KOREAN RESIDENT REGISTRATION SYSTEM FOR UNIVERSAL HEALTH COVERAGE

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WORLD BANK GROUP
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Abstract: This paper is a comprehensive case study on how the Korean civil registration and vital statistics (CRVS) system facilitates achievement of universal health coverage (UHC) in the Republic of Korea. The case study briefly summarizes the resident registration system—the main part of the Korea CRVS system—and the health care system in Korea; it provides an overview of UHC-related problems from the perspective of three major stakeholders: patients, providers, and government. It presents case studies illustrating how the Korean Resident Registration Number (RRN) system facilitates implementation of UHC in Korea, including three main areas of health service provision (prevention, treatment and management, and health care data usage). It discusses key considerations for UHC implementation using RRNs, focusing on personal information protection and use of health care data in UHC implementation; and, it presents lessons learned and provides a conclusion of the study.

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LIST OF ACRONYMS

CRVS	Civil registration and vital statistics
EMR	Electronic medical record
HIRA	Health Insurance Review and Assessment Service
KCDC	Korean Centers for Disease Control and Prevention
MOHW	Ministry of Health and Welfare
NHI	National health insurance
NHIS	National Health Insurance Service
NHISS	National Health Insurance Sharing Service
OECD	Organization for Economic Cooperation and Development
PIN	Personal identification number
PIPA	Personal Information Protection Act
RR	Resident registration
RRN	Resident Registration Number
SDG	Sustainable development goal
UIN	Unique identification number
UHC	Universal health coverage
WBG	World Bank Group

ACKNOWLEDGMENTS

PREFACE

The World Bank Group (WBG) Data Council endorsed the 2016–2030 Civil Registration and Vital Statistics (CRVS) Action Plan in December 2015. This plan has a goal of achieving universal civil registration (CR) of births, deaths, and other vital events—including reporting the cause of death and providing access to legal proof of registration—for all individuals by 2030. The WBG has been working closely with development partners to provide the requisite support to countries through three interlinked initiatives: The Strategic Action Program for Addressing Development Data Gaps; Identification for Development; and the Global Financing Facility.

The goal of the WBG's Health, Nutrition, and Population Global Practice is to contribute to the two WBG goals of ending extreme poverty within a generation and boosting shared prosperity by helping countries improve HNP outcomes and reduce impoverishment due to illness. Enabling countries to achieve universal health coverage (UHC) is the main way to attain this goal, by ensuring that all people have access to the quality, essential HNP services they need without enduring financial hardship. Documentation and dissemination of the CRVS-related country case studies, such as the use of a unique identification number (UIN) for UHC are key to this process.

This report on the Republic of Korea, one of a series of case studies commissioned by the Health, Nutrition, and Population Global Practice, provides a comprehensive view of how the resident registration system has facilitated the achievement of UHC.

PART I – BACKGROUND

An effective civil registration and vital statistics (CRVS) system is crucial to accurate planning and monitoring of programs in various sectors, including those for achieving universal healthcare coverage (UHC). Robust CRVS systems linked to identity management systems and tailored to local contexts form the foundation of all sectors and pillars of the economy. They contribute to achieving the sustainable development goals (SDGs) of ending poverty and to ensuring all-inclusive prosperity for the people. Well-functioning CRVS systems are the best sources of data to monitor the progress of 12 of the 17 SDGs. In particular, CRVS data are needed to measure 67 of the 232 SDG indicators. Nevertheless, more than 110 low- and middle-income countries have yet deficient CRVS systems.

PART II – OBJECTIVE AND SCOPE

The objective of this paper is to develop a comprehensive case study on how the Korean CRVS system facilitates achievement of universal health coverage (UHC) in Korea.

Chapter II describes the objective and scope of this report. Chapter III briefly summarizes the resident registration (RR) system, which is the main part of the Korea CRVS system, and healthcare system in Korea. Chapter IV provides an overview of UHC-related problems from the perspectives of three major stakeholders: patients, providers, and government. Chapter V contains case studies illustrating how the Korean Resident Registration Number (RRN) system facilitates implementation of UHC in Korea. This chapter comprises three main areas of health service provision: prevention, treatment and management, and healthcare data usage. Each subchapter has three subsections on enrollment, management, and review and feedback. Chapter VI discusses key considerations for UHC implementation using RRNs. In particular, we focus on personal information protection and use of healthcare data in UHC implementation. Chapters VII and VIII present lessons learned and conclusion of the study.

PART III – OVERVIEW OF THE CRVS SYSTEM IN KOREA

A. THE RR SYSTEM IN KOREA

The UN Department of Economic and Social Affairs (2015) defines CRVS as "universal, continuous, permanent, and mandatory recording and documentation of the occurrences and characteristics of vital events, including births, deaths, marriages, divorces and annulments, adoptions, and registrations in accordance with the legal and regulatory requirements of each country." Efficient management of data on population size, births, deaths, and other events might be used as a foundation to support a state's administrative systems in various areas including education, social welfare, health care, election and taxation. Consistent gathering, storage, control, and use of information creates a comprehensive CRVS system that is a basic element of good governance and plays an essential role in producing the vital statistics and other important indicators relevant to the health of national populations (Song et al. 2016).

The Korean CRVS system began to develop in the 1960s. Initially, CRVS services were paper based, and citizens visited government offices for civil services. With the advent of digitization and e-government, most of these services became available via the Internet so that citizens in Korea could use the service at home. Korea's CRVS includes three parts: (1) family relationship registration and (2) RR, which are both involved in Civil Registration, and (3) Vital Statistics (Song et al. 2016). The RR system automatically registers Korean citizens through birth registration and RR numbers (RRN) are generated at birth. Birth registration is a part of family relationship registration.

The central and municipal governments manage and maintain the Korean CRVS system, with each having different functions and responsibilities. The CRVS system collects significant personal information from citizens; protection of that information is of great concern, so Korea has passed laws and written regulations to strengthen protection of individual information (Song et al. 2016).

The main purpose of the RR system has been to register and manage individuals' residential status and movements, but the purpose and functions of the RR system changed along the system's historical development (figure 1). Although the system dates back to the Japanese colonial era, the current system, which requires RR of all Koreans, was established in 1962, when the Resident Registration Act was enacted (Ko 2012; Kwon 2004). In 1962, the RR system required all residents to register their name, sex, date of birth, relationship to their householders, place of family registration, and address with the mayor, town manager, or village headman of their residence to illustrate their residency relationships (Kim 2011). It became a citizen's obligation to obtain and maintain RR numbers and RR cards (Ministry of Strategy and Finance 2015). The initial function of the RR system was to collect a wide range of residential data and to monitor and supervise residents, which became important to strengthening national security given the conflict with North Korea. Since then, the government has been able to collect, manage, and search individuals' vital events and residential records (Kim 2011; Ko 2012). The law was revised in 1997 to expand its purpose to manage records collectively and promote citizen's welfare as well as to identify residency relationships and population dynamics.

Figure 1: Developmental Process of the RR System

~1980s Administrative management instrument	1990s Secure efficiency in Administration	2000s Provide integrated administrative service
• Nonexistence of communication with citizens • Managing and controlling population mobilization • Simple Instrument for administrative management • Nonexistence of civil services	• Incomplete two-way communication • Established fast and efficient administrative process • Provided fragmentary administrative information • Lack of awareness of privacy protection	• The completion of two-way communication channel • Established administrative information sharing system • Integrated administrative service provision • Ensured Privacy protection
Established Resident Registration system	Established Electronic RR System (RR DB)	Integrated Electronic RR System (Minwon 24, Administrative Information Common Utilization

Source: Ministry of Strategy and Finance 2015

Using the RR data, the Korean government provides a variety of administrative services to households and individuals. In particular, after the integrated e-RR system was established in the 2000s, instead of administrative office visits, citizens can access civil services directly over the Internet at home using their RR numbers (Ministry of Strategy and Finance 2015). Citizens can file civil complaints and obtain certificates through Minwon 24, which is an on-line system for civil services.[1]

1. The RR System in Korea

The Korean government operates the RR system to identify the boundary and coverage of the national community and enable individuals to self-identify for various purposes (S. Kim 2011). The computational center of the Ministry of the Interior and Safety issues RR cards to all citizens aged 17 and older at the requests of mayors, governors, and heads of boroughs (M. Kim 2011). The RR card contains personal information such as name, photo, RR number, address, fingerprint, date of issuance, and issuing institution. Additional information, such as blood type, is sometimes recorded (M. Kim 2011; Ko 2012).

The RRN system has been revised several times, and the RR number, which had contained 11 digits in the beginning, now contains 13 digits (table 1). The RR card also changed from a paper card to a plastic card with holograms. Changes to the RR system stemmed from various problems that arose over time, such as the counterfeit of the paper RR card. As a response, the plastic card system was adopted, but the system still cannot completely prevent illegal use and fraud.

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[1]Minwon 24(www.minwon.go.kr) is an on-line system for civil service. As of 2018, the system is combined into Gov24(www.gov.kr), which is a comprehensive system which operates as an on-line portal and provides various on-line government and civil services to citizens as well as foreigners.

The RR system is noted for the following five purposes (M. Kim 2011):

1. **Identification** The administrative system allows easy and fast identification of individuals and their residency relationships.
2. **National security** It contributes to social order and stability by detecting suspected criminals.
3. **Convenience for citizens** The RR number enables the government to provide prompt, seamless, and consistent services.
4. **Socio-ethics** It protects vulnerable population such as youth from harm and allows prioritization of people with special needs such as elderly adults.
5. **National integration** It makes omnidirectional management possible for all people.

It is estimated that financial institutions, the automatic response service, and the Minwon 24 check an estimated 100,000 RR numbers daily to authenticate individuals (Ko 2012).

Table 1: Historical Revisions to the RR Card

Data location	Initial Issuance: 1968	First revision: 1975	Second revision: 1983	Third revision: 1999
Front	• Photo • Name • 12-digit RR number • Date of birth • Permanent residence • Address • Military service • Military service number • Date of issuance • Duty to carry RR card • Notification for acquisition	• Photo • Name • 13-digit RR number • Date of birth • Permanent residence • Address • Military service • Military service number • Date of issuance • Duty to carry RR card • Notification for acquisition	• Photo • Name • 13-digit RR number • Permanent residence • Address • Military service • Name of household head • Date of issuance • Name of issuing institution	• Photo • Name (with Chinese characters) • 13-digit RR number • Address • Date of issuance • Name of issuing institution
Back	• Address change • Employment • Two-thumb fingerprint	• Address change • Employment • Two-thumb fingerprint	• Change of information • Thumbprint • Notification for acquisition	• Address change • Thumbprint • Notification for acquisition

2. The RR Number as UIN

In Korea, the RR number is used as the fundamental identification. Korean citizens are provided with their RR numbers when their birth is registered. Every individual is assigned a RR number to eliminate the inconveniences and risks of using names and dates of birth, which sometimes are not unique (Ko 2012).

The RR number has several useful characteristics. The numbers are unique, and they do not change during the lifetime (consistent). The numbers identify one individual (exclusive), distinguish among individuals (identification function), confirm and prove a person's identity or status (authentication function), and describe an individual's characteristics through information contained (descriptive function). Many government personal data files are managed using RR numbers. Therefore, RR numbers connect various types of data through the information communication networks (connection function) (Ko 2012; Sung 2016).

The RR number includes date of birth, age, sex, area where the RR card was first issued, order of registration, and forgery status (Ko 2012). The current RR numbers use the 13-digit numbering system (figure 2) established in the third amendment to the law in 1975, when the requirement was established that citizens aged 17 years and older have a number. The first six digits of the RR number consist of the date of birth, and the last seven digits combine a sex identifier with the place of issuance of the RR number (Kwon 2004; Ministry of Strategy and Finance 2015).

Figure 2: Structure of the RR Numbering Method
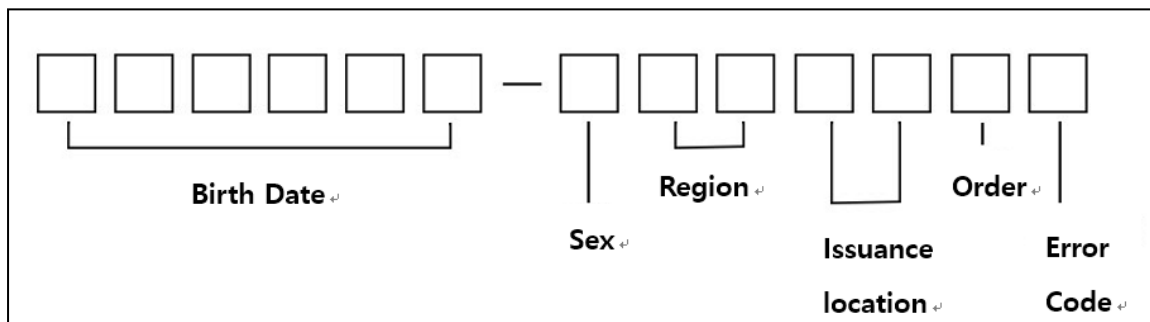
Source: Adapted from Kwon 2004

The first digit of the second part of the RR number represents the individual's sex and period of birth. Men who were born in the 1800s are assigned "9," and women who were born in the 1800s are assigned "0." Men who were born in the 1900s are assigned "1," and women who were born in the 1900s are assigned "2." Boys born in the 2000s are assigned "3," and girls born in the 2000s are assigned "4." The second through the fifth digits indicate the individual's RR application location and the first issuer of the RR number, which identifies the first issuance location. The sixth digit is the individual's sequential registration position among people with the same surname in the same application location on the same registration date. The last number is an error correction number that checks the correctness of the RR number, which makes it possible to identify counterfeit or otherwise incorrect numbers (S. Kim 2011; Ko 2012; Kwon 2004). Under the current numbering method, the RR number of a person reveals a

significant amount of personal information that, if disclosed, might seriously threaten an individual's privacy (Kwon 2004).

B. Use of Personal Information in the Administrative Systems

From an administrative perspective, Korea's RR system is an effective policy tool because it collects and processes the personal records needed to assess population dynamics, such as residents' residency relationships, as well as integrates all essential data on individuals (M. Kim 2011). In the beginning, the system was introduced to enhance the convenience and efficiency of administrative institutions and to manage people effectively, as opposed to protecting them and making their lives more convenient through services, such as connecting to social welfare programs and benefits (M. Kim 2011). As Korea matures as a welfare state, the RR system's focus has shifted away from managing, controlling, and protecting the people toward providing services (Y Kim and M Kang, 2016).

Table 2: Application Examples of Data from the RR System

Data type	Application Examples for healthcare
Birth	• Estimate number of sickbeds and physicians needed for obstetric and gynecological care relative to number of births • Estimate demand for childcare supplies and childcare costs • Develop policies to boost fertility rate • Estimate changes in household consumption expenditures caused by changes in fertility
Death	• Develop health and disease policies • Make decisions on healthcare resource allocation • Conduct life table analyses

Source: Y. Lee 2015

Efficient and transparent public administrative services can be provided using information collected through a national identity system. One key element for building information systems to provide effective administrative services is assignment of RRNs (Ministry of Strategy and Finance 2015). The RR system ensures that public services are provided in the areas of, for example, civil complaints, taxation, welfare, healthcare, insurance, pension, and elections. The system is a basic, essential device that enables the state's welfare system and democratic processes to function correctly. Furthermore, the RR system contributes to efficient administration, public convenience, and maintenance of social order and safety (Ministry of Strategy and Finance 2015).

In Korea, the RR number assigned at the time of birth registration provides access to the national welfare system such as the National Health Insurance (NHI) throughout a person's lifetime. Korean citizens are sent notification letters about free health examinations, and they receive a variety of services tailored to each life stage. In addition, the information that individuals report on their family relationships, such as births, deaths, marriages, and divorces, is used to investigate population dynamics and is important for understanding various changes

that are occurring in the society. For example, these data provide information about changes in social structure and family trends. The data are used to develop social and economic plans and policies on population, housing, healthcare, social welfare, education, and traffic (Y. Lee 2015).

At the same time, Korea's investment in developing various administrative services using RR data enables citizens to use administrative services easily using their RR number. In 2005, the public information sharing and utilization policy promoted sharing RR information across governmental ministries and agencies, establishing an environment in which people do not need to provide duplicate documentation when registering civil complaints or using public services (Ministry of Strategy and Finance 2015). Digitized personal information documents are filed using RR numbers, which is important for maintaining and managing the databases of institutional computer systems such as the administrative computer network, or for completing the tasks that need to use government databases (Ko 2012). In addition, the RR numbers are widely used for other administrative purposes. They serve as a public certificate, verifying residency and confirming identity in private transactions (S. Kim 2011).

C. HEALTHCARE INFORMATIZATION

With recent developments in science, medicine, and technology and Korea's rapid advancement into the information age, construction of health and healthcare information infrastructures is becoming an important policy agenda. An increasing number of documents and images related to health and healthcare are being computerized. Collecting, analyzing, and studying this computerized information is becoming essential for improving healthcare services and developing effective health policy (I. Lee 2015).

In the healthcare system like the one in Korea, which relies heavily on the public health insurance system, use of health services and healthcare data has been promoted as an important strategy for the advancement of the healthcare service industry. Data can be used to stimulate innovations throughout the healthcare system and provide benefits to individuals whose information is being used (Jang 2017; Jung 2015). Healthcare data could be used to promote public health, prevent disease, improve healthcare technology, and prepare for the fourth industrial revolution. For, Korea, an information technology powerhouse, the universal coverage of RR numbers has enabled a robust foundation for the computerized healthcare service provision to its citizens (Ko et al. 2014).

It is predicted that Korea's population aged 65 and older will account for approximately 14 percent of the total population by 2019 and 20 percent by 2026, at which point Korea will be defined as a "super-aged" society. The growth potential of the healthcare sector is high because of the unprecedented rate of aging and the healthcare needs of elderly adults. Thus, data management is needed to conduct effective medical research on genomes and diseases (Jang 2017). Several other countries that need to use sensitive personal information for the advancement of medical research have established guidelines and enacted laws regarding medical research (Jang et al. 2017; Ko et al. 2015). Korea also should introduce institutional changes and present clear guidelines that enable healthcare research while protecting personal information.

PART IV – OVERVIEW OF UHC IN KOREA

A. THE HEALTHCARE SECURITY SYSTEM IN KOREA

Despite the fact that Korea has an NHI program with universal coverage, issues including catastrophic health expenditures, families facing disastrous medical expenses, and management of non-reimbursed services remain as major healthcare policy challenges due to low benefit coverage of the NHI.

Korea's national health insurance system (NHIS) provides insurance benefits to prevent, diagnose, and treat disease, illness, injury, childbirth, and death. As a social insurance system, it aims to lower healthcare costs and stabilize residents' lives by improving public health and promoting social security (Ministry of Health and Welfare, MOHW).[2] Table 3 illustrates several differences between social insurance and private insurance. Social insurance premiums are based on income and enrollment is mandatory. The Koreans pay insurance premium at a different rate based on their income, but the whole population is covered by uniform insurance benefits.

Table 3: Differences Between Social Insurance and Private Insurance

Aspect	Social insurance	Private insurance
Registration	Mandatory	Optional
Premium cost	Based on income	Based on level of health risk and income
Benefits	Uniform across the population	Depends on premium-linked level of coverage
Insurance premiums	Legally mandated collection of premiums based on income	Privately contracted collection of premiums

Source: MOHW

Korea achieved universal population coverage in a short period of 12 years (figure 3). The NHI system was initiated in 1977 with large businesses in industrial parks that employed more than 500 people. In 1979, civil servants and educational faculties joined the system. From there, it expanded in 1988 to companies of more than five employees. It added farmers and self-employed individuals nationwide in 1989. Eventually, it became today's universal NHI system (Jeon 2007; Moon 2005).

