Chapter 1 - II

"Osekkai" Digital Platform Controlled Health Management

: A System Design Approach for New Healthcare Systems

Masako Toriya*

Japan's healthcare[1] system faces significant challenges in the wake of its aging population and evolving healthcare needs. This chapter explores the role of digital healthcare, specifically the Osekkai Digital Platform (DPF) system, in addressing these challenges.

1 Challenges in Japan's Healthcare System and Emerging Opportunities in Digital Healthcare

Japan is currently facing an unprecedented challenge due to its rapidly aging population. By 2040, population aged 65 and above is projected to reach approximately 40 million[2]. Simultaneously, declining birth rates are expected to significantly reduce the working-age population. This demographic shift raises concerns about increasing social security costs.

Enhancing healthy life expectancies is crucial in response to these demographic changes. Healthy life expectancy is defined as a period during which individuals lead their daily lives without health-related restrictions. Introduced by the World Health Organization (WHO) in 2000, the concept has garnered global attention. However, Japanese people currently face prolonged periods of "unhealthy life," necessitating a

* **Masako TORIYA:** Associate Professor at the Institute of Science Tokyo, School of Environment and Society., toriya.m.8d28@m.isct.ac.jp

1 Health care can be defined in several ways and often implies a wide range of "health management," including medical and long-term care. The Japan Association of Health Care Initiative defines health care (simplified version) as "the creation of new value through cross-industry support to achieve freedom from illness and mental and physical infirmity by raising one's own "zest for living" and "various activities for this purpose." According to the report's detailed version, in total 29 health care-related fields in the three areas of medicine, health, and daily life, including medical care, pharmaceuticals, home care, and care for the elderly, among others are the envisaged health care-related fields that need to be considered. A clear definition of health care is neither provided by the Ministry of International Trade and Industry (MITI) nor the Ministry of Health, Labour and Welfare (MHLW), which implies that the scope of health care is often interpreted as mentioned above. However, in this working paper, we distinguish between those covered by the existing medical insurance and long-term care insurance systems and various other measures and devices related to health maintenance and position the latter as "health care."

2 National Institute of Population and Social Security Research. (2017) Population Projections for Japan (2016-2065): Summary. Accessed February 8, 2024. https://www.ipss.go.jp/pp-zenkoku/e/zenkoku_e2017/pp_zenkoku2017e_gaiyou.html#e_zenkoku_II_A-2

focus on individuals' health management to improve overall life expectancy.

Despite the need for enhanced health management, structural issues within Japan's healthcare system have hampered the growth of preventive healthcare. Japan's universal health insurance system, with its lower out-of-pocket costs and a freedom to choose medical institutions[3,4], has inadvertently resulted in low preventive healthcare awareness[5]. Consequently, expanding the preventive healthcare service market in such an environment becomes a daunting task.

In contrast, United States faces different challenges. Medicare is a federal health insurance program that covers older adults, people with disabilities, and individuals with End-Stage Renal Disease (ESRD). High healthcare costs for other population segments have resulted in affordability issues[6], creating a substantial market for preventive healthcare services. Hence, the United States market is driven by heightened awareness and the need for affordable care.

Although Japan's healthcare system is accessible but the rising healthcare costs have become a major cause of concern. A growing need is felt for proactive health behaviors and preventive healthcare measures to mitigate these issues. Thus, we investigated and analyzed the current situation and issues in the Japanese healthcare market and new technologies to explore effective approaches. This includes completely new services and social systems in which preventive healthcare can be enhanced, going beyond the confines of traditional medical and long-term care insurance frameworks. Based on information on existing health care services obtained through research and analysis of a wide range of health care fields, we aimed to generate new ideas that departed from those typical services.

Recently, digital technology has garnered significant attention in the healthcare sector. Digital technologies offer low cost, high speed processing, and accessible data integration with other systems, enabling the seamless provision of high-quality healthcare services with immediate response and personalization. However, in Japan's current landscape, no mega-DPF exists in the healthcare field with various service providers offering individualized services to users[7]. Consequently, individuals' health data are scattered across service providers. While these service providers aspire to evolve into major DPFs and dominate the market, the market is crowded with a multitude of small-to medium-sized service providers resulting in stagnation and a lack of data integration. This coexistence impedes the flow and integration of data among the

3 Japan Medical Association website https://www.med.or.jp/people/info/kaifo/compare/

4 Shimizu Takeshi. (1999). Iryou keizaiteki sokumen kara mita Nihon no iryou [Medical aspects of Japan's healthcare from an economic perspective]. Nihon Mibyou System Gakkai Zasshi [Journal of the Japan Society of Metabolic Syndrome], 5(1), p.96-100.

