



Humanscape

A Blockchain-based Patient Network

Whitepaper

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Introduction

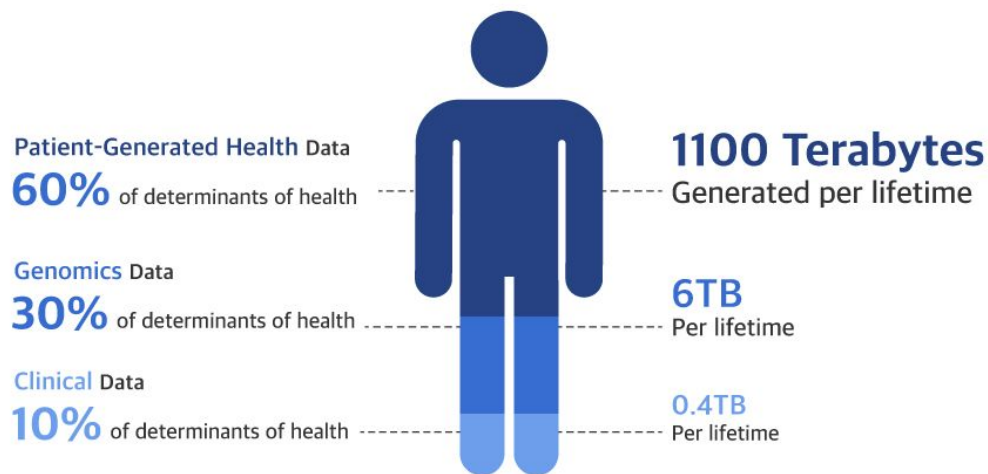
1. Incurable diseases

Although all human beings are susceptible to diseases, we continuously repeat the process of recovering our health through medical treatments. However, some patients suffer from incurable diseases whose etiologies are uncertain, exact diagnoses are difficult, and as a result, complete recovery is not possible. These incurable diseases include chronic diseases contracted by a large number of patients but with no complete cure and the need for lifelong management, such as diabetes mellitus, hypertension, cardiovascular diseases and cancer, in addition to rare and incurable diseases contracted by a small number of patients with a relatively small volume of epidemics data.

Chronic diseases are becoming a global challenge due to rapidly-progressing population aging, decline in physical activity and lifestyle changes such as increased intake of fat and beverages [1]. According to the World Health Organization (WHO), chronic diseases are the leading causes of deaths worldwide. As of 2015, 40 million out of 56 million deaths were caused by chronic diseases, and in addition, 1.7 million patients were predicted to die before the age of 70. Moreover, more than one third of the world's population simultaneously suffer from multiple chronic conditions, which constitutes significant threats to patients' health and imposes enormous costs on society. Specifically, medical costs in patients with multiple chronic diseases have been shown to increase by around 80 percent up to 300 percent, depending on age, gender and health conditions. Meanwhile, "rare and incurable diseases" are defined differently in each country, but generally refer to diseases for which the exact number of patients are unknown because of their small number of patients and difficulty of diagnosis [2]. As of 2016, the number of rare diseases registered on Orphanet, a portal for rare diseases, amounted to 6,084 and the worldwide population with rare diseases is estimated at 350 million. In Korea, the total number of rare diseases is estimated at around 2,000 and the affected population is calculated at 600,000 [3].

It is characteristic of incurable diseases that their symptoms are controllable by medication, lifestyle changes, operations, etc. but it is not possible to eradicate or treat the underlying causes. Although early diagnosis may allow the early completion of treatment, these diseases cause suffering to patients and their families due to the inadequacy of knowledge on the diseases, insufficient research development and support, and the consequent lack of awareness toward the need for self-care.

2. Patient-Generated Health Data, a clue to solution



Source: "The Relative Contribution of Multiple Determinants to Health Outcomes",
Lauren McGover et al., Health Affairs, 33, no.2(2014)

Figure 1. Exponential Growth and Important Role of PGHD

Patient-Generated Health Data (hereinafter PGHD) refers to health-related data recorded and generated by patients outside hospitals [4]. Due to the widespread penetration of smartphones and the growing familiarity of patients with smart devices, the collection of diverse PGHD has become easier through the utilization of online survey, mobile apps and wearable devices. PGHD is a component of health data alongside genetic and clinical data, and occupies more than 60 percent of health data with the ratio gradually increasing [5, Figure 1].

Since the majority of a patient's activities occur outside hospitals, information recorded at a clinical office is inevitably limited. Therefore, a growing importance is being placed on PGHD, as information directly collected from patients and directly produced by patients throughout their struggle against diseases. While PGHD has previously been regarded with less clinical value and interest compared to other types of information, it fills an information niche by complementing aspects that cannot be explained by existing medical data, and allows a more comprehensive understanding of patients' health. An Accenture survey found that the number of consumers who participated in the collection of PGHD using mobile healthcare applications rose to 33 percent in 2016, up from 16 percent in 2014 [6], which shows that the volume of PGHD collected will increase exponentially in the future. Therefore, PGHD, which includes information on patients' health and diseases, can provide a clue to the solution for diseases that are currently incurable.

2.1. Patients

As PGHD becomes more accessible with technology advancements, patients have become able to capture their health-related data independently and thoroughly. As a result, patients are more actively engaged in overcoming their diseases and are more interested in their own health. In addition, patients are able to participate in the collection of data; to observe how their health status has changed with time; to independently identify behaviors that influence health; and to satisfy their intellectual desire to be informed about diseases and the human body by sharing information with other patients. These processes allow patients to be more deeply engaged in treatments or research on their diseases and reinforce their desire to undergo treatment. For instance, according to a survey conducted on heart disease patients in the Connected Cardiac Care Program at Partners HealthCare, 98 percent of the respondents reportedly became more aware of their diseases through PGHD, and 85 percent of them came to be able to better control their diseases [7]. A pilot project conducted by the Care Beyond Walls & Wires revealed that PGHD had an effect on reducing the readmission rate by 44 percent, average length of stay by 64 percent and hospital cost per patient by USD 92,000 [8]. As such, PGHD has been shown to have an actual influence on various aspects of patients' struggle against diseases.

