[0156] As illustrated in FIG. 19, the PHR big data analyzing unit 121 performs a cohort analysis of this large-scale genome cohort database 114a as a target and generates a “health risk estimation table T” used for estimating a health risk for each combination of the type of genome and the type of lifestyle. In addition, as described above, the PHR accumulation unit 110 newly accumulates the PHR data, thereby increasing the scale of the large-scale genome cohort database 114a. Thus, the PHR big data analyzing unit 121 newly performs an analysis according to a daily increase in the large-scale genome cohort database 114a, thereby acquiring the “health risk estimation table T” that is a new analysis result. The primary use service providing unit 122 estimates a health risk by using the analysis result that is newly acquired. Accordingly, the accuracy of the “health risk estimation table T” is improved day by day, and the accuracy of the estimation of the health risk that is made by the primary use service providing unit 122 is also improved day by day.

[0157] First, in this embodiment, the PHR big data analyzing unit 121 sets the combination pattern of a base pair or a plurality of base pairs among three billion base pairs or the combination pattern of a base pair or a plurality of base pairs among one million base pairs regarded to represent the individuality of a person as the type of genome.

[0158] FIG. 20 is a diagram that illustrates the type of lifestyle according to this embodiment. As illustrated in FIG. 20, the PHR big data analyzing unit 121 classifies ten items acquired from the life log information respectively into three levels of “level I” to “level III” and sets patterns of all the combinations thereof (for example, combinations corresponding to tenth power of three) as the types of lifestyles. In this embodiment, the types of lifestyles are merely examples, and the items and the levels may be arbitrary changed. In addition, the method of deriving the type of lifestyle may be arbitrarily changed.

[0159] Accordingly, while the number of combinations of a type of genome and a type of lifestyle is a large number, at the beginning, combinations of types of which the relevance with the outbreak of a disease is cleared by the cohort analysis performed by the PHR big data analyzing unit 121 are considered to be some thereof. As a daily increase in the large-scale genome cohort database 114a, outcomes of researches that individually progress, and the like are gradually reflected, the number of combinations of the types of

which the relevance with the outbreak of a disease is cleared gradually increases, and blank fields located inside the health risk estimation table T are gradually filled up reflecting the result.

[0160] In each cohort analysis process, the PHR big data analyzing unit 121 maintains an algorithm for deriving the ten items based on the life log information in advance. For example, the PHR big data analyzing unit 121 derives smoking/non-smoking of the user and a smoking level representing the degree of smoking based on the “intake amount of nicotine” that is acquired from the biological sensor as the biological information. In addition, the PHR big data analyzing unit 121 derives drinking/no-drinking of the user and a drinking level representing the degree of drinking based on the “intake amount of alcohol” that is acquired from the biological sensor as the biological information. Furthermore, for example, the PHR big data analyzing unit 121 derives a sleeping level such as a user’s sleeping time and a sleeping quality from the “heart rate” acquired from a sensor as the biological information, “time at which an alarm has been set” and “alarm time” acquired from a smartphone as the behavior information, and a living sound acquired from a sensor.

[0161] In addition, for example, the PHR big data analyzing unit 121 derives a stress level representing the degree of stress felt by the user from the “blood pressure” and the “heart rate” acquired from sensors as the biological information, the “schedule information” acquired from a smartphone as the behavior information, and the like. In addition, for example, the PHR big data analyzing unit 121 derives an exercise level representing the degree of exercise performed by the user from the “heart rate” acquired from a sensor as the biological information, the posture and the operation of the user that are acquired from sensors as the behavior information, the “exercise information” acquired by the motor system application of a smartphone as the behavior information, and the like. Furthermore, for example, by measuring the balance between a sympathetic nerve and a parasympathetic nerve from a change in the peripheral body temperature or the degree of perspiration that is measured by a sensor, the degree of strain and relaxation of the mind is derived. In addition, for example, the PHR big data analyzing unit 121 derives a level of eating habits that represents the user’s eating habits from the “sugar content”, the “salt content”, the “gastric acid”, the “alcohol intake amount” and the like acquired from sensors as the biological information. In addition, for example, the PHR big data analyzing unit 121 derives a level of pharmaceutical supplements representing a medicine and a supplement that are taken by the user from the “medicament component” and the like that are acquired from sensors as the biological information. The above-described algorithm is merely an example.

[0162] In this way, the PHR big data analyzing unit 121 acquires values of the ten items described above from one side of the biological information and the behavior information included in the life log information or a combination of both sides and derives the level of each item based on these values. Here, for the same target person, while the type of genome is basically not changed, the type of the lifestyle may change in accordance with an elapse of time.

[0163] FIG. 21 is a diagram that illustrates the health risk estimation table T according to this embodiment. In this embodiment, it is assumed that, even for users having the same type of lifestyle, in a case where the types of genome

are different from each other, the kinds and the order of diseases having high outbreak risks are different from each other. In addition, even for users having the same type of genome, in a case where the types of lifestyles are different from each other, the kinds and the order of diseases having high outbreak risks are different from each other. A method of representing the health risk estimation table T illustrated in FIG. 21 is merely an example, and also the kinds and the order of diseases illustrated in FIG. 21 are merely an example used for the convenience of description.

[0164] For example, the PHR big data analyzing unit 121 generates a health risk graph representing a disease outbreak risk for each combination of a type of genome and a type of lifestyle. In each health risk graph, the vertical axis represents ratios of a lifestyle factor and a genome factor in the disease outbreak risk, and diseases are aligned in the horizontal axis. As a disease is located to the further right side in the horizontal axis, it represents that the disease has a strong influence of the lifestyle factor. On the other hand, as a disease is located to the further left side, it represents that the disease has a strong influence of the genome factor. In other words, the health risk graph is a list of diseases, which can be caused in the future, ordered according to a stronger influence of either the genome factor or the lifestyle factor for each combination of a type of genome and a type of lifestyle. In addition, in the horizontal axis, an official name of a disease as a name of the disease, and an ICD (International Classification of Diseases) code that is based on the international classification of diseases are displayed. However, this embodiment is not limited thereto, and for example, only one of the official name and the ICD code of the disease may be displayed.

[0165] For example, when (A) and (B) of FIG. 21 are compared with each other, even for users having the same lifestyle type 3, in a case where the types of genome are different as being type 2 and type 3, it can be understood that the kinds and the order of diseases having high outbreak risks are different. For example, while “alcoholic liver disease (K70)” is commonly a disease that is strongly influenced by the lifestyle factor, “gouty arthritis (M1009)” that is a disease strongly influenced by the lifestyle factor for users of genome type 2 is placed as a disease that is strongly influenced rather by the genome factor for users of genome type 3. On the contrary, “diabetic nephropathy (E142)” that is a disease strongly influenced by the lifestyle factor for users of genome type 3 is placed as a disease that is strongly influenced rather by the genome factor for users of genome type 2.

[0166] For example, when (B) and (C) of FIG. 21 are compared with each other, even for users having the same genome type 3, in a case where the types of lifestyle are different as being type 3 and type 2, it can be understood that the kinds and the order of diseases having high outbreak risks are different. For example, while “alcoholic liver disease (K70)”, “hepatocellular carcinoma (C220)”, and “diabetic nephropathy (E142)” are placed as diseases that are strongly influenced by the lifestyle factor for users of lifestyle type 3, for users of lifestyle type 2, “alveolar emphysema (J43)”, “pulmonary hilum adenocarcinoma (C340)”, “acute right ventricular infarction (I212)”, and the like are placed as diseases that are strongly influenced by the lifestyle factor. For example, a case in which, among users of the same genome type 3, the lifestyle type 3 is a user having a high drinking level, and the lifestyle type 2 is a user

having a high smoking level or the like may be considered. In addition, for users of the same genome type 3, regardless of the type of lifestyle, “spinocerebellar degeneration (G319)”, “gouty arthritis (M1009)”, and the like are positioned as diseases that are strongly influenced by the genome factor.

[0167] Here, an example of the process of generating the “health risk graph” that is performed by the PHR big data analyzing unit 121 will be described. As a specific example, a case will be described in which the “health risk graph” is generated for a combination of the genome type 3 and the lifestyle type 3.

[0168] For example, the PHR big data analyzing unit 121 specifies “disease A, disease B, disease C, and disease D” as diseases having high outbreak risks for users of the genome type 3 by referring to clinical history information (for example, it can be acquired from the electronic medical record information) of users having the genome type 3 as the genome information. In addition, the PHR big data analyzing unit 121 specifies “disease D, disease E, disease F, and disease G” as diseases having high outbreak risks for users of the lifestyle type 3 by referring to clinical history information of users having the lifestyle type 3 as the life log information. Then, the PHR big data analyzing unit 121 compares the specified diseases with each other and classifies the “disease A, disease B, and disease C” that are included only in the diseases having high outbreak risks into “diseases having a strong influence of the genetic factor” for users of the genome type 3. In addition, the PHR big data analyzing unit 121 classifies the “disease E, disease F, and disease G” that are included only in the diseases having high outbreak risks into “diseases having a strong influence of the lifestyle factor” for users of the lifestyle type 3. Furthermore, the PHR big data analyzing unit 121 classifies the “disease D” included in both thereof into a “disease having strong influences of the lifestyle factor and the genetic factor”.

[0169] Subsequently, the PHR big data analyzing unit 121 specifies diseases having high outbreak risks for users of a combination of genome type 3 and lifestyle type 3 by referring to the clinical history information of users of the combination of genome type 3 and lifestyle type 3. Here, for example, the PHR big data analyzing unit 121 is assumed to specify “disease A, disease C, disease F, and disease G” as diseases having high outbreak risks for users of the combination of genome type 3 and lifestyle type 3. In such a case, the PHR big data analyzing unit 121 determines “disease A” and “disease C” that are common to “disease A, disease B, and disease C” classified into “diseases having strong influences of the genetic factor” in advance as “diseases having strong influences of the genetic factor” and positions the determined diseases on the left side on the “health risk graph” illustrated in FIG. 21 in the horizontal axis. In addition, the PHR big data analyzing unit 121 determines “disease F” and “disease G” that are common to “disease E, disease F, and disease G” classified into “diseases having strong influences of the lifestyle factor” in advance as “diseases having strong influences of the lifestyle factor” and positions the determined diseases on the right side on the “health risk graph” illustrated in FIG. 21 in the horizontal axis.