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[2] Retrieved August 7, 2019 from
http://www.mohw.go.kr/react/policy/index.jsp?PAR_MENU_ID=06&MENU_ID=06320101&PAGE=1&topTitle=%C0%C7%C0%C7

Figure 3: History of Korea's NHI Development

1963 ~ 1979	1981 ~ 2000	2001 ~ 2011
Jan. 1979 Implemented public official & private school teacher medical insurance	**Jul.2000** Integrated the national health insurance management corporation and employee medical insurance associations (139 societies)	**Jan.2011** Unified collection of major social insurance fees (National Health Insurance, National Pension, Unemployment Insurance, and Workers' Compension)
Jul. 1977 Implemented medical insurance for workplaces with 500 or more workers (established 486 societies)	**Feb.1999** Legislated the national health insurance law	**Jul.2008** Implemented long-term care insurance
Dec. 1963 Amended the medical insurance act	**Oct.1998** ntegrated regional medical insurance (227 associations) and official & teacher medical insurance Established the National Medical Insurance Management Corporation	**Apr.2007** Legislated the act on long-term care insurance for senior citizens (Act No. 8403)
	Dec.1997 Legislated the national medical insurance law	**Jul.2005** Implemented long-term care insurance pilot project
	Jul.1989 Implemented urban medical insurance > Enabled nationwide medical insurance	**Jul.2003** Integrated industrial financing and regional financing (De facto integration of two health insurances)
	Jul. 1988 Applied medical insurance to workplaces with 5 or more workers	**Jan.2002** Legislated the special act on national health insurance healthy financing
	Jan. 1988 Expanded regional medical insurance to farming and fishing villages	**Jul.2001** Incorporated workers of workplace with less than 5 workers in employment provided policyholders
	Jan.1981 Expanded medical insurance to workplaces with 100 or more workers	

Source: Health Insurance Review & Assessment (HIRA) Website

At the end of 2016, the system covered 97.7 percent of the population (about 50.77 million people). The remaining 2.3 percent, including individuals eligible for basic livelihood protection, were covered under the Medical Aid Program (MOHW 2016). Health insurance subscribers are categorized as employed subscribers or local subscribers. Workers in all places of business, public officials, and educational faculties are employed subscribers, whereas rural residents, urban self-employed individuals, and their dependents are local subscribers (MOHW 2016). Since January 2011, the NHIS provides a combined management services for the four major social insurance systems in Korea, namely, the national pension payments, industrial accident compensation insurance, NHI, and employment insurance (MOHW) (figure 4).

Figure 4: Korea's Social Insurance Premium Collection System
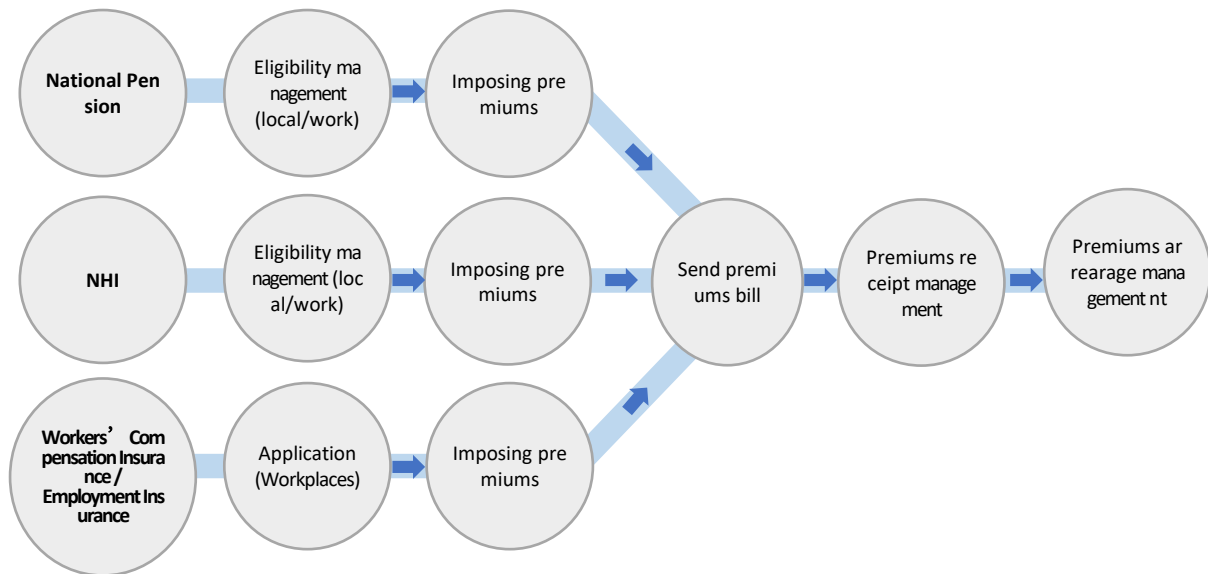
Source: Ministry of Health & Welfare website[3]

In Korea, the MOHW, the NHIS, and the Health Insurance Review and Assessment Service (HIRA) administer the NHI system (figure 5). The MOHW establishes the policies relevant to health insurance and services all related matters. The NHIS is a health insurance provider and handles subscriber qualifications, determines insurance premiums, collects payments, and pays insurance benefits. The HIRA reviews and determines the appropriateness of healthcare costs that healthcare providers and facilities charged (MOHW 2010).

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[3]

http://www.mohw.go.kr/react/policy/index.jsp?PAR_MENU_ID=06&MENU_ID=06320107&PAGE=7&top
Title=사회보험징수통합

Figure 5: Korea's NHI System

- Premiums
- Premiums imposing standard
- Payment coverage
- NHIS budget and

Ministry of Health and Welfare

Policy Decision

Policy Implementation

Evaluation standards

Premiums

The Insured

Medical insurance card

NHIS

Announce review results

Health Insurance Review & Assessment Service

Evaluation & Decision

Co-payment

Healthcare service

Ask NHIS to pay for health care service costs. (corporation's share)

- Eligibility management
- Imposing premiums
- Health care service costs
- Payment
- Payment management

Announce review results

Ask the corporation to pay for care benefit expense (corporation's share)

Health care institutions

Source: Ministry of Health & Welfare website[4]

B. UHC ISSUES IN KOREA FROM THREE PERSPECTIVES

In this section, we describe the UHC issues in Korea from the perspectives of patients, providers, and the Government and how the RR System is related to each issue.

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[4]

http://www.mohw.go.kr/react/policy/index.jsp?PAR_MENU_ID=06&MENU_ID=06320104&PAGE=4&topTitle=관리운영체계

Table 3: Summarsy of UHC issues from Three Perspectives

	Patient
Access	The NHI system allows accessibility to healthcare benefits for citizens whose RRNs are listed in the system.
Affordability	Out-of-pocket costs still are serious issues for many patients in Korea and they vary by individual economic conditions and the type of disease. Information for the financial and health condition of an individual can be obtained using his/her RRN.
Contribution	To calculate an individual's contribution rate, the NHIS uses information on his/her income and property using the RRNs.
	Provider
Reimbursement	Providers register their license numbers and medical facility numbers in the NHI system using their RRNs. Then the NHIS provides reimbursement for services provided.
Performance evaluation	The Health Insurance Review and Assessment Service evaluates the quality of medical care based on data from the provider using the license and medical care agency number that are linked with their RRNs.
Expenditure control	Healthcare providers may receive monetary and nonmonetary incentives and disincentives according to the treatment and prescription data, which is obtained using their license and medical care facility number that are linked with the RRNs.
	Government
Benefit coverage enhancement decision	Decisions on insurance coverage for each patient can be made using the patient's RRN. For example, once a diagnosis of one of the four major serious diseases is recorded in the patient's billing record, then the government can apply an extended insurance coverage standard for the patient's treatment.
Evidence-based decision	To decide whether new medicine and technologies to be included in the benefit list. Only registered patients who are identified by the RRN can access to the technologies under the regulation of the system.
Sustainability and innovation	Healthcare big data to be used for decision making on inclusion of costly treatment of chronic diseases that may threaten the sustainability of health insurance financing.

Note: NHI, NHI; RRN, RRN; NHIS, NHIS

1. Patient Perspective

1) Access

Korea's health insurance covers 100 percent of the population and adheres to mandatory registration of medical facilities to the NHI system. The NHI system is linked to the RRNs and, in principle, ensures accessibility to necessary healthcare for all citizens.

In Korea, as of 2015, there are 2.2 doctors per 10 million people, which is lower than the Organization for Economic Cooperation and Development (OECD) average of 3.4, but Korea has had the largest increase in doctors since 2000 of OECD countries (OECD, 2015). Formally, there is a distinction between primary care and secondary care, but practically, there are few to no barriers to receipt of primary and secondary care from a preferred specialist (Kang Heejung 2016). Anyone in Korea can easily receive treatment at an advanced general hospital, and the waiting time is generally not long. To limit unnecessary use of advanced hospitals, the HIRA conducts a case-by-case assessment linked to a person's RRN so that copayments are higher when an advanced general hospital is visited for a mild illness. The MOHW has created and implemented various policies to discourage use of advanced hospitals when they are not necessary, but the preference of Koreans for advanced general hospitals has not decreased significantly.

Physical access to medical care is not a barrier and, as a result, Korea has the most visits per patient among OECD countries. Excessive medical use is of more concern than constraints on physical access to care. Moreover, relative to the size of its population, Korea has among the most high-tech medical equipment, such as MRI units and CT scanners, of OECD countries, and the number of hospital beds per 10 million people was the second highest of OECD countries, second only to Japan, and has increased the most since 2000. The average length of hospital stay was also second only to Japan among OECD countries; the average length of stay in hospitals declined in most OECD countries from 2000 to 2015, but it has been increased in Korea more rapidly than in any other country.

Unlike the great improvement in physical accessibility of medical resources and healthcare from 2000 to 2015, NHI coverage has remained relatively unchanged over the past 10 years. Since the slight decline in 2007, Korea's health insurance coverage rate has never been greater than 62 percent to 63 percent (figure 6). In particular, the proportion of reimbursed services requiring copayment has increased, and in spite of the policy to enhance coverage, the overall health insurance coverage rate remains unchanged. This stagnation is often interpreted as being a result of the increase in the number of non-reimbursed services, which has resulted in balloon effects. Covered services are linked to RRNs, and through this link, the HIRA evaluates and assesses services provided to patients. Information about non-reimbursed services is recorded and stored in the electronic medical record (EMR) in medical facilities through the RRN, but the government cannot manage this information because it is not transferred to the NHIS or HIRA. The government's efforts to manage non-reimbursed services have been a constant source of political debate.

Figure 6: NHI Coverage

	2007	2008	2009	2010	2011	2012	2013	2014	2015
NHI coverage	65	62.6	65	63.6	63	62.5	62	63.2	63.4
insured services OOP	21.3	21.9	21.3	20.6	20	20.3	20	19.7	20.1
non-insured services OOP	13.7	15.5	13.7	15.8	17	17.2	18	17.1	16.5
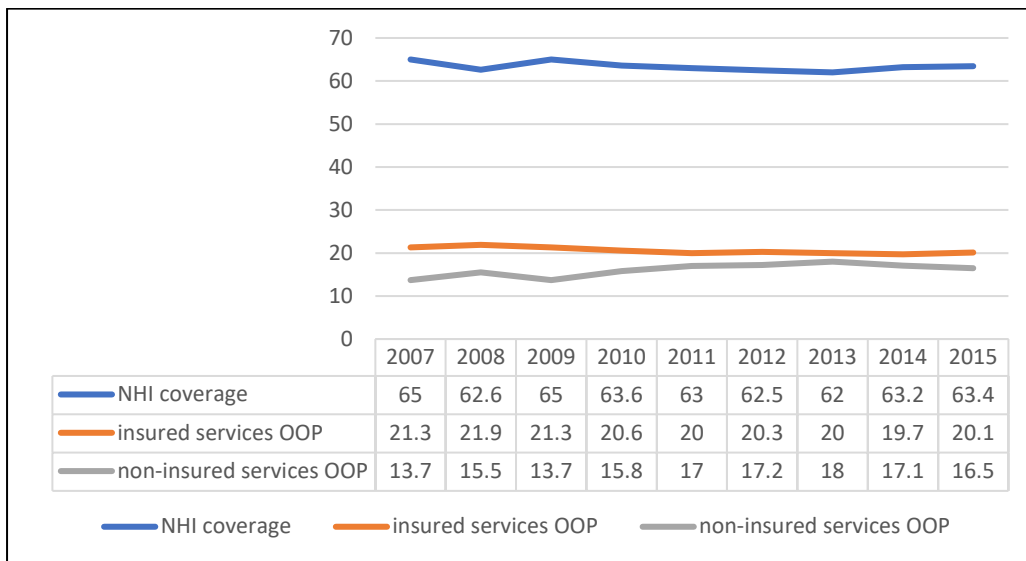
Source: 2015 Survey on the Current State of Medical Expenses (2016), NHS

For this reason, many people in Korea also depend on private health insurance. Korea's private health insurance coverage is supplementary to the NHI, and the rate of private insurance coverage is significantly higher than in other OECD countries (figure 7). According to OECD health data comparing private health insurance coverage in 2005 and 2015, there was a significantly greater increase in the private health insurance coverage rate in Korea than in other OECD countries. Private insurers can access the RRN-based medical records similarly to the HIRA and the insurance company can evaluate medical care services provided by providers to make decisions on reimbursement.

Figure 7: Private Health Insurance Coverage, According to Type, 2015

Legend: ■ Primary ■ Complementary ■ Supplementary ■ Duplicate

Country	Values
FRANCE	95.5
SLOVENIA	71.2 / 15.60
NETHERLANDS	84.1
ISRAEL	83.4 / 83.4
BELGIUM	81.6
CANADA	67
KOREA	66.8 / 66.8
UNITED STATES	55.3 / 7.7
AUSTRALIA	55.8 / 55.8
LUXEMBOURG	50.3
CHILE	18.8 / 29.5
IRELAND	45.4
DENMARK	36.5 / 36.5
AUSTRIA	36.2
GERMANY	10.8 / 23.1
NEW ZEALAND	28.8
SWITZERLAND	27.9
PORTUGAL	25.7
SPAIN	8 14.9
FINLAND	15.4
GREECE	11.5
UNITED KINGDOM	10.6
MEXICO	7.5
ICELAND	
SWEDEN	

Note: Private health insurance can be both duplicate and supplementary in Australia; both complementary and supplementary in Denmark and Korea; and duplicate, complementary and supplementary in Israel and Slovenia.

Source: OECD iLibrary: Population coverage for health care (https://www.oecd-ilibrary.org/sites/health_glance-2017-24-en/index.html?itemId=/content/component/health_glance-2017-24-en); Statlink: http://dx.doi.org/10.1787/888933603127

2) Affordability

Despite the universal coverage of the national insurance system, Korea had the second highest out-of-pocket cost ratio of OECD countries in 2015. Out-of-pocket expenses can be a financial burden for poor because the medical care received determines how much an individual has to pay regardless of his or her income. Poor households have reported that they have experienced a larger increase in the share of medical expenses in total household

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income than wealthier households (Jung and Huh 2012). According to the national health statistics, in 2013, the rate of unmet healthcare needs for economic reasons was 5.0 percent for low-income households, which is 4.2 times as high as the 1.2 percent for high-income households. High out-of-pocket expenses result in catastrophic expenditures on health, spending more than 10 percent of total annual household income. Copayments have risen due to an increase in services that insurance does not cover, such as new medical technologies, new drugs, extra payments for private wards, and surcharges for specialist services (WHO 2015).

Table 4: Economic Burden of Medical Expenses By Income Quintile

Classification	Indicators	Income Quintile					
		1 (low)	2	3	4	5 (high)	Q5/Q1
Economic burden of medical expenses	Percentage of population younger than 65 in households with health insurance premiums and out-of-pocket costs accounting for 10 percent or more of total household income	31.8	23.2	14.6	10.8	7.4	4.3
	Catastrophic health expenditure household ratio	6.9	2.5	1.2	0.7	0.5	14.9
	Percentage of households with unpaid health insurance premiums	3.2	1.3				2.5
Unmet needs	Percentage of people who could not see a health provider despite the need (in year)	26.0	19.4	9.9	7.1		3.6
	Percentage of people who could not see a health provider for economic reasons (in year)	22.3	17.9	8.2	6.2		3.6

Source: Adapted from Kang Heejung 2016

According to the Korean Institute for Health and Social Affairs 2016 Korea Healthcare Quality Report (Kang Heejung 2016), non-reimbursed copayments have significantly increased in Korea, and the number of households with catastrophic health expenditures has grown since 2009. As a result, the gap between income brackets is reported to become larger than before. For example, 6.9 percent of low-income households and only 0.5 percent of high-income households have catastrophic health expenditures—approximately 14.9 times as many low-income as high-income households (table 4, figure 8).

Figure 8: Medical Expenses by Quintile Income Class

Bar chart with y-axis from 0.0 to 35.0, showing three groups of bars labeled Q1, Q2, Q3, Q4, Q5.

Categories:
- Percentage of the population under 65 who belongs to households whose health insurance premiums and OOP are at least 10% of total household income
- Catastrophic health expenditure household ratio
- Percentage of households with unpaid health insurance premiums

Legend: ■ Q1 ■ Q2 ■ Q3 ■ Q4 ■ Q5
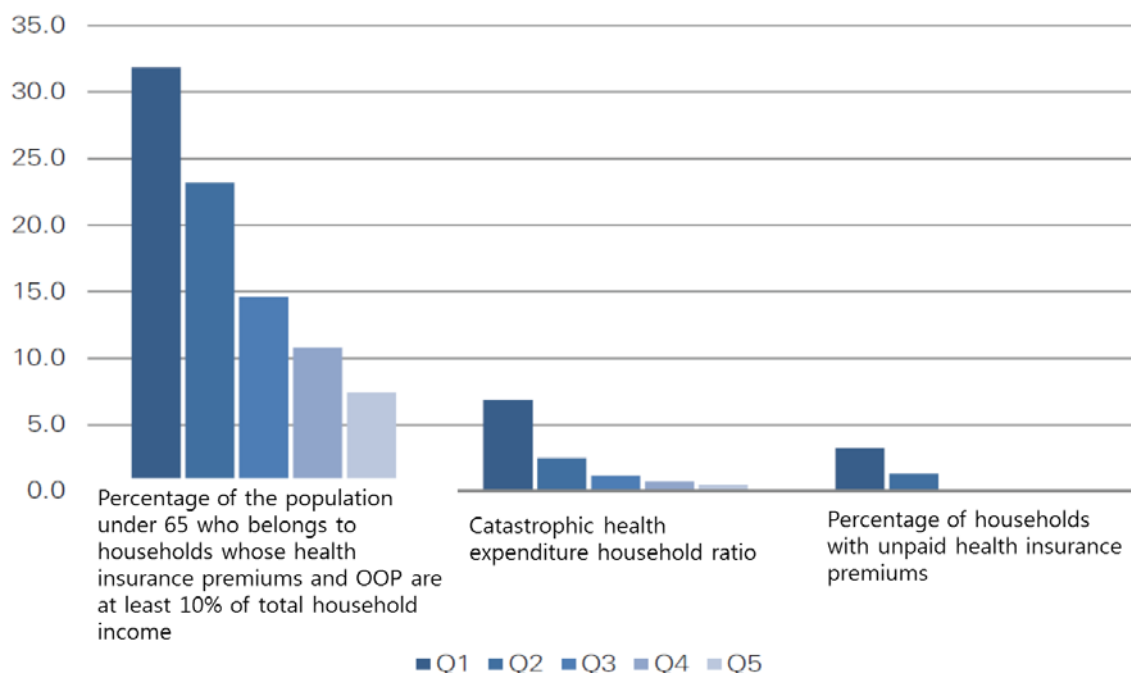
Source: Adapted from Kang Heejung 2016

Out-of-pocket payments can vary by individuals' economic conditions and the type of disease, of which information can be obtained using their RRNs. For example, from 2008, the Korean government implemented a policy to reduce out-of-pocket expenses for individuals with cancer from 20 percent to 5 percent. When individuals with cancer are treated at a medical facility, they are enrolled using their RRNs and are responsible for paying 5 percent of their medical and prescription drug expenses. In the case of high-priced anticancer drugs such as those that have been newly developed, if the cost-effectiveness is uncertain, the pharmaceutical companies and the NHIS will make a special contract to make the drug accessible. To receive the risk-sharing drug prescription, the patient is registered as a user of that drug based on his or her RRN.