2.2. Healthcare Professionals

Healthcare professionals make decisions on medical treatments based on data collected from hospitals. However, these data are created by capturing patients' health at a certain timepoint, and therefore exclude PGHD, which involves continuous changes of conditions or phenomena occurring outside hospitals. Sole dependence on clinical data does not allow for a comprehensive evaluation of patients' health and may result in incomplete diagnosis or underdiagnosis. To improve this situation, PGHD collected in patients' daily life can be used to reduce misdiagnoses and aid the treatment of incurable diseases. Furthermore, healthcare professionals will be able to more comprehensively understand patients' health using PGHD [9]. For example, they may take proper actions earlier, after detecting sudden changes in patients' health conditions, and manage patients' health to the best possible extent by changing treatment methods if necessary. In addition, their continuous observation of patients' daily life through PGHD yield insight into patients' health as well as information necessary for treatments tailored for patients' condition, which ultimately assist the improvement of patients' health.

2.3. Research Institutes

Based on PGHD, researchers and pharmaceutical companies can recruit test subjects more easily and diversely through online ads or social media without being dependent on hospitals or hospital-based systems. These collection methods can improve the speed of research and reduce the time required to establish a cohort or a data set to facilitate effective analysis. For example, PatientsLikeMe functions as a platform for patients to better manage their health and for researchers to easily obtain data. Pharmaceutical companies and clinical trial institutes acquire patients' data through PatientsLikeMe and are using the data for research purposes[10]. Likewise, Humanscape will also contribute to disease research, through the documentation of shared data on the medication effectiveness and side effects to patients and the categorization of patient groups for various diseases [9].

The US Food and Drug Administration (FDA) is already reflecting the PGHD of patients' opinions and experiences in its drug review process for rare and incurable diseases. This is because reflecting patients' direct experiences and opinions in the development stage of a new drug, such as in clinical trials, may result in the production of safer and more effective medicine. Specifically, the FDA is developing Externally-Led Patient-Focused Drug Development (EL-PFDD) meetings into a channel for the collection of data based on the experiences of actual patients to provide them with helpful information on medication and treatments [11].

3. Humanscape, a Patient Networking Service

3.1. Attempts and Limitations on Building a Health Information Community

To date, the interchange of health information has largely taken place through Q&A services provided by web portals or online communities for specific diseases. In particular, online health communities and patient associations were generally organized around a specific disease and featured intensive discussions focused on a single disease, which restricted their expansion into other areas. Furthermore, existing communities are not equipped with mechanisms to sustain internal activities such as new posts or information sharing, which became problematic as users were alienated to “lurker” status or compelled to leave the community altogether. In this regard, a decline in community engagement results in a corresponding decline of expectation or satisfaction toward the community, which then poses a threat to the community’s sustainability [12].

Meanwhile, PatientsLikeMe constitutes a case in which the exchange of health information is occurring at an extremely active rate. Established in 2004, PatientsLikeMe is an online community for sharing information on symptoms among patients, mainly those with incurable diseases. Patients with incurable diseases have voluntarily shared information on their symptoms with other users complaining of similar symptoms, and currently, the number of patients registered on the platform is around 600,000 [13].

However, PatientsLikeMe remains somewhat limited in its capacity as a health information community.

Over 14 years since 2004, around 600,000 patients have joined PatientsLikeMe, but the number of active patients on the site accounts for only around 17,000 as of 2018, and it is predicted that the accumulated volume of data will not increase dramatically in the future. Moreover, as the main services of PatientsLikeMe are focused on the sale of health “data” to pharmaceutical, insurance, and medical device companies, the site is not active regarding exchanges of patients’ subjective experiences, information or emotions shared as “content.” This signifies that patient activities in PatientsLikeMe are limited to only the temporary input of data with limited practical and direct utility for patients. Therefore, patients are not compelled to share information unless they are heavily involved in PatientsLikeMe, and

consequently, this implies that it is difficult to collect a high volume of PGHD across a diverse spectrum.

3.2. Difficulty in Collecting PGHD

Active utilization of PGHD can be a way to contribute to treatments for patients suffering from incurable diseases. At present, however, PGHD is not systematically arranged or accumulated to be used as a valuable data source. Patients have no choice but to investigate and understand their conditions independently without any informative and emotional support for their health conditions, unless they belong to any specific group or organization [14]. If PGHD is not systematized and only individually owned without accumulation on the scale of big data, it is highly likely to lose any potential value for research necessary for the development of new drugs or treatments. In addition, patients are less likely to be able to efficiently find necessary information on diseases or drugs, which would narrow the range of choices available for the effective treatment of diseases, and potentially suffer from diminished control over their body due to their dependence on information gathered passively. Naturally, healthcare professionals may also lose the motivation to use PGHD in making diagnoses, and face the risk of judging patients' health from an incomplete and simplistic perspective.

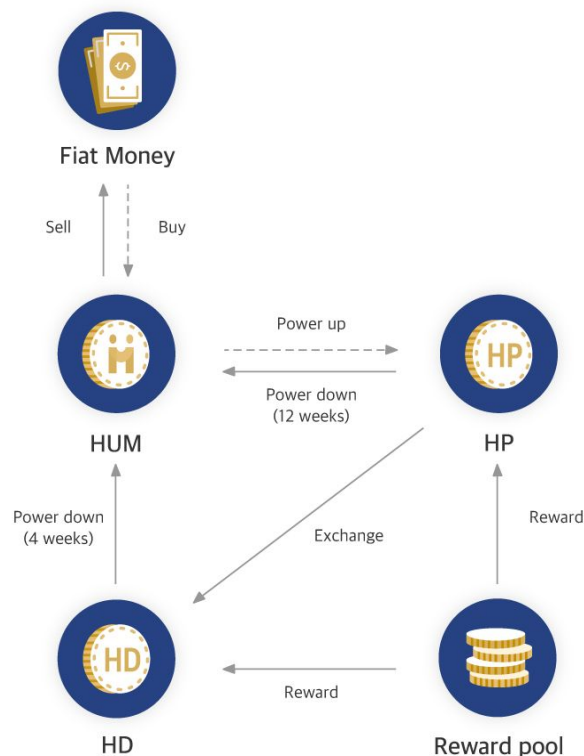
3.3. Potential of a Patient Networking Service

Against this backdrop, Humanscape is working to establish its namesake platform Humanscape, a decentralized patient network based on blockchains. Humanscape can provide practical help for patients to overcome their diseases through intellectual and emotional interaction with each other based on community activities. This process is expected to generate and collect a high volume of patient data, namely PGHD, on various disease groups. Furthermore, Humanscape facilitates active research into incurable diseases and the development of new drugs by linking patients to external industry sectors such as pharmaceutical firms and research institutes and helps patients to avoid complications and enjoy healthy lives through the continuous self-management of their lifestyle and symptoms. With these services, Humanscape is taking steps to liberate patients from incurable diseases, as its contribution to a world where everyone is healthy.