[0170] The PHR big data analyzing unit 121 generates the health risk estimation table T illustrated in FIG. 21 under a specific criterion. For example, the PHR big data analyzing

unit 121 generates the health risk estimation table T under a criterion of “a health risk (an outbreak probability of 30%) after 10 years of a case where a person who is in a standard health state continues living of the same lifestyle type, for example, for one year. Regarding this point, generally, the lifestyle type of an actual user is regarded to be different according to the length of the period such as one day, one week, one month, or one year. For example, there may be a case where, while the amount of drinking has increased particularly due to many welcome and farewell parties, the amount of drinking is not that much in terms of one month. Thus, when a user's health risk is to be estimated by using the health risk estimation table T, the primary use service providing unit 122 performs individual estimation according to the period (referred to as an estimation target period) of the PHR data used for the estimation and adjustment according to the health state of the present. In addition, the PHR big data analyzing unit 121 may appropriately change the criterion described above. Furthermore, the PHR big data analyzing unit 121 may set a plurality of future “time points” for the estimation among criteria described above (for example, after one day, after one week, after one month, after one year, after five years, after 10 years, after 20 years, or the like). In such a case, the PHR big data analyzing unit 121 generates a health risk estimation table T corresponding to each criterion. In addition, when the health risk estimation tables T of mutually-different “time points” are compared with each other, for example, there are cases where diseases that are immediately caused are listed in the health risk estimation table in the health risk estimation table T after one month, and diseases that is caused after an elapse of a long period are listed in the health risk estimation table T after 10 years.

[0171] FIG. 22 is a diagram that illustrates the estimation of a health risk according to this embodiment. For example, when the health risk of user A is to be estimated, the primary use service providing unit 122 extracts life log information according to the estimation target period from the PHR data of user A. For example, the primary use service providing unit 122, as illustrated in FIG. 22, according to the estimation target periods designated by an operator, for example, extracts life log information D1 of this week, life log information D2 of this month, and life log information D3 of this year from the PHR data of user A.

[0172] Subsequently, the primary use service providing unit 122, for each estimation period, acquires values of ten items (smoking, drinking, sleep, stress, exercise, a food life, a medicine/supplement, a mental state, fatigue, and immunity) and derives the levels of the items based on these values. Then, the primary use service providing unit 122, for each estimation target period, determines the type of lifestyle that is one of a pattern of a combination of the level of each item as the type (the type of lifestyle of this week, the type of lifestyle of this month, and the type of lifestyle of this year) of lifestyle of user A. For example, the primary use service providing unit 122, as illustrated in FIG. 22, determines the type “type 3” of lifestyle of this week based on the life log information D1 of this week, determines the type “type 30” of lifestyle of this month based on the life log information D2 of this month, and determines the type “type 30” of lifestyle of this year based on the life log information D3 of this year.

[0173] Next, the primary use service providing unit 122 specifies a corresponding health risk graph for each estimation

target period by referring to the health risk estimation table T using the determined type of lifestyle. For example, in the example illustrated in FIG. 22, in the health risk graph of lifestyle type 3, “alcoholic liver disease (K70)”, “hepatocellular carcinoma (C220)”, and “diabetic nephropathy (E142)” are listed as diseases having high outbreak risks. However, in the health risk graph of lifestyle type 30, “alcoholic liver disease (K70)” and “hepatocellular carcinoma (C220)” are excluded from the diseases having high outbreak risks, and only “diabetic nephropathy (E142)” is listed as a disease having a high outbreak risk. While this is merely an example for the convenience of description, in this way, in a case where the type of lifestyle is different for each estimation target period, the kinds of diseases having high outbreak risks and the order thereof are different for each estimation target period. By performing individual estimation according to each estimation target period and, for example, comparing the results of the estimations of this week, this month, and this year, the directivity (for example, in a good direction, a bad direction, or the like) of the health risk can be presented.

[0174] In addition, the primary use service providing unit 122 performs an adjustment of each health risk graph specified for each estimation target period according to the health state of the present. For example, the primary use service providing unit 122 changes the content of each health risk graph to a content according to the health state of the present of the individual user in consideration of the biological information included in the life log information. For example, it is assumed that the primary use service providing unit 122 analyzes the biological information of user A and determines that the liver function of user A is extremely satisfactory state. Then, the primary use service providing unit 122, in the health risk graph of a combination of the genome type 3 and the lifestyle type 3, determines that an outbreak risk of “hepatocellular carcinoma (C220)” among “alcoholic liver disease (K70)”, “hepatocellular carcinoma (C220)”, and “diabetic nephropathy (E142)” is low and removes “hepatocellular carcinoma (C220)”. While this is merely an example for the convenience of description, in this way, the kinds of diseases having high outbreak risks and the order thereof are changed based on the health state of the present.

[0175] When the primary use service providing unit 122 according to this embodiment performs estimation of the health risk, individual estimation according to the estimation target period and the adjustment according to the health state of the present as described above are performed. In the example described above, as the estimation target periods, while “this week”, “this month”, and “this year” are used, the embodiment is not limited thereto. Thus, the estimation target period may be a period that is divided into predetermined units such as “yesterday”, “past one week”, “past one month”, and “past one year”. Alternatively, an appropriate setting may be received from a user, and an arbitrary period according to a user's desire may be used as the estimation target period.

[0176] Until now, the PHR big data analyzing unit 121 has been described to generate the “health risk estimation table T” representing the ratios of the genome factor and the lifestyle factor in the disease outbreak risk in accordance with a combination of the type of genome and the type of lifestyle. In addition to this, the PHR big data analyzing unit 121 may generate information representing a lifestyle that

becomes a factor further increasing the disease outbreak risk for the “disease having a strong influence of the genome factor”.

[0177] Until now, in a case where SNP is included in an ALDH2 genome, it is known that the outbreak risk of esophageal cancer is increased when there is a smoking habit and a drinking habit. From this, for example, by analyzing diseases having high outbreak risks for each lifestyle for a user of the type of genome having SNP in a specific genome, a correlation between a disease caused due to the inclusion of SNP and the lifestyle can be estimated.

[0178] In such a case, for example, the PHR big data analyzing unit 121 searches for a user having the type of genome including SNP in a specific genome based on the genome information. Then, the PHR big data analyzing unit 121 specifies diseases having high outbreak risks by referring to the clinical history information (for example, it can be acquired from the electronic medical record information or the like) of a user having the type of genome including SNP in a specific genome. Subsequently, the PHR big data analyzing unit 121 specifies lifestyles increasing the outbreak risk of a specific disease by referring to the life log information of the user having the type of genome including SNP in a specific genome.

[0179] In the embodiment described above, while the health risk graph has been described to be generated in consideration of “a person who is in the standard health state”, the embodiment is not limited thereto. For example, it is known that there are complications such as nephropathy, retinopathy, and neuropathy in diabetes. In addition, it is known that there are complications such as a cerebral stroke, various heart diseases, and nephropathy in hypertension. Furthermore, it is known that there are complications such as bacterial pneumonia, influenza encephalopathy, and myocarditis in influenza. As above, in a case where there are complications in a disease, in a health risk graph of a person having such a disease, it is considered that the outbreak risk of such complications is increased. Thus, for example, the PHR big data analyzing unit 121 classifies persons who have diseases each having complications and performs a cohort analysis, whereby, for example, a health risk graph dedicated for a person considered as “a person having diabetes”, “a person having hypertension”, or “a person having influenza” can be generated. In addition, in such a case, the “daily medical checkup” service is provided for “a person having diabetes”, “a person having hypertension”, or “a person having influenza”, the primary use service providing unit 122 can specify diseases having high outbreak risks by referring to the health risk graph that is dedicated for this patient.

[0180] (Daily Medical Checkup—Future Health Risk Notification)

[0181] In this embodiment, the primary use service providing unit 122 performs feedback for the user providing the PHR data by using the health risk estimation table T, thereby providing the “daily medical checkup” as a primary use service. As a technique for the provision, while various techniques may be considered, hereinafter, one technique will be described with reference to FIG. 23.

[0182] FIG. 23 is a diagram that illustrates a health forecast portal site according to this embodiment. As illustrated in FIG. 23, for example, the primary use service providing unit 122 starts up a portal site 14a used for user A on the health care cloud 10 and permits user A and his family

members to access the portal site 14a. In addition, for example, the primary use service providing unit 122 starts up a portal site 14b for an attending doctor on the health care cloud 10 and permits the attending doctor to access the portal site 14a used for user A through the portal site 14b for the attending doctor. In this way, by accepting accesses from user A, the family members, and the attending doctor through the portal site 14a used for user A, feedback to user A and information sharing among third parties are realized.

[0183] In addition, as illustrated in FIG. 23, in this embodiment, a range that can be read through the portal site 14a is different between the attending doctor and user A (and his family members). In other words, the attending doctor can read both the PHR data of user A and a result of the estimation of a health risk that is based on the PHR data. On the other hand, user A and his family members cannot read the PHR data of user A. For example, the reason for this is that the disclosure of the genome information of a person to the person needs to be appropriately restricted. The restriction of the range of reading is merely an example, and any other restriction may be applied. However, generally, it is considered that there are many cases where the reading range of the attending doctor is wider than the reading range of the person.

[0184] In addition, based on the opinion of the attending doctor, the reading range for user A and the family members may be adjusted. For example, the primary use service providing unit 122, among estimation results of the health risk, receives designation of items that are preferably read by user A and items that are not preferably read by user A from the attending doctor. Then, the primary use service providing unit 122, according to the designation made by the attending doctor, adjusts the reading range to be read by user A. For example, the primary use service providing unit 122 does not display some of diseases, which are displayed in a case where a health risk graph used for the attending doctor is displayed, in a case where a health risk graph used for the user is displayed. In this embodiment, there is a possibility that also a disease that is strongly influenced by the genome factor of the user is determined as a disease having a high outbreak risk. However, a situation may be considered in which the disease that is strongly influenced by the genome factor cannot be avoided by even changing the lifestyle, and, for example, in the case of an incurable disease for which a treatment has not been set, a notification thereof for the person does not mean anything (it may be adversely influenced). Thus, the primary use service providing unit 122, in a case where the health risk graph used for the user is to be displayed, does not display some of the diseases. For example, the primary use service providing unit 122 receives designation of diseases not to be displayed from the attending doctor, and such designation is reflected on the display of the health risk graph so as not to display the designated diseases. In addition, non-display of diseases is not limited to incurable diseases, but, for example, a case may be considered in which the attending doctor thinks that a notification for the person is not desirable in consideration of the characteristics of the person. Also in such a case, for example, the primary use service providing unit 122 receives designation of diseases not to be displayed from the attending doctor and reflects the designation on the display of the health risk graph so as not to display the designated diseases.