3) Contribution to Social Insurance

Overall in Korea, citizens' insurance premiums finance 80 to 85 percent of Korea's NHI system budget, and the government finances the remaining 15 to 20 percent. Since 2007, the government has been required to pay 20 percent of estimated health insurance premiums, but the actual contribution by the government did not reach that level and the contribution was as low as 13.6 percent in 2013. Government payments have declined every year and were set at less than 10 percent for the 2018 budget, although this expires December 31, 2022, at which point premiums for the public could rise.

There have been continuous complaints about the unequal treatment of the health insurance premium system between the employed and self-employed, which has been in effect for 17 years. Employed subscribers' premiums are calculated based on income, and their family members (who have no income) can be enrolled as dependents without additional premiums.

For local subscribers, premiums are calculated based on a sum of points according to their sex, age, property, vehicle ownership, and income. The NHIS has been able to obtain income and property information for subscribers in connection with their RRNs.

Since July 2018, the NHI methods to calculate NHI premiums have changed. The previous method to calculate premiums used information on family members' sex, age, property, income, and automobile insurance even for subscribers with low or no income. Instead, the NHIS introduces a system that excludes the value of vehicles from the premium calculation for local subscribers when the vehicles are necessary for subsistence or are small or old. For employed subscribers, when extra earnings from interest or lease income exceed a certain level, the system will impose an income premium. Dependents used to be enrolled without restrictions based on proof of family relationship through the RRN, but beginning in July 2018, dependents with high incomes and substantial property ownership will gradually be shifted to individual local subscribership. By calculating an appropriate premium based on family, property, and tax information and changing the system to a sliding scale one based on subscriber's income quintile, Korea is trying to move towards a more equitable premium system.

1. Provider

1) Reimbursement

Health care providers register their provider license number and medical facility number with the NHI system using their own RRNs, and then the NHIS requests reimbursement for services provided. Next, the HIRA reviews and evaluates the claimed medical treatment and reimburses only for approved medical treatment. If the HIRA's review and assessment rejects the reimbursement claim, then providers may request the patient to pay in full.

The payment model in Korea is a fee-for-service system in which the price for a medical service (medical treatment, medicine, materials for treatment) provided by medical personnel in a medical facility is determined for each service, and payment is made according to quantity and price. To determine the cost of a service, a Resource-Based relative values scale[5] system calculation that considers work volume, medical treatment cost, and risk level for each medical treatment is performed. The amount is determined by multiplying the relative value score by the unit price per service type. The number of service items that are converted into scores increased 10-fold from 1977 to January 2017, reaching 9,219 items (HIRA webpage, 2017)[6]. According to the HIRA 2016 information on medical trends, medical treatment fees accounted for 41.1 percent of medical expenses, 24.6 percent of basic medical fees, 22.3 percent of drug costs, 8.3 percent of diagnosis-related group costs, and 3.7 percent of costs for materials for medical treatment. To review and assess the numerous service items for which types of benefits and services increase continuously at a rapid rate, the HIRA plans to introduce an

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[5] A Resource-Based relative values scale is the relative score of behaviors such as consultation, examination, and surgical procedures, calculated by the level of resource input expended when physicians produce services and procedures. It is a function of the physician's work input, the opportunity cost of specialty training, and the relative practice costs for each specialty

[6] https://www.hira.or.kr/dummy.do?pgmid=HIRAA020028000000

electronic review and assessment system based on EMR. The HIRA also plans to use an artificial intelligence system for a drug utilization review system. All these systems will be linked with the EMR as well as with patient and provider RRNs.

2) Performance Evaluation

The HIRA evaluates the quality of medical care of a healthcare provider, using the provider's license number and medical care agency number that are associated with the provider's RRN. Various Information on quality of services is used by the HIRA for providers' performance evaluation.

For example, the number of days for medication filled can be information used to evaluate the quality of care for hypertension.[7] Similarly, in the assessment of quality of diabetes care by a provider or his/her clinic, the number of prescription days for diabetes and percentage of patients who visit at least once every quarter can be used as indicators to monitor quality of care. Information on payments for prescription trends for outpatients, and unnecessary prescriptions of antibiotics as well as inappropriate prescription of injections for acute upper respiratory infections can be used to monitor providers' prescription behaviors. Thirty-day mortality for acute myocardial infarction, hemorrhagic stroke, and ischemic stroke can also be used to evaluate the quality of acute disease care. The goal is to reduce mortality by providing early and appropriate treatment.

Through an EMR-based review system, the HIRA plans to expand medical evaluation and performance-related payment to providers to improve medical care performance and quality of care.

3) Expenditure Control

Various monetary and non-monetary incentives or disincentives are provided to healthcare providers, based on their treatment and prescription performance, which is evaluated using their license and medical care facility numbers that are associated with the RRNs. In Korea, incentive/disincentive schemes have been implemented to regulate the cost and quality of medicine and medical care services. For example, in 2008, to reduce the growth of outpatient drug expenditures, Korea implemented a system that provides monetary and nonmonetary incentives to clinics that reduce drug costs. Whether the policy is successful, resulting an actual decrease in drug costs at a medical facility and in the high cost index of outpatient prescription drugs, is to be further evaluated.

Health expenditure control is a major policy objective of the MOHW. The government tries to have a firm control over health care expenditure because of expected cost increase due to various reasons including Korea's transition to a super-aging society and increasing demand for more advanced and better medical care (Heejung Kang 2016).

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[7] Managing blood pressure through regular medical visits and taking medication can reduce serious complications of hypertension. Therefore, the number of visits for blood pressure management and the number of prescriptions of hypertension medication can be indicators to evaluate quality of hypertension care. A higher rate of filled prescriptions (more days a medication is taken) results in a better performance.

However, policy efforts to control the increasing expenditure, especially, the prices of non-reimbursed services and products, are not yet successful. In April 2017, as an effort to control the cost of non-reimbursed services and products, the government commissioned the HIRA to disclose the cost of non-reimbursed medical care. The HIRA has started to disclose pricing information for 107 types of non-reimbursable care from 3,666 hospitals, but in the absence of an appropriate system for non-reimbursement management, price standardization of non-reimbursable items and disclosure of non-reimbursable medical care costs alone cannot achieve the goals to control expenditure.

In September 2016, when Article 45-2 of the Medical Service Act was newly established, the price disclosure system for non-reimbursable items became effective, and each medical facility has to submit the price data. Medical facilities have to submit data electronically using their license number. Many believe that it is necessary to construct a non-reimbursed medical care cost monitoring system that provides real-time updates by constructing an integrated management system. For this, standardization of the non-reimbursement classification system should be developed, and a standard model that can be linked with the EMR should be developed. Government apparatus, such as the Non-reimbursement Management Policy Council, Non-reimbursement System Improvement Task Force, and Institutionalization of Catastrophic Health Expenditure Support Council, are working to establish a comprehensive standard for reimbursement in Korea.

2. Government

1) Coverage Enhancement

For the government, Individual's RRN is a tool to provide enhanced insurance coverage for the patient who needs the extra benefit coverage.

As an effort to enhance NHI coverage and to protect the vulnerable population from catastrophic medical expenditure, in March 2013, the MOHW established the 4 Major Serious Diseases Security Enhancement Plan and then the 4 Major Serious Diseases Medical Care Enhancement Plan from 2013 to 2016. The four major serious diseases are cancer, heart disease, brain disease, and rare and incurable disease. Of the 50 diseases for which large-scale medical expenses (annual healthcare costs of over KRW 5 million), these four diseases accounted for 61% in 2011. Because of lack of cost effectiveness, these diseases require many medical treatments and medicines that insurance does not cover. According to the health insurance coverage enhancement program, a diagnosis of one of the four diseases (cancer, heart disease, brain disease, and rare and incurable disease) is recorded in the individual's claim record that has the patient's RRN, and the government applies a distinctive insurance standard that provides extended insurance coverage for the patient.

The MOHW is also attempting to reduce the household burden of 1.8 million individuals with a medical condition from catastrophic expenditures related to other serious diseases. Meanwhile, the MOHW has expanded its benefits to 100 items, including 25 items such as ultrasound in 2013 and high-end cancer drugs and advanced diagnostic methods in 2014, lowering the patient non-reimbursement burden by 42.9 percent (KRW 434.4 billion) from KRW 1.119 billion in 2012 (figure 9). In 2015, the MOHW expanded reimbursement for high-

priced cancer drugs, high-cost treatment methods, and advanced essential tests and expanded health insurance coverage for individuals with rare diseases. In addition, the MOHW has been pursuing a policy of partially covering expensive new medical treatments to decrease the burden of medical expenses. For items that insurance only partially covers, diagnosis, treatment, effectiveness, and price are reassessed every three years.

Figure 9: Increasing Health Insurance Coverage

Total Scope of non-reimbursement for 4 Major Serious Diseases

Total of 4.27 million people have received the benefit

Decrease in 42.9%

1 trillion and 11.9 billion KRW

577.5 billion KRW

2012

2014

Drugs 7 3 items **+** **Surgery 31 items** **+** **Tests 21 items** **=** Total of **125** items covered by the Health Insurance

Drugs	Erbitux, Drug Therapy for Colorectal Cancer (Monthly) 450 million KRW	➡	23 million KR
Surgery	OOP of Artificial Vocal Cord Insertion, 94 million KRW	➡	33 thousand KRW
Examination	OOP of Capsule Endoscopy, 1.3 million KRW	➡	10.7 million KRW

Source: MOHW: The total scope of uncovered four major diseases and additional item types for improved coverage protection, 2017[8]

2) *Evidence-Based Policy Decisions*

Patients' RRNs can be also used to facilitate the government to make evidence-based decision-making. As a part of evidence-based medicine, since 2007, the new medical technology evaluation system of the National Evidence-based Healthcare Collaborating Agency (NECA) determines whether new and existing medical technology is safe and effective. Currently, the MOHW, National Evidence-based Healthcare Collaborating Agency,

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[8] http://www.mohw.go.kr/sotong/cy/scy0101ls.jsp?PAR_MENU_ID=12&MENU_ID=12040501&page=3

and HIRA run the program together (figure 10). Since its introduction, approximately 2,000 evaluations have been performed to prevent the use of medical technologies that have not been verified. The new medical technology evaluation system of the National Evidence-based Healthcare Collaborating Agency confirms the basic safety and efficacy of medical technologies that are available to all citizens under the Korean health insurance system, but there has been disagreement among stakeholders about the appropriate methods of evaluation (Park 2017).
.
The new medical technology evaluation system uses the clinical ground of applied medical technology as the basis for assessment. Artificial intelligence, large-scale rapid sequencing, 3D printing, and medical technology using robots have not yet matured as reliable medical technologies. So, it is important to develop a framework for how these new technologies, will be evaluated and introduced. Clinical trials should be registered with patients' RRNs so that the process can be followed closely based on the framework.

Figure 10: The New Medical Technology Evaluation System
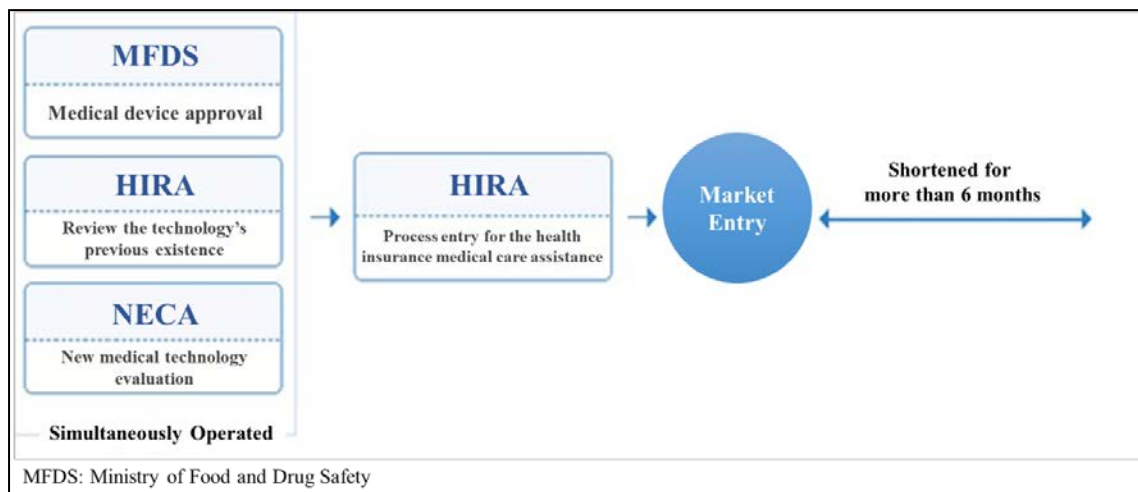
Source: National Evidence-based Healthcare Collaborating Agency webpage[9]

3) Sustainability and Innovation

Maintaining a solid vital statistics system of the population based on the healthcare big data can be useful for producing innovative solutions for the sustainable healthcare system. Korea is experiencing a rapid change in population composition due to an increase in the proportion of elderly adults and a decline in the fertility rate. By 2026, Korea is expected to be a super-aging society in which elderly adults will account for 20 percent of the population (Gong 2017). The total fertility rate of Korea is approximately 1.05 in 2017. Despite the government's effort to increase the fertility rate with extensive spending, there has been no visible result. This situation is expected to persist for a long time because of sociocultural and economic factors such as long-term employment instability and difficulty in work-life balance that are challenging

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[9] https://www.neca.re.kr/eng/lay1/S120T136C138/contents.do

to address. With the prospect of a declining economically active population beginning in 2017, because of the low fertility rate and aging population, the rising cost of healthcare for elderly adults has become a challenge for health insurance sustainability.

In addition, income per capita is estimated to be close to US$30,000, which is expected to further heighten the public's desire for better health and longer life. At the same time, expectations for better quality of healthcare services will increase, and demand for new and different forms of healthcare services will arise. The rapid increase in the prevalence of chronic diseases, which is an important factor in global health, is also occurring in Korea. In particular, there is a great increase in demand for mental healthcare and treatment of noncommunicable diseases such as hypertension and diabetes. These factors will continue to increase national health expenditures and threaten the sustainability of health insurance financing.

In addition, Korea as an information technology powerhouse is experiencing a powerful wave of the fourth industrial revolution, with the growth of big data, the Internet of things, and information and communication technology. There is a gradual shift in how customized medical services that monitor and analyze individuals' vital signs to predict health risk factors and manage them in cooperation with physicians are growing. Personal health-related mobile data are accumulating, and when these data are combined with clinical data and specimen analysis data such as genomes, the evidence-based standard healthcare technology assessment will soon move beyond its current possibilities, toward customized prevention, diagnosis, and treatment based on differences in individual genetic traits, lifestyle, and habits.

Korea has cumulative health insurance data that only a few countries in the world possess thanks to its RR system, the NHI with the entire population coverage, and the single-payer system. Health, income, property, tax payment, and insurance payment information for each patient is connected through the RR system linked with RRNs, which makes the NHI management to be more efficient and effective. Nevertheless, the Korea health care system is in need of innovation that not only promotes more efficiency but also pursues sustainability, equality, and quality for all.

PART V – CASE STUDY

A. PREVENTION

1. Infectious Disease Immunization Support Program

1) Enrollment

Based on Article 33 (2) of the Infectious Disease Control and Prevention Act, the vaccination information system of the Korean Centers for Disease Control and Prevention (KCDC) registers and manages inoculation. This system links the KCDC with local public health centers in each city and district and medical facilities that are in charge of vaccination services. It is also linked to other ministerial department databases to manage vaccination records, such as the RR Information System of the Ministry of the Interior and Safety, the Social Welfare Integrated Information System of the MOHW, and the National Education Information System of the Ministry of Education (figure 11). RR numbers are used as the PINs to link the various systems for registration and management of vaccinations.

For example, the Ministry of Education's National Education Information System data are used to determine whether a child has been vaccinated and to make sure that nonvaccinated children receive vaccinations. Using the RR number, day care centers use the MOHW social welfare integrated information system and integrated child care management system to confirm whether children have been vaccinated and to make sure that unvaccinated children receive vaccinations. When all vaccinations have been received, the vaccination history will be reported to the MOHW social welfare integrated information system. The NHIS is provided with vaccination records for infants and toddlers, and local public health centers and private medical facilities can prevent double vaccination by examining vaccination history before administering immunizations.

Figure 11: Vaccination Information System
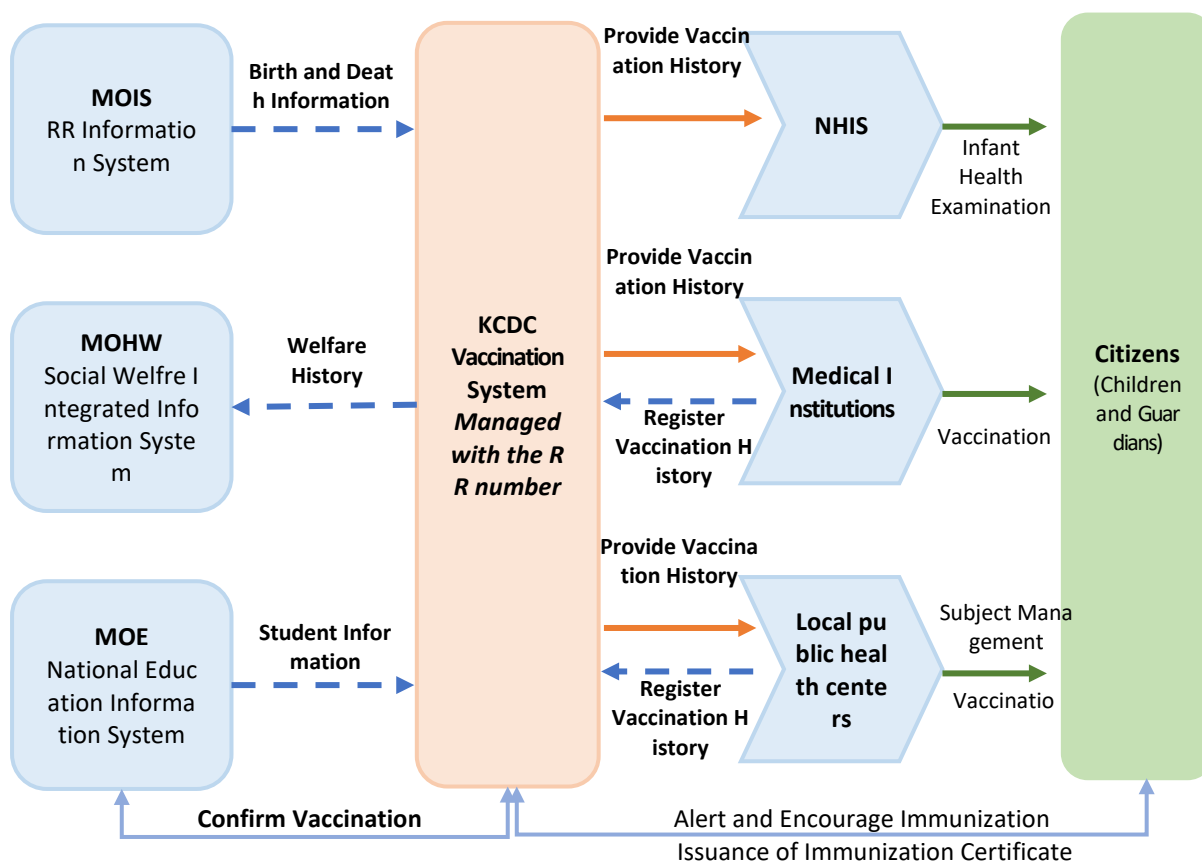
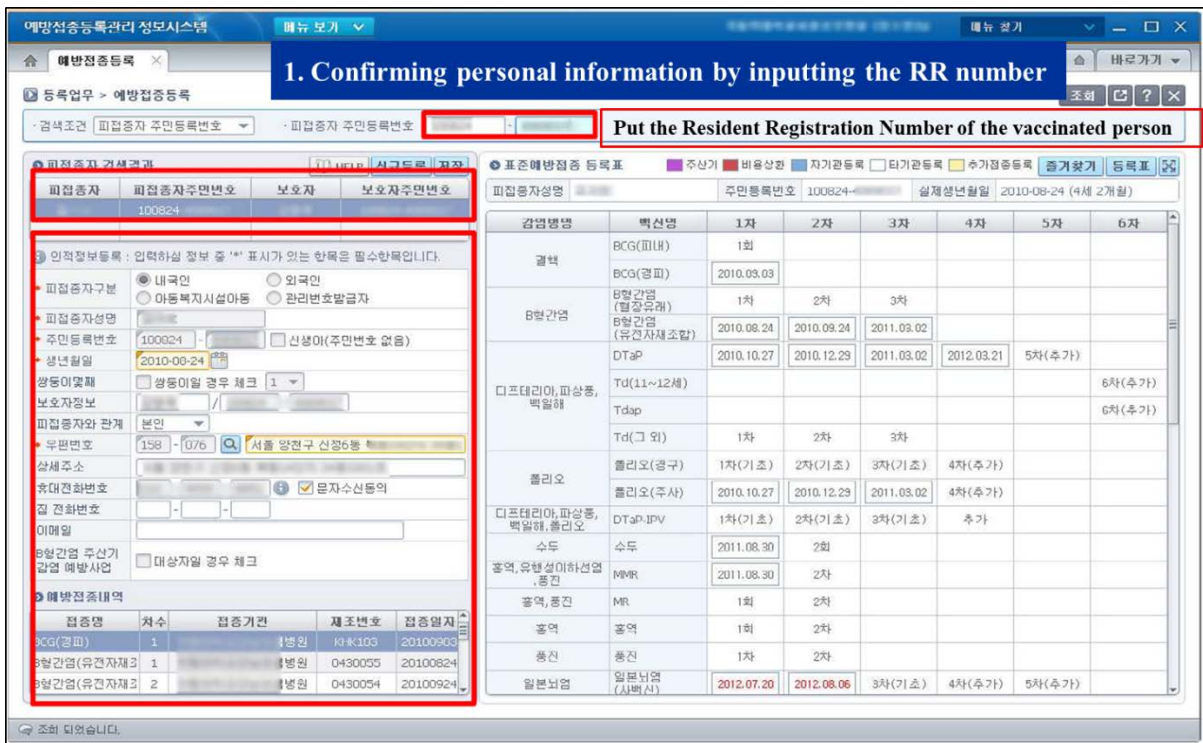*Source:* Korea Center for Disease Control, 2015[10]