Blockchain-based Patient Network, Humanscape

1. Humanscape

1.1. Token Utilities



Token utilities of Humanscape induces stakeholders to behave in a way that helps patients, who are the principal community users, to overcome their diseases.

The blockchain of Humanscape consists of HUM Tokens (HUM), the basic unit for transactions; HUM Points (HP), points used within in the community; and HUM Donations (HD), points used for donations. In addition, Activity Index, Donation Index and User Score affect the token utilities. The token model of Humanscape is based on the STEEM model, which is evaluated as one of the most innovative among blockchain-based communities, and has been optimized to suit the needs of patient communities.

1.1.1. HUM Token

HUM is the basic transactional token in Humanscape's blockchain. It can be purchased and sold in the exchange and transferred among users. The HUM holding is used for the operation of Humanscape except the HUM used for the Initial Coin Offering (ICO).

Inflation

After the ICO, HUM issues tokens at an inflation rate of 10 percent. The inflation rate decreases by 1 percent each year for four years following the issuance. Subsequently, it decreases at a steady rate of 0.5 percent every year and the inflation rate eventually reaches 0.5 percent after 16 years. Inflation is an important factor in stimulating token utilities, but could lead to an excessive depreciation of tokens as supply outstrips demand. Humanscape prepares ways to burn token holdings in case of a plunge in token value due to excessive inflation. This burning process is carried out when the reward value is not deemed to be commensurate to the services.

1.1.2. HUM Point

HP refers to points used within the Humanscape community. HP is not traded in the exchange but can be purchased using HUM or earned through activities in the community. Although speculators may attempt to trade HUM for short-term profits, Humanscape intends to minimize the potential for speculation by limiting the routes for earning HP used in the community and its conversion to HUM.

Earning HP

HP can be earned in five ways. First, patients earn HP when their contents are rewarded with votes from other users. Second, HP and HD holders are paid interest in HD according to the inflation of their HP and HD holdings. Third, patients earn HP when institutions utilize their health data to recruit subjects for clinical studies and to be used in post marketing surveillance for new drugs. Fourth, HP is earned when patients take part in the qualification process of institutions. And finally, HP is earned when HUM is converted to HP.

Inflation Distribution Method

As for rewards for content creation and payment for interest, users are awarded tokens from the Reward Pool, which is formed as a result of inflation. Community activities eligible for rewards include “contents creation” and “voting.” Of the total inflation, 85 percent goes to the content creator and users who vote on it, while 15 percent is paid to users as interest in proportion to their HP and HD holdings. .

Applicable reward percentage for Content x is calculated based on the formula below.

$$P_x = \frac{V_x^p}{\sum_i^n V_i^p}$$

P: reward percentage for content, V: number of votes given to the content,
p: weighted value index (adjusted by learning the community activity rate)

Of the total amount of additional tokens issued on the relevant day (M), Content x is rewarded tokens in proportion to P.

$$R_x = P_x \times (M_d \times 0.85)$$

P: reward percentage for content, M: additional tokens issued on the relevant day
R: reward for the content

The creator of Content x receives 65 percent of the calculated rewards, and the voters receive 35 percent.

$$S_x = R_x \times 0.65 / C_x = R_x \times 0.35$$

S: author rewards, C: voter rewards

Interest on User x’s HP and HD holdings is calculated as follows:

$$I_x = (M_x \times 0.15) \times \frac{H_x}{\sum_0^n H_i}$$

M: additional tokens issued on the relevant day, I: interest payments,
H: HP and HD holdings

To prevent indiscriminate conversion, HP is converted to HUM tokens in 12 equal installments over a period of 12 weeks.

Limits on HP Conversion

HP can be converted into HUM. However, considering the value of HP, which exists to operate and promote the community, Humanscape intends to place a limit on its conversion in order to forestall a disturbance of the Humanscape ecosystem caused by economic power. Specifically, HP can be easily converted up to a certain volume, but the conversion cost increases exponentially if a user wants to hold HP above the cap. An exception is made for institutions that seek to utilize health information data using HP.

1.1.3. HUM Donation

HD refers to donation points earned through contributions to the community. Activities within the community benefit patient associations supported by patients themselves, which encourages their motivation to participate, and patient associations can gain actual benefits through financial rewards. In the long term, patient associations' activities to represent the rights and interests of patients and take a lead role in the treatment of diseases may yield outstanding results that cannot be achieved by the strength of an individual patient alone.

Users' earned HD cannot be converted to HUM or HP, as only patient associations that can organize donation events are allowed to convert HD to HUM. HD is earned when receiving rewards for uploaded content and through 1:1 conversion using HP. Users receive a base rate of 10 percent of the total rewards in HD for creating content. If they wish to receive additional HD, they can adjust the ratio of HP and HD in the reward. To encourage donations, Humanscape provides additional rewards in addition to the basic HD reward, corresponding to 10 percent of the adjusted HD in cases where the ratio of HD is adjusted. For example, a user who decides to receive 60 percent of the total reward in HP and 40 percent in HD will receive an extra 4 percent in HD. In other words, users are able to receive more HD by setting the HD ratio higher, compared to conversion at a 1:1 ratio. HD earned through this process can be freely donated within the community.

HD can be raised by patient associations and the HD collected can be withdrawn in two ways depending on the type of donations. First, for the unlimited fundraising method (regular contribution) with no set period and target amount, the HD raised is converted to HUM tokens in 12 equal installments over a period of 12 weeks. For the raising method with a deadline, on the other hand, the HD raised is converted to HUM tokens over a period of 4 weeks from the deadline or after the target amount is met. The contributions collected are prohibited from being donated again.