[0185] As above, the reading range is different between the attending doctor and user A and the family members, and, originally, the purpose of reading is different between the attending doctor and user A and the family members. Thus, in this embodiment, as illustrated in FIG. 23, a content 14c used for the attending doctor and a content 14d used for user A and the family members are separated prepared. This point will be described in detail when a screen transition is described below.

[0186] In addition, in this embodiment, the primary use service providing unit 122 presents the estimation result of the health risk as one or more of a “health risk graph”, a “virtual clone”, a “health status”, a “mark that visually represents the health risk”, and “character information”.

[0187] For example, the primary use service providing unit 122 presents the estimation result of the health risk using the “virtual clone” associated with the PHR data of user A. For example, the “virtual clone” is set with being associated with each time point from the past to the future and maintains the health state at each time point in the form of a health status in which a point is given to each region. For example, the primary use service providing unit 122 appropriately extracts diseases having strong influences of the lifestyle factor from the health risk graph and calculates a point for each region by performing weighting according to the kind of each disease. In addition, in a case where a disease of a region has an influence on the other region, the primary use service providing unit 122 calculates points in consideration of such a point. For example, the “virtual clone” maintains an image of an expression according to the health status. In this way, visualization of distances from diseases is realized.

[0188] For example, the “virtual clone” of the past maintains the past health state and the health status according to the type of lifestyle, that are determined based on the past PHR data, and information of previous diseases. The “virtual clone” of the present maintains the health state of the present and the health status according to the type of lifestyle, that are determined based on the PHR data of the present, and information of current diseases. The “virtual clone” of the future maintains a future health status acquired by adding the type of lifestyle of the present to the health state of the present determined based on the PHR data of the present and information of diseases having high outbreak risks in the future. In addition, in this embodiment, an ideal “virtual clone” for user A is set and presented as well.

[0189] For example, user A or the attending doctor can acquire the health state of user A from the past to the future by accessing the portal site 14a used for user A and reading the “virtual clone” of user A. For example, user A or the attending doctor can acquire the clinical history of the user and the severity of an illness by moving the time of the “virtual clone” to the past. In addition, for example, user A or the attending doctor can display a future health risk that is premised on the lifestyle of the present of the user by moving the time of the “virtual clone” to the future.

[0190] In addition, for example, the primary use service providing unit 122 presents an estimation result of the health risk as a “mark that visually represents the health risk”. This mark, for example, is a mark according to the health status and preferably is a mark that can be easily recognized by the user such as a “devil” of a case where the health status is bad and an “angel” of a case where the health status is good. In addition, for example, the primary use service providing unit

122 presents an estimation result of the health risk as “character information”. For example, the primary use service providing unit 122 appropriately extracts diseases having strong influences of the lifestyle factor from the health risk graph and presents the extracted diseases to be aligned. Alternatively, in the “virtual clone” described above, by presenting a self-image acquired by reflecting a characteristic look predicted from the future health state on the face or the appearance of a person, a future image of the person after X years on which the present life is influenced may be displayed.

[0191] FIG. 24 is a diagram that illustrates the processing sequence of the “daily medical checkup” according to this embodiment. As illustrated in FIG. 24, it is assumed that user A registers the genome information in the PHR processing apparatus 100 in advance (Step S301). The process of this Step S301 is basically a process that may be performed at least once and is a process in which the process of Step S302 and subsequent steps are repeatedly performed.

[0192] In addition, as illustrated in FIG. 24, user A transmits the life log information collected from sensors and other information terminals from the wearing-type information terminal to the PHR processing apparatus 100 on a daily basis (Step S302). The PHR accumulation unit 110 of the PHR processing apparatus 100 accumulates the received life log information as the PHR data of user A on a daily basis and manages the accumulated life log information in a unified manner.

[0193] The primary use service providing unit 122, for example, performs the process of Step S303 and subsequent steps at the frequency of once per week. First, the primary use service providing unit 122 determines the type of lifestyle of user A for each estimation target period of the health risk (Step S303). For example, the primary use service providing unit 122 extracts the life log information D1 of this week, the life log information D2 of this month, and the life log information D3 of this year from the PHR data of user A and determines the type of lifestyle of user A for each estimation target period.

[0194] Subsequently, the primary use service providing unit 122 refers to the health risk estimation table T for each estimation target period of the health risk by using the type of genome of user A, which has been determined in advance, and the type of lifestyle determined in Step S303 (Step S304). For example, the primary use service providing unit 122 refers to the health risk estimation table T and, in a case where the type of genome of user A is type 3, and the type of lifestyle of this week is type 3, specifies the health risk graph illustrated in (B) of FIG. 21. In this way, the primary use service providing unit 122 specifies a health risk graph for each estimation target period.

[0195] Next, the primary use service providing unit 122 adjusts the health risk graph acquired in Step S304 in accordance with the health state of the present of user A for each estimation target period (Step S305). For example, in a case where the liver function of user A is determined to be in an extremely good state based on the biological information of user A, the primary use service providing unit 122 determines that the outbreak risk of “hepatocellular carcinoma (C220)” is low and removes “hepatocellular carcinoma (C220)” from the health risk graph of this week.

[0196] Then, the primary use service providing unit 122 calculates the health statuses of the present to the future for each estimation target period (Step S306) and registers the

calculated health statuses in the “virtual clones” of the present to the future that are prepared for each estimation target period (Step S307). For example, the primary use service providing unit 122 calculates the health status of the present of user A based on the health status of the present calculated in the previous week and the biological information of this week and registers the calculated health status of the present in association with the “virtual clone” of the present of user A. In addition, the primary use service providing unit 122 calculates a health status of the future by combining a subtracted point accompanied with aging, a subtracted point accompanied with the health risk of the future determined in Step S305, and the like with the health status of the present being used as the reference and registers the calculated health status of the future in association with the “virtual clone” of the future of user A. In addition, when a health status of a future time point is calculated, the primary use service providing unit 122 calculates a health status of a middle time point between the present to the time point or a time point that is in the further future after the time point through appropriate interpolation (in a case where the health risk estimation tables T of a plurality of time points are prepared, by using the health risk estimation tables). For example, the primary use service providing unit 122 calculates a health status of each time point from after one day, after one week, or after one month to after one year, after five years, after 10 years, or after 20 years. In addition, the primary use service providing unit 122 calculates such a health status for each estimation target period.

[0197] In addition, the primary use service providing unit 122 updates a health risk ranking list maintained by the attending doctor of user A (Step S307). For example, the primary use service providing unit 122, for a plurality of users for whom the attending doctor is responsible, based on a health status after 10 years of a case where the estimation target period is “this year”, generates a health risk ranking list in which the users are aligned in order of highest to lowest outbreak risk of a disease. Thus, the primary use service providing unit 122 updates this health risk ranking list based on the health status of “this year” that is calculated in Step S106.

[0198] Then, the primary use service providing unit 122 reflects the result of the process described above on the content used for the attending doctor and the content used for user A (step S308). For example, the primary use service providing unit 122 reflects the updated health risk ranking on the content used for the attending doctor. In addition, the primary use service providing unit 122 reflects the type of lifestyle of each estimation target period, the health risk graph of each estimation target period, and the health status of each estimation target period on the content used for user A.

[0199] Then, the primary use service providing unit 122 notifies the attending doctor of the registration (Step S309). The attending doctor, first, reads the health risk ranking at the portal site for the attending doctor. Then, for example, in a case where user A is positioned at high ranking in the health risk ranking, the attending doctor further reads the portal site for user A, records his comment, and uploads the recorded comment to the portal site for user A (Step S310). Here, the comment is not limited to moving image data but may be a comment using text data or the like.

[0200] Subsequently, the primary use service providing unit 122 notifies user A of the registration (Step S311), and

user A reads the portal site for user A (Step S312). In a case where the comment of the attending doctor has already been recorded in Step S110, user A may reproduce the moving image as the comment of the attending doctor.

[0201] The processing sequence illustrated in FIG. 24 is merely an example. For example, in FIG. 24, while the processing sequence has been illustrated in which the process waits for a comment from the attending doctor, and user A is enabled to read the comment, the embodiment is not limited thereto. For example, the primary use service providing unit 122 may simultaneously notify three parties of the user, the family member, and the attending doctor of the registration of the portal site. In addition, the processing sequence illustrated in FIG. 24 may be performed not on the premise of the intervention of the attending doctor. Other than that, the setting of the estimation target period, the calculation of the health status, and the like may be arbitrarily changed in accordance with the provision form of services or may be omitted.

[0202] Next, at the portal site for the attending doctor or the portal site for user A, examples of contents to be read will be described according to screen transitions. FIG. 25 is a diagram that illustrates screen transitions at the portal site for the attending doctor according to this embodiment, and FIG. 26 is a diagram that illustrates screen transitions at the portal site for the user according to this embodiment. Here, the screen transitions illustrated in FIGS. 25 and 26 are merely examples, and the sequence of the screen transitions, the configuration of screens, and the like may be arbitrarily changed.

[0203] Here, the screen transitions illustrated hereinafter as examples are made in the PHR display apparatus 200 of the attending doctor or the PHR display apparatus 200 of user A. This is realized by a control process performed by the primary use service providing unit 122 and, at the same time, is realized by a display control process performed by the display control unit 210 arranged on the PHR display apparatus 200 side.

[0204] First, the screen transitions on the attending doctor side will be described. The attending doctor accesses the portal site for the attending doctor by using the PHR display apparatus 200. Then, as illustrated in screen P1 illustrated in FIG. 25, an update of the health risk ranking list is notified. Thus, the attending doctor presses a button ‘Enter’ and reads the health risk ranking list.

[0205] Then, as illustrated in screen P2, the primary use service providing unit 122 displays the health risk ranking on the PHR display apparatus 200 of the attending doctor. In the health risk ranking, user names, health risk scores, and the names of diseases having high outbreak risks are displayed in order of lowest to highest health risk score. For example, it is assumed that the name of user A is included in a high rank of the health risk ranking.

