

Incorporating Technologies into Big Data-based Health and Welfare Policies

Oh Miae



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I

Introduction

I Introduction

The Fourth Industrial Revolution is understood, in Korea, as the sweeping set of social and economic phenomena that are creating and dramatically increasing new value and improving productivity and everyday convenience thanks to the diverse digital technologies—artificial intelligence (AI), big data, Internet of Things (IoT), among others—that have been incorporated into the intelligent production, distribution, and consumption of services. The First Industrial Revolution, of course, began with the invention of the steam engine in Britain in 1784. The invention of electricity and the division of labor made automation and mass production possible in the 1870s, culminating in the Second Industrial Revolution. The Third Industrial Revolution was driven by the emergence of information and digital technologies in 1969. Now, the Fourth Industrial Revolution has arrived, highlighting the importance of AI and big data (Choi and Oh, 2017).

The Fourth Industrial Revolution revolves around groundbreaking technologies that revolutionize our everyday existence. It is exerting ever more profound impacts on our daily lives particularly as it percolates throughout social services, health, and culture. In recent years, national governments

have begun to apply these new technologies to the making and implementation of policies that aim to raise the quality of life for people with greater social service and health needs, such as seniors and people with disabilities.

AI, IoT, 3D printing, blockchain, and other such new technologies have thus become essential tools of effective and efficient welfare policy. Furthermore, these technologies are being combined to create even more novel technologies or applications of existing technologies, with each application helping to expand the growing system that is generating endless added value. The R&D projects that are tackling actual social issues in Korea today, sponsored by the Ministry of Science and ICT (MSIT), for example, involve keeping track of new and major social issues that arise in order to find scientific and technological solutions that require interdepartmental collaboration.

The purpose of this study is to pave the basis for establishing a system of convergence and collaboration between, on the one hand, big data-based health and welfare policy and, on the other, science and technology, based on the assumption that new technologies can enhance the effectiveness and efficiency of policy. Assuming that technologies applicable to health and welfare policy are highly advanced, we shall focus, in this study, on the divide due to differences in values and understanding.

Big data analysis can provide evidence for health and welfare

policy, and new technologies such as AI can function their best when given big data support. The objective of this study is to help develop a mid- to long-term strategy for making health and welfare policy decisions on the basis of big data by proposing a system of policy-technology convergence for sustainable and evidence-based policy responses. The findings of this study can help decide the course of the convergence of health and welfare policy and new technologies and disseminate future research discoveries. Furthermore, this study may contribute to enhancing the public's interest in, acceptance of, and support for technology-based health and welfare policy, while enabling policymakers to identify appropriate responses.

Our project spans three years. For its first year, we have put together, in this report, our analysis of the welfare needs that can be effectively identified using big data, as well as the current status and future direction of new technologies applied to health and welfare policy.

Specifically, this study discusses examples of new technologies applied to the identification and analysis of health and welfare needs. As our project is oriented toward a concrete mission of solving social and economic policy issues in areas that make significant differences to Koreans' everyday existence, we also explore how open the Korean public is to new technologies being used in health and welfare policy. Accordingly, we discuss the results of our surveys of the general

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public and experts on their perceptions of health and welfare policy and the need for new technologies and analyze the public's reaction to the health and welfare policy measures based on irregular big data. Finally, this study summarizes major issues and policy measures to be addressed in light of the second year of the research project.



II

Surveys on the Perceived Need for the Convergence of Health and Welfare Policy and Technology

1. Overview
2. Findings

II

Surveys on the Perceived Need for the Convergence of Health and Welfare Policy and Technology

1. Overview

Our survey of the general public targeted 2,000 Korean adults, both male and female, aged 19 or older nationwide. Specifically, we determined our sample size in proportion to the distribution of the resident population aged 19 or older, registered as of May 2019, by region, sex, and age. The polling company (Korea Research) framed the sample using its master sample panel.

Our Delphi survey was conducted after snowball-sampling experts on science and technology in general, natural sciences, and health and welfare policy.