1.1.4. Activity Index

The Activity Index indicates a user's activeness on the Humanscape community. The score increases when the user logs in, creates content, casts votes, etc. and has a half-life of 30 days to reflect the most recent Activity Index. Users are able to cast more votes with a higher Activity Index.

$$A_t = A_0 \times \left(\frac{1}{2}\right)^{\frac{t}{T}}$$

At: current Activity Index, A0: Activity Index of the last active day,

T: half-life (30 days), t: elapsed days

1.1.5. Donation Index

The Donation Index measures the volume of donations made by a user and is designed to encourage user donations. The Donation Index increases when a user makes donations using HD. Donations are recognized as contributions to community activities, and therefore a user with a high Donation Index is allocated more votes, as is the case with the Activity Index. Unlike the Activity Index, however, the Donation Index accumulates without a half-life.

1.1.6. User Score

User Score is a composite index calculated based on the HP and HD holding amounts, as well as the Activity Index and Donation Index. User Score determines the number of votes and bandwidth allocated to users. Based on the assumption that the overall distribution of the total HP and HD holding and the total sum of the Activity Index and Donation Index follows a normal distribution, a standard score is calculated using the formula below. This standard score is used to prevent new or minority users from exercising or abusing excessive influence.

$$M_x = 20 \times \frac{G_x - m}{\sigma} + 100$$

G: a user's HP and HD holding + Activity Index + Donation Index

: StDev of G, m: average of G, M: User Score (minimum value of M = 10)

1.1.7. Bandwidth

The various user activities within the community create transactions that generate data. Since there is a limit to data usage capacity due to the characteristics of the blockchain network, Humanscape uses dynamic bandwidth allocation method like Steem, to resolve the data capacity issue. The dynamic bandwidth allocation method sets a target capacity and lowers each user's maximum bandwidth per share when demand soars and raises it when demand drops.

Humanscape limits the bandwidth that each user can use in proportion to their User Score, while the whole bandwidth depends on the total data capacity of the blockchain network.

$$B_x = B \times \frac{M_x}{\sum_0^n M_i}$$

B: total bandwidth capacity, B_x: bandwidth of User x, M: User Score, n: total number of users

1.1.8. Voting Right

Users can "upvote" or "downvote" uploaded content up to the number of votes allocated to them. Since they can only cast a limited number of votes each day, users are made to choose carefully. They will also use their votes in a way that encourages quality content to be generated within the community, partly in order to keep the value of their HUM from falling. This is expected to facilitate the self-regulation of content quality.

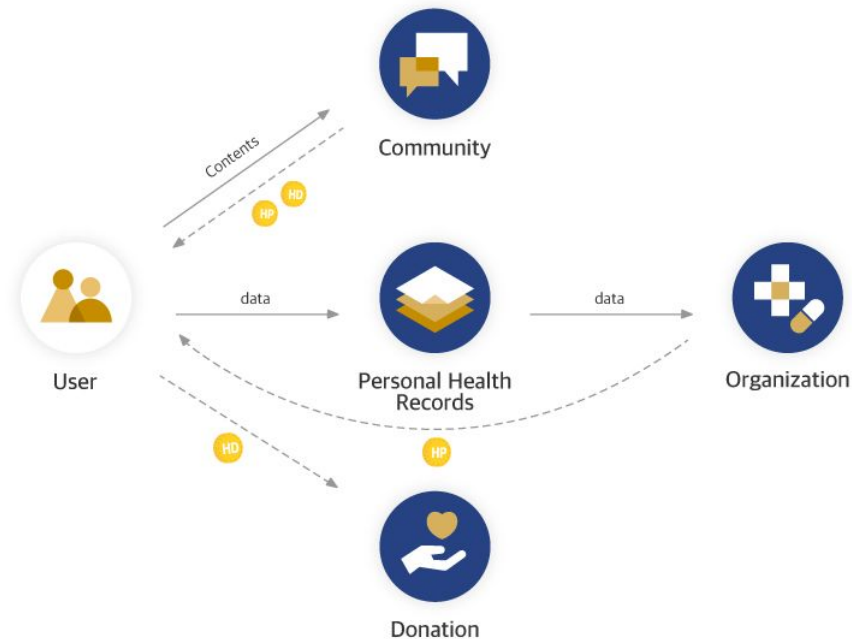
To promote user activities, more votes are given to users with high HP and HD holdings and high Activity and Donation Indexes. Every 24 hours, each user's votes are replenished up to 20 percent of the maximum number of votes, and each vote can be used only once as an "upvote" or a "downvote" for a single item of content.

$$V_x = 250 \times \frac{M_x}{100}$$

V: maximum votes, M: User Score

Users who create quality content will generate many “votes” and receive rewards in proportion to the votes. Users who “vote” on such content also earn rewards in proportion to the number of votes the content has received.

1.2. Service Composition



1.2.1. Personal Health Records

Chronic or incurable diseases require patients to constantly document and manage their own health conditions. Humanscape allows users to create content such as disease-related records and to input and manage data, e.g. symptoms, administered medication, and IoT, on a single user profile. For example, diabetics who need blood sugar management can measure and record their blood sugar level on their user profile on a daily basis, along with factors that influence blood sugar, such as dietary habits and other physical changes.

Such personal health data not only helps each patient to self-manage their health but also serves as useful sources for various services. Firstly, disease-related records and symptoms can be shared within the community through various content. High-quality content is more likely to be shared and receive a high number of votes from users, awarding the author with rewards proportional to the number of votes. Secondly, users who record their symptoms in detail are more likely to be exposed to the profiles or posts of other patients with similar

symptoms. With greater usage of the services, users are provided with customized information in order to enhance their user experience. In addition, numerous healthcare-related institutions conduct a variety of research and marketing programs, in which patients may participate to earn HP. For example, users could take part in pharmaceutical companies' clinical tests, post marketing surveillance on new drugs or medical devices, and insurance companies' marketing programs for recommending an insurance policy tailored to patients' health. These institutions' activities based on patients' personal health records can offer actual benefits to those with incurable diseases and alleviate the financial burden facing their families due to insurance costs, etc. As such, Humanscape aims to use accumulated information on patients' health in a way that is beneficial to the health of patients as well as humankind at large.