[0206] In such a case, the attending doctor selects the name of user A on the health risk ranking and accesses the portal site for user A. Then, as illustrated in screen P3, the primary use service providing unit 122 displays the portal site for user A on the PHR display apparatus 200 of the attending doctor. For example, the primary use service providing unit 122 displays a “virtual clone” of the present of user A. In addition, as illustrated in screen P3, tabs (tabs of “this week”, “this month”, and “this year”) used for selecting an estimation target period are set on the screen. Here, in the description, it is assumed that the attending

doctor selects “this week” as the estimation target period. In addition, under the “virtual clone”, a bar is displayed as a tool used for receiving a time point desired to be checked. For example, the attending doctor adjusts the position of this bar to “Year 2023” that is after 10 years and presses a button of ‘check the health risk graph’.

[0207] Then, as illustrated in screen P4, the primary use service providing unit 122 displays, together with the type of genome of user A and the type of lifestyle of this week, a corresponding health risk graph on the PHR display apparatus 200 of the attending doctor. In addition, while not illustrated in the figure, the primary use service providing unit 122 may specifically display the content of each item of the type of lifestyle as is necessary. Then, for example, after checking the health risk graph, the attending doctor presses a button of ‘PHR checking’.

[0208] Then, as illustrated in screen P5, the primary use service providing unit 122 displays the PHR data of user A. In addition, in screen P5, while an example is illustrated in which the life log information is displayed in a graph form, the embodiment is not limited thereto. The primary use service providing unit 122 can process the PHR data designated by the attending doctor in a form (for example, a table form) desired by the attending doctor and displays the processed PHR data. For example, when the health risk graph of each estimation target period and the PHR data are schematically checked, the attending doctor presses a button of ‘comment’.

[0209] Then, as illustrated in screen P6, the attending doctor records a comment moving image, for example, by using a recording function of the PHR display apparatus 200 and, by pressing a button of ‘transmission’, uploads the comment moving image.

[0210] The screen transitions described above will be described as below from a viewpoint of display control performed by the display control unit 210 of the PHR display apparatus 200. For example, the PHR display apparatus 200 of the attending doctor includes the display control unit 210 that displays the user’s future health risk estimated based on the user’s PHR data on the display unit 220. The display control unit 210 displays the health risk ranking list based on a comparison among a plurality of users and, in a case where a predetermined user is designated from the health risk ranking list, displays the future health risk and the PHR data of the designated user. The future health risk, for example, is displayed as a virtual clone, a health risk graph, any other character information, or the like. In addition, the PHR data is displayed as a graph form, a table form, any other character information, or the like. In addition, the display control unit 210 displays the type of genome and the type of lifestyle as the PHR data of the user. In addition, while not illustrated in FIG. 25, in a case where the name of a disease is to be displayed, the display control unit 210 displays the name as a formal name or an ICD code.

[0211] Next, the screen transitions on user A side will be described. User A accesses the portal site for user A by using the PHR display apparatus 200. Then, a screen represented as screen P7 illustrated in FIG. 26 is displayed, and thus, user A starts reading by pressing the button of ‘Enter’.

[0212] Then, as illustrated on screen P8, the primary use service providing unit 122 displays the “virtual clone” of the present of user A. In addition, as illustrated in screen P8, tabs (tabs of “this week”, “this month”, and “this year”) used for selecting an estimation target period are set on the screen.

Here, in the description, it is assumed that user A selects “this week” as the estimation target period. In addition, under the “virtual clone”, a bar is displayed as a tool used for receiving a time point desired to be checked. For example, user A adjusts the position of this bar to “Year 2023” that is after 10 years and presses a button of ‘details’.

[0213] Then, as illustrated in screen P9, the primary use service providing unit 122 displays a “virtual clone” of the time point designated by user A and the health status of the time point. In addition, the primary use service providing unit 122, as an estimation result of the health risk, displays that “After 10 years (the year of 2023), the outbreak risks of “alcoholic liver disease” and “diabetes” are increased”. In addition, the primary use service providing unit 122 displays a mark that visually represents the health risk. In the example illustrated in screen P9, as a meaning visually representing that the outbreak risk of a severe disease is increased, a mark of “devil” is displayed. Here, for example, the user presses a button of ‘simulation’.

[0214] Then, as illustrated in screen P10, the primary use service providing unit 122 receives a change in the lifestyle and displays a simulation screen simulating the health risk. FIG. 27 is a diagram that illustrates a simulation of the health risk according to this embodiment. For example, the primary use service providing unit 122, as illustrated in FIG. 27, displays a GUI (Graphical User Interface) from which three steps of “level I” to “level III” can be selected for 10 items acquired from the life log information. In the GUI illustrated in FIG. 27, each level of each item is configured as a button that can be selected by being pressed by the user. While the primary use service providing unit 122, first, as illustrated on the left side in FIG. 27, displays the type of the lifestyle of the present of user A in a selected state, as illustrated on the right side in FIG. 27, the primary use service providing unit 122 receives a pressing operation from user A and changes the type of lifestyle. Here, an example is illustrated in which, for example, user A decreases the level of the item “drinking” from “level III” to “level II” and decreases the level of the item “fatigue” from “level II” to level “I”. In addition, as a result of the selection made by user A, it is also represented that the type of lifestyle is changed to type 30. Here, the GUI used for the simulation is not limited to the example illustrated in FIG. 27. For example, the GUI may be changed to a pull-down menu or the like.

[0215] In this way, when the type of lifestyle desired to be simulated is selected, user A presses a button of ‘execution’ on screen P10 illustrated in FIG. 26. Then, the primary use service providing unit 122, together with specifying a health risk graph corresponding to the type of lifestyle that is simulated, adjusts the health risk graph according to the health state of the present of user A and, as illustrated in screen P11, displays the health risk graph after the simulation.

[0216] Here, the primary use service providing unit 122 changes the display form between a case where the health risk graph is displayed for a doctor such as the attending doctor and a case where the health risk graph is displayed for the user. FIG. 28 is a diagram that illustrates health risk graphs displayed for the attending doctor and the user in this embodiment. Here, points for changing the display form are mainly the following two points.

[0217] First, the first point is the display form of names of diseases. As illustrated in FIG. 28, in a case where the health risk graph used for the attending doctor is to be displayed,

the primary use service providing unit **122** displays a formal name and an ICD code of a disease. On the other hand, in a case where the health risk graph for the user is to be displayed, the primary use service providing unit **122** displays a common name of a disease. For example, the primary use service providing unit **122** displays a disease displayed as “hepatocellular carcinoma (C220)” in the health risk graph used for the attending doctor as “liver cancer” in the health risk graph used for the user. In addition, for example, the primary use service providing unit **122** displays a disease displayed as “diabetic nephropathy (E142)” in the health risk graph used for the attending doctor simply as “diabetes” in the health risk graph used for the user. The primary use service providing unit **122** maintains correspondence between the formal names and the ICD codes and the common names in advance and appropriately performs replacement in displaying the health risk graph by referring to the correspondence.

[0218] Next, the second point is non-display of diseases. As illustrated in FIG. 28, the primary use service providing unit **122** sets some of diseases displayed in a case where the health risk graph used for the attending doctor is displayed not to be displayed in a case where the health risk graph used for the user is displayed. In other words, as described above, in this embodiment, there is a possibility that also a disease strongly influenced by the genome factor of the user is determined as a disease having a high outbreak risk. However, a situation may be considered in which the disease that is strongly influenced by the genome factor cannot be avoided by even changing the lifestyle, and, for example, in the case of an incurable disease for which a treatment has not been set, a notification thereof for the person does not mean anything (it may be adversely influenced). Thus, the primary use service providing unit **122**, in a case where the health risk graph used for the user is to be displayed, may not display some of the diseases. For example, the primary use service providing unit **122** sets a disease “spinocerebellar degeneration (G319)”, which is displayed in a case where the health risk graph used for the attending doctor is displayed, not to be displayed in a case where the health risk graph used for the user is displayed. In addition, for example, the primary use service providing unit **122** maintains a list of incurable diseases having strong influences of the genome factor in advance and sets the diseases not to be appropriately displayed in displaying the health risk graph by referring to this list. Alternatively, for example, the primary use service providing unit **122** receives designation of diseases not to be displayed from the attending doctor and reflects the designation on the display of the health risk graph so as not to display the designated diseases.

[0219] For example, when the health risk graph after the simulation is checked, user A presses a button of ‘health status’ represented as screen P11. Then, as illustrated in screen P12, the primary use service providing unit **122** displays the “virtual clone” and the health status after the simulation. For example, by executing the content of the simulation by checking the expression of the “virtual clone” after the simulation and the health status after the simulation, user A can recognize that the health risk and the health status are improved. For example, user A can recognize that the outbreak of the “alcoholic liver disease” and the “liver cancer” can be avoided by switching the life to a life slightly refraining from drinking and taking a sufficient rest. In addition, the primary use service providing unit **122** displays

a mark of “angel” as a mark visually representing that an outbreak risk of a serious disease decreases. Furthermore, for example, in a case where a comment is uploaded from an attending doctor, the primary use service providing unit **122** displays a button of ‘comment from attending doctor’ on screen P12. Then, user A can check the comment of the attending doctor by pressing the button of ‘comment from attending doctor’.

[0220] The screen transitions described above will be described as below from a viewpoint of display control performed by the display control unit **210** of the PHR display apparatus **200**. For example, the PHR display apparatus **200** of user A includes the display control unit **210** that displays the user’s future health risk estimated based on the user’s PHR data on the display unit **220**. The display control unit **210**, together with the future health risk, displays at least one of the target health state of user A and guidance information for arriving at the target health state. The future health risk, for example, is displayed as a “virtual clone”, a health status, a health risk graph, any other character information, or the like. In addition, the target health state is displayed as an ideal “virtual clone”, an ideal health status, a health risk graph after the simulation, any other character information, or the like. Furthermore, the guidance information is displayed using a comment from the attending doctor, character information prepared in advance, or the like.

[0221] In addition, when designation of an estimation time point is received from the operator, the display control unit **210** displays a health risk of the future corresponding to the received time point. Furthermore, when the width of a period of the PHR data of the user that is used for the estimation is received from the operator, the display control unit **210** displays a health risk of the future according to the received width of the period. The health risk of the future according to the received width of the period may be prepared in advance for each period or may be prepared after the designation is received from the user. In addition, when an instruction for changing the lifestyle is received from the operator, the display control unit **210** further displays a health risk of the future that is simulated according to the received change instruction. Furthermore, the display control unit **210** displays the names of diseases that may be caused for user A in the future by using common names as the health risk of the future. In addition, in a case where the names of the diseases are displayed for user A or a family member of user A, the display control unit **210** does not display the names of some of the diseases as is necessary.