2) Management

The data linkage between the vaccination information system and other ministerial departments and institutions is based on an individual's RR number. Vaccination records of infants are managed using the mother's RR number, registering information about vaccinations needed in the first month after birth (BCG, first hepatitis B vaccination). If birth notification is delayed, the local public health center can register the infant and issue a control number. Electronic registration and reimbursement will follow. After birth notification, all vaccination records are integrated and managed using the RR number. For foreigners, the alien registration number issued pursuant to Section 31 of the Immigration Act is used to manage vaccinations. The local public health center issues a control number to people without an alien registration number and institutionalized children who do not have a medical benefit number, and the vaccination information system manages the vaccination record.

Figure 12 is a screenshot of the vaccination information system used in medical facilities. After confirming personal information by entering the RR number of the individual, vaccination numbers and dates for all vaccinations are recorded. This history can be accessed by entering the individual's RR number at any medical facility or local public health center that provides vaccination.

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[10] The immunization registry, KDCD, 2017 https://nip.cdc.go.kr/irgd/introduce.do?MnLv1=3&MnLv2=4

Figure 12: Screenshot of Integrated Immunization Management Information System
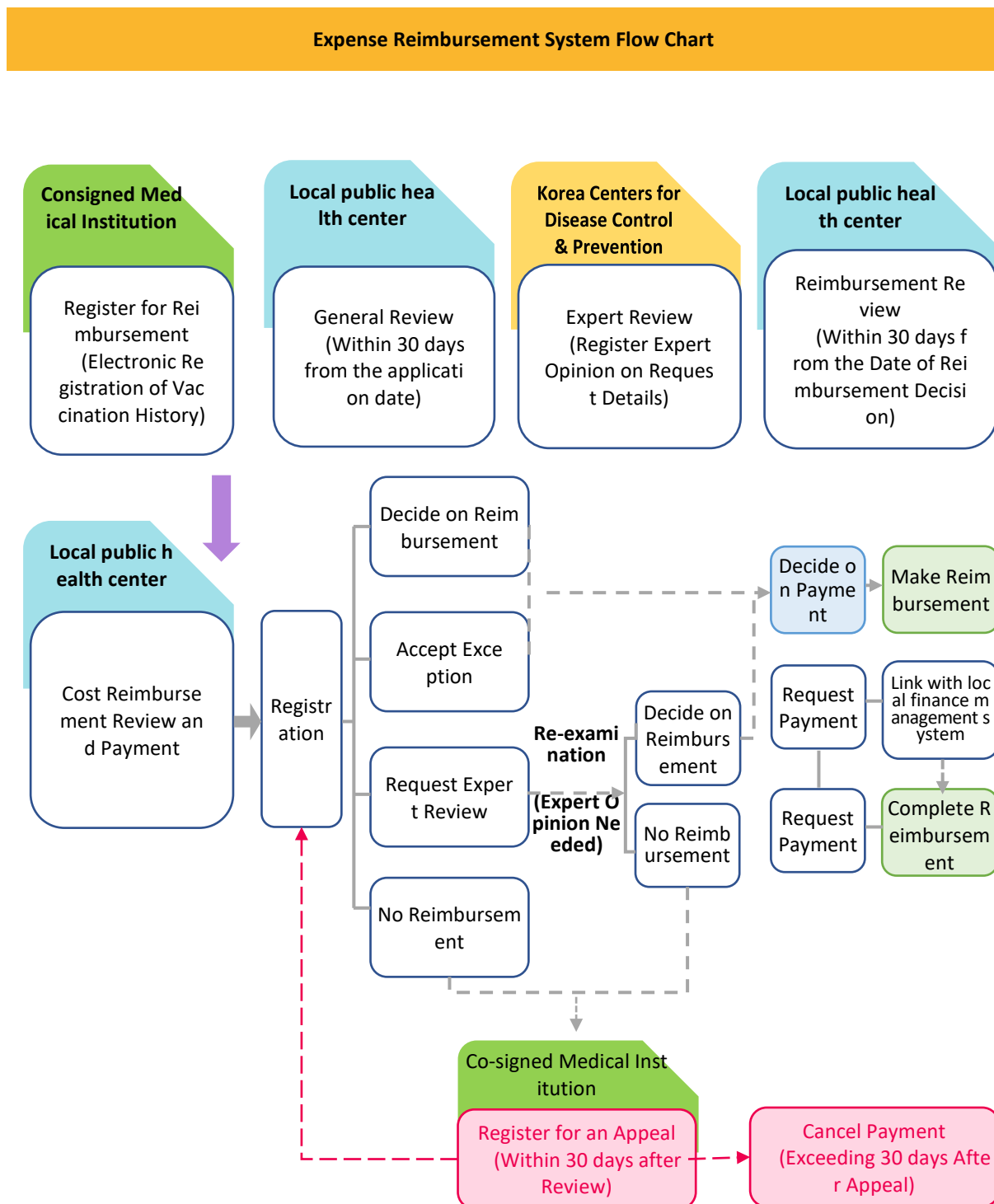

Source: Immunization registration management information system, Korea center for disease control (access 2017. 11. 23)

The public cannot directly access this management system, but they can manage their own vaccination history through the KCDC Vaccination Help site (https://nip.cdc.go.kr/irgd/index.html). Records on when and where and the number of vaccinations that were administered, can be obtained at any time, and people can receive text messages at a registered mobile phone number with information about vaccination names and timing. Infant vaccination and H1N1 vaccination for pregnant women can be managed using the webpage.

3) Review and Feedback
The billing and screening system for the immunization program is shown in Figure 13. At the medical facility, vaccinations are administered after confirmation of the identity of the recipient. Information about the vaccinations is registered using the RR number of the recipient or of his or her guardian, and the reimbursement process begins. Information about the vaccination is sent to the designated local public health center for the recipient's RR address. The results are received, reviewed (general review, expert review, and appeal), and submitted to the local public health center for delivery to the recipient's RR address.

Figure 13: Flow of Immunization Program and Reimbursement System

Expense Reimbursement System Flow Chart

Consigned Medical Institution
Register for Reimbursement (Electronic Registration of Vaccination History)

Local public health center
General Review (Within 30 days from the application date)

Korea Centers for Disease Control & Prevention
Expert Review (Register Expert Opinion on Request Details)

Local public health center
Reimbursement Review (Within 30 days from the Date of Reimbursement Decision)

Local public health center
Cost Reimbursement Review and Payment

Registration

Decide on Reimbursement
Accept Exception
Request Expert Review
No Reimbursement

Re-examination (Expert Opinion Needed)

Decide on Reimbursement
No Reimbursement

Decide on Payment
Make Reimbursement

Request Payment
Link with local finance management system

Request Payment
Complete Reimbursement

Co-signed Medical Institution
Register for an Appeal (Within 30 days after Review)
Cancel Payment (Exceeding 30 days After Appeal)

Source: Korea Center for Disease Control and Prevention 2016

The recipient is required to report any adverse reactions that occur after the vaccination; the KCDC runs the National Vaccination Committee and the Vaccination Damage Compensation Committee to conduct ongoing program reviews and provide feedback.

2. Meal Aid Program for Undernourished Children

1) Enrollment

Local governments in Korea run meal aid programs for undernourished children under Article 4 (Responsibilities of the State and Local Governments), Article 35 (Preservation of Healthy Body and Soul) Section 2, No. 3 (Matters Concerning the Prevention of Skipping Meals and Improvement of Nourishment Through Subsidized Meals), and Article 36 (1) (Enforcement Degree of Child Welfare) of the Child Welfare Act [11].

Figure 14: An Application Form for the Meal Aid

Source: A Meal Aid Application Form of Gangnam District, Seoul

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[11] The Minister of Health and Welfare, mayors of the city, province, and district, in accordance with Article 35 (4), must provide meals to children at risk of being neglected, under the Article 2(2) of the National Basic Living Security Act and low-income household children under the protection of Article 5 of the National Basic Living Security Act.

Figure 14 is an image of a meal aid application. Personal information and the RR number of the child beneficiary must be entered on the application. A consent form for joint use of administrative information is attached to the application. Providing consent allows the official to access the Public Information Sharing Network using the applicant's RR number to review the applicant's record (e.g., household income, whether child is from a single-parent household, whether child has disabilities) to determine eligibility.

Figure 15: Application for Electronic Card for Meal Aid

	Name	Personal Identification Number	Address	School/Year
Recipient Child				

Application of the Electronic Card for the Food Service and Consent on the provision of Personal Information

| Service Delivery | Food Service Facilities ( )   General Restaurants ( ) | | | |

Service	Weekdays	
	① Breakfast( ) ② Lunch( ) ③ Dinner( )	
	Weekend during semester	
	① Breakfast( ) ② Lunch( ) ③ Dinner( )	
	During vacation	
	① Breakfast( ) ② Lunch( ) ③ Dinner( )	

I apply for the electronic card and agree with the provision of information above, based on the consent of provision of personal information in the 「Act on Real Name Financial Transactions and Confidentiality」 and 「Enforcement Decree of the Act on Real Name Financial Transactions and Confidentiality」.

Month /Day / Year

Relationship with the child :   Name :   (Signature)

To the Head of Gangnam-Gu
To the President of Woori Bank

2) Management

Meal aid for undernourished children comes in various forms (e.g., vouchers, meal cards to use in restaurants, a designated cafeteria, or lunchbox delivery). People have complained that use of meal cards can be stigmatizing because the payment must be made on designated equipment, and the card has a recognizable design. Improvements have been suggested such as integrating the meal plan card with ordinary welfare voucher cards that other citizens use widely, changing payment methods, or altering the design of the card (Lee Seung-Mi 2015). As a response to these concerns, Seoul city introduced new programs, such as delivering home-made lunchbox and credit-card like meal vouchers. Personal information such as the child's RR number is provided to the financial institution that provides the electronic meal card; when submitting application forms for meal aid support, applicants must consent to provide personal information to the financial institution.

3) Review and Feedback

The childcare departments of local governments operate meal aid programs for undernourished children, but a children's committee deliberates and reviews selection of eligible children and determines how meal aid will be provided and its quality will be ensured. The composition of the children's committee depends on each local government's ordinance but generally consists of members of the community that the chief of the village recommends, and the district mayor then appoints. The committee meetings take place at set times throughout the year. The committee selects applicants, evaluates how to provide meals, selects meal providers (company), and monitors services (menu selection and inspection). These committees consider recipients' family situation and income in determining eligibility. The beneficiary's RR number is used as his or her identification number for the program.

3. Nutri Plus Program

1) Enrollment

The Nutri Plus Program is a nutritional support management program for infants and pregnant women operated by local public health centers and is similar to the U.S. Special Supplemental Nutrition Program for Women, Infants and Children. The program has its legal basis in Article 15 (Nutrition Improvement) and Article 19 (Health Promotion Programs, etc.) of the National Health Promotion Act and Article 11 (Nutrition Management Services for Poorly Nourished Classes of People) of the National Nutrition Management Act. The pilot program was implemented in 2005 and expanded to operate as a nationwide program in 2008.

This program is provided to the National Basic Livelihood Security recipients[12], individuals near poverty, households earning less than 80 percent of the median income, infants younger than 6 years old in vulnerable households, pregnant woman, new mothers, and mothers who are breast feeding who have at least one of four conditions (anemia, underweight, poor growth, malnutrition), targeting individuals with poor nutritional status. Recipients are provided with nutrition education and nutrient-rich foods such as rice, carrots, potatoes, eggs, and milk and receive regular nutrition check-ups.

During the selection process, program managers first determine the number of family members and household members. The RR number is used at the public information sharing center to confirm the relationship between the mother and child. The health insurance premium, health insurance card or insurance payment receipt, eligibility certificate, and RR certificate for households will be examined to verify the income level of the beneficiaries. Currently, individuals must provide these documents. It is argued that procedures to prove the beneficiary's income level should be streamlined using the public information sharing system to simplify the procedure and documentation (Lee Yoonna et al. 2014).

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[12] National Basic Livelihood Security Program that was introduced in 2000 in Korea has income guaranteed program. This program implemented to help those who have difficulty in living to pay for their needs and to help them live their lives at the minimum level.

Table 5: List of Documents to be Submitted When Applying for Nutri Plus Program

Category of information	Examples of Documents
RR	Copy of birth certificate, RR or family relationship registration certificate
Health Insurance	Health and long-term care insurance payment receipt, health insurance qualification certificate
Birth	Proof of pregnancy and childbirth: maternal handbook (copy), doctor's diagnosis certificate or notes of pregnancy
Income	National basic livelihood recipient confirmation document or near poverty group confirmation document (only when relevant)
	Vehicle insurance certificate (employed subscribers only)

2) Management

The Nutri Plus program consists largely of providing supplementary food, nutrition education, and counseling. Supplementary food is delivered directly to the recipient's home or distributed at various places like welfare centers and public health centers. A receipt should be provided to the local public health center to ensure that the supplementary food has been delivered to the intended recipients. Nutrition education and counseling programs consist of group classes, individual counseling, and home visits. In each local public health center, the Nutri Plus program management system (operated within the local healthcare information system) must input and record recipient management details and nutrition status evaluation results.

As part of the effort to protect personal information during implementation of the Nutri Plus program, based on the Personal Information Protection Act, the MOHW is required to obtain a consent form for gathering personal information when registering recipients. Because the supplementary food distribution system delivers items to the home, the recipient's personal information must be provided to a third party such as the food distributor. Therefore, local governments may collect only the personal information necessary for the program, and they are advised to pay close attention to the security of such information. Figure 16 shows the consent form for using personal information.

Figure 16: Consent Form to Collect and Use Personal Information for Nutri Plus Program

3) *Review and Feedback*

The overall process of determining eligibility of Nutri Plus program recipients (including interim reevaluation and end-of-term evaluation for discharge from the program) uses the RR number. Figure 17 shows the Nutri Plus program's overall management and review process for recipient eligibility evaluation and feedback.

First, selected recipients receive supplementary food, health counseling, and nutrition education for 6 months, after which they are reevaluated. At this time, recipients must re-submit personal income documentation or a family relationship registration certificate based

on RR number to be reassessed for eligibility. If the criteria are not met at the reevaluation stage, the recipient will be discharged. Also, if there is a change in qualification status before the 6 months, the recipient will be discharged. After an individual has received benefits for 12 months, recipients are discharged from the program.

Figure 17: Nutri Plus Program Recipient Selection and Qualification Management System
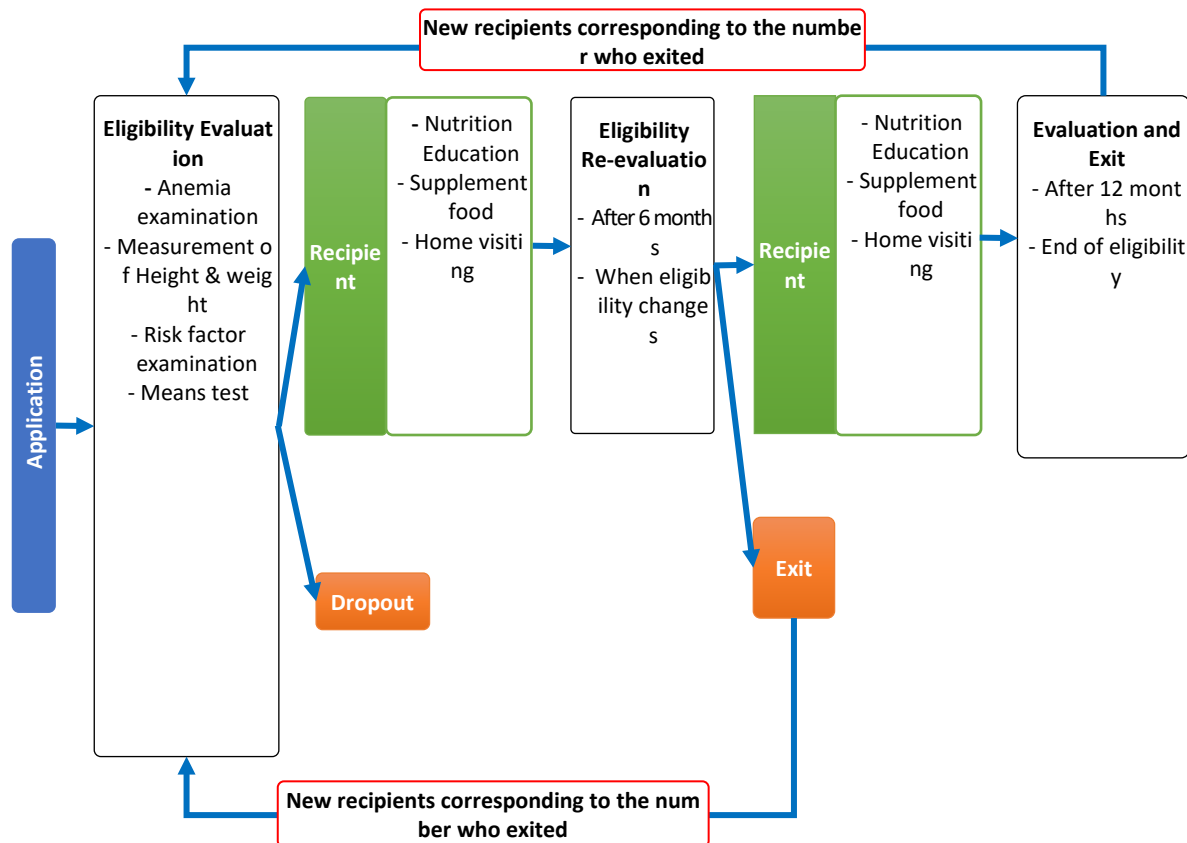
Source: Gangnam District, Seoul, 2017

4. Health Promotion Programs at Local Public Health Centers

1) Enrollment

Because local public health centers are also medical facilities that operate within the NHI system, they utilize recipients' RR number when they operate various health promotion programs. At local public health centers, individuals with chronic disease are treated, infants and children receive health examinations, national immunization are provided, and postpartum and prenatal maternity support care is provided.