1.2.2. Community

Communities by Topic

Users share content, such as daily treatment records, knowhow and latest information on various topics like diseases, symptoms and side effects in communities with specific themes, where patients can post their personal health records directly on a bulletin board. If posts or comments receive an upvote, HP is given as a reward. A part of the reward is given as HD, which can be used to donate to donation events organized by patient associations.

Communities for Patient Associations

A community is created for a patient association that is registered after a qualification process, which allows members of the association to use the bulletin board. In a patient association community, the administrator can post notices announcing information or events related to the patient association, while members can share information with each other and socialize among themselves.

Content Sharing and Voting

Content shared among patients includes daily treatment records, knowhow and latest information, as a combination of texts, images and the uploader's health data (diseases, symptoms and administered medicine). The number and volume of posts that can be uploaded within a given period are limited by bandwidth. Uploaded content can be voted on by other users, and content that receives an upvote within 30 days since the upload date is given a reward proportional to the number of upvotes, and no reward can be awarded after 30 days. The number of votes that a user can cast differs according to the User Score. In order to

provide reliable and quality content to patients, content is displayed in order based on the upvote/downvote count.

1.2.3. Patient Association

Humanscape allows patient associations to register and conduct various activities for its operation. With the exception of some large-scale patient associations, it is difficult for patient associations to make sufficient investments in online infrastructure such as websites, as they generally operate with membership fees and donations. In addition, patients were limited to share their information with certain patient associations only, which resulted in a lack of online channels to share such information, since the information was shared mostly at offline meetings. Humanscape aims to meet patients' needs for online activities, by providing online community platforms organized by disease. Furthermore, Humanscape allows HD obtained through community activities to be donated to donation events organized by patient associations so as to encourage donations.

1.2.4. Institutions

Institutions registered on Humanscape after a qualification process can create an official username. Institutions can upload various news and information, and post official replies. For example, a pharmaceutical company can post its latest news on the bulletin board for its products, or reply to an inquiry about possible side effects. Also, institutions can hold events using HP, such as the recruitment of subjects for clinical trials and post marketing surveillance for targeted patients. HP paid by institutions for such events are given to patients after discounting some of the advertising costs incurred during the recruitment process. Lastly, institutions may support patient associations or participate in donation events using HP.

1.2.5. Qualification Process for Organization

Organizations such as patient associations and institutions may request registration as an organization in a Humanscape community and be approved according to a qualification process. Verified organizations may conduct additional activities according to their qualification, as described previously.

In Humanscape, patient associations and institutions play a vital role in improving the quality of the community and developing the ecosystem, and thus the participation of organizations is vital. During its early stage, Humanscape will organize its ecosystem to manage the inflow and verification of these organizations' qualification. Later, a qualification system will be introduced so that the process is conducted automatically.

The qualification process is as follows.

First, applicants who wish to verify qualifications can request verification of their qualifications by submitting documentary evidence. At this stage, a certain amount of HP is used but some of it is returned once the qualification gets approved at the final stage. However, if disapproved, the HP gets lost. When the request for verification is made, the verifier undertakes verification. The person who first undertakes the verification becomes the verifier of that particular request. The verifier must use a part of his or her HP as a guarantee for verification. If the verifier's result aligns with the final result for approval, the verifier receives the additional HP as well as HP provided as a guarantee. But if the results do not align, the verifier loses the HP provided as a guarantee. With the completion of verification by the verifier, the final assessment for the approval of the qualification begins, and the process is completed after this stage. Deliberators must also use HP as a guarantee and if their deliberation aligns with the final result of deliberation, the HP used as a guarantee is returned along with additional HP.

1.2.6. Donations

Humanscape aims to help patients to improve their health in various ways through community activities. One of these ways involves the introduction of a donation system. Patient associations, whose purpose is to support patients, are non-profit organizations that operate with membership fees and donations. There are many ways for individual users to support their own patient association, but financial contributions will serve as a foundation for patient associations to further support their patients. Humanscape awards HD to users who actively perform activities such as providing health-related information, allowing the user to donate financial support to desired patient associations.

Donation Process

Users can donate some of the rewards given for content. When a donation event is designated, the HD earned for content is provided to the donation event. When a donation event has not been designated, the user can select an event to donate to through a donation channel and give some of the HD holding to the selected event. The user obtains donation points in proportion to

the donated HD, which is accumulated and displayed on the user's profile. Patient associations that created the relevant donation event can convert HD to HUM according to the type of the event, which may then be used for the original purpose of the donation.

Organization of a Donation Event

Donation events can be generated by the administrator account of a patient association. Creating a donation event requires information such as organization information, the donation type, project introduction, fundraising period, fundraising goal and donation usage plan. In order to create a donation event, a patient association must be registered with more than 30 members, and the Activity Index of the group members must be above a certain level. When the administrator account creates a donation event, the donation event is finally registered on the donation channel through a vote within the patient association. The vote is determined when the Activity Index of the voters exceeds 50 percent of the Activity Index of total members of the patient association.

2. Usecases

2.1. Private Sector

Targeted Advertising

Targeted advertising is currently one of the most general and effective methods of online advertising. Some of the world's leading IT companies such as Google and Facebook have grown to their current scale based on earnings from targeted advertising. Humanscape aims to provide a targeted advertising solution that designates a target group for advertising based on patient-recorded health information to display or induce clicks on ads. This method of advertisement will be favored by various clients such as pharmaceutical companies, insurance companies and health supplement foods sellers. As the target is a patient group formed around healthcare and medical topics, advertisements tailored for such topics are expected to be more effective than in other channels.

Targeted advertisements are charged fees that contribute toward the operation of the Humanscape Community. HP paid by clients for targeted advertising is added to the Humanscape pool, and can be used to reward patients with HP when they record their health information, contributing to the sustainability of the ecosystem. Later, the margin of inflation may be partially set aside for operation funds, instead of charging advertising fees.