[0222] In the example illustrated in FIG. 26, while an example has been described in which user A performs a simulation changing the lifestyle and checks the health risk graph and the health status after the simulation, the embodiment is not limited thereto. For example, the primary use service providing unit **122** may present the ideal “virtual clone” together with a lifestyle proposed to user A and automatically propose enhancement of the lifestyle to user A.

[0223] As above, according to the “future health risk notification”, a family member or the attending doctor can monitor the health of the body and the mind of the user through the “virtual clone”. Then, an appropriate encouragement or guidance toward the ideal can be performed. The user can check a technique for being healthy and the progress status more specifically, and accordingly, the moti-

vation can be increased further. In the embodiment described above, while a conversation or a response with/from the “virtual clone” is not considered, for example, by using a simulation technology altogether, a conversation or a response with/from the “virtual clone” can be realized. In such a case, not only a “virtual clone” of the user but also a “virtual clone” of a family member or a “virtual clone” of the attending doctor may be set. In such a “virtual clone”, the conversation or the content of the guidance that is considered is set in advance. Then, also in a situation in which a comment is not actually given from a family member or the attending doctor, the user can acquire the comment. In addition, the user may have a conversation with his “virtual clone”.

[0224] As described above, according to this embodiment, the future health risk according to the lifestyle of each individual and the continuation of the lifestyle can be presented with high accuracy by using the PHR data including the genome information. In addition, according to this embodiment, by estimating a food, an exercise, and a change in the lifestyle that are optimal and medicine and supplements that are effective for the individual, an environment for approaching a more healthy and ideal individuality can be brought. Furthermore, the checking of the degree of approach to the ideal individuality materializes the result of efforts, of which the target is not visible, and turns the result into a will and a joy. In addition, this embodiment can respond to disaster resilience for remotely checking and managing the presence, the existence status, and the condition when the condition deteriorates at a refuge site due to isolation according to a disaster or the like.

[0225] (Other Use of “Health Risk Estimation Table T”)

[0226] In the embodiment described above, as a specific example, an example has been described in which information of diseases having strong influences of the lifestyle factor is fed back as a result of the estimation of the health risk by referring to the “health risk estimation table T” by using the type of genome and the type of lifestyle of the user. However, the form of the use of information acquired from the “health risk estimation table T” is not limited thereto.

[0227] For example, based on the determination of diseases having high outbreak risks for a user, for example, items of the life log information collected from the user may be narrowed into items relating to the diseases having high outbreak risks and be intensively collected. For example, the types of sensors and the items used on the user side may be changed according to the type of the genome and the type of lifestyle of the user.

[0228] In addition, by referring to the “health risk estimation table T” by using the type of genome and the type of lifestyle of the user, information of diseases having strong influences of the genome factor, in other words, diseases that are genetically at a high risk according to the user can be estimated.

[0229] Furthermore, for example, the primary use service providing unit 122 may provide a mechanism for quickly supplementing indications of diseases having high outbreak risks for the user from the PHR data that is transmitted from the user on a daily basis. For example, the primary use service providing unit 122 arranges a threshold matching a specific disease and sequentially checks the PHR data transmitted from the user using the threshold.

[0230] For example, for a user for whom high-risk diseases are determined, for example, by concentrating the

supplement of indications of severe diseases such as brain or heart diseases using all the sensors, there is a ripple effect bringing such a new preventive/preemptive medical revolution that an individual is warned and is urged to take a rest by acquiring signs, an attack is suppressed by preparing an early medical examination, and, even in the case of the occurrence of an attack, a speedy countermeasure or treatment can be performed in a low degree of the attack. Alternatively, users having a high outbreak risk for cardiac sudden death are selected using the genome information, the users are constantly monitored using the sensors, and an emergency system can be built for an instruction for a lifestyle for preventing an attack in advance, operating a pace maker only at the time of an occurrence of arrhythmia in an auxiliary manner, turning on an electronic pill in which an antiarrhythmic agent or an antithrombotic agent is filled, or instantly contacting a nearby medical institution at the time of deterioration of the condition for an emergency call, and an instruction for a place at which a nearby AED (Automated External Defibrillator) is present or support for relief at the time of a cardiac arrest, or the like. As a result, sudden death, an aftereffect lasting over a long period accompanied with seriousness after cardiac attack, or a bedridden life or dementia according to rehabilitation or a secondary damage can be prevented or reduced, and accordingly, also in an aging society, everyone can deal with hobbies, work, and housework without any concern for the health and spend a pleasant and peaceful life.

[0231] In addition, for a disease outbreak reserve of a genetically high risk such as signs of an outbreak of cerebral infarction accompanied with arrhythmia due to stress or the like, daily data monitoring is strengthened, and an abnormal log is caught without missing them, whereby early alarm information or a disease outbreak preventive measure can be fed back to each individual or a medical institution with high accuracy. In addition, information of a separated family member registered in advance can be fed back in this way. As a result, through a health guidance method for individualization that is based on an optimal evidence for each individual, a more appropriate selection of foods and exercises, and even a selection of a living mode, the ideal individuality can be realized more specifically, reasonably, and pleasantly, and watching for a family member is constantly performed as if he is present nearby, whereby a peaceful life can be realized.

[0232] (Secondary Use Service)

[0233] Until now, as an example of the primary use service of the PHR data, while the “daily medical checkup” and the “future health risk notification” have been described, as described above, in this embodiment, the PHR processing apparatus 100 is considered to provide a secondary use service of the PHR data as well. For example, the PHR processing apparatus 100 acquires an analysis result representing predetermined relevance by analyzing the large-scale genome cohort database 114a such that the relevance between a combination of a type of genome and a type of lifestyle and a specific object can be derived and provides the analysis result for medical institutions, various companies, and the like.

[0234] In addition, the PHR big data accumulated in the large-scale genome cohort database 114a is PHR data that is originally collected from each individual, in other words, personal information. For this reason, regarding the use of the PHR data, there are cases where the intention of each

individual is different such as “a primary use of the PHR data is permitted, but a secondary use thereof is not permitted” and “none of a primary use and a secondary use of the PHR data is permitted”. Thus, in this embodiment, the PHR processing apparatus **100** accepts use permission representing the permitted range of uses from each individual providing the PHR data in advance and manages information of the use permission in accompaniment with the PHR data. The use permission may be accepted for the whole PHR data or for the PHR data in units of subdivided items of the PHR data. Hereinafter, on the premise that such use permission is acquired, specific examples of the secondary use service will be described. However, the specific examples described below are merely examples, and the secondary use service is not limited to the specific examples described below.

[0235] First, as a first example, an example will be described in which relevance between a combination of a type of genome and a type of lifestyle and a “drug effect” is derived, and the relevance is used for a prescription of a drug.

[0236] FIGS. **29** and **30** are diagrams that illustrate an example (first example) of the secondary use service according to this embodiment. As described above, in the large-scale genome cohort database **114a**, the life log information that is the PHR data of each individual and the like are newly accumulated day by day, and the PHR data of a new individual is accumulated as a new operating/managing target, whereby the scale of the large-scale genome cohort database **114a** increases day by day.

[0237] The PHR big data analyzing unit **121** receives an input of an object of the analysis that is a drug effect of a specific drug and performs a cohort analysis of the PHR big data accumulated in the large-scale genome cohort database **114a** as the target, thereby deriving relevance between a combination of a type of genome and a type of lifestyle and a drug effect of a specific drug. For example, in the PHR data, the electronic medical record information is included, and, in the electronic medical record information, information of a drug prescribed to the individual and information representing the progress made thereafter are included. In addition, in the PHR data, the life log information is included, and, in the life log information, information representing a condition change of the individual after the prescription of the drug and information representing the life status of the individual are included.

[0238] Thus, the PHR big data analyzing unit **121** performs a cohort analysis of the PHR big data including such information as the target, thereby deriving relevance between a combination of a type of genome and a type of lifestyle and a drug effect and a side effect. Then, the PHR big data analyzing unit **121**, as illustrated in FIG. **29**, classifies combinations of a type of genome and a type of lifestyle based on the presence/no-presence of the drug effect and the side effect.

[0239] For example, the PHR big data analyzing unit **121** traces a group (a group matching a combination of a specific type of genome and a specific type of lifestyle) that is exposed to a specific factor and a group (a group not matching the combination) that is not exposed to the specific factor for a predetermined period and compares the presence/no-presence of the drug effect and the side effect, thereby deriving relevance between the factor (the combination of the specific type of genome and the specific type of lifestyle) and the drug effect and the side effect. Then, the

PHR big data analyzing unit **121**, based on the derived relevance, classifies combinations of a type of genome and a type of lifestyle into groups of “drug effect (–) and side effect (+)”, “drug effect (–) and side effect (–)”, “drug effect (+) and side effect (+)”, and “drug effect (+) and side effect (–)”.

[0240] Here, to a person having a type of combination classified into the groups of “drug effect (–) and side effect (+)” and “drug effect (–) and side effect (–)”, the drug cannot be prescribed. In addition, to a person having a type of combination classified into the group of “drug effect (+) and side effect (+)”, the drug can be prescribed, but the side effect need to be considered. In addition, to a person having a type of combination classified into the group of “drug effect (+) and side effect (–)”, the drug can be prescribed. By providing such information for a doctor, the doctor can perform a determination according to the type of combination of a patient before prescribing the drug to the patient.

[0241] Thus, for example, the secondary use service providing unit **123**, based on a contract exchanged with a medical institution in advance, provides a secondary use service for utilizing the relevance between a combination a type of genome and a type of lifestyle and the drug effect and the side effect for doctors of the medical institution. As a technique used for the provision, while various techniques may be considered, hereinafter, one technique will be described with reference to FIG. **30**.

[0242] As illustrated in FIG. **30**, for example, the secondary use service providing unit **123** starts up a portal site **14e** for a secondary use service on the health care cloud **10** and permits a doctor of the medical institution to access the portal site **14e**. In addition, the secondary use service providing unit **123** permits the doctor to access the PHR data of each individual and permits the doctor to access a classification result of combinations of a type of genome and a type of lifestyle. Then, the doctor, for example, reads the PHR data of patient B through the portal site **14e** and checks the combination of the type of genome and the type of lifestyle of patient B. In addition, the doctor checks the classification result through the portal site **14e**. Then, the doctor combines the classification result of the type of genome and the type of lifestyle of patient B and determines whether or not a specific drug is to be prescribed to patient B or whether or not it is necessary to consider the side effect in the prescription. Then, the doctor generates a prescription for patient B based on the determination.