2) Management

In addition to providing various public health services, based on the Framework Act on Health and Medical Services, local public health centers also conduct long-term epidemiological studies on chronic diseases and collect data. The Pharmaceutical Affairs Act requires the Korean Institute of Drug Safety and Risk Management to request data that includes RR number to collect drug safety information from public health centers. Then, the centers must provide the information after deleting personal identification information (including RR number).

For example, the Mother and Child Health Act allows limited access to data including RR numbers to implement maternal and child health programs at medical facilities or local public health centers. For prenatal and postpartum care support services are provided to residents in the district of the local public health center, recipients' resident numbers and addresses are required to determine eligibility. Programs such as adolescent pregnancy and childbirth medical expense support programs, infertility treatment support programs, and prenatal care services are also managed by RR numbers. The postpartum maternal and child health management support programs, newborn hearing screenings, congenital metabolic abnormality tests, and support for medical expenses for premature birth and congenital anomalies work similarly.

Benefit support that the NHI covers can be provided in the form of a voucher card using the RR number. For example, a voucher of KRW 500 thousand per child can be used for up to 6 months after birth. Infant and child examinations and vaccinations are managed based on RR number so that they can be accessed at local public health centers and general medical facilities. The infant and child health examination program can be accessed at local public health centers and medical facilities using the RR number. Guidelines for examination schedules and the list of medical facilities that provide these services are sent in the mail to the address registered in the RR system.

In contrast, school health programs are managed using the students' school name, class number, and student number instead of a student's RR numbers. So, education authorities administer physical examinations, nutrition examinations, and some health management programs that educational institutions conduct using data on school name, class number, student number. In such cases, their names and school numbers are linked to the students' RR number.

The process of reporting and evaluating the management results for health promotion programs or maternal and child health programs at the local level differs between programs. In the case of the medical expense support program, during the claim process the RR number of the applicant is used as a means of personal identification. Such linkage can facilitate evaluation and facilitate steering committees for each of the maternal and child health programs to provide evaluation of the programs and feedback on their performance using the quality of care information.

5. Summary

Local community-based disease prevention and health promotion programs and nutrition programs are examples for preventive healthcare systems that are linked to RR numbers. For disease prevention and health promotion programs, vaccination management programs, health promotion programs, and maternal and child health programs were introduced. For the nutrition programs, undernourished child meal aid programs and Nutri Plus programs were described as case studies to examine how RR numbers and personal identification information are used at each stage of the program.

Table 7 summarizes how RR numbers are used at each stage of these programs. First, in the registration phase of the immunization management program, the National Immunization Registry manage recipients' vaccination history using their RR number as a PIN. In the management stage, the medical facilities administering the vaccine should prevent double vaccination by checking recipients' vaccination history by entering their RR number into the information system. Recipients can check and manage their own vaccination history on a website and are provided with information on the next required vaccination. Finally, at the review and feedback stage, the medical facility reports personal information, including recipients' RR numbers and their vaccination history, to the local public health center. Vaccine recipients may report any adverse reactions that occurred after vaccination. The National Vaccination Committee and the Vaccination Damage Compensation Committee conduct ongoing program reviews and feedback processes.

For the health promotion programs and maternal and child health programs that local public health centers provide, RR numbers are used as the main tool to register recipients. RR numbers are also used in establishing programs and policies for health promotion and safety of residents. To protect privacy, RR numbers are handled in a restricted way when the numbers are collected for a long-term epidemiological survey of chronic diseases and for the establishment of health promotion plans.

For the undernourished children's meal aid program, the RR number is also used in all stages of enrollment, such as recipient registration, management, and screening. A child's RR is used to obtain information on family relationships and household income from the Public Information Sharing System to evaluate his or her eligibility for meal aid. In the program management stage, the child's RR number is provided to the financial institution issuing the meal card so that the electronic meal card can be issued to the child and its use managed. Finally, in the

review and feedback phase, the children's committee for each local government continues to reevaluate the child's eligibility and provides evaluation and feedback to the children's meal aid program. During this process, the child's RR number is used as a means of individual identification.

The Nutri Plus program for pregnant women, new mothers, and infants uses the RR number to check personal information, residence information, the relationship between the mother and child, and income data at the recipient registration stage. In the program management operation stage, management details and nutrition status screening results are continuously reported to the Nutri Plus Program Management System based on recipients' RR numbers. Finally, during the review and feedback stage, the RR number is used to identify the information needed to reevaluate eligibility.

Table 6: Cases of RR Number Use in the Prevention Phase of the Healthcare Program

Classification	Disease Prevention and Health Promotion Program		Nutrition Program	
Program / Stage	Vaccination Management	Local Public Health Center Health Promotion Program and Maternal and Child Health Program	Undernourished Children's Meal Aid Program	Nutri Plus Program
Enrollment	When registering vaccination history with the National Immunization Registry, RR number is used to identify personal information.	Health promotion programs and maternal and child health programs are provided to individuals identified by RR numbers at local public health centers.	Public information sharing system based on RR number is used to investigate personal information and home environment of recipient children.	To review eligibility of pregnant women and new mothers who wish to receive nutritional support, personal information and income details are checked and verified using RR number.
Management	-The medical facility must confirm recipient's previous vaccination history using the RR number in information system before vaccination. -Individuals can manage their vaccination history through a website. They also receive notification of their vaccination schedule.	- Data with RR numbers are used for long-term epidemiological study on chronic disease and establishing health promotion plan. - To operate the maternal and child health program, RR numbers are used to review eligibility.	- A child's RR number is provided to the financial institution that provides an electronic meal card. - There are various attempts to eliminate factors that may stigmatize recipients.	RR numbers are used to follow up recipient's management history and results from nutritional assessment in the Nutri Plus program management system.
Review & feedback	- Medical facilities report personal information including RR numbers and	For the medical expenses subsidy program, recipients' RR numbers are used to	Assessment Committee for Children's Welfare established in each	During eligibility reevaluation process in the Nutri Plus program,

| | vaccination records to local public health centers and receive reimbursement.
- The recipients can report on any adverse reactions after vaccination, and the National Vaccination Committee and the Vaccination Damage Compensation Committee provide continuous program review and feedback. | determine eligibility and an appropriate level of the subsidy. Medical facilities use recipients' RR numbers to request payment. | municipality reevaluate eligibility and provide feedback and evaluation of children's meal aid program. Personal information including the child's RR number is used. | related information is checked using RR number to access income details and family relationship information. |

B. TREATMENT AND MANAGEMENT

1. Registration and Management of Individuals with Infectious Diseases

1) Enrollment

Under the Infectious Disease Control and Prevention Act, to prevent infectious diseases and transmission of infectious diseases, a report and notification system is used for individuals with infectious diseases. Individuals with infectious diseases must be identified and listed for infectious disease sample surveillance, epidemiological investigation, and medical examination. According to the Infectious Disease Control and Prevention Act, Article 76-2 (Request to Provide Information, etc.), if necessary to prevent infectious diseases and block the spread of infection, the Minister of Health and Welfare or the Director of the KCDC may request that the heads of relevant central administrative agencies and local governments, medical facilities, pharmacies, corporations, and organizations provide personal information and RR numbers of persons with infectious diseases and persons likely to have infectious diseases. In particular, infectious disease surveillance agencies, such as medical facilities and the Korean Immigration Service, must submit personal information based on the infected person's RR number to the KCDC, MOHW, and HIRA.

Figure 18: Diagram of Reporting and Registration System for Infectious Disease
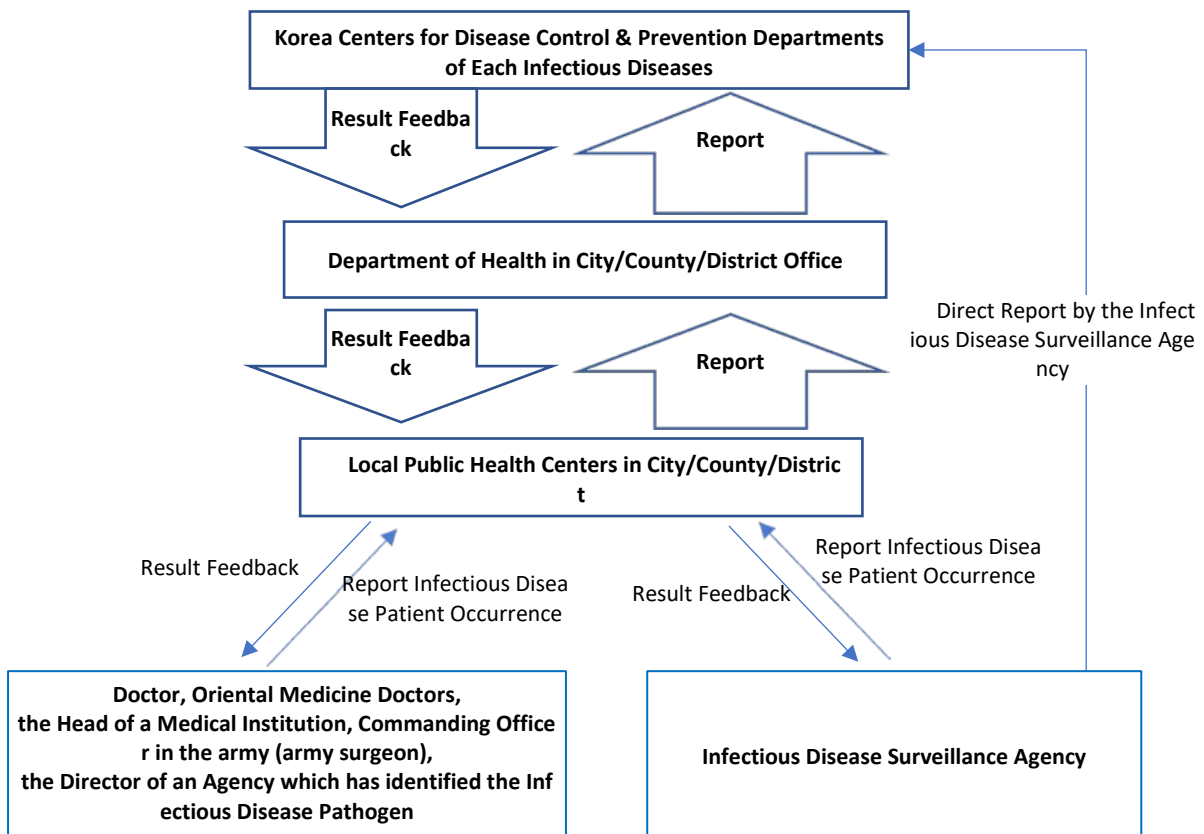
The KCDC operates the Integrated Disease Management System (https://is.cdc.go.kr) as a web-based infection control and report system. Each medical facility and infectious disease surveillance agency can register an individual with an infectious disease to the local public health center. It is also possible to report to the KCDC through the web-based integrated

disease management system using the personal information and RR number of an individual with infectious disease. Test results are recorded in the integrated disease management system. Figure 18 is a diagram of the reporting and registration system for infectious disease.

2) Management

The Minister of Health and Welfare and the heads of the local governments may conduct investigations and examinations to determine the diagnosis of an individual who is suspected of having an infectious disease. If the individual tests positive for the disease, the minister or government head has the power to hospitalize and treat the individual. The individual will be hospitalized at a designated hospital for infectious disease or given a self-management option, and management measures will be implemented. The method of treatment and management of individuals with infectious disease, and completion of hospitalization and self-management, should be reported to and confirmed by local public health centers. At this time, those individuals are followed up by their RR numbers.

According to the Enforcement Decree of the Infectious Disease Control and Prevention Act, Article 32-3 (Processing Sensitive Personal Information and Personally Identifiable Information), regional and local governments (including any person to whom relevant authority is delegated or entrusted) may process data containing information on health prescribed in Article 23 of the Personal Information Protection Act and RR numbers or foreigner registration numbers prescribed in subparagraph 1 or 4 of Article 19 of the Enforcement Decree of the same act. This type of sensitive information, including RR numbers of individuals with infectious diseases, will be provided to the designated institutions in charge of prevention and management of the infectious disease. The sensitive information must be used only for this purpose, and the information must be deleted immediately after the purpose has been fulfilled.

3) Review and Feedback
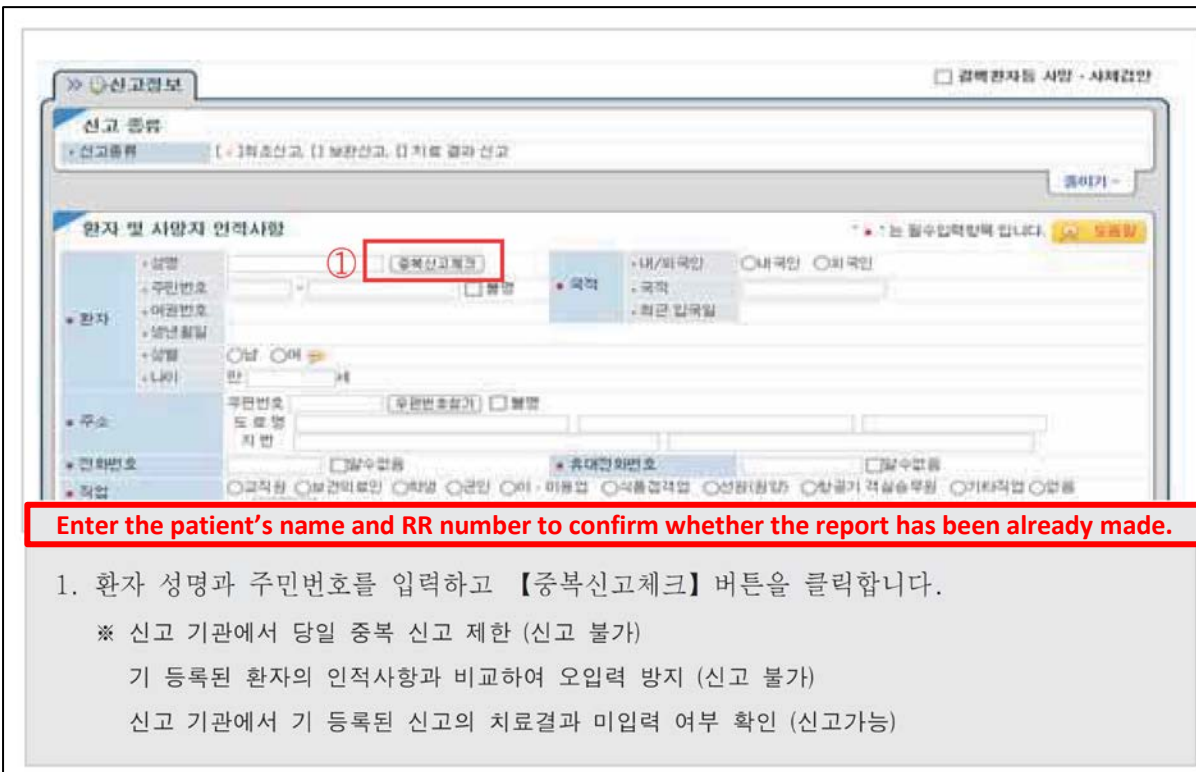
According to the Infectious Disease Control and Prevention Act, the government must pay compensation to individuals with infectious disease who experience financial losses during medical treatment. Individuals can claim medical expenses that occurred during treatment in the medical facilities, and each city, county or district department of health will process the payment. Individuals may also receive livelihood assistance while they are quarantined. Employers must grant paid leave while the person is quarantined. The individual's RR number is used to confirm his or her identification, and payment is made Inpatient fees for such services as quarantine, patient care, and negative pressure room are paid according to specific criteria that the HIRA sets. In such cases, the NHIS also uses RR numbers as a means of personal identification and payment for inpatient fees.

3. Management of Tuberculosis and HIV/AIDS

1) Enrollment

In general, when an individual contracts any infectious disease, the individual's information is managed based on his or her RR number, and related organizations, such as the HIRA, are notified. As part of the Tuberculosis Control Plan, individuals with tuberculosis are also managed using RR numbers for individual epidemiological investigations, quarantine, and screening for persons who have come into contact with the patient. The RR number of a patient must be included on the tuberculosis notification form. Figure 19 is a screenshot of the form used to report individuals with tuberculosis to the KCDC using the Integrated Disease Management System in each medical facility. The system asks for the individual's name and RR number to confirm whether the same report was already made.

Figure 19: A Screenshot of A Report Form of Individuals with Tuberculosis

Source: KCDC 2017a

In the case of HIV/AIDS, individuals can be tested free of charge at any local public health center and undergo an anonymous examination. Their RR numbers are used only once to assign an infected patient number that is then used in the patient management. HIV/AIDS is managed using the HIV/AIDS Supporting Network System.

Tuberculosis management includes training and counseling of individuals with tuberculosis by a designated nurse, conduct of individual epidemiological studies, medication management for individuals with infectious tuberculosis, information guidance on temporary limitation of employment for individuals with infectious tuberculosis, recording treatment and management of individuals with tuberculosis (integrated disease management system), managing records of newly admitted individuals with tuberculosis, and deleting records of individuals who have been cured from the system.

The NHI covers the entire tuberculosis treatment fee and, if the individual is from a vulnerable social group without healthcare coverage, the NHI also covers expenses such as transportation and treatment fees. Individuals with multidrug-resistant tuberculosis and those who do not adhere to treatment will be admitted to the local public hospitals. Measures will be taken to isolate and treat them until they test clear of tuberculosis. Medical expenses of individuals ordered to be hospitalized and quarantined will be covered, along with support for dependents, if they are deemed eligible to receive such support through an income investigation. All these tuberculosis management and treatment support programs are processed using RR numbers to verify identity, healthcare eligibility, and residence.

The HIV/AIDS test can be taken anonymously, although to receive support from the KCDC for HIV/AIDS treatment, individuals must register under their name along with their patient number and be an NHI subscriber. Individuals registered under their real names and infants born to HIV-infected mothers are eligible for medical expense subsidy. If an infected person dies, his or her doctor is required to report the RR number to the authorities. Although medical coverage and support are available for individuals with HIV, because of social prejudice many choose to remain anonymous in the system and receive treatment at their own expense.

3）*Review and Feedback*

In the management program for individuals with tuberculosis, the local public health center in the individual's district oversees patient management and evaluation. When patient management is completed, the medical facility in charge of the treatment is followed up to see whether the individual is completely free of the disease. If there was an order for quarantine, at least 1 month of patient management is needed, and the results are recorded into the system. Also, when management of an individual with tuberculosis ends, such as when there is a change in diagnosis or the patient dies, an epidemiological investigation process is conducted through the local public health centers, and the RR number is used as the main means of identification of the patient.

Because coverage and support are available for individuals who are ordered to be hospitalized and quarantined, the HIRA reviews the claims for the medical expenses, drug expenses, care costs, and cost of living expenses for dependents. The NHIS verifies the amount of the payment, and then the payment will be made to the medical facility that treated the individual. For non-reimbursable items or items that the individual pays for him- or herself, the medical facility will request payment through the individual's local public health center, and the individual will be charged directly. Figure 20 shows the screening system for covering medical expenses for individuals with tuberculosis.