Both the general public and Delphi surveys were conducted through computer-aided web interviews (CAWIs) based on structured questionnaires. People who were included in the sample but failed to respond were encouraged to participate in the survey. The logic between the questions was programmed and verified simultaneously as the interviews were conducted. Data were cleaned of incomplete and inaccurate responses, which were later corrected through additional interviews. The interviews were held over a 20-day period from July 11 to 31, 2019.

The major tasks of health and welfare policy were identified by first reviewing the existing major policy measures and then engaging in multiple consultations with health and welfare policy experts.

The seven areas of new technological applications were identified, likewise, through multiple consultations with science and technology experts.

〈Table 2-1〉 Major Tasks of Health and Welfare Policy

No.	Task
1	Increase public assistance to ensure the minimum standard of living for the vulnerable classes.
2	Strengthen the employment security net.
3	Increase old-age income security for seniors.
4	Alleviate the financial burden of medical costs on households through expanded public health insurance coverage.
5	Increase essential and vital medical care and establish a robust system for preventing, monitoring, and managing infectious diseases.
6	Establish a system of preventive healthcare.
7	Increase social services for diverse groups.
8	Integrate health, care, and nursing services in local communities (for patients in hospitals and at home alike).
9	Enhance housing welfare for those at greater risk of losing housing.
10	Ensure better management of environmental and social disasters (including air and water pollution).

Note: These tasks of health and welfare policy finally included in the survey were identified and determined independently of their amenability to new technological applications. Therefore, they include tasks that have little room for technological innovation (e.g., Increase old-age income security for seniors.).

〈Table 2-2〉 Tasks of New Technological Applications

No.	Technology
1	AI and big data
2	Self-driving vehicles
3	3D printing
4	Wearable devices
5	Robotics
6	IoT
7	Digital content (augmented and virtual reality/AR and VR)

2. Findings

The surveys on the perceived need for a system of convergence between health and welfare policy and technology were conducted in the form of CAWIs using structured questionnaires. The general public survey targeted 2,000 adult Koreans aged 19 or older nationwide. The participants of the Delphi survey were chosen through snowball sampling among experts on science and technology in general, natural sciences, and health and welfare policy. The final sample included 72 experts.

The findings of the surveys can be divided into three main areas: namely, perceptions of health and welfare policy issues, perceptions of new technologies, and perceptions of the applications of new technologies to health and welfare policy. Asked

whether they thought Korea was a welfare state, 57.4 percent and 51.4 percent of lay and expert respondents, respectively, agreed (combining the numbers of respondents choosing the three answers of “Strongly agree (6),” “Agree (5),” and “Agree somewhat (4)”). Both lay and expert respondents chose “Strengthening the employment security net (2)” as the most pressing health and welfare policy task that the government should address (with respondents allowed to select more than one from the tasks listed as options).

Asked to rate the competitiveness of Korea’s new technologies on a four-point scale, lay and expert respondents gave overall ratings of 2.9 and 2.8 points, respectively. Although the respondents generally agreed that all seven new technologies were important to national development, AI and big data garnered the most votes (83.9 percent of lay respondents and 95.8 percent of experts) as the technologies that the state should prioritize (with respondents allowed to select more than one option).

Both lay and expert respondents regarded applying new technologies to health and welfare policy as important. However, the vast majority of both groups (75.5 percent of lay respondents and 90.3 percent of experts) thought that effective convergence was missing (combining the numbers of respondents choosing one of the three answers, “Strongly disagree (1),” “Disagree (2),” and “Disagree somewhat (3)”).

Experts were also asked to rank the new technologies in descending order of necessity. They chose AI as the most important for seniors, followed by self-driving vehicles, wearable devices, robotics, and IoT, in descending order. AI/big data and wearable devices were also ranked as the two most important for senior households, while self-driving vehicles, 3D printing, robotics, IoT, and digital content (AR/VR) were rated as more important for households with disabled members. Asked to select the new technologies most necessary for health and welfare policy (and permitted to choose more than one of the 10 options given), AI/big data topped the list for all areas of health and welfare policy. Also asked to select the measures needed to facilitate policy-technology convergence (and permitted to choose more than one option), the experts chose fostering convergence research as the most important, followed by increasing investment in science and technology and the development of specialized workforces capable of using technology.