[0243] However, the technique used for the providing the secondary use service is not limited to the technique described above. The secondary use service providing unit **123**, for example, may be configured to generate a real name list including information of the type of genome and the type of lifestyle of each individual and a classification result for a specific drug and transmit the real name list and the classification result to the medical institution or the like. Here, the real name list and the classification result may be provided via offline.

[0244] Subsequently, as a second example, an example will be described in which relevance between a combination of a type of genome and a type of lifestyle and “effects of foods and supplements” is derived, and the derived relevance is utilized for the sales, advertisement, and the like of the foods and supplements.

[0245] FIG. **31** is a diagram that illustrates an example (second example) of the secondary use service according to

this embodiment. The PHR big data analyzing unit **121** receives an input of an object of the analysis that is an object of deriving relevance with an effect of a component (or a similar component thereof) contained in a specific health beverage and performs a cohort analysis of the PHR big data accumulated in the large-scale genome cohort database **114a** as the target, thereby deriving relevance between a combination of a type of genome and a type of lifestyle and the specific health beverage. For example, in the PHR data, the life log information is included, and, in the life log information, information representing the condition of the individual and information representing the intake status of foods and supplements are included.

[0246] Thus, the PHR big data analyzing unit **121** performs the cohort analysis of the PHR big data including such information as the target, thereby deriving relevance between a combination of a type of genome and a type of lifestyle and the specific health beverage. For example, the PHR big data analyzing unit **121** traces a group (a group matching a combination of a specific type of genome and a specific type of lifestyle) that is exposed to a specific factor and a group (a group not matching the combination) that is not exposed to the specific factor for a predetermined period and compares the presence/no-presence of the effects of components (or similar components thereof) contained in the specific health beverage that is the target for the analysis, thereby deriving relevance between the factor (the combination of the specific type of genome and the specific type of lifestyle) and the specific health beverage.

[0247] Then, the PHR big data analyzing unit **121**, based on the derived relevance, classifies combinations of a type of genome and a type of lifestyle into a group having an effect for a component (or a similar component thereof) contained in the specific health beverage and a group not having an effect for the component. In addition, the PHR big data analyzing unit **121** classifies the group having the effect into two groups in view of a combination with the intaking food.

[0248] In other words, it is not recommended to sell a specific health beverage to persons each having a combination of types classified into the group not having the effect for the health beverage. In addition, while the health beverage can be sold to persons each having a combination of the types classified into a group to which attention needs to be paid regarding a combination with the intaking foods and supplements among the group having the effect for the specific health beverage, it is preferable to report points to consider regarding the combination with the intaking foods. In addition, it is recommended to sell the health beverage to persons each having a combination of the types classified into the remaining groups.

[0249] Thus, for example, the secondary use service providing unit **123**, based on a contract exchanged with a food/supplements sales company in advance, provides a secondary use service for utilizing the relevance between a combination a type of genome and a type of lifestyle and the health beverage for a food/supplements sales company **15a**. As a technique used for the provision, while various techniques may be considered, hereinafter, one technique will be described with reference to FIG. **31**.

[0250] As illustrated in FIG. **31**, for example, the secondary use service providing unit **123** extracts users having combinations of types classified into groups to which the specific health beverage can be sold or is recommended to be sold from among a user group that is a provider of the

PHR data. Then, the secondary use service providing unit **123** generates a real name list including points to be considered for such users and transmits the real name list to the food/supplements sales company **15a**. Here, the real name list may be provided to be read through a portal site or may be provided via offline. Then, as illustrated in FIG. **31**, the food/supplements sales company **15a** performs sales promotion activities through direct mails (DM) or the like by using the real name list. In addition, the food/supplements sales company **15a** reports points to be considered as is necessary in the sale promotion activities.

[0251] Next, for example, the secondary use service providing unit **123** traces PHR data corresponding to the users each having a combination of the types classified into the groups to which the specific health beverage can be sold or is recommended to be sold for a predetermined period. Then, the secondary use service providing unit **123** calculates users who have purchased the specific health beverage by using the life log information and transmits the PHR data of the purchasing users to the food/supplements sales company **15a**. There, the PHR data of the purchasing users may be provided to be read through a portal site or be provided via offline.

[0252] Then, as illustrated in FIG. **31**, the food/supplements sales company **15a** verifies the effect of the health beverage by using the PHR data. For example, the food/supplements sales company **15a** calculates quantitative numerical values representing the effects. Then, the food/supplements sales company **15a** feeds back the effects that are based on the calculated numerical values to users who have not purchased the health beverage among the users each having a combination of the types classified into the groups to which the specific health beverage can be sold or is recommended to be sold.

[0253] In addition, in the example described above, while an example has been described in which the secondary use service providing unit **123** calculates users who have purchased the specific health beverage by using the PHR data and provides the PHR data of the users who have purchased the specific health beverage for the food/supplements sales company **15a**, the embodiment is not limited thereto.

[0254] For example, the secondary use service providing unit **123** may calculate users who have purchased the specific health beverage, narrow down the users into users actually having an effect by analyzing the PHR data, and provide a real name list of the narrowed-down users to the food/supplements sales company **15a**. For example, in a case where the food/supplements sales company **15a** desires to perform sales activities by narrowing down users having a remarkable effect into targets, such a narrowing-down process is effective. In addition, for example, the secondary use service providing unit **123** narrows down the types of lifestyle of users for whom an actual effect is acquired and specifies lifestyles relating to the effect. Then, the secondary use service providing unit **123** may provide information of the specified lifestyles to the food/supplements sales company **15a**. In such a case, additionally, the food/supplements sales company **15a** may propose a lifestyle at the time of selling foods or supplements.

[0255] In addition, for example, the secondary use service providing unit **123** may find effectiveness, side effects, long-term effects, and the like of a drug by analyzing the PHR data of the user using the specific drug and provide them for a pharmaceutical company. Accordingly, for

example, in the development of a drug, the pharmaceutical company can effectively develop a drug that is suitable for each user by finding effectiveness, side effects, and long-term effects of the drug for each type of life style or each type of genome.

[0256] Subsequently, as a third example, an example will be described in which the PHR data transmitted from a user is utilized for a family watching service for a family member who is separated far or the like.

[0257] FIG. 32 is a diagram that illustrates an example (third example) of the secondary use service according to this embodiment. As illustrated in FIG. 32, for example, the secondary use service providing unit 123 receives use permission from each user who provides the PHR data in advance. The contents of this use permission, for example, are items of the life log information that are permitted to be disclosed (disclosure items) and a disclosure partner (disclosure destination).

[0258] For example, the secondary use service providing unit 123 receives use permission from user E who is an old person on a portal site 14f for user E. For example, in the example illustrated in FIG. 32, it is represented that the secondary use of the blood pressure and the heart rate among the life log information is permitted for the family watching service, and the disclosure partners of the information are user A who is a daughter of user E and user D who is a son of user E. Similarly, it is represented that the secondary use of the amount of exercise and the sleeping hours among the life log information is permitted for the family watching service, and the disclosure partners of the information are user A who is a daughter of user E and user D who is a son of user E. On the other hand, among the life log information, it is represented that the positional information is not permitted for the secondary use for the family watching service.

[0259] The secondary use service providing unit 123 transmits the information of such use permission received for the secondary use to the PHR accumulation unit 110. Then, the PHR accumulation unit 110 causes the information of the use permission in which the above-described contents are described to be in accompaniment with the PHR data transmitted from user E and stores the information. In addition, a method of causing the use permission information to be accompanied may use a technique of causing the use permission information to be accompanied with the whole PHR data or a technique of causing the use permission information to be accompanied with data of each subdivided item. Any arbitrary technique may be used for a method of causing the use permission information to be accompanied such that the use permission information can be checked on the side on which the PHR data is used.

[0260] In addition, the secondary use service providing unit 123 processes the PHR data provided as above into a form that is appropriate for the family watching service or the like and supplies the processed PHR data to a security company 15b that provides the family watching service. For example, the secondary use service providing unit 123, for blood pressure, a heart rate, an amount of exercise, and sleeping hours corresponding to one week, processes each value into a form such as a graph in which each value is plotted in a time series sequence such that a trend for one week can be easily checked and supplies the PHR data after the processing to the security company 15b. In addition, a technique for the provision may be an online technique or an offline technique. In addition, the secondary use service

providing unit 123 may be configured to supply the PHR data to the security company 15b. In such a case, the above-described processing is performed by the security company 15b as is necessary.

[0261] For example, the security company 15b operates the family watching service. For example, a subscriber of the family watching service is user A who is a daughter of user E who is an old person. In the contract with the security company 15b, user A determines that user E who is an old person is a watching target, and user D who is a son of user E desires to use the service in addition to user A. Here, the subscriber of the family watching service and the user using the service provided by the PHR processing apparatus 100 side do not necessarily coincide with each other.

[0262] In this way, for example, the security company 15b starts up a watching portal site 14g for user E who is an old person at the site thereof. An access to the watching portal site 14g is permitted only to user A and user D. Then, user A and user D, on the watching portal site 14g, for example, can check the health state, the appearance of exercises, the sleeping status, and the like of the mother thereof for this one week.

[0263] As described above, in the third example, the secondary use service providing unit 123, for the PHR data transmitted from the user, receives use permission relating to disclosure items and a disclosure destination. Then, the secondary use service providing unit 123 outputs the user's PHR data or the processing information of the PHR data in accordance with the received use permission. In this way, based on the life log information of a family member who is separated far, a service providing the status of the family member even in a case where the family member is separated far can be provided. In addition, at that time, a mechanism in which only designated information among the life log information can be disclosed for a specific partner can be realized. Furthermore, the information of the use permission is accompanied with each life log information, and a method having data to which a mark indicating that the data may be disclosed to a specific partner can be attached is formed.

[0264] As above, as the secondary use of the PHR big data, the first, second, and third examples have been described. As such a secondary use progresses, not only a support service for returning only an evaluation result of a health risk of the future to the provider of the PHR data but a new business model can be built in which various economical merits such as provision of distribution and product selling services, design of a lifestyle, a system of returning points that can be used as local currency, and the like are returned to individuals, a local government, and the society.