5 Kamikoube Yasuko. (2021). Kokunai herusu kea saabisu doutai to PHR rikatsuyou ni tsuite [Trends in domestic healthcare services and the utilization of PHRs]. JIPDEC Denshi Jouhou Rikatsuyou Kenkyuubu Repooto 2021 [JIPDEC Electronic Information Utilization Research Department Report 2021]. Retrieved from https://www.jipdec.or.jp/library/report/u71kba0000017at2-att/20210706.pdf

6 JETRO Chousa-bu Beishuuka, JETRO New York Jimusho. (2021). Beikoku ni okeru iryou hoken seido no gaiyou [Overview of the healthcare insurance system in the United States]. P.7. Retrieved from https://www.jetro.go.jp/ext_images/_Reports/01/01168598c658e4b0/20210019.pdf

7 Kabushiki-gaisha Nihon Sougou Kenkyuujyo [The Japan Research Institute, United] Sentan Gijutsu Rabo, Kabushiki-gaisha Mitsui Sumitomo Finansharu Gurūpu, Shirikon Barē Dejitaru Inobēshon Rabo. (2021). Dejitaru de henkou suru Beikoku no 'The Healthy Company' ~ Nichibei kenkou keiei no hikaku kara kousatsu suru waga kuni no kadai ~ [The transformation of the United States' 'The Healthy Company' in the digital age: Reflecting on Japan's challenges through a comparison of Japanese and American health management]. P.28.

service providers and undermines the market's overall innovation and efficiency. Consequently, when users utilize multiple services (apps), they have to self-manage their data, which is burdensome. Data interoperability is essential for enabling the seamless use of multiple services, but currently, such interoperability is not well established in Japan[8]. For instance, when analyzing data from an app monitoring sleep patterns and another app assessing stress, operated by two different companies, a potentiality exists to accurately capture the user's mental state. However, in the absence of collaboration between these two companies, users may fail to reap the benefits of an integration. A major factor hindering collaboration is the lack of data standardization for a comprehensive handling of the data. In addition, the rules, guidelines, and third-party certification mechanisms have not been sufficiently established for businesses that deal with individuals' vital data measured on a daily basis in addition to medical and health examination information.

In contrast, in the United States, data integration through Application Programming Interface (API)s, driven primarily by mega-DPFs such as Apple and Google has witnessed considerable progress. Users in the United States have full authority over their health data and can easily share it with hospitals and service providers through apps, allowing them to aggregate and manage multiple data sources[9]. Although, data integration in Japan is less common compared to the US, efforts are underway to promote data integration in healthcare. For example, the General Incorporated Association PHR Council[10] has been conducting activities to promote the adoption of Personal Health Records (PHR). Data standardization plans encompass standardizing data exchange formats, which focus on evidence-based data related to lifestyle diseases, such as weight, blood pressure, step count, HbA1c (Hemoglobin A1c), information related to emergency medication, and critical allergy information[11]. Furthermore, the Ministry of Health, Labour and Welfare (MHLW) is promoting the use of "HL7 FHIR (Fast Healthcare Interoperability Resources)" as a standard framework. Compliance with the HL7 FHIR is stated explicitly for specific health checkups, health examination data, discharge summaries, and patient medical information-sharing documents. In future, with the establishment of an information exchange infrastructure through Open FHIR, not only will data exchange between hospitals become more efficient, but its primary use through Personal Health Records (PHRs) on individuals' mobile phones and secondary use through data outsourcing to the "Personal Data Trust Banks" will become

8 Nihon Keizai Dantai Rengoukai [Japan Business Federation]. (2020, July 14). Society 5.0 jidai no herusukea II ~ DX ni yoru COVID-19 taiou to sono saki no mirai ~ [Healthcare in the era of Society 5.0 II – The future beyond COVID-19 response through digital transformation]. Retrieved from https://www.keidanren.or.jp/policy/2020/062_honbun.pdf

9 Kabushiki-gaisha Nihon Sougou Kenkyuujyo [The Japan Research Institute, United] Sentan Gijutsu Rabo, Kabushiki-gaisha Mitsui Sumitomo Finansharu Gurūpu, Shirikon Barē Dejitaru Inobēshon Rabo. (2021). Dejitaru de henkou suru Beikoku no 'The Healthy Company' ~ Nichibei kenkou keiei no hikaku kara kousatsu suru waga kuni no kadai ~ [The transformation of the United States' 'The Healthy Company' in the digital age: Reflecting on Japan's challenges through a comparison of Japanese and American health management]. p.28. (previously mentioned material)

10 General Incorporated Association PHR Council. https://phr.or.jp. An organization that conducts research and studies for the proper promotion of Personal Health Records (PHR), establishes guidelines and certification systems, and engages in policy advocacy activities. The PHR Council, with 13 municipalities and 45 companies as members, focuses on a broader definition of PHR, not just as records accessible to patients by healthcare providers but as a system that leverages data related to medical care, nursing care, and health (Person Generated Data) under the individual's discretion.