III

Social Big Data Analysis

1. Data Collection: Overview
2. Results

III Social Big Data Analysis

1. Data Collection: Overview

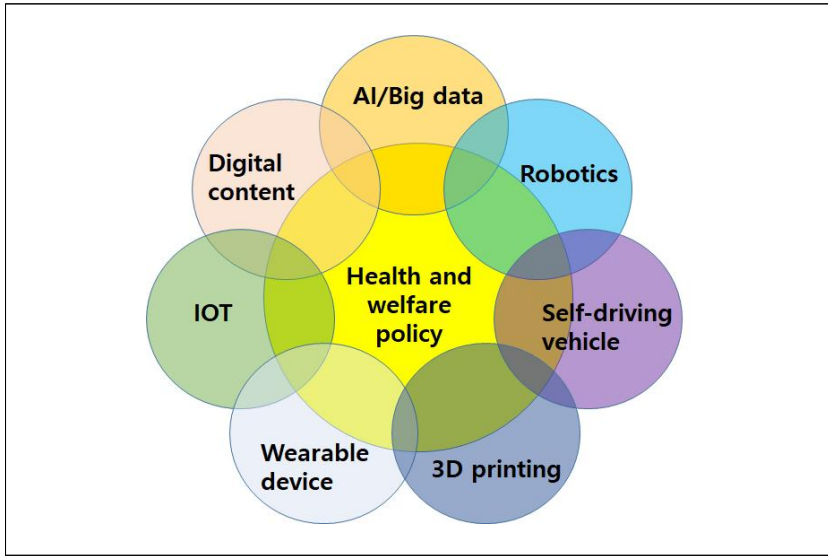
Social big data were gathered using the 10 health and welfare policy tasks and seven new technologies listed in Chapter II as keywords. The sources of data were limited to online news article postings (on www.naver.com and www.daum.net) in order to gauge public opinion on policy-technology convergence.¹⁾ Specifically, articles posted from January 1, 2017, to April 30, 2019, were searched to gain an understanding of the more recent tide of public opinion. The analysis targeted news articles that were returned as search results to queries made with each of the seven technological keywords and that contained any of the health and welfare policy keywords,²⁾ as well as the user

1) In Korea, the comment section under news articles published online and individual social media accounts are the two main routes via which the public airs its opinions. Blogs and message boards mostly serve as channels of information. This study initially targeted social media posts as sources of data, but the number of data entries meeting the keyword qualifications was too small. The news articles targeted and searched are those published by major newspapers and outlets in the country, including *Chosun Ilbo*, *Joong-Ang Ilbo*, *Dong-a Ilbo*, *Yonhap News*, *Electronic News*, and *The Herald Business*.

2) Health and welfare keywords: jobs, labor, employment, job-seeking, landing jobs, workplace, occupation, work, searching for jobs, particulate matter, natural disaster, water pollution, social disaster, emergency, disaster, housing, housing vulnerability, housing welfare, care, care service, health and medicine, social service, electronic voucher, prevention, health management, medicine for severe symptoms, infection, health insurance, medical cost, old-age income

comments posted below those articles.

[Figure 3-1] Conceptual Map for Social Big Data Analysis



security, pension, basic pension, National Pension, retirement pension, old age, private pension, elderly poverty, retirement, old-age assets, old-age capital, post-retirement preparation, farmland pension, housing pension, public assistance, minimum standard of living, basic livelihood security, living benefits, housing benefits, medical benefits, education benefits, postpartum benefits, funeral benefits, self-sufficiency benefits, minimum cost of living, minimum living, basic living, people with disabilities, disability assisting devices, rare disease, children with disabilities, livelihood struggle, vulnerable classes, health, welfare, medicine, senior, diagnosis, new drug, senile dementia, disability, child, social security, low birth rates, North Korean settlers, multiculturalism, single-parent, middle-aged, old, pregnancy, birth, infant and toddler, health, regular job, irregular job, near-poverty, child benefits, employment insurance, workers' compensation insurance, emergency, childcare, living alone, and volunteering.