[0265] As described above, in this embodiment, as the number of participants or the scale increases, verification cycles and evidences are accumulated, and the performance is improved as a system having higher reliability and creditability. In addition, since the system is configured by various kinds of data, the degree of usefulness is high. By processing such a database and promoting the secondary use for the industry in various forms, basic data that is based on the life log big data and the genome information, which has been accumulated only and of which the value cannot be sufficiently found until now, is enabled to have a new and groundbreaking value, and accordingly, a new revolutionary industry using such data can be created.

[0266] (Incentive for Collecting PHR Data)

[0267] Until now, as examples of the primary use service of the PHR data, the “daily medical checkup” and the “future health risk notification” have been described. In addition, the secondary use service of the PHR data has been described with reference to the specific examples. In any case, it is preferable that the PHR data satisfying the amount of data and kinds of data required for the primary use or the secondary use is continuously transmitted from each individual. Thus, in this embodiment, the PHR processing apparatus 100 further builds an incentive mechanism for each individual to continuously transmit the PHR data.

[0268] First one of such mechanisms is a link to the secondary use service. In a case where a permission is acquired from a corresponding user, the PHR data transmitted from each user is supplied also for the secondary use service. Thus, the PHR processing apparatus 100, for example, based on earnings acquired from the data trust company 11 relating to the secondary use service, builds a feedback mechanism for each user in a form such as a point system (points, mileage, dividend, or the like) or the like.

[0269] Second one of such mechanisms is competition among users. Each user competes with competition partners such as friends and family members for a win, and accordingly, a will toward healthiness can be increased. Thus, the PHR processing apparatus 100 builds a competition mechanism for a win, for example, by comparing the data amount and the number of kinds of the PHR data, biological information such as weight or blood pressure, or behavior information such as a distance taken for a walk or the number of steps taken per day between competition partners. The competition partner may be a virtual friend, a virtual lover, a virtual family member, or the like that is virtually set.

[0270] Third one of such mechanisms is a health forecast described in the above-described embodiment. In other words, by supplying the PHR data to the PHR processing apparatus 100, each user can receive his future health risk that is estimated based on the PHR data as a health forecast. As described above, the health forecast presents a future health risk in various forms. For example, the user may estimate the health risk corresponding to an estimation target period such as this week, this month, this year, past one day, past one week, past one month, or past one year or may estimate the health risk by setting an arbitrary time point such as after one day, after one week, after one month, after one year, after five years, after 10 years, or after 20 years as a future time point.

[0271] Then, hereinafter, the first one and the second one of the mechanisms described above will be described in detail.

[0272] FIG. 33 is a diagram that illustrates a first one of incentive mechanisms according to this embodiment. As illustrated in FIG. 33, the primary use service providing unit 122 includes an incentive processing unit 122a (also referred to as a “presentation unit”). The incentive processing unit 122a evaluates the PHR data of a specific user and presents a result of the evaluation to the specific user. For example, the incentive processing unit 122a, in cooperation with the secondary use service providing unit 123, regarding the specific user who has permitted the secondary use of the PHR data, receives use information such as the amount of data, kinds, the number of kinds of the PHR data used for the secondary use and the usefulness of the secondary use

service in which the PHR data is utilized from the secondary use service providing unit 123. Then, the incentive processing unit 122a calculates points based on the use information and presents information (for example, points, a service restored to the user according to the points, the amount of dividend, or the like) relating to the calculated points to the user.

[0273] For example, the incentive processing unit 122a presents public advertisement information to a portal site 14h of user A. In this public advertisement information, for example, an overview of the purpose of the secondary use “Please help for the development of a drug”, the value of the point”, the data amount (for example, the transmission frequency, the transmission period, and the like) and the kind (for example, specific items of biological information or behavior information) of PHR data required for the purpose are described. For example, user A reads this public advertisement information and goes through the procedure of the application (use permission). In addition, user A transmits the PHR data to the PHR processing apparatus 100 in accordance with the rules of the PHR data that are described in the public advertisement information.

[0274] The PHR data of user A that is transmitted to the PHR processing apparatus 100 in this way and is accumulated therein is provided for the secondary use having the purpose described above according to the use permission. Then, as described above, the incentive processing unit 122a receives the use information from the secondary use service providing unit 123, calculates points based on the use information, and presents information relating to the calculated points to the user. For example, the incentive processing unit 122a, as illustrated in FIG. 33, displays “Acquired points of user A are 000 pts” at a portal site 14i. Here, the calculation of points does not necessarily need to be performed after the secondary use but may be performed before the provision of the PHR data for the secondary use.

[0275] This point system is operated and managed by the data trust company 11, and the data trust company 11 performs specific restoration based on the points for user A. For example, in a case where the data trust company 11 acquires earnings in relation with the secondary use service, the data trust company 11 affiliates with a company or a store based on the earnings and allows user A to restore points from a company that is an affiliation or a product. The restoration of points, for example, may be in any form such as a service or a free gift. Alternatively, the data trust company 11 may transfer a part of the earnings to user A in the form of dividend.

[0276] The points are described to be calculated based on the usefulness of the secondary use service. This point will be additionally described. As the purpose of the secondary use service, there are a purpose that has high social significance as in the case of a clinical test (clinical trial) performed for the development of a drug and the acquisition of an approval defined in the Pharmaceutical Affairs Law or a post-evaluation (after marketing) of true effectiveness and effects according to long-term administration of a drug and a purpose for a part of simple marketing as in the case of collecting biological information represented in the body from a viewer of a movie or a program. While a purpose to be determined as a purpose having a high degree of usefulness and a purpose to be determined as a purpose having a low degree of usefulness may be arbitrary set by the data trust company 11 side, for example, the data trust company

11 may set the usefulness such that a medical purpose has a high degree of usefulness, and a marketing purpose has a low degree of usefulness. Alternatively, the data trust company 11 may set the usefulness based on a ratio of earnings (or prospected earnings to be acquired) that are actually acquired to total earnings.

[0277] In addition, in the example described above, on the premise that the PHR data transmitted from the user is provided also for the secondary use service, while the feedback mechanism for the user such as the point system in any form in relation with the secondary use service has been described, the embodiment is not limited thereto. The point system operated by the incentive processing unit 122a, separately from the secondary use service, may be operated based on only the data amount, the kinds, and the number of kinds of the PHR data transmitted from the user. In such a case, for example, the incentive processing unit 122a calculates points for the PHR data of each user based on at least one of the data amount, the kinds, and the number of the kinds and presents information relating to the calculated points to the user.

[0278] Furthermore, in the example described above, while an example has been described in which the points are calculated based on the data amount, the kinds, and the number of the kinds of the PHR data, the usefulness of the secondary use service for which the PHR data is utilized, and the like, the embodiment is not limited thereto. The incentive processing unit 122a may calculate the points based on a criterion used for evaluating the transmission status of the PHR data.

[0279] Next, FIG. 34 is a diagram that illustrates a second one of the incentive mechanisms according to this embodiment. Also in the second one, the incentive processing unit 122a evaluates the PHR data of a specific user and presents a result of the evaluation to the specific user. For example, as illustrated in FIG. 34, the incentive processing unit 122a sets a competition relation among a plurality of users transmitting the PHR data and compares the life log information among the users. Then, the incentive processing unit 122a presents a result thereof to the users having the competition relation.

[0280] For example, the incentive processing unit 122a accepts an application for setting user C as a competition partner from user A. Then, the incentive processing unit 122a sets a portal site 14j used for a competition between user A and user C on the health care cloud 10 and attaches a link toward this portal site 14j used for the competition to the portal sites of user A and user C. In this way, each of user A and user C can read the portal site 14j used for the competition between two users through the portal site thereof.

[0281] In addition, for example, the incentive processing unit 122a updates the portal site 14j used for the competition between two users at a frequency (for example, once a day, once a week, once a month, once a year, or the like) according to the desire of user A and user C. For example, it is assumed that the desire of user A and user C is the frequency of once a week. Then, the incentive processing unit 122a, once a week, extracts information of a competition item designated as a competition target in advance from the PHR data of user A corresponding to the past one week and similarly, extracts information of a competition item designated as a competition target in advance from the PHR data of user C. Then, the incentive processing unit 122a

compares the information of the competition item extracted from each PHR data and determines a winner.

[0282] In the case of the example illustrated in FIG. 34, for example, the incentive processing unit 122a, for the PHR data of each user, specifies the data amount and the number of the kinds and acquires weight information, blood information, an average number of steps per day, and the like from the life log information. In the example illustrated in FIG. 34, during one week, user A transmits the PHR data seven days and transmits 20 items. User A succeeds in decreasing the weight of 0.5 kg, has normal blood pressure, and has an average number of steps of 7,500 per day, which is a relatively large. On the other hand, user C, during one week, transmits the PHR data five days and transmits 19 items. In addition, user C gains a weight of 1.0 kg, has normal blood pressure, and has an average number of steps of 5,000 per day, which is relatively small.

[0283] The incentive processing unit 122a evaluates such information based on a criterion determined in advance and determines a winner. Then, the incentive processing unit 122a, for example, as illustrated in FIG. 34, displays a result of the determination using a mark that visually represents a winner, character information, or the like. In the example illustrated in FIG. 20, the incentive processing unit 122a gives points also to the result of such a competition. The competition items, the criterion of the competition, the GUI of the portal site 14j used for a competition, a method of feeding back the result of the competition, and the like described above may be arbitrarily changed. For example, the incentive processing unit 122a may be configured to transmit the result of the competition to the mail address of each user.

[0284] (Detailed Configuration of PHR Processing Apparatus 100)

[0285] Until now, the “daily medical checkup” service and the “secondary use service” of the PHR data, which are provided in this embodiment, have been described in detail. While the basic configuration of the PHR processing apparatus 100 has been described, hereinafter, the configuration of the PHR processing apparatus 100 will be described in more detail. All the PHR accumulation unit 110, the PHR big data analyzing unit 121, the primary use service providing unit 122, and the secondary use service providing unit 123 to be described below respectively correspond to the PHR accumulation unit 110, the PHR big data analyzing unit 121, the primary use service providing unit 122, and the secondary use service providing unit 123 described in the above-described embodiment. In addition, the PHR processing apparatus 100 does not necessarily include all the units described below, and some of the units may be omitted as is appropriate. Furthermore, the PHR processing apparatus 100 may further include any other unit.