11 Research Project Keio 2040, the Extending Healthy Life Expectancy Project Team. (2023). Proposal for a Behavioral Change Digital Platform to Extend Healthy Life Expectancy Towards 2040. p. 30. Retrieved from https://www.kgri.keio.ac.jp/docs/L0120230905_full.pdf

rapid and convenient. As Japan grapples with these multifaceted healthcare challenges, the integration of digital healthcare solutions has emerged pivotal. This approach not only addresses the immediate needs of its aging population but also establishes the foundation for a more interconnected and efficient healthcare system[12].

2 Digital Healthcare Adoption Challenges

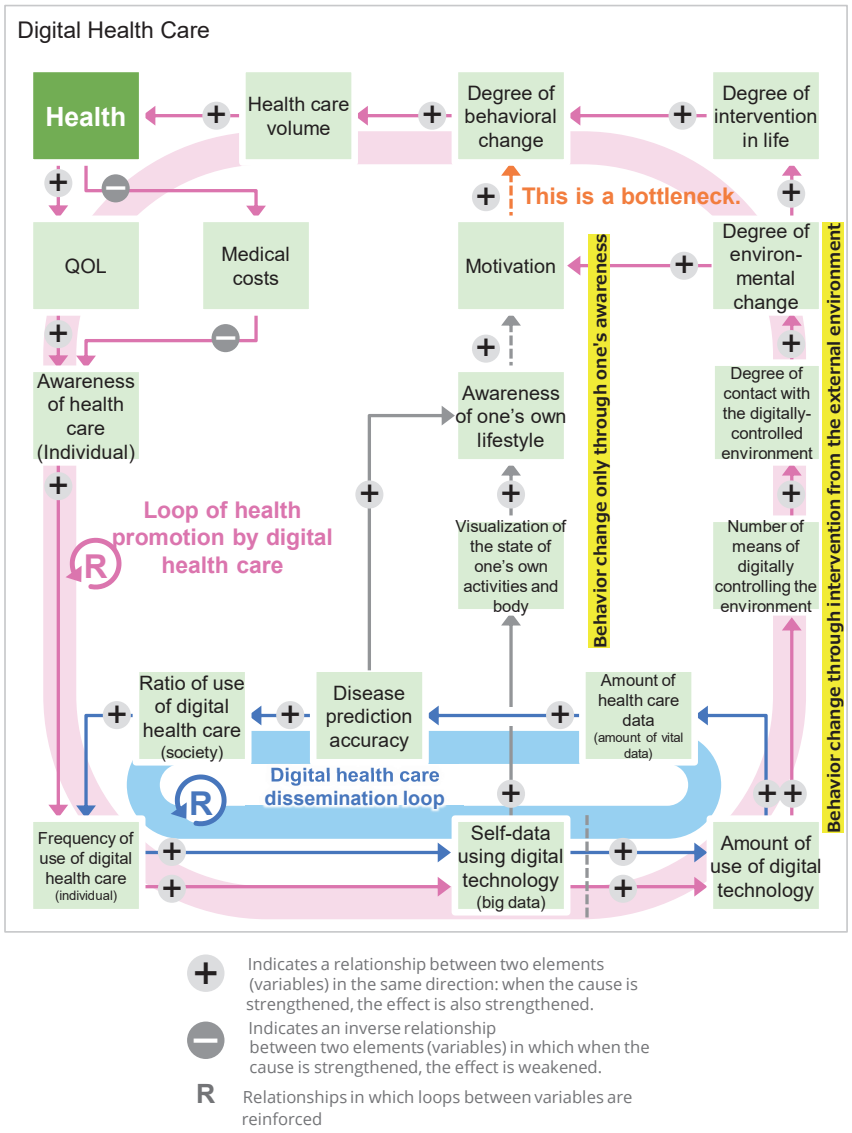
It is significant to understand whether it is possible to achieve digital healthcare, along with health maintenance and disease prevention goals, solely by addressing data management challenges, including data standardization and establishment of rules for data interoperability. Despite the availability of digital healthcare services, many individuals still face challenges in managing their health status independently. A major factor contributing to the limited market expansion of digital healthcare services is its inability to fully deliver health benefits.