〈Table 3-1〉 Number of Data Entries Collected

Technology keyword	No. of tech data (A)	No. of tech and policy data (B = C + D)	(B)/(A) percentage	No. of articles (C)	No. of comments (D)
AI/big data	1,825,540	420,255	23.0	136,209	284,046
Robotics	520,675	185,857	35.7	39,774	146,083
Self-driving vehicle	283,788	126,457	44.6	24,385	102,072
3D printing	33,403	15,687	47.0	8,880	6,807
Wearable device	5,579	2,033	36.4	1,061	972
IoT	273,054	114,666	42.0	60,348	54,318
Digital content	744,690	190,871	25.6	59,796	131,075

2. Results

The health and welfare keywords related to technologies, as ranked in descending order of frequency, are shown in Table 3-2. “Medicine” is a keyword that frequently appears in relation to all the seven new technologies. This suggests that “medicine” is perceived in Korea as a key area of policy-technology convergence.

〈Table 3-2〉 Ranking the Keywords by Frequency

Rank	AI/big data	Robotics	Self-driving vehicle	3D printing	Wearable device	IoT	Digital content
1	Data	Robotics	Driving	Medicine	Health	Particulate matter	Education
2	Medicine	Surgery	Self-driving	Printer	Medicine	Security	Communications
3	Robotics	Medicine	Car	Entrepreneurship	Health	Safety	Entrepreneurship
4	Job	Education	Robotics	Bio	Patient	Data	Safety
5	Regulation	Patient	Vehicle	Job	Entrepreneurship	Blockchain	Robotics
6	Employment	Job	Regulation	Surgery	Research	Energy	Medicine
7	Patient	Research	Job	Research	Insurance	Entrepreneurship	Sports
8	AI	Hospital	Train	Experience	Monitoring	Apartment	Video
9	Bio	Experience	Hydrogen	Patient	Blockchain	Robotics	Broadcasting
10	Hospital	Treatment	Particulate matter	Job-seeking	Data	Communications	Job
11	Policy	Cleaning	Taxi	Production	Training	Regulation	Regulation
12	Diagnosis	Device	Communications	Hospital	Sports	Housing	Olympics
13	Particulate matter	Entrepreneurship	Policy	Material	Watch	Job	Data
14	Digital	Safety	Parts	Artificial	Exercise	Research	Research
15	Safety	AI	Union	Regulation	Sleep	Cloud	Blockchain

We formed networks of associated words that frequently appear together in texts mentioning both the health and welfare keywords and the new technologies. Some of the keywords, such as “medicine,” appear in relation to all or most of the seven new technologies. However, the list of frequently appearing keywords still varies significantly from technology to technology, requiring analysis of each network.

We need to analyze each network of frequently appearing keywords and their associations in order to determine the essential keywords that ought to be considered in developing a system of convergence between health and welfare policy and new technologies. The findings of this study can form the basis upon which the strategy for policy-technology convergence can be envisioned. Of the 10 health and welfare policy tasks, three—strengthening the employment security net, establishing a system of preventive healthcare, and increasing social services for diverse groups—can be prioritized.

The keywords related to AI/big data were connected to six tasks of health and welfare policy. Specifically, “employment,” “job-seeking,” and “youth” were associated with strengthening the employment security net; “consumer” and “insurance,” with alleviating the financial burden of medical costs on households through expanded public health insurance coverage; “patient,” “pharmaceuticals,” and “disease,” with establishing a robust system for preventing, monitoring, and managing infectious diseases; “medicine” and “diagnosis,” with establishing a system of preventive healthcare; “hospital” and “health,” with integrating health, care, and nursing services in local communities; and “particulate matter” and “data,” with ensuring better management of environmental and social disasters.

The keywords related to robotics were connected to four policy tasks: “people with disabilities” and “seniors,” to increasing public assistance to ensure the minimum standard of living for

the vulnerable classes; “automation,” “manufacturing,” and “employment,” to strengthening the employment security net; “robotics” and “surgery,” to alleviating the financial burden of medical costs on households through expanded public health insurance coverage; and “medicine” and “doctor,” to integrating health, care, and nursing services in local communities.