Figure 20: Screening System for Covering Medical Expenses for Individuals with Tuberculosis
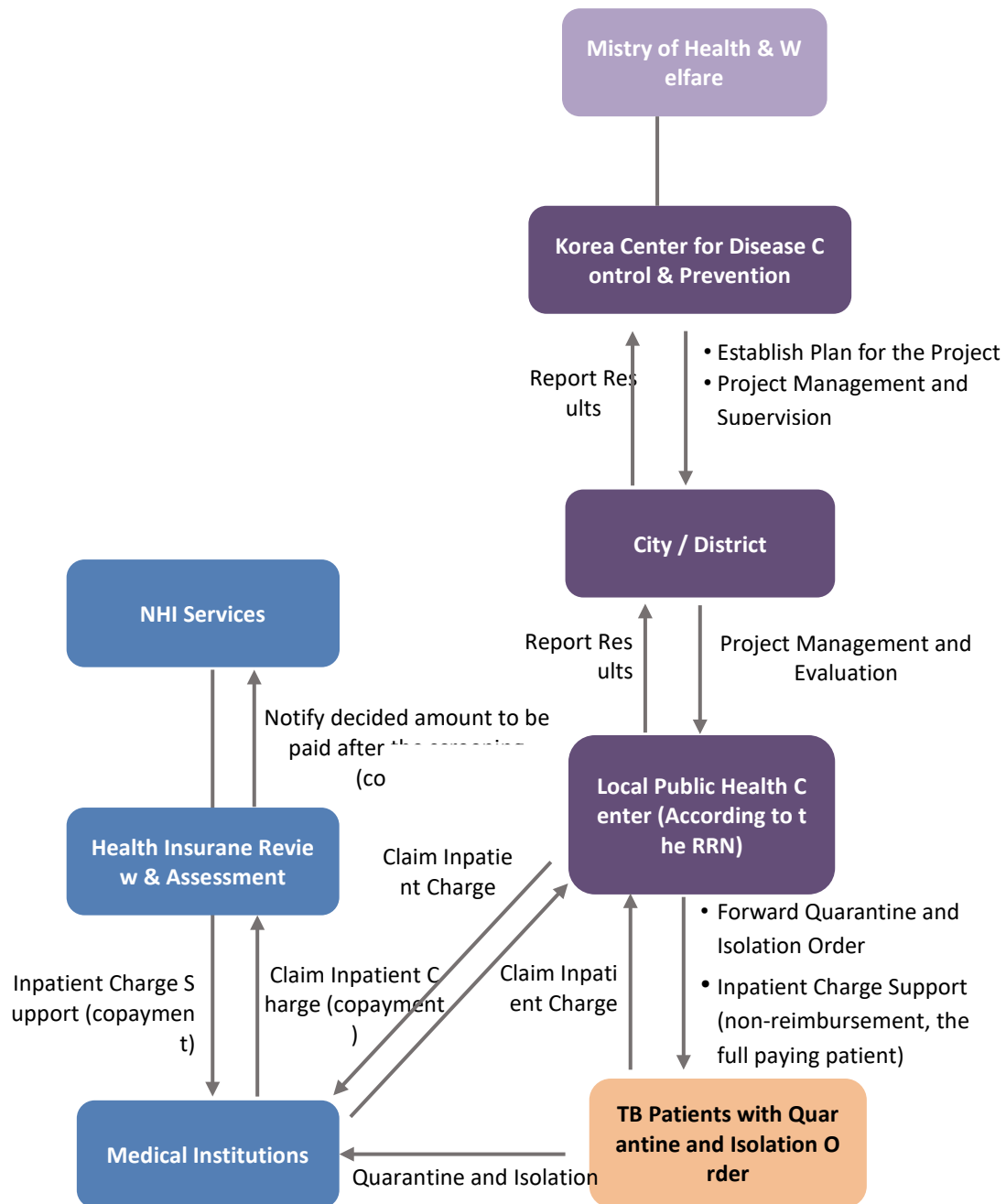
Source: Korea Centers for Disease control & Prevention, 2017b

The local government covers 50 percent of medical expenses of individuals with HIV/AIDS, and the KCDC covers the remaining 50 percent. Local governments should report to the HIV/AIDS Supporting Network System when payment is made and report payment status to the AIDS and Tuberculosis Control Division of the KCDC. The payment history of medical expenses should be reported to the AIDS and Tuberculosis Control Division of the KCDC every six months.

4. Management of Chronic Diseases

1 ）Enrollment

In the NHIS Chronic Disease Management Pilot Program, RR numbers are linked to EMR systems to monitor people with chronic illnesses. The program and its website were launched in 2016 to manage patients with chronic diseases like hypertension and diabetes continuously and interactively. Individuals with hypertension and diabetes register their personal information at clinics that participating in the pilot program, transmit their blood pressure and blood glucose information through the mobile platform, and consult with the physician who receives the data. In 2017, the NHI introduced a feature to automatically link participating clinics' EMRs and the NHIS Chronic Disease Management Program to allow medical facilities to bill patients directly. Medical facilities submit claims for insured individuals to the NHIS based on their RR number.

2 ）Management

Figure 21: A Service Model for Chronic Disease Management Pilot Program
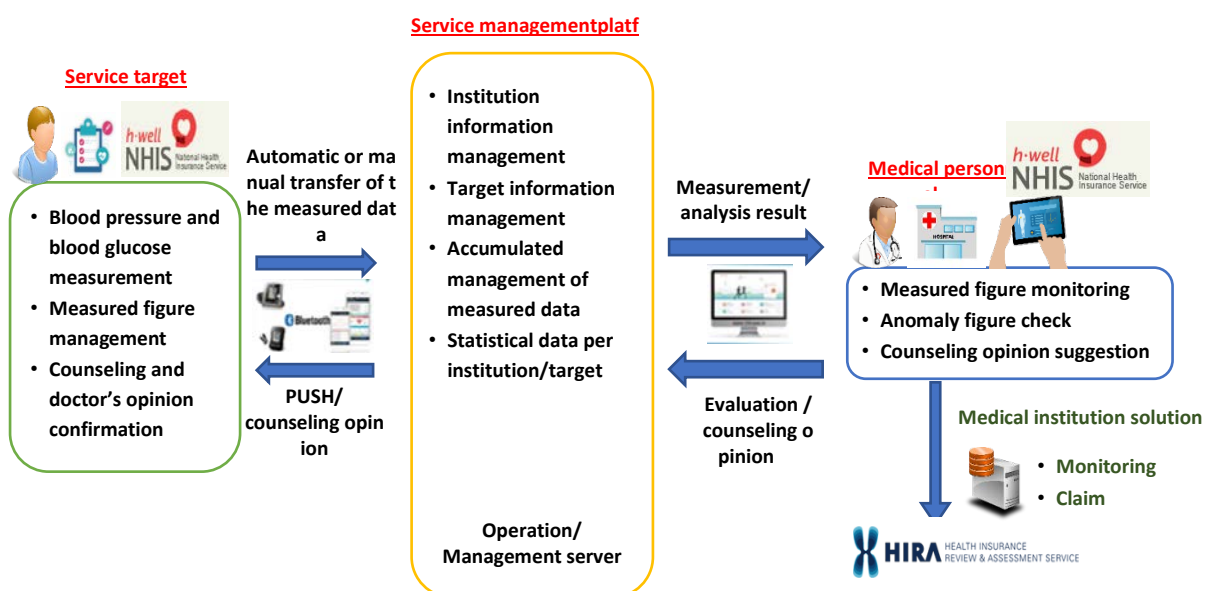
Source: NHIS 2016

The chronic disease management program allows chronic disease to be managed at local clinics. Figure 21 shows the service model of this program. After registering personal and disease information, including RR numbers, at the local clinic, the physician and the individual establish a chronic disease management plan together. The individual then checks blood pressure or blood glucose level and transmits the information to the physician over a mobile platform once a week, and the physician checks the information and provides feedback. When necessary, telephone counseling will be provided, and the next treatment plan is established during face-to-face consultation. The local clinic bills the NHIS for chronic disease management based on the individual's RR number. When an individual reports blood pressure and blood glucose data to a medical facility through a website or a mobile app, they must use an authentication certificate to confirm their identity.

3 ）Review and Feedback

Medical facilities participating in the pilot program for chronic disease management can claim management fee for their patients with chronic disease, which includes planning, reviewing, and evaluating chronic disease management; a continuous management fee; and the bill for telephone counseling sessions are billable to the HIRA. These charges will be paid through the NHIC after the HIRA reviews them. During the process, the RR number is used to confirm the treatment and care management activities that the medical facility enters on the medical care assistance cost statement.

5. NHI System

1) Enrollment

Korea's NHI system is consisted of an information system that uses individuals' RR numbers as keys to link to other systems (Lee Ho-Yong 2013). When an NHI subscriber needs to receive medical treatment at a medical facility, the subscriber must provide his/her RR number so that the facility can confirm insurance coverage and get reimbursement for the claim expenses. Databases for mortality and birth, patient registry, and health examinations are linked and used to perform NHI-related tasks.

For example, at the level of local clinics, the bill management system is linked to RR and numbers of patients with health insurance eligibility. In higher-level medical facilities such as general hospitals as well as tertiary hospitals, patient numbers for the facility are generated and their RR numbers are entered in the EMR for health insurance claims. At every level, protection of personal identification information, including sensitive medical information, is recognized as a serious obligation.

Figure 22: Diagram of NHI Data System

Health Screening Data Base

Beneficiary & Contribution Data Base

Medical Institution Data Base

NHI Data (2001~2013)

Long-term care Data Base

Mortality & Birth Data Base

Patient registry Data Base

Service Benefits Data Base

Whole Population (50 millions)

Managing Eligibilities & Contributions

Medical service / Health screening service

Long-term care service
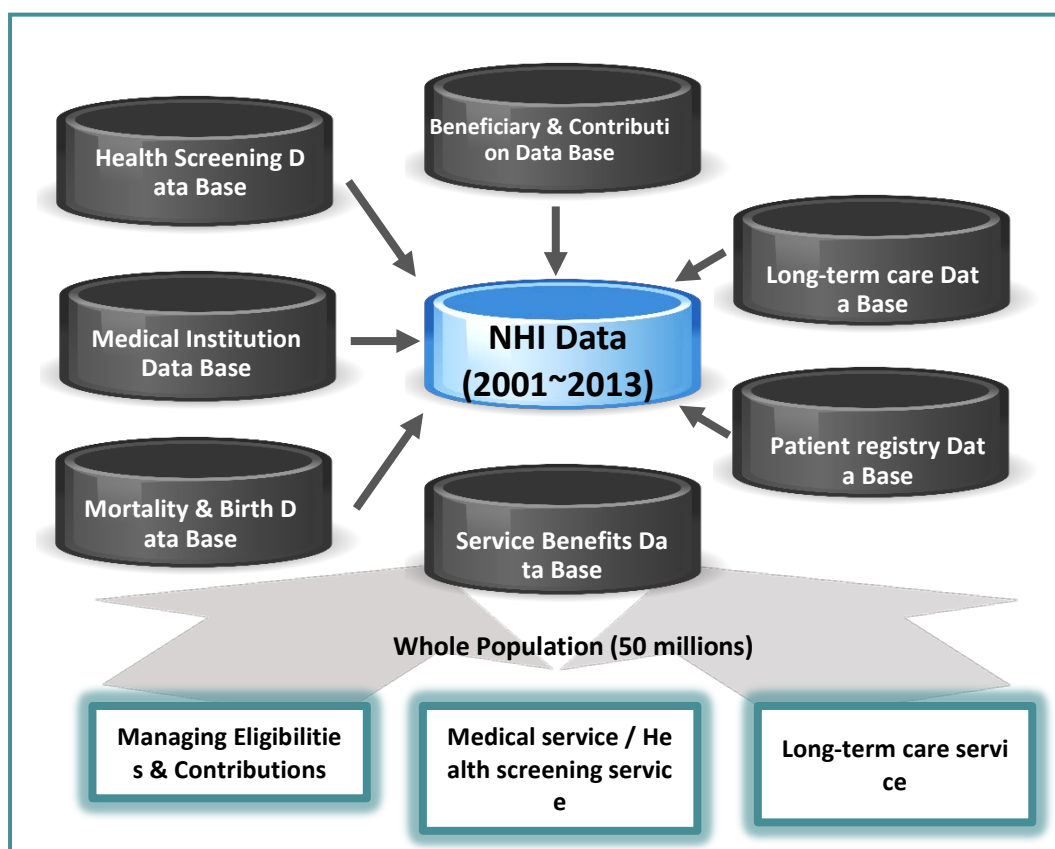
*All DBs are linked by RRN

Source: Park 2015

2） Management

Health insurance cards of NHI subscribers are issued in a paper form each time a change is made in eligibility or when a dependent is registered. In 2007, to confirm NHI eligibility, the NHIS established an eligibility inquiry system between the NHIS and medical facilities (see http://m.nhis.or.kr/webzine/201702/sub/p02_00_01.html). Since the amendment of the National Health Insurance Act in March 2008, an identification card such as a RR card can be used in place of a health insurance card. Before 2008, examinees had to bring their health insurance card every time they visited the hospital, but with the amendment, the card is no longer needed when seeking medical care. As a result, the main function of the health insurance card has disappeared (http://m.nhis.or.kr/webzine/201702/sub/p02_00_01.html), and whether health insurance cards need to be issued is being questioned. The NHIS, which issues health insurance cards, argues that, because young adults and foreigners do not have RR cards, health insurance cards are used to verify their health insurance coverage. Also, issuance of the health insurance card serves to notify subscribers of changes in their eligibility. Therefore, the NHIS argues for the needs to continue issuing physical health insurance cards. As of 2017, the NHIS issues health insurance cards only to subscribers who apply for a physical card.

Electronic health insurance cards were suggested as an option in 2001, but due to concerns of civic groups and medical facilities about leakage of personal information, the idea was not pursued further. Discussion of the advantages and disadvantages of introducing an electronic health insurance card has been continued for approximately 16 years.

Figure 23: Health Insurance Card

Source: http://www.hankookilbo.com/v/65a7f03eb81347f28af2045f5545169f
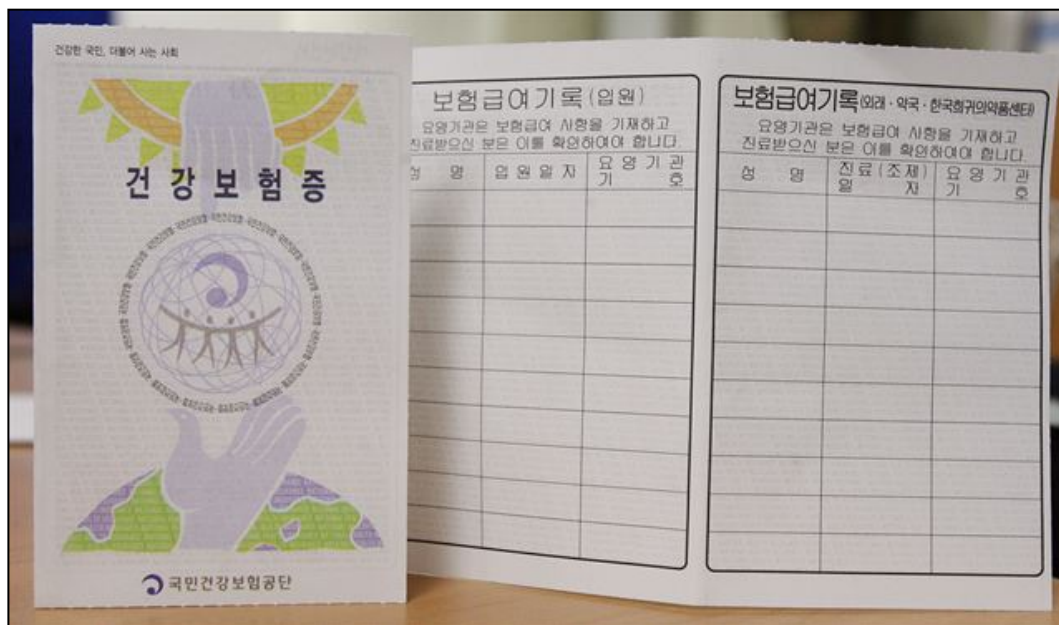
The RR numbers of subscribers and household members were included on the previous health insurance cards, but since the beginning of 2012, only the first 6 digits of the RR number (birthdate) and the health insurance card number are included. Thanks to the data linkage between the RR system and the NHIS, it is now possible to confirm the insurance coverage eligibility of a patient using the first 6 digits of his/her RR number and the health insurance card number.

3) Review and Feedback

When a healthcare provider sends the details of medical treatment to a patient to the HIRA directly, the HIRA reviews the details of the claim and notifies the provider of the review results. During the review and feedback process, the individual's RR number is used as the main means of patient identification.

The HIRA also uses the healthcare provider's RR numbers during the evaluation of clinical and pharmacological cost effectiveness of the services, provides real-time risk information for side effects of the drugs, confirms information about the costs of medical treatment, and makes sure that the medical expenses an individual has paid to the hospital are in accordance with the standards set in laws. With the review system, individuals may receive reimbursement if they were overcharged.

6. Medical Care Assistance

1) Enrollment

Medical Care Assistance is a state-sponsored public assistance system that ensures healthcare coverage for low-income individuals. Along with the NHI, it is a welfare system that is an important source of healthcare coverage. It provides medical services (e.g., medical examinations, treatment) for people who cannot afford them (MOHW 2017a). Eligible recipients of this assistance are:

1. Recipients of medical benefits under the National Basic Living Security Act;
2. Disaster victims defined under the Disaster Relief Act, recognized by the Minister of Health and Welfare as those who need medical benefits;
3. Persons who receive medical benefits pursuant to the Act on Honorable Treatment and Support of Persons Wounded or Killed for a Just Cause;
4. Children younger than 18 who are adopted into a family in the Republic of Korea pursuant to the Act on Special Cases concerning Adoption;
5. Persons who the Minister of Health and Welfare recognizes as needing medical benefits from among persons who the Minister of Patriots and Veterans Affairs recommends be provided medical benefits, who are governed by the Act on the Honorable Treatment of Persons of Distinguished Services to Independence, the Act on the Honorable Treatment and Support of Persons, etc. of Distinguished Services to the State, and the Act on Support for Persons Eligible for Veteran's Compensation, and their family members;
6. Persons that the Minister of Health and Welfare recognizes as needing medical benefits from among persons that the Administrator of the Cultural Heritage Administration recommends as needing medical benefits, who are holders (including honorary holders) of national intangible cultural heritage designated pursuant to the Act on the Safeguarding and Promotion of Intangible Cultural Heritage and their family members;
7. Persons who the Minister of Health and Welfare recognizes as needing medical benefits who are governed by the Act on the Protection and Settlement Support of North Korean Refugees and their family members;
8. Persons who the Minister of Health and Welfare recognizes as needing medical benefits who received compensation pursuant to Article 8 of the Act on Compensation to Persons Associated with the May 18th Democratization Movement and Similar Matters and their family members;
9. Persons who the Minister of Health and Welfare recognizes as needing medical benefits who are homeless under the Act on Support for Welfare and Self-Reliance of the Homeless;
10. Other persons according to Presidential Decree who are unable to support themselves or who are indigent.
(Source: Medical Care Assistance Act)

The medical care assistance system uses RR numbers to review and register beneficiaries. According to the Enforcement Decree of the Medical Care Assistance Act, data that include RR numbers or alien registration numbers can be processed with regard to recognition, change, and suspension of the benefit. In principle, medical benefit eligibility management system is operated using individual RR number, although in particular cases, such as homeless persons without a permanent residence, persons from socially disadvantaged status who are not in support facilities (e.g., basic living security program recipient, children who are to be adopted, North Korean defectors), persons who are in a support facility with missing RR numbers (persons who have requested to remain anonymous for protection and in facilities that require personal privacy such as sexual violence victim protection facilities,

domestic violence victim protection facilities, and single-mother facilities), a control number is assigned, which is linked to his/her RR number.