Recruitments for Clinical Trials

Clinical studies are based on people's participation in new diagnostic, preventive, and therapeutic methods. The global clinical research market is valued at 40 billion dollars as of 2016 [15] and it is also estimated that 13% of total clinical research cost is used for patient recruitment [16]. In this context, the Humanscape community can bring about the following cost reduction effects:

First, using health information accumulated in Humanscape can reduce the cost of recruiting clinical research subjects. Recruiters can quickly screen patients who are suitable for clinical studies based on the patient's recorded health information. Patients are more likely to respond positively because they are asked for clinical studies that are closely related to their current health status. According to the survey by pharmaceutical companies and clinical agencies, 80% of respondents reported that online community or patient network is overwhelmingly effective

in mass recruitment compared to other methods such as media advertisement or posters in hospitals.[17].

These patient group networks are similar in character to online health communities. Patientslikeme, for example, has signed with inVentiv Health [18] for effective patient recruitment and has affiliated with government agencies like clinicaltrials.gov[19] in order to accelerate clinical research. According to the report issued by the Tufts Center for the Study of Drug Development, 37% of the online recruiters for clinical research failed to recruit a sufficient number of patients, 11% did not register a single patient, revealing a problem of low participation in clinical studies [20]. Therefore, Humanscape community could be a good alternative as to encouraging patient participation in clinical research.

In addition, when people are recruited from Humanscape, the rate of dropout will be lowered and the cost will be reduced. Even if patients agreed to participate in clinical studies, they are likely to drop out in the middle of the process if the research venue is far away from the patient's house or workplace or if he/she cannot fit into the schedule. With the fact that about 30% of patients give up the research halfway, appropriate compensation and information on individual's health status proved to be effective for complete participation in clinical trials[20]. Humanscape can reduce the cost of dropout by offering appropriate compensation and negotiating participation schedule in real time.

Post Market Surveillance(PMS)

Post market surveillance (PMS) is the safety assessment of newly launched medicines or medical devices [21]. Because it is not possible to predict all side effects that may occur during use of a medicine with pre-approval research conducted on a limited number of patients, the FDA undertakes PMS and risk assessment programs[22]. More specifically, PMS is conducted to review safety issues in closer detail and side effects that were not pre-identified by collecting data on side effects and unintended effects from an unidentified group of patients. Types of data used in PMS include data voluntarily submitted and recorded by patients and the patient registry. In Humanscape, there are patients who suffer from many different diseases. These patients record treatment effects and the side effects of their medications. Therefore, data necessary for PMS gets accumulated in Humanscape, which can then be put to use actively for PMS. Furthermore, by initiating surveys on patient groups within Humanscape, more standardized information necessary for monitoring can be selectively collected. In the US, the budget for PMS is, on average, 2.16 million dollars per case (about 2.2 billion won) with the total cost amounting to 1.02 billion dollars (about 11 trillion won) [23]. Domestic pharmaceutical companies have also been making a significant investment in PMS. Currently, pharmaceutical companies contact individual hospitals and other medical

institutions for PMS but Humanscape can establish itself as the platform where high-quality information can be provided.

One problem with PMS is that it minimizes the observation period and the number of test participants in order to receive approval for the release of new medicines as quickly as possible [24]. In other words, while the assessment of treatment effects of the medicine can take place effectively during PMS, it is difficult to completely guarantee the safety of the medicine. In this regard, Humanscape can help overcome the practical limitations of PMS with data from patients accumulated over a long period of time.

E-commerce

E-commerce is a service for trading products that assist the treatment of diseases, such as healthcare devices, medical devices, health supplement foods and over-the-counter (OTC) drugs. Relevant products are automatically selected and recommended based on personal symptom records submitted by patients, and useful product information is provided to help patients make informed purchases. In addition, patients can share their reviews of purchased products with the community and search for products that they are interested in. In other words, patients are able to easily and conveniently purchase products that are most relevant to their health condition and disease, thereby effectively improving their own health. Furthermore, as E-commerce is a service linked with the blockchain-based Humanscape Community, brokerage fees can be reduced, helping patients toward reasonable consumption, and guaranteeing greater transparency compared with other commerce services.

Insurance Solicitation and Sales

The Internet has emerged as the most important marketing channel for the sale of insurance products. Insurance companies can lower their operating costs with the internet [25], which is the most cost-effective channel, and consumers can benefit from lower premiums. According to a research study by Bain&Company in 2015, 8% of life insurance and 10% of property and casualty insurance worldwide is being sold online, and this is expected to increase to 15% and 23% within 3-5 years, respectively [26].

Keeping pace with such trends, Humanscape can offer more advanced types of online insurance products to patients. More specifically, patients can not only compare and analyze diverse insurance products at a single glance but also receive recommendations for the most suitable insurance based on their personal information. Furthermore, the platform helps patients to make decisions by surveying the insurance products purchased by people with similar diseases and soliciting their feedback.

In addition, patients can benefit from lower premiums through IoT data that can be acquired by linking the digital wellness platform and the Humanscape community. The digital wellness

platform that aims to promote health in all aspects of life with digital technology is used by many people as it can be accessed easily regardless of time or space concerns. Humanscape connects smart phones and wearable devices to the platform and provides services so that users can set individual health targets and achieve them. In particular, for patients with chronic diseases, the community can serve as an opportunity to promote healthy lifestyles via daily activities by encouraging healthy habits suitable for the treatment of specific diseases, separately from hospital or medication treatment. If patients regain their health, their medical expenses decrease. As insurance companies lower premiums accordingly, patients and insurance companies both gain economic benefits.

2.2. Public Sector

Improving the Health of Patients in Developing Countries

The blockchain-based Humanscape community may help narrow the healthcare gap between developed and developing countries and improve the health of people in developing countries. Compared to those of advanced nations benefiting from sophisticated healthcare services, many countries in Africa, South America and Asia still suffer from epidemics, starvation and water pollution. In Indonesia, for example, children under the age of five die from various illnesses every four minutes[27]. In Africa, the spread of infectious diseases such as Ebola virus and HIV/AIDS is not adequately controlled. According to the World Health Organization (WHO), people from developing countries account for one third (30.7 million) of total worldwide deaths caused by chronic diseases such as diabetes and cancer, and among them, 48 percent are 70 years old or younger [28].

International agencies and organizations are investing vast amounts of money in programs to support drugs, medical supplies and promote the health of the people of developing countries [29].

Despite the assistance and continued advances in the medical treatment of diseases over the past century, developing countries still suffer from a high mortality rate due to poor health facilities and a lack of pharmaceuticals.