The keywords related to self-driving vehicles bore relevance to four policy tasks: “people with disabilities” and “traffic safety,” to increasing public assistance to ensure the minimum standard of living for the vulnerable classes; “job,” “union,” “delivery,” and “minimum wage,” to strengthening the employment security net; “safety,” “delivery,” and “commonplace,” to integrating health, care, and nursing services in local communities; and “particulate matter” and “reduction,” to ensuring better management of environmental and social disasters.

The keywords related to 3D printing were associated with three policy tasks: “job,” “entrepreneurship,” and “job-seeking,” with strengthening the employment security net; “long-term,” “surgery,” “artificial,” “material,” and “cell,” with alleviating the financial burden of medical costs on households through expanded public health insurance coverage; and “housing” and “material,” with enhancing housing welfare for those at greater risk of losing housing.

The keywords related to wearable devices had areas of overlap with three policy tasks: “insurance,” “compensation,” and

“data,” with alleviating the financial burden of medical costs through expanded public health insurance coverage; “health management,” “blood glucose,” and “sleep,” with establishing a system of preventive healthcare; and “hospital,” “monitoring,” and “disease,” with integrating health, care, and nursing services in local communities.

The keywords for IoT were associated with five policy tasks: “job,” “hiring,” “entrepreneurship,” and “youth,” with strengthening the employment security net; “medicine,” “hospital,” and “facilities,” with establishing a robust system for preventing, monitoring, and managing infectious diseases; “indoor,” “sensor,” and “environment,” with establishing a system of preventive healthcare; “welfare” and “patient,” with integrating health, care, and nursing services in local communities; and “monitoring” and “disaster,” with ensuring better management of environmental and social disasters.

Finally, the keywords for digital content bore relevance to four policy tasks: “job,” “career path,” and “entrepreneurship,” to strengthening the employment security net; “health” and “communications,” to establishing a robust system for preventing, monitoring, and managing infectious diseases; “people with disabilities,” “patient,” and “training,” to increasing social services for diverse groups; and “particulate matter” and “safety,” to ensuring better management of environmental and social disasters.



IV

Comparison of Survey and Social Big Data Analysis Results

IV Comparison of Survey and Social Big Data Analysis Results

Chapter II discusses the results of the surveys of the general public and experts alike regarding their perceptions of the need for the convergence of health and welfare policy and new technologies. Chapter III provides the results of the big data analysis on current issues. The two analyses therefore supplement each other.

Table 4-1 shows the result of converging the results of the Delphi survey and the social big data analysis, with areas of overlap marked in bright yellow. As AI/big data featured high on the list of priorities concerning all policy tasks, it deserves special attention.

The specific aims and subjects of analysis for the second year of this research will be determined on the basis of the keywords in yellow cells.

Asked to identify the biggest factor of concern at the moment, respondents participating in the surveys picked “jobs” (28.6 percent). “Strengthening the employment security net” was also picked as the No. 1 policy task that policymakers needed to work on (37.9 percent).

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(Table 4-1) Merging the Results of the Delphi Survey and Big Data Analysis

Policy task	AI/big data	Robotics	Self-driving vehicles	3D printing	Wearable devices	IoT, ICT	Digital content
1		People with disabilities, seniors	People with disabilities, traffic safety				
2	Employment, job-seeking, youth	Automation, manufacturing, employment	Job, union, delivery, minimum wage	Entrepreneurship, employment, job		Job, employment, entrepreneurship, youth	Job, career path, entrepreneurship
3							
4	Consumer, insurance	Robotics, surgery		Long-term, surgery, material, artificial, cell	Insurance, compensation, data		
5	Patient, pharmaceuticals, disease					Medicine, hospital, facilities	Health, communication
6	Medicine, diagnosis				Health management, blood glucose, sleep	Indoor, sensor, environment	
7							People with disabilities, patient, training
8	Hospital, health	Medicine, hospital	Safety, delivery, common-place		Hospital, monitoring, disease	Welfare, patient	
9				Housing, material			
10	Particulate matter, data		Reduction, particulate matter			Monitoring, disaster, management	Particulate matter, safety

Note: Policy task 1: Increase public assistance to ensure the minimum standard of living for the vulnerable classes.

Policy task 2: Strengthen the employment security net.