[0286] FIG. 35 is a functional block diagram of the PHR processing apparatus 100 according to this embodiment. The PHR processing apparatus 100 can be realized by using one or a plurality of general-purpose computers and includes a processor, a memory, and an input/output interface. Each unit illustrated in FIG. 35 may be appropriately assigned to the processor, the memory, and the input/output interface.

[0287] The PHR processing apparatus 100 includes: a PHR accumulation unit 110, a PHR operating/managing unit 120; and a system control unit 130. The system control unit 130 controls the overall operation of the PHR processing apparatus 100. For example, the system control unit 130

receives an operation from an operator of the data trust company **11** and performs account registration of a user who is a management target of the PHR data, family members thereof, and an attending doctor and account registration of medical institutions, various companies, and the like receiving the provision of the secondary use service.

[0288] The PHR accumulation unit **110** includes: a security function unit **111**; a data format conversion/normalization unit **112**; an unstructured data processing unit **113**; and a PHR data accumulation unit **114**.

[0289] The security function unit **111** performs various processes used for acquiring the security of the PHR data. The PHR data is personal information requiring extremely sensitive handling. For this reason, the security function unit **111** performs authentication of a connection destination and approves an access right as the input/output interface (API: Application Programming Interface) of the PHR data. In addition, in order to provide data for utilization and applications after a process for causing each individual not to be specified is performed therefore, the security function unit **111** performs an anonymity process of the PHR data as is necessary. Furthermore, the security function unit **111** encrypts the PHR data for which the anonymity process is not performed using an appropriately managed encryption key. In addition, in a case where the PHR data is to be provided for a destination other than the health care cloud **10**, the security function unit **111** performs data transmission having durability against unrightful infringement.

[0290] In addition, the security function unit **111** provides a function for performing appropriate personal authentication for all the data access users such as a system supervisor, a researcher analyzing the PHR big data, and an individual user registering PHR data and referring to the registered PHR data. Since sensitive health information of an individual is handled on the health care cloud **10**, the security function unit **111** provides a multi-element authentication technology for securing security of a level higher than the security level of ID/password authentication. In addition, the security function unit **111** provides a name identification function used for identifying and specifying the owner of data input from various devices and systems.

[0291] In order to flexibly respond to the transmission of the PHR data from devices in various forms, the data format conversion/normalization unit **112** provides a data changing/normalizing function and a service bus function for delivering converted normalized data to a predetermined system. In addition, in this embodiment, in order to perform an analysis relating to medical care and health of individuals, the PHR accumulation unit **110** collects complementary information such as information of images and Twitter text of social media or the like and information of audio, images, and texts supplied from a smartphone application. For this reason, the unstructured data processing unit **113** has an interface function and functions called speech recognition, a natural language analysis, image recognition, and data mining used for processing such unstructured data.

[0292] The PHR data accumulation unit **114** is the large-scale genome cohort database **114a** in which the PHR big data is accumulated.

[0293] The PHR operating/managing unit **120** includes: a PHR big data analyzing unit **121**; a primary use service providing unit **122**; and a secondary use service providing unit **123**. In addition, the PHR big data analyzing unit **121** includes: an analysis engine unit **121a**; a distributed process

database **121b**; and an event processing unit **121c**. The analysis engine unit **121a** performs a cohort analysis and the like of the PHR big data stored in the PHR data accumulation unit **114** as the target. The analysis performed by the analysis engine unit **121a** may be performed by using a distributed processing technology. In such a case, the PHR data accumulation unit **114** and the distributed process database **121b** cooperate with each other, and the analysis engine unit **121a** has the PHR big data stored in the distributed process database **121b** as its processing target. In addition, the event processing unit **121c** performs an event process according to the distributed process performed by the analysis engine unit **121a**.

[0294] The primary use service providing unit **122** provides the “daily medical checkup” service as the primary use service. In addition, the primary use service providing unit **122** includes an incentive processing unit **122a**. In order for an individual user to wear a sensor and to continue the input of his health information and the supplement information thereof over a long period, an incentive is of significance. The incentive processing unit **122a** provides a point system that can be an incentive, various rankings, game elements, and a function of an advertisement model. The secondary use service providing unit **123** provides the secondary use service.

[0295] (Hardware Configuration)

[0296] FIG. 36 is a diagram that illustrates the hardware configuration of the PHR processing apparatus **100** (or the PHR display apparatus **200**) according to this embodiment. The PHR processing apparatus **100** (or the PHR display apparatus **200**) includes: a CPU (Central Processing Unit) **310**; ROM (Read Only Memory) **320**; RAM (Random Access Memory) **330**; a display unit **340**; and an input unit **350**. In addition, in the PHR processing apparatus **100** (or the PHR display apparatus **200**), the CPU **310**, the ROM **320**, the RAM **330**, the display unit **340**, and the input unit **350** are interconnected through a bus line **301**.

[0297] In the embodiment described above, a PHR processing program (or a PHR display program) performing various processes is stored in the ROM **320** and is loaded into the RAM **330** through the bus line **301**. The CPU **310** executes the PHR processing program (or the PHR display program) loaded into the RAM **330**. For example, in the PHR processing apparatus **100** (or the PHR display apparatus **200**), according to the input of an instruction from the input unit **350** that is performed by the operator, the CPU **310** reads the PHR processing program (or the PHR display program) from the inside of the ROM **320**, expands the read program into a program storage area arranged inside the RAM **330**, and executes various processes. The CPU **310** causes various kinds of data generated at the time of performing these various processes to be temporarily stored in a data storage area formed inside the RAM **330**.

[0298] The PHR processing program (or the PHR display program) executed by the PHR processing apparatus **100** (or the PHR display apparatus **200**) has a module configuration including the PHR big data analyzing unit **121**, the primary use service providing unit **122**, and the secondary use service providing unit **123** (or the display control unit **210**), and such modules are loaded into a main storage device and are generated on the main storage device.

OTHER EMBODIMENTS

[0299] The embodiments are not limited to the above-described embodiments.

[0300] (Configuration)

[0301] In the above-described embodiment, while a configuration has been described in which the PHR processing apparatus 100 is built on the cloud, the embodiment is not limited thereto. Some or all of the functions of the PHR processing apparatus 100, for example, may be built on a network arranged inside the data trust company 11. In addition, the PHR processing apparatus 100 does not need to be built at one base. The PHR processing apparatus 100 may be realized by cooperating functions that are distributed at a plurality of bases.

[0302] In addition, the physical configurations illustrated in the above-described embodiment are merely examples. The units illustrated in the above-described embodiment are appropriately integrated or distributed according to the operating form or the load thereof.

[0303] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

1-11. (canceled)

12. A swallowable sensor to be discharged without being digested or absorbed also when entering inside of a body, the swallowable sensor comprising:

- a sensor configured to detect predetermined biological information on the inside of the body;
- a detector configured to detect whether the sensor has entered the inside of the body; and
- a transmitter configured to transmit the predetermined biological information detected by the sensor to a communication device disposed outside the body based on a detection of an entrance of the sensor into the inside of the body that is made by the detector,

wherein the sensor, when detected by the detector as being entered inside the body, starts sensing the predetermined biological information on the inside of the body and detects the predetermined biological information on the inside of the body by decreasing frequency of the sensing in accordance with a time elapsed after entering the body.

13. The swallowable sensor according to claim 12, wherein the decrease in the frequency of the sensing is achieved through each part of the body which the swallowable sensor passes.

14. The swallowable sensor according to claim 12, wherein the decrease in the frequency of the sensing is determined for each of a stomach, a small intestine, and a large intestine in accordance with a time at which the swallowable sensor passes.

15. The swallowable sensor according to claim 12, wherein the detector is configured to detect whether the swallowable sensor has come to outside of the body.

16. The swallowable sensor according to claim 15, wherein the detector is configured to detect whether the

swallowable sensor has come to the outside of the body based on at least one of a temperature, a hydrogen ion exponent, and light.

17. The swallowable sensor according to claim 12, wherein the detector is configured to detect whether the sensor has entered the inside of the body based on at least one of a temperature, a hydrogen ion exponent, a predetermined enzyme, and light.

18. The swallowable sensor according to claim 12, wherein the swallowable sensor is formed in one millimeter square or less.

19. The swallowable sensor according to claim 12, wherein a surface of the swallowable sensor is coated with a substance having resistance against digestion and absorption inside the body.

20. The swallowable sensor according to claim 12, wherein the communication device is a wearing type device.

21. A sensing method performed by a swallowable sensor including a sensor configured to detect predetermined biological information on inside of a body, a detector configured to detect whether the sensor has entered the inside of the body, and a transmitter configured to transmit the predetermined biological information detected by the sensor, the method comprising:

detecting, using the detector, whether the sensor detecting the predetermined biological information on the inside of the body has entered the inside of the body;

starting sensing, using the sensor, the predetermined biological information on the inside of the body based upon detection of the sensor entering inside the body and detecting the predetermined biological information on the inside of the body by decreasing frequency of the sensing in accordance with a time elapsed after the sensor entering the body; and

transmitting, to a communication device disposed outside the body, the predetermined biological information detected by the sensor at the detecting.

22. The sensing method according to claim 21, wherein the decrease in the frequency of the sensing at the detecting is achieved through each part of the body which the swallowable sensor passes.

23. The sensing method according to claim 21, wherein the decrease in the frequency of the sensing at the detecting is determined for each of a stomach, a small intestine, and a large intestine in accordance with a time at which the swallowable sensor passes.

24. The sensing method according to claim 21, further comprising detecting, using the detector, whether the swallowable sensor has come to outside of the body.

25. The sensing method according to claim 24, wherein the detecting whether the swallowable sensor has come to the outside of the body includes detecting, using the detector, whether the swallowable sensor has come to the outside of the body based on at least one of a temperature, a hydrogen ion exponent, and light.

26. The sensing method according to claim 21, wherein the detecting whether the sensor has entered the inside of the body includes detecting, using the detector, whether the sensor has entered the inside of the body based on at least one of a temperature, a hydrogen ion exponent, and a predetermined enzyme, and light.

27. The sensing method according to claim 21, wherein the communication device is a wearing type device.

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摘要(译)

根据实施例的可摄入传感器包括传感器，检测器和发射器，并且当进入身体内部时也将与食物混合并在不被消化或吸收的情况下被排出。传感器被配置为检测设置在体内的预定物质。检测器被配置为检测传感器是否已经进入身体内部。发送器被配置为基于由检测器对传感器进入身体内部的进入的检测，将由传感器检测到的预定物质的信息发送到布置在身体外部的通信设备。