Since medical problems in developing countries derive from information asymmetry, low access, monopoly of health data by the authorities[30] and lack of medical infrastructure[31], however, such investment is but a temporary measure to delay the deterioration of people's health rather than a fundamental solution.

In this context, the Humanscape community helps address the imbalance in health information, problem of expert shortage issues and prevent people from being deteriorated by wrong treatment. Like the case in Zambia, where the youth HIV/AIDS transmission rate is high, the AIDS self-diagnosis rate has increased from 12% to 40% after acquiring relevant information[32].

Therefore, the Humanscape Community helps patients in developing countries to share information on their diseases. This allows information on infectious diseases to be obtained quickly to reduce damage and secure access to medical care.

Public Health Crisis

Continuous monitoring of health information updated in Humanscape makes it possible to detect health issues within the population group that may prevent health risks and minimize damage. Based on the flow of data on the symptoms of specific diseases, we can capture the signs of infectious diseases. In addition, the spread of the disease can be prevented by analyzing the infection route based on the personal symptom record of the suspected infectee.

Comparative Effectiveness Research

Healthcare data in Humanscape can be used for the comparative effectiveness research to overcome limitations of existing clinical studies and reduce medical expenditures.

A regulatory nature of current clinical studies shortens the follow-up period and fails in reflecting actual clinical field. A way to solve these problems is to conduct a comparative effectiveness research that identifies the most effective treatments by comparing the various treatments and effects of the same disease. The use of health information in Humanscape allows us to compare and analyze the effects of treatment among patients with the same disease undergoing different procedures, thereby enabling them to compare different therapies and find the most effective method.

In this way, health information that is shared and accumulated by Humanscape can be effectively used for data-based comparative effectiveness studies, and helps consumers, clinicians, buyers, and policymakers to make decisions to improve healthcare at the individual or group level.

2.3. Research Sector

Rare and Incurable Diseases

Voluntary health information from patients may contribute in the study of rare and incurable diseases that are difficult to obtain data samples. For example, Patientslikeme published a paper in Nature Biotechnology in 2011. Patientslikeme refuted a paper [33] that claimed Lithium could slow the progression of ALS published at the National Academy of Sciences (PNAS) in 2008. Patientslikeme tracked the experience of 149 patients for a year to prove ineffectiveness of lithium [34]. What is interesting is the number of patients who voluntarily offered their health data in Patientslikeme was higher than the number of patients participating in PNAS studies using traditional clinical testing methods [35]. In the PNAS study, lithium was administered only to 16 patients out of 44, whereas in Patientslikeme, 348 of 4,318 ALS patients were reportedly taking Lithium. Among those 348 patients, a total of 149 patients who met a certain condition was analyzed for data. Relevant data accumulated in Humanscape will also be available to take part in the research of rare and incurable diseases

Development of New Medicines and Clinical Research

It usually requires more than 10 years and over one trillion won of investment to find a potential medicinal substance and to pass clinical research trials for developing a new medicine [36]. Because of the astronomical costs and time involved, this process has mainly been confined to global pharmaceutical companies with sufficient capital and while the development of new medicines for rare or incurable diseases was delayed. In order to resolve this issue, diverse methods to change the paradigm of the development of new medicines are being designed and one such method is utilizing artificial intelligence based on clinical data provided by patients. Using AI could significantly reduce the cost and time required to find a new medicinal substance via analysis of big data on health and medical services offered to patients [37]. In this regard, incidence of side effects or the medical history of patients accumulated in Humanscape could be actively utilized. In addition, building on the data provided by patients, candidate medicinal substances for new tailored medicines can be developed and increase the success rate of clinical trials by efficiently connecting with patients.

3. Technical Features

3.1. Smart Media Token(SMT)

Smart Media Token (SMT) is a Steem-based blockchain token protocol that enables the creation and release of token.

There are well-known token protocols such as Ethereum(ERC-20), NEO and Counterparty. However, because of the transaction costs, processing speed and the hierarchical relationship of private keys created for financial institutions, - not for social media - it is hard to provide a desirable user experience in a community service led by the content[38]. Therefore, Humanscape adopts SMT as a token protocol and tries to solve the existing problems by utilizing the proprietary characteristics of the widely recognized steem blockchain.

3.2. Performance

The concept presented above is proved through Steemit. Steemit is a social network platform based on a database of Steem blockchain. It is similar to a blog site such as reddit.com, except for the financial rewards and text-storage in blockchain. Steem blockchain is design to estimate the contribution of contents creators and distribute rewards through the collective intelligence in the platform. Concept of this Steem blockchain is called Proof-of-Brain (PoB). PoB makes it possible to create steadily growing community by distributing tokens appropriately and let users contribute to Steem with high-value contents.

Consensus algorithm of Steem is Delegated Proof of Stake (DPoS). Witnesses are selected by Steem token holders and they creates the block. Only selected witnesses can quickly generate blocks by taking part in block generation.

The Steem network is based on Graphene, which is known to withstand more than 1,000 transactions per second. Graphene, which is also used in Bitshares and EOS, has been successfully run in the Steemit service, resulting in more transactions through Steem than the sum of the number of transactions processed in Bitcoin and Ethereum [39].