Policy task 3: Increase old-age income security for seniors.

Policy task 4: Alleviate the financial burden of medical costs on households through expanded public health insurance coverage.

Policy task 5: Increase essential and vital medical care and establish a robust system for preventing, monitoring, and managing infectious diseases.

Policy task 6: Establish a system of preventive healthcare.

Policy task 7: Increase social services for diverse groups.

Policy task 8: Integrate health, care, and nursing services in local communities (for patients in hospitals and at home alike).

Policy task 9: Enhance housing welfare for those at greater risk of losing housing.

Policy task 10: Ensure better management of environmental and social disasters (including air and water pollution).

The keyword network analysis suggests three main areas of policy-technology convergence. First, strengthening the employment security net would be the top-priority area in which AI and big data should be introduced. “Employment,” “job-seeking,” and “youth” appeared frequently as keywords in the network analysis of AI and big data. Survey participants, too, expressed high expectations of AI and big data being fruitfully applied to strengthening the employment security net (52.6 percent). Specifically, survey participants expect policy support for the development of specialized personnel who are capable of utilizing new technologies such as AI and big data, more than the direct application of these technologies to policy services. Second, the task of establishing a system of preventive healthcare may also prompt the application of wearable devices. The keyword network for wearable devices included such words as “health management,” “sleep,” “blood glucose,” and “habit.” Wearable sensors for monitoring these health-related conditions could significantly improve the quality of the overall healthcare system. Third, digital content may

be needed to increase social services for diverse groups. The network for digital content included such keywords as “people with disabilities,” “patient,” and “training,” suggesting the potential for applying digital content (including AR and VR) to rehabilitative medicine.

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V

Conclusion and Policy Implications

V Conclusion and Policy Implications

Bringing health and welfare policy and new technologies together will be a key area of public interest in the coming years. The implications of this study for policy-technology convergence can be summarized as follows. First, new technologies should be used to respond to the health and welfare needs of the people, thereby making policy services and benefits more relevant to many people's lives. Second, policymakers should strive to meet the public's growing expectations of AI and big data. Third, as technology will affect and reshape the concept of health and welfare as well as the scope of health and welfare policy, a broader concept of health and welfare should be applied to the development of new services. Fourth, demand-based services should be provided. Fifth, a cooperative networking environment should be fostered to identify people's needs and tailor technologically advanced services accordingly. Sixth, efforts should be made to minimize or overcome the adverse effects of new technologies. Seventh, and finally, efforts are also needed to minimize the information-deprived and shrink the blind spots of the digital welfare system.

Three issues will be considered in future research. The first issue has to do with the integration of formal and informal

data. Research is needed to determine how best to achieve that integration. The design and aims of future research will therefore depart from this year's research. Furthermore, future research should also seek to make sense of the differences between the general public and experts, as well as between the survey results and social big data analysis.

The second issue involves analyzing the latest trends in health and welfare policy and technologies. Review is needed to determine whether the seven categories of new technologies used in this year's research will remain valid next year as well, and what new technologies and issues are being discussed in new technology forecasts. Analysis is also needed to identify evolving technological trends over time, preferably year to year. Health and welfare policy issues, too, should be subjected to annual trend analysis to determine what grabbed Korean society's attention each year.

The third issue involves conducting specific case studies toward facilitating the convergence of health and welfare policy and new technologies. In its second year, our research project will focus on a couple of actual cases, selected on the basis of the surveys and big data analysis and subject to consultations with experts. We will select two major policy programs with implications for new technologies, and analyze the frequency of keywords appearing in relation to each technology in order to rank the technologies in order of public relevance and iden-

tify policy and technological initiatives that may be used to develop an index.

To ensure the effective use of new technologies in health and welfare policy, it is critical to predict and assess both positive and negative effects that may arise, and take that consideration into account in designing the system of convergence. In the second year of our research, we will continue monitoring trends and changes, identified on the basis of our 2019 big data analysis, of policy and technology and focus our attention on analyzing specific cases to forecast and assess possible issues and solutions.

Such work will be essential to the development of an effective system that can narrow the gap between health and welfare policy and new technologies.

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