Figure 24: Medical Care Assistance Eligibility System and Its Connection to Other Databases
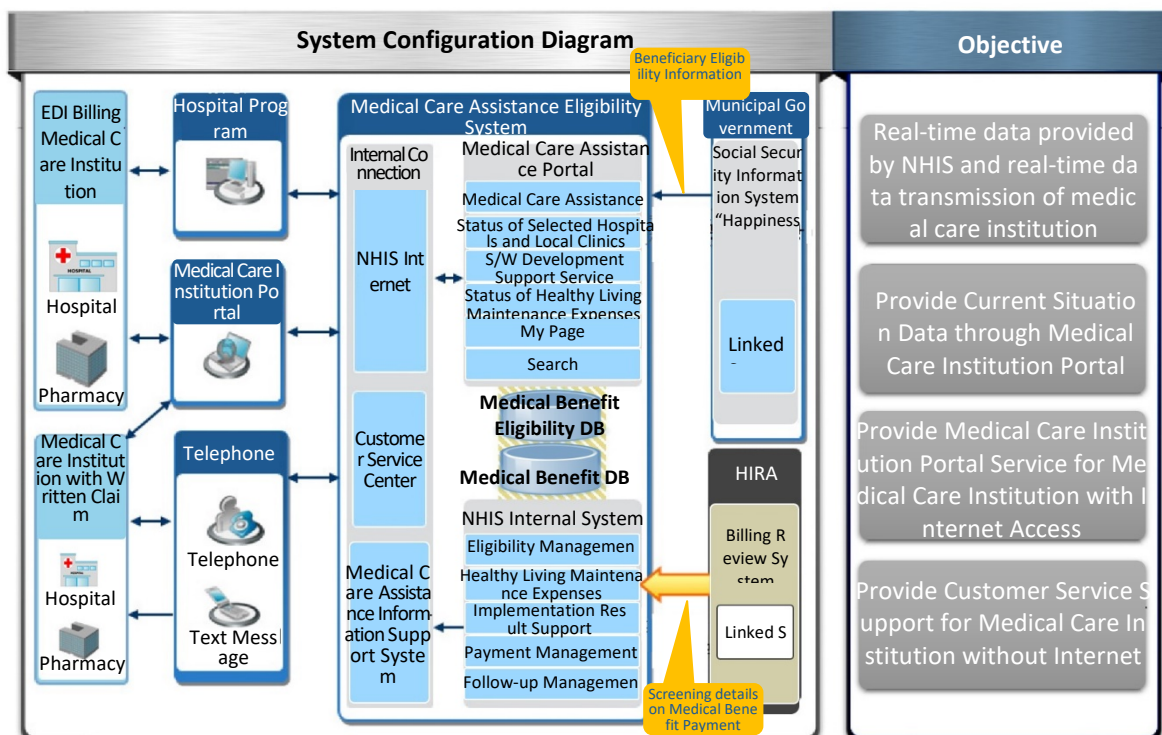
Source: Health Insurance Review & Assessment (HIRA), 2016

Eligibility registration management for the medical care assistance system is integrated into a welfare information system called "Happiness-e" that is linked to the NHIS Medical Care Assistance Eligibility System in real time. This system uses RR numbers for detecting beneficiary's eligibility status, payment management, case management, and conducting post-processing tasks. Figure 24 is a basic configuration diagram of such a system.

2) Management

Medical benefits for diseases, injury, and childbirth include examinations, payment for medications and treatment materials, surgeries and procedures, prevention and rehabilitation, hospitalization, nursing, transportation, and other measures to achieve medical goals.

When a beneficiary wants to receive medical care at a medical facility, the medical facility confirms the eligibility of the beneficiary by entering the RR number into the Medical Care Assistance Eligibility System. As mentioned above, if a beneficiary has been given a special control number, the eligibility of the beneficiary is confirmed using that number instead of a RR number, which is linked to the control number. The medical facility then provides medical treatment. After treatment, information such as length and type (e.g., inpatient, outpatient) of treatment is sent to the NHIC through the Medical Care Assistance Eligibility System.

Figure 25 shows the screen that medical facilities use to determine a beneficiary's eligibility for medical care assistance.

Figure 25: Medical Care Assistance Eligibility Check System Using Recipient RRN
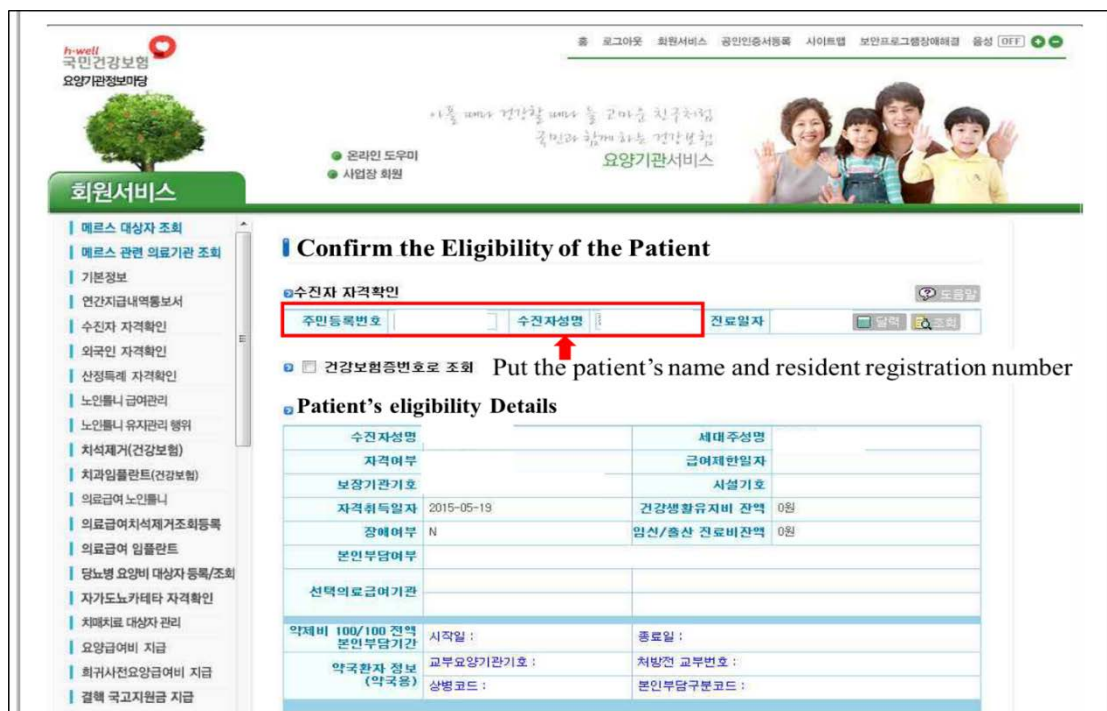
Source: Ministry of Health & Welfare 2017b

3) Review and Feedback

The overall work flow of the Medical Care Assistance System is shown in table 8 below. At each medical facility, the beneficiary is verified, and the medical benefit is provided. The HIRA reviews the medical benefit claim, and after screening and confirmation of eligibility through the NHIS, payment is made, and there is a post-treatment case review.

Table 7: Step-by-Step Workflow Diagram of Medical Care Assistance System

Classification	Department	Tasks
1. Selection of a beneficiary	City, county, district	▪When selected as a National Basic Livelihood Security recipient through an asset investigation, one becomes eligible for the medical benefit ▪ Beneficiaries can be also selected by meeting the criteria of other relevant ministries or through a civil petitioner registration ▪ Homeless individuals can be selected as beneficiaries when registered by hospitals and local clinics

2. Transmit data to NHIS	City, county, district	▪ Submit beneficiary eligibility data to the NHIS - When the beneficiary uses a hospital or a local clinic, confirm eligibility with the NHI system
3. Provide medical benefits	Hospital, local clinic, pharmacy	▪ Before providing treatment, confirm eligibility with Medical Care Assistance Eligibility System - classification, possibility of copayment, possibility of receiving medical benefit from the selected medical facility ▪Provide medical benefit (e.g., examination) - Make copayment ▪After treatment, submit information such as the number of benefit days and the type of treatment (inpatient or outpatient) through the Medical Care Assistance Eligibility System -The NHIS issues a treatment confirmation number
4. Review cost	Hospital, local clinic, HIRA	▪ Hospital or local clinic: request for cost review -Submit the treatment confirmation number -Can be requested within 3 years from the date of treatment ▪ HIRA: Determines eligibility and notifies appropriateness of medical care payment to the hospital, local clinic and the NHI
5. Make payment	NHIS	▪ Make payment to the hospital or the local clinic (according to HIRA notification)
6. Follow-up	MOHW City, county, district NHIS HIRA	▪MOHW -Formulate policies, supervise and perform administrative functions ▪City, county, district offices -Manage beneficiary status (e.g., residence change, death) -Case management for excessive users of medical facilities -Manage fraudulent beneficiaries, collect illegal receipts of benefits ▪NHIS -Select inappropriate benefit recipients -Provide history to city, county, or district and investigate fraud and abuse of payment ▪HIRA -Review medical care billing -Support field investigation on false and fraudulent billings by hospitals and local clinics

Source: MOHW 2017b
Note: NHI System, NHIS; HIRA, Health Insurance Review and Assessment Service; MOHW, MOHW

7. Summary

In this chapter, we examined examples of the healthcare system in terms of patient treatment and management linked to the RR number. The chapter is divided into observing infectious disease and chronic disease management systems and the medical security system, and it analyzes specific instances in which RR numbers are used. Infectious and chronic disease management systems include infectious disease patient registration and management, tuberculosis and HIV/AIDS management, and chronic disease management. Regarding the health insurance system, the use of RR numbers by the NHI and Medical Care Assistance System was examined in this chapter. Table 9 summarizes the use of RR numbers at each stage of these examples.

First, in the infectious disease patient registration and management program, at the patient registration stage, RR numbers are used at the reporting and notifying stages of the system when individuals with an infectious disease are identified. According to the infectious disease reporting system, a medical facility with an individual who has an infectious disease is required to provide his or her personal information, including the RR number, through the Integrated Disease Management System. Then, at the patient management stage, a registered patient receives medical treatment in quarantine. During this process, the health authority uses the individual's RR number to manage his or her overall treatment. Finally, at the review and feedback stage, when the individual's care is reviewed, and the medical expense payment and medical facility's medical benefit payment are received, the fact checking process for the treatment occurs based on the individual's RR number.

The RR number is also used in the overall operation of the tuberculosis and HIV/AIDS management programs. Individuals with tuberculosis are managed in a manner like that of other individuals with infectious diseases, although use of the RR number is more limited in the cases of individuals with HIV/AIDS. In particular, AIDS screening tests can be taken anonymously and free of charge. When registration is needed after a positive result, the RR number is used only once, and thereafter the individual will be managed using a control number, although if an individual with HIV/AIDS wants to receive medical benefits, he or she must register with his or her name to submit a claim to the NHIS; the RR number can be used indirectly.

The Chronic Disease Management Pilot Project runs a program for the continuous management of individuals with hypertension and diabetes at local clinics. The RR number is used for identification of patients throughout registration, management, and review and feedback. This program introduces a system that allows patient management to be linked to the EMR of a local clinic and the NHIS database, and the RR number is used as the main means of personal identification in the data link between the EMR and the NHIS.

In case of the NHI system, the qualifications of health insurance subscribers are managed in connection with the databases of other Ministries through the administrative information sharing system. In this process, the RR number of the subscriber is used as the main means of personal identification. In the management stage, health insurance subscribers must provide their RR numbers to medical facilities so that they can submit claims. Eligibility can be

inquired about using only the first six digits of the RR number (birthdate) and the health insurance number.

The Medical Care Assistance System covers the medical expenses of low-income citizens who have difficulty or are unable to maintain their basic livelihood. In principle, the beneficiary registration process uses RR numbers, although in cases of individuals without identities such as homeless people, people in social care facilities who wish to remain anonymous, North Korean defectors, and children to be adopted, registrations are managed using a control number instead of the RR number. When a beneficiary's identity is confirmed, or a RR number is issued, all medical care should be handled using the RR number.

Table 8: Use of RR Number at the Treatment and Management Stage

Classification	Infectious and Chronic Disease Management System			Medical Security System	
Program Stage	Registration and management of individuals with infectious diseases	Tuberculosis and HIV/AIDS Management System	Chronic Disease Management Pilot Program	NHI	Medical Care Assistance
Enrollment	-At medical facilities with patients with infectious diseases, patient information, including RR number, reported through integrated management system, and patient registration completed	- Individual with tuberculosis registered with RR number - HIV/AIDS can be anonymously tested at local public health center, so use of RR number is limited during treatment	-Registration of individuals with hypertension and diabetes according to patient RR number at local medical clinic	-Health insurance subscribers must provide RR numbers to medical facility to receive healthcare benefits and services	- Beneficiary should be registered using RR number, although special computer administration numbers are given to individuals without RR number (e.g., homeless individuals)
Management	- RR number used for identification during management of infectious disease	- RR number used to identify patients throughout treatment and management of tuberculosis. - HIV/AIDS managed using control number rather than RR number; no RR number used until the individual dies	RR numbers used in overall management of individuals with chronic disease. Local medical clinics use RR numbers for patient identification in the claims stage and use authentication certificates to identify individuals when	Health insurance card issued to health insurance subscribers Includes date of birth and health insurance card number.	Medical facility confirms eligibility by entering RR number in the Medical Care Assistance Eligibility System

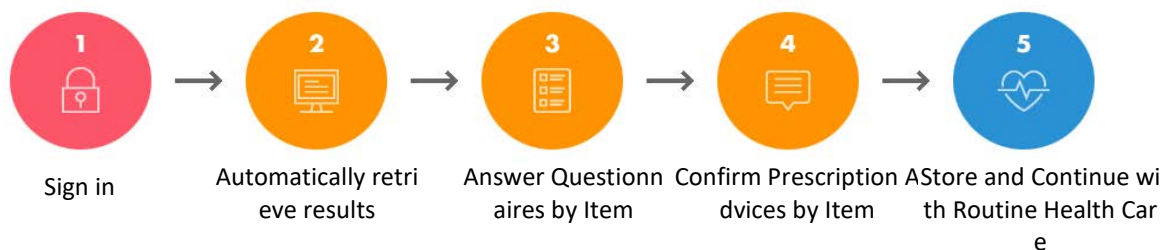|					
		- RR numbers are used indirectly to receive HIV/AIDS medical insurance coverage, as they required to register with a name and be an NHI subscriber	reporting blood pressure and blood glucose levels.		
Review and feedback	- Government covers treatment costs, so RR numbers are used for claims.	- When management of individual with tuberculosis completed, RR numbers are used to report completion of management - HIRA reviews the treatment cost for individuals with tuberculosis	- A medical facility participating in chronic disease management program enters RR numbers to verify treatment and submits them for reimbursement	- Healthcare providers send patient's personal information to the HIRA, including RR numbers for billing.	- In the follow-up management, the eligibility of beneficiaries and the feedback process are periodically evaluated.

C.   HEALTHCARE DATA USE

1.   Customization of Health Information Using the NHI Data

1) Registration

The NHIS health information website, Health-iN, provides general information on various diseases and appropriate healthcare services to the public (Figure 26). It gives personalized health information to subscribers, using the results of medical examination survey information that the NHIS has. Mostly, the website provides services on personal risk assessment along with customized information for general health improvement tips, for metabolic problems, and lifestyle improvement programs for obese people and smokers. User registration is authenticated using a RR number of the subscriber and an authentication certificate on the Health-iN website. When registration is completed, results from one's health examination and a hospital survey that the NHIS provides are automatically brought into the system, and user registration is complete.

Figure 26: User Registration Procedure for Personalized Health Management System

| Sign in | Automatically retrieve results | Answer Questionnaires by Item | Confirm Prescription Advices by Item | Store and Continue with Routine Health Care |

Source: NHIS "Health-iN" Website. http://jr.nhis.or.kr/ae/ggpae001/ggpae001_m02.do

Patients can register in the Chronic Disease Management Pilot Program and manage their treatment using the Health-iN website or the mobile app for the website. Individuals who have registered for the program are given a blood pressure monitor and blood glucose meter for self-monitoring so that they can enter their results into the Health-iN mobile app and receive feedback from a doctor. When users register at the program website or mobile app, and the patient control number is issued and used throughout the management process, rather than their RR numbers.

2) Storage Format and Security

For the Chronic Disease Management Pilot Program, a financial institution (a local bank) or NHIS or National Pension Service can issue the authentication certificate required for numeric data transmission through Internet applications. After an individual is registered, a patient control number will be issued, and the individual can use the control number and password to log in to the website. Measurement results on blood pressure and glucose should be electronically transmitted by M-Health Insurance (mobile application) or Health-iN (the internet website), but access to the Internet and mobile phones in certain areas is limited, so, in such cases, the program also accepts data input from local medical clinics. A plan is underway to enable individuals in rural areas, elderly people living alone, and those who cannot use the

Internet or a smartphone to submit measurement results over telephone calls. Program guidance is enhanced by giving people access to printed versions of their healthcare management plans. After the management plan is posted on-line, a notification pop-up window shows up on the screen. Program-related information such as patient registration, management method, and billing method are posted on the Korean Medical Association website (http://www.kma.org) and the NHIS homepage (http://medi.nhis.or.kr), that are continuously updated.

As of the end of July 2017, the approximately 40,000 individuals who had visited 204 clinics reported that they were highly satisfied with the provision of customized healthcare services and the rapport they had built with the doctors. With the establishment of the Expansion Program for Primary Medical Institutions in Local Communities, it is anticipated that a coordination system will be established between residents, local public health centers, local health insurance branch offices to provide effective and diverse healthcare services to people with chronic diseases such as hypertension and diabetes.

Figure 27: Health-iN Mobile Portal

Source: NHIS, 2017

The NHIS has access to personal health data, unique identification information, and other sensitive information, which are all necessary due to the nature of the service, so policies for personal information protection are specified in detail. The NHIS constantly updates its privacy policy, in an effort to prevent and provide remedies for infringement of personal information. Establishment and execution of an internal data management plan, management of access rights, access control, encryption of personal information, storage and checking of access records, prevention of malicious programs (e.g., data management room), physical safety measures, and disaster preparedness measures are used to secure personal information.

Health-iN links the NHIS national health information database with the Ministry of Food and Drug Safety, Korean Meteorological Administration, and Ministry of Environment data on food poisoning and weather climate and environment. Then it integrates private social media information (e.g., tweets, blogs) to follow trends for major diseases and provide warnings to the public. The national health information database is also linked to the health insurance databases. Through this service, the public can check regional risks of major diseases, step-by-step action plans during emergencies, regional weather information, air pollution levels, medical trends, and social media information. Figure 28 provides a conceptual map of and the website for the national health alarm service.