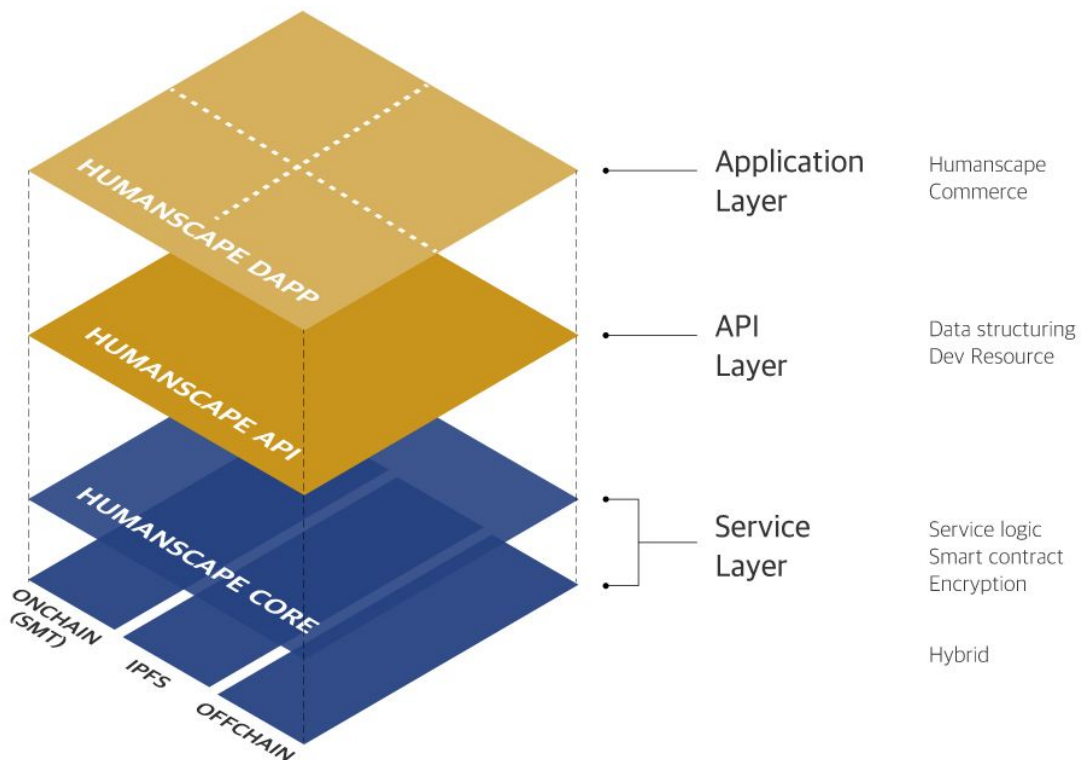
In this technological concept, Steemit is almost a perfect example and proven to be feasible.

3.3. Smart Contract

Smart Contract is a technology that allows stakeholders to conclude and implement contracts without intermediaries using a blockchain based on the technical characteristics of a distributed ledger. In Humanscape, rewards are given when various user-created content (videos, texts, etc.) is evaluated as meaningful data and receives an upvote. Smart Contract is used to ensure the reliability of data trading during the implementation of such payment contracts.

In addition, Smart Contract is used for various types of in-service trading, verification of qualification, and implementation of other service logic. Smart Contract is based on SMT, and the data collection and operations that occur outside the blockchain are executed through Oracle.

3.4. Hierarchical Structure of Service



3.4.1 Service Layer

Service Layer is an area where Humanscape's core logic is executed and core data is saved. Service Layer is comprised of data storage (blockchain, InterPlanetary File System (IPFS) and hybrid) and other service logics. Patient data entering from the API layer is recorded on the blockchain after implementing Smart Contract in Humanscape's core.

Data handled in Humanscape can mainly be categorized into personal information, personal health data and content shared with the community. Personal information and personal health data are comprised of sensitive information that must be kept confidential or valuable data that constitute patients' assets as required by institutions, and are therefore saved encrypted in dispersed storage areas to prevent public exposure. In order to specify the ownership of saved data, a hash value is saved on a STEEM blockchain and mapped to prevent forgery or tampering in outside areas including Humanscape. Content data can include large-volume data such as images and videos, and is stored in external storage such as AWS S3 to ensure the effective management of resources. Later, IPFS will be used to implement decentralization in more areas.

The aforementioned data defines various activities in the Humanscape ecosystem (posting, commenting, voting, rewarding, verifying the qualification of patient associations and institutions, and donating tokens) as Smart Contract, based on which users give out tokens as rewards or payments.

3.4.2 API Layer

The API layer is comprised of API for the storage and search of patient data and the development of services. The data recorded by patients is categorized through the API layer and gains greater value, and patients can select any desired data through conditional search.

In the long term, there are plans to analyze and convert qualitative and unmeasurable data into meaningful data, in addition to qualitative and measurable data among personal symptom records submitted by patients.

Furthermore, the Humanscape API is designed to be available for use by third parties to allow their services to be linked with Humanscape or to allow the development of new services linked with Humanscape.

3.4.3 Application Layer

The application layer provides web and mobile applications to ensure easy access for patients. The application layer provides optimal UX/UI, through which patients can use their personal symptom records more conveniently, and a community environment where users can share information through communication with other users and naturally benefit from emotional support. Also, the application layer provides various services such as donation and commerce services to allow the meaningful usage of HP issued in the community ecosystem.

4. Token Events

4.1. Summary

- HUM Token
- HUM is a meta token of SMT. Initially, token conversion event was scheduled for existing token holders after issuing ERC20 tokens on Ethereum and Steem-based tokens through SMT in the near future.
- Total issue volume : 2,500,000,000 HUM
- Standard price : 1 HUM = \$ 0.01

4.2. Allocation



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7. Roadmap

2016

- 1Q** Company Incorporation - Seoul, Korea
- 2Q** Development and Launch of 'Beautycare', a mobile application for aftercare services
- 3Q** Angel Investment Promotion from 'Mashup Angels' (Taek-Kyung Lee, CEO and Founder of 'Daum')
- 4Q** Client Usage Agreement with 'Dream Medical Group' and 'DA Plastic Surgery'

2017

- 1Q** Development and Beta test of 'Helen', Mobile Medical Assistant
- 2Q** Official Launch of 'Helen'
- 3Q** Follow-up Investment Promotion from 'Magellan Technology Investment(VC)'
- 4Q** Acquisition of 10,000 PHR Data from 'Beautycare' and 'Helen'
Concept Building of 'Humanscape', a Health Information Ecosystem

2018

- 1Q** Whitepaper Publication
Company Incorporation - Hongkong
- 2Q** 'Humanscape' MVP Development Begins
Pre-sale 1st, 2nd and 3rd round
- 3Q** Main Sale
Test Group(Patients/Health Professionals) Building
Indonesia Incorporation / Organization PoC
- 4Q** Exchange Listing
MVP Release
Alpha Test
PoC with Global Pharmaceutical Companies and Contract Research Institutes

2019

- 1Q** Closed Beta Test
Soft Launch (South Korea, Indonesia)
Business Model Validation
- 2Q** Main Launch (South Korea, Indonesia)

8. Others

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