Utilizing a systems thinking approach, we identified a critical bottleneck in behavior change for enhancing user health, which is majorly dependent on individual initiatives and self-motivation (Figure 1). Even if digital healthcare services are disseminated, they will not directly result in improved health conditions. For example, although numerous services that monitor health status through wearable devices exist, they require users to proactively change their lifestyle to take advantage of them, such as by increasing physical activity and modifying their diet. This underscores the importance for individuals to take initiative in their personal health improvement journey. In reality, however, few people possess the strong will required to change lifestyle habits. Hence, we wondered how it would be possible to promote behavior change without relying solely on individual motivation. We acknowledged that in addition to changes in users' motivation, it is equally important to foster environmental changes that promote behavior change. This entails digitally controlling one's living environment and providing motivation and intervention to facilitate behavioral change. For instance, the entry of e-commerce platforms into the digital healthcare market and their integration with information on individual preferences and health information may lead to a rapid provision of personalized healthcare services tailored to each individual's lifestyle and health condition, thereby accelerating the creation of personalized living environments.

Furthermore, as the Internet of Things (IoT) expands, the integration of physical objects in our surroundings with the Internet will become more widespread. This will enable the digital management and personalization of living environments, such as homes and offices, which will further intervene in our actions. Environmental interventions can lead to increased behavioral changes in health, including exercise, ultimately contributing to health promotion. The quantitative monitoring of health promotion is expected to raise awareness on healthcare resulting in an increased utilization of digital healthcare services.

12 Research Project Keio 2040, the Extending Healthy Life Expectancy Project Team. (2023). Same as above. p. 32.

Figure 1: Bottleneck for Digital Health Care to Improve Health



(The figure is adapted from the working paper by Research Project[13] Keio 2040, the Extending Healthy Life Expectancy Project Team)

3 Proposal on "Osekkai" Digital Healthcare System

Therefore, based on the aforementioned considerations, we propose a new system that utilizes digital technology for proactive intervention in users' living environments for promotion of behavioral changes for better health and extension of a healthy life expectancy. This goes beyond merely influencing individ-

13 Research Project Keio 2040, the Extending Healthy Life Expectancy Project Team. (2023). Proposal for a Behavioral Change Digital Platform to Extend Healthy Life Expectancy Towards 2040. p. 27. Retrieved from https://www.kgri.keio.ac.jp/docs/L0120230905_full.pdf

uals' through reminders and encouragement. It actively intervenes in the user's physical living environment, including changes in the surroundings and attitudes of people in the user's social circle, to stimulate behavior and lifestyle changes—an "Osekkai" form of support. The Japanese term "Osekkai" carries a mix of negative and positive implications. Although, it can indicate unwelcome meddling depending on its context and timing, in this chapter we refer to it as a benevolent step to assist someone. Such intervention requires a thorough comprehension of the individual's situation and needs, and involves resolving not only issues considered significant by the individual, but also those not yet considered important. Various use cases can be envisaged; for instance, in an office setting, the system can remind someone sitting for a long time to take a stretch break. Another example could be the automatic adjustment of a food delivery order to a low-calorie meal for users following dietary restrictions.

To provide appropriate "Osekkai" interventions, it is significant for the system to monitor the user's health status and lifestyle behaviors, integrate and analyze the acquired data, and determine suitable intervention services at the appropriate time. Examples of environmental interventions include a system that locks a computer every hour, requiring push-ups to unlock it—a more direct form of intervention[14]. In a subtler intervention, a university cafeteria increased the number of vegetarian meal options from one of four to two, which in turn resulted in the purchase of vegetarian meals among individuals who had not previously chosen them[15].

In addition to the physical environmental changes outlined above, it is also possible to positively influence the social environment. This can be achieved by encouraging people in the users' social circle to engage in supportive behaviors, thereby creating a more conducive atmosphere for positive interactions and well-being. For instance, a system that detects stress due to excessive workload in office could notify supervisors or colleagues, leading to a reduced or redistributed workload and an enhanced working environment. An effective utilization of the aforementioned system can result in natural changes in the surrounding environment, which may assist in resolving health-related issues, such as diet, exercise, overwork, and stress, with minimal effort. As the "Osekkai" behavior change system evolves, it has the potential to intervene in every aspect of a user's life for achieve various objectives. Additionally, it can be utilized as a platform for providing appropriate support to individuals with disabilities and other specific needs.

As detailed above, although experiments and individual services which involve interventions in living environments are currently available, a comprehensive DPF that connects various monitoring and interventions is lacking in implementation. Nevertheless, it is likely that a potential DPF with the capability of physical interventions in our behaviors and action control will emerge sooner than later.

14 Raspberry Pi. (2022, April 26). Unlock your PC with a pushup or two. Raspberry Pi website. Accessed November 30, 2023. https://www.raspberrypi.com/news/unlock-your-pc-with-a-pushup-or-two/

15 Emma E. Garnett, Andrew Balmford, Chris Sandbrook, Theresa M. Marteau. Impact of increasing vegetarian availability on meal selection and sales in cafeterias. Proc Natl Acad Sci USA. 2019. 116(42) 20923–20929. https://doi.org/10.1073/pnas.1907207116

4 Risk Management Associated with "Osekkai" Digital Healthcare System

While DPFs for controlling physical actions can potentially promote behavioral changes in challenging health-related activities, DPFs that affect purchasing and viewing behaviors may exert a stronger influence in comparison to existing ones. Therefore, it is crucial not only to prioritize personal data protection and security to safeguard users from third-party malice but also to establish mechanisms that prevent control beyond users' own decision-making boundaries.

In contemplating the potential impact of "Osekkai" DPFs' on individuals, it is necessary to categorize the operation patterns. It is acknowledged that entities other than corporations can become DPF operators in the healthcare domain. An example of a local government taking the lead in the operation of a health-related DPF is the "MY CONDITION KOBE" initiative in Kobe. This initiative allows registered residents to record lifestyle data, such as steps taken, meals, and health examination results, which enables them to monitor their health information. It also awards health points that can be exchanged for benefits sponsored by local companies[16]. However, with local governments as the primary service providers, these services are usually restricted to residents within specific municipalities. This limitation hinders the ability to offer services across regions and poses challenges in their widespread adoption.

Another theoretical possibility is to connect the "Osekkai" DPF to "My Number Portal," an individual oriented government portal site primarily managed by the national government. This scenario does not result in disparities in the regional dissemination of services. Additionally, with the government as the managing entity, people's trust is fostered in personal data management, thus, the acceptability of use of personal information increases. However, this arrangement could also be viewed as a governmental tool for surveying citizens, potentially leading to opposition.

Further, it is significant to discuss issues, which might arise if "Osekkai" DPFs are operated by for-profit companies instead of the government. In addition to concerns about the reliability of user data management and utilization, there is an added risk of favoring specific intervention service providers who pay more, potentially directing users toward specific intervention services that they may not otherwise desire. In such cases, users may be induced to make purchase decisions for unwanted intervention services, necessitating governance mechanisms that serve as checks and balances. However, as mentioned previously, considering the unique characteristics of the Japanese healthcare market, where the possibility for individual service providers to connect is smaller, dominance by a mega DPF is highly unlikely. Thus, it is possible that dominant "Osekkai" DPFs may only emerge in a different form to the current one.

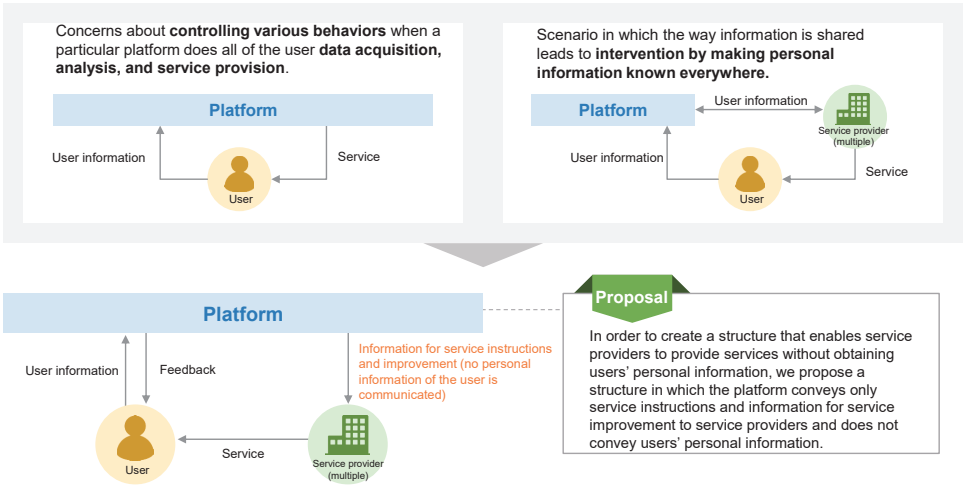
Alternatively, we propose a structure that connects users with multiple service providers offering health and behavior monitoring services (such as wearable-device-based heart rate and step tracking) and interven-

16 Kobe-shi. (2022, October 14). MY CONDITION KOBE no un'ei shūryō oyobi min'ei sābisu to shite no kongo no apuri sābisu no keizoku ni tsuite [About the termination of MY CONDITION KOBE operation and the continuation of the app service as a private service]. Kobe City website. Accessed November 30, 2023. https://www.city.kobe.lg.jp/a15830/kenko/phr/580610427145.html

tion services through a matching system. Initially, we assume that the DPF entity would directly monitor individuals' health and behavior. However, in planning pilot experiments for the "Osekkai" DPF with multiple health monitoring service providers, it is ascertained that these providers are hesitant to share data collected with their own devices, even with the "Osekkai" DPF, despite the potential business expansion from being connected to the DPF. Their reluctance likely stems from the need to obtain user consent for secondary data use and their desire to monopolize the data's technological value. Consequently, we explored methods by which health-monitoring service providers can utilize data acquired independently without sharing it externally. This led us to propose a structure where only the "meaning of health status," such as whether it warrants attention or requires urgent intervention, is provided to the platform.

Furthermore, if individual intervention service providers are to obtain detailed health status information from users and offer intervention services, the greater the number of service providers involved, the greater is the risk of user information dissemination into the wider world (as depicted in the upper right of Figure 2). In this scenario, numerous entities can access sensitive personal health data and users can be subjected to unsolicited interventions in various locations, including their homes, offices, and public spaces. Therefore, in addition to the "meaning of health status" framework, we propose a structure wherein the platform conveys service instructions and information for service improvement to intervention service providers without disclosing users' personal information (as illustrated in the lower part of Figure 2). This ensures that only the action instructions for providing service X to User A at a particular moment are conveyed to the intervention service provider by the DPF. To illustrate, in an office scenario, if User A is experiencing depressive symptoms owing to overwork, the system would only instruct the supervisor to urgently review the distribution of tasks without disclosing individual's physical and mental health status. Thus, in our proposal, we position the DPF at the center of the system and use contextually interpreted information to appropriately segregate users and service providers. Currently, we are collaborating with numerous universities and companies to conduct proof-of-concept experiments to verify the feasibility of this proposal.

Figure 2: Proposal for a Mechanism to Receive Intervention Services without Informing Service Providers of Personal Information



Although, the proposed structure mitigated the diffusion of personal information and domination by the DPF, ethical challenges persisted. The fundamental premise of our proposed "Osekkai" service is that the decision to use the intervention service is autonomous and based on users' own free will. Nevertheless, if interventions are conducted in a manner unbeknownst to the individual, can they still be considered a voluntary and autonomous choice? Moreover, even if all intervention histories are made visible, the genuinity of the autonomy guaranteed is questionable because many users may not thoroughly read the terms of use and provide their full consent. Furthermore, the design of websites that use cognitive biases to induce consent, referred to as dark patterns[17], may lead individuals to believe that they are making autonomous decisions when, in reality their decisions are induced, potentially infringing on their unconscious right to self-determination. It is crucial to avoid assuming that any form of intervention is automatically permissible simply because it is user-decided; maintaining user autonomy is essential in all aspects of DPF operation, especially because various decisions may be made discreetly, unbeknownst to the user.

Furthermore, suppose that a municipality or government offers this program as part of its public services. In this case, concerns may arise about the government's legitimacy to intervene in the actions of individuals, even though the service is used voluntarily. Thus, achieving societal consensus and trust is crucial for implementing such services at the community level. Therefore, in a future where "Osekkai" services become a reality on DPFs, it is important to proactive address and analyze the potential ethical challenges that may arise.

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17 Mathur A, Acar G, Friedman M, Lucherini E, Mayer J, Chetty M, Narayanan A. Dark Patterns at Scale: Findings from a Crawl of 11K Shopping Websites. Proc. ACM Hum.-Comput. Interact., Vol. 3, No. CSCW, Article 81. 2019.

18 Research Project Keio 2040, the Extending Healthy Life Expectancy Project Team. (2023) p.1-53. (previously mentioned material)