Figure 28: Conceptual Map of National Health Alarm Service (Top) and Service Screen (Bottom)
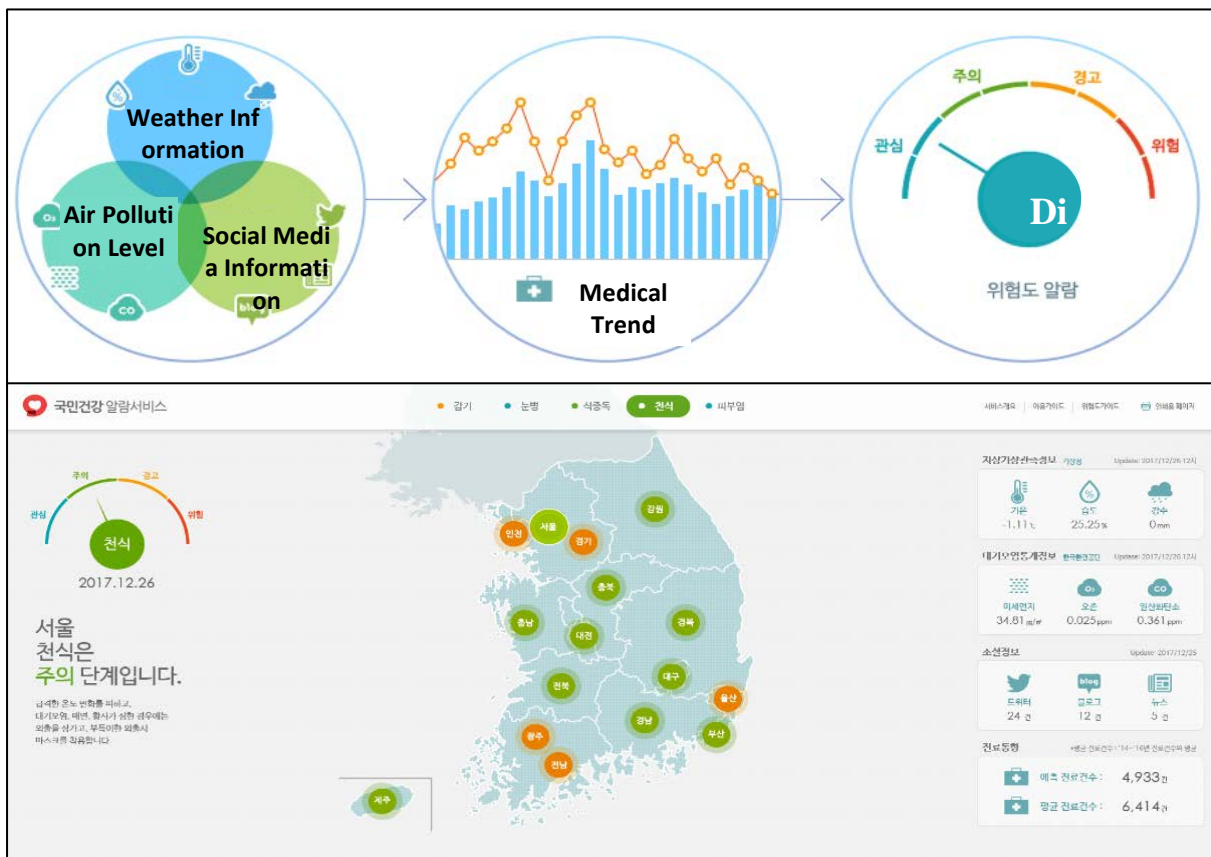
8.   Health Information Exchange Service

1） Registration

For the purpose of sharing EMRs between hospitals. the MOHW announced in June 2017 that it would introduce a health information exchange system through the revision of the Enforcement Decree of the Medical Act. For medical records to be shared electronically between medical facilities, the EMR of each medical facility must be standardized. The revised decree became a legal basis for the introduction of the EMR standardization and certification system.

Before the revision of the decree, it was somewhat complicated and inconvenient for an individual to obtain his or her own medical records because they were stored in a hard copy format or recorded on CDs in the medical facility. Once obtained, the records had to be submitted to other medical facilities in person by the patient. Some of the tertiary hospitals built a medical record sharing system, but it was a one-way service running from primary hospitals to tertiary hospitals. (http://www.etnews.com/20160620000383).   With the amendment of the Enforcement Decree, the basis for electronic exchange of EMRs among medical facilities has been established, and records such as medical referral letters, transcripts, medical history summaries (e.g., patient information, diagnosis, drugs, test information), and radiological results can be shared through the EMR exchange system. As a result, in July 2017, the MOHW and Ministry of Science, Information and Communication Technology, and Future Planning announced that they would provide funding to establish an exchange system for sharing medical records electronically to 600 hospitals and local medical clinics in the city of Busan. It is planned to expand this to other regions.

Figure 29: Structure of the Medical Record Sharing System the Medical Record Sharing System
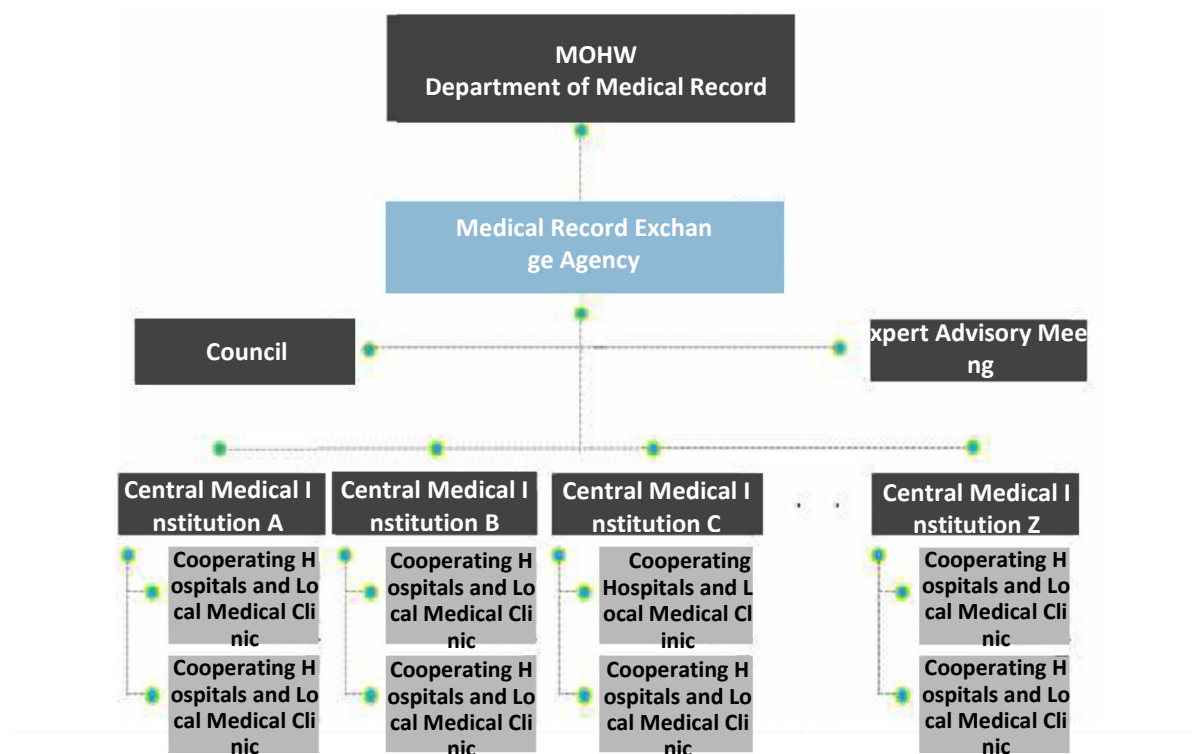
The Health Information Exchange Service enables health information exchanges in a central medical facility, operation of a medical document repository and tasks such as making referrals and medical diagnoses and generating care record summaries. Under each central medical facility, there are cooperating medical facilities responsible for performing practical medical record exchange work such as making referral services and care record summary using the medical record sharing system (figure 29). An individual who wishes to use the

medical record sharing service must sign a Personal Information Agreement for Medical Record Sharing, which includes consent to sharing sensitive information, such as personal identification information, RR number, and various medical records.

2) Storage Format and Security

An individual can apply for a medical imaging record (CT, MRI) from a medical facility and request to store it on a CD but cannot directly access the server and download the information or inquire in the EMR. Personal EMR information at the hospital is protected according to law as highly sensitive personal information. Medical records are transmitted only with the consent of the individual or the individual's guardian when requested by the head of a medical facility or a doctor. In case of an emergency or when no guardian is present, a record can be transferred without consent as an exception.

In the Medical Record Sharing System, individual medical records are stored in each medical facility, and the care record summary is distributed to the central medical facility to minimize information overload. The system allows users to extract and transmit documents such as the standardized care record summary from various types of medical records stored in the EMR of each medical facility. The extracted records are stored in the medical record sharing document repository. Index information such as document storage location is stored in the medical record sharing support system of the National Information Resource Service in the city of Daejeon. The system is operated by the Ministry of the Interior and Safety, the National Information Resource Service, and advanced general hospitals with an information security system to manage the sensitive records.

In relation to the personal identification system, the Medical Record Sharing System assigns a unique number that could identify a person. For information that is extracted and transmitted, such as a care record summary, only this unique number is used, making it difficult to know who the record belongs to. In addition, only the substitute number is stored, preventing personal information leakage (figure 30). Security measures such as technical security devices and cyber control are also used.

Figure 30: Use of Unique Number in Medical Record Sharing System
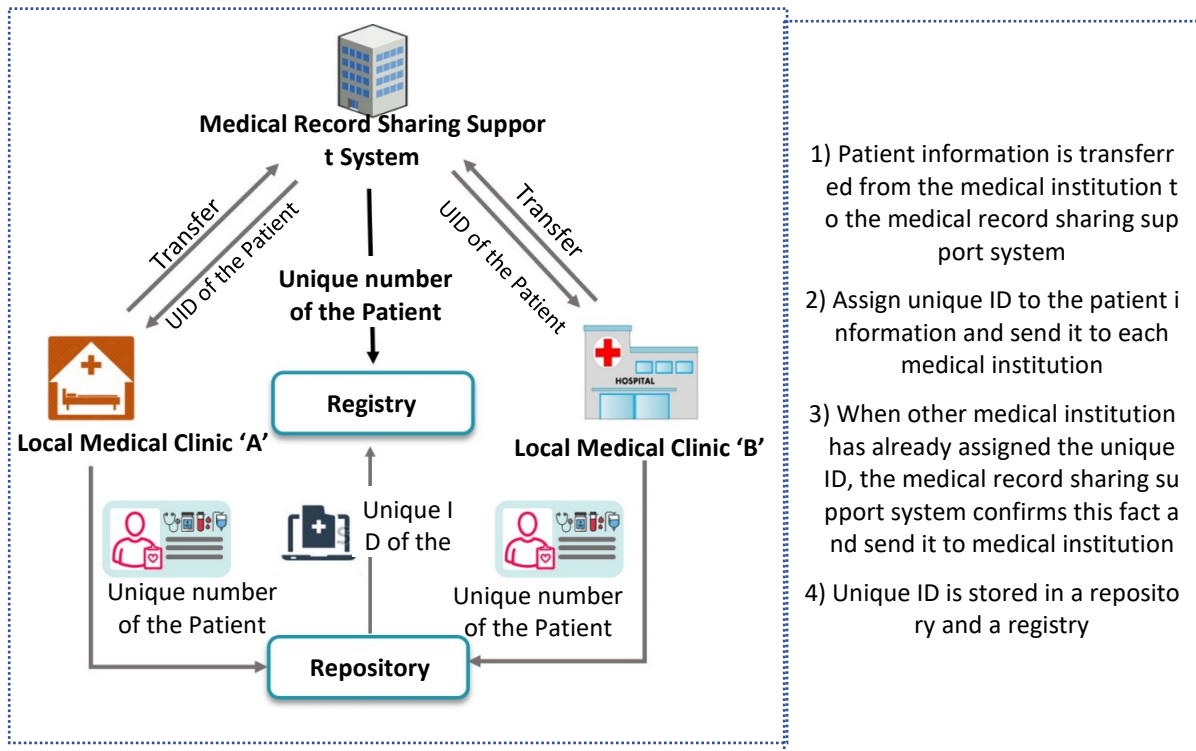
Source: Ministry of Health Welfare, 2017c.

The MOHW announced in a press release on June 12, 2017, that it will operate a health information exchange support system to facilitate exchange of information between medical facilities to ensure continuity of care and enhance patient convenience. The Online Portal (medical record sharing portal) started its service on November 17, 2017. In this portal, people can confirm their own medical history records, such as care referrals and the dates and locations of medical treatments, by entering their RR number and the authentication certificate for self-identification. Figure 31 is a screenshot of 'My Chart' – the Medical Record Sharing Portal (https://mychart.kr).

Figure 31: 'My Chart' – the Medical Record Sharing Portal

Source: 'My Chart' Website. https://mychart.kr/portal/main/main.do

Figure 32 shows the conceptual diagram of the health information exchange service and how the service is used. If a medical facility applies for inclusion to the service, the MOHW evaluates and confirms the application and authorizes the facility to participate in the health information exchange. For the exchange of information, patients are asked to provide consent to the sharing of personal information, including their RR numbers. The facility processes and stores the consent form and issues the patient number and then manages the patient's health information and exchanges it with other institutions when necessary.

Figure 32: Roles and responsibility of patients, medical institutions and the MOHW in operation of the Medical Information Exchange Service system33
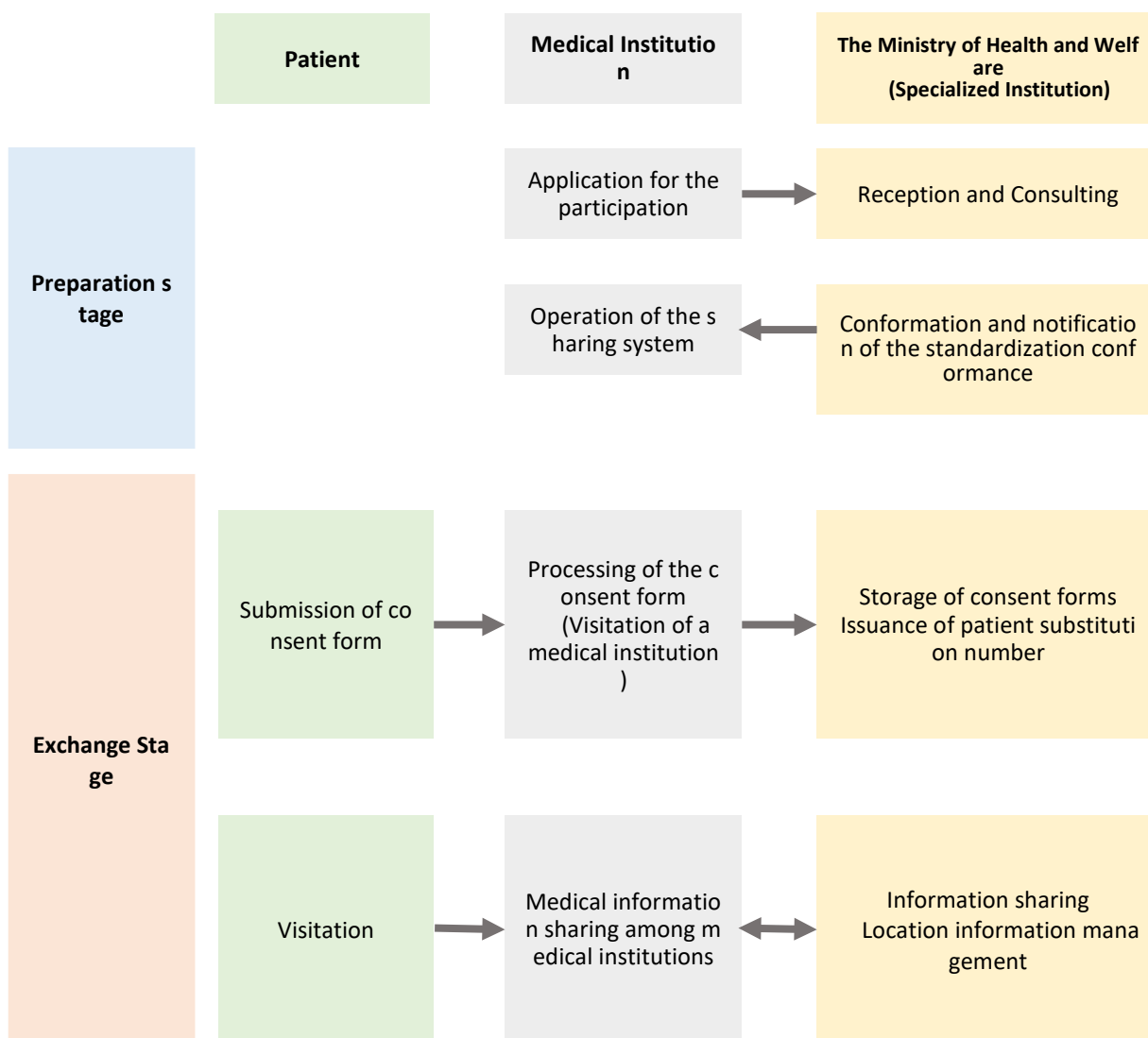
Source: Ministry of Health & Welfare, 2017d

Figure 34 illustrates how medical facilities, including clinics and tertiary hospitals, store health information. The information can be exchanged electronically, and the index information is stored in the central registry of the Health Information Exchange Support System.

Figure 34: The Medical Information Exchange Service Process
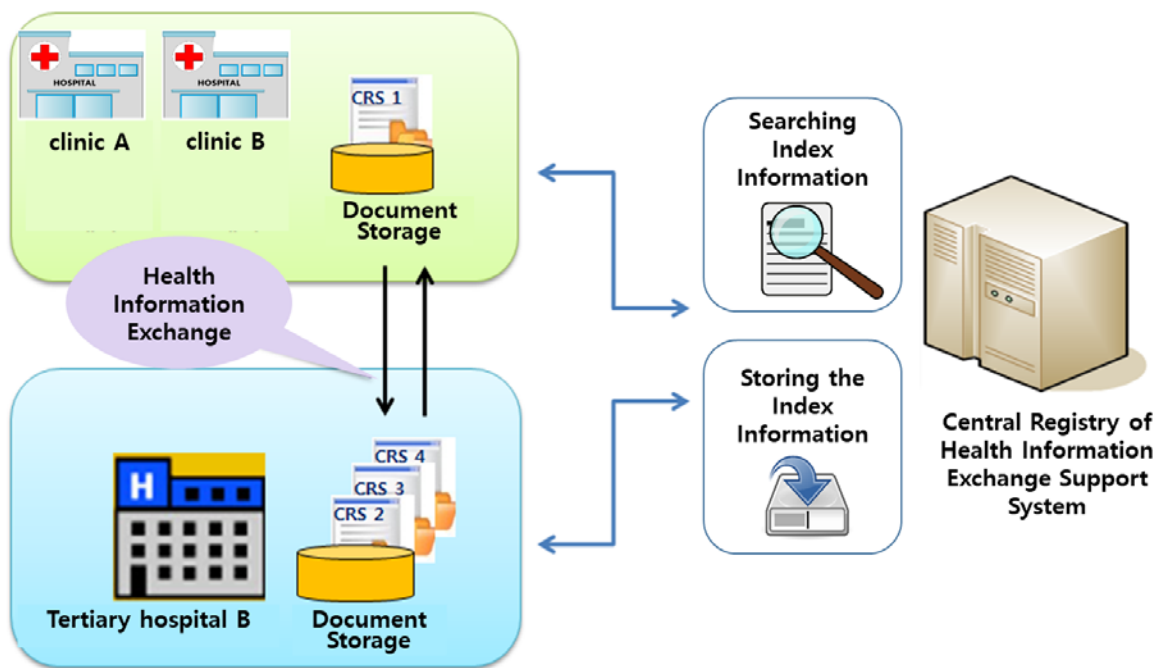
Source: MOHW 2016

3）Data Analysis

The data generated and accumulated in the health information exchange supporting system is not used for data analysis, but the MOHW is trying to use health information for data analysis; in August 2017, the MOHW held the Future Healthcare Forum and discussed the policy agenda and future plans for using the Health Information Exchange system for data analysis
(http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page
=1&CONT_SEQ=341349).

3. Use of Health Insurance Data

1）Registration

The National Health Insurance Sharing Service (NHISS) of the NHIS supports policy and academic research by providing access public health data to the public. The NHISS aims to support the evidence-based policy and academic research of the healthcare sector by providing a sample research database, customized research database, and health disease index and sharing research results.

The NHIS provides data in four categories. The National Health Information Database contains 1.3 trillion data cases, including the qualifications and premiums of all citizens, the results of medical examinations, medical treatment records, long-term care insurance data for elderly adults, the status of medical facilities, and registration information on cancer and rare incurable diseases. The Sample Research Data Base is a high-demand data set from the NHISS in which deidentification have been completed so that information on subjects is not recognizable. It has been standardized for policy and academic research. There are five types

of data sets: sample cohort, health examination cohort, elderly cohort, infant and young child health examination cohort, and working women cohort.

The Customized Research Database makes it impossible to identify subjects by extracting, summarizing, and processing the health insurance and long-term care insurance data that the NHIS collects. The data can be accessed and analyzed only in the Big Data Analysis Center at the NHIS with a designated computer and statistical analysis tool. The Health Disease Index uses NHIS data to systematically calculate risk factors for chronic diseases and their occurrence and complications, so means of identification, such as RR numbers, that can identify an individual are eliminated. Researchers who want to conduct research using these data must submit their personal information and research plan to obtain approval. Figure 35 shows the process of obtaining health insurance data.

Figure 35: NHI Data Provision Procedure

Source: NHISS website. https://nhiss.nhis.or.kr/bd/ab/bdaba019lv.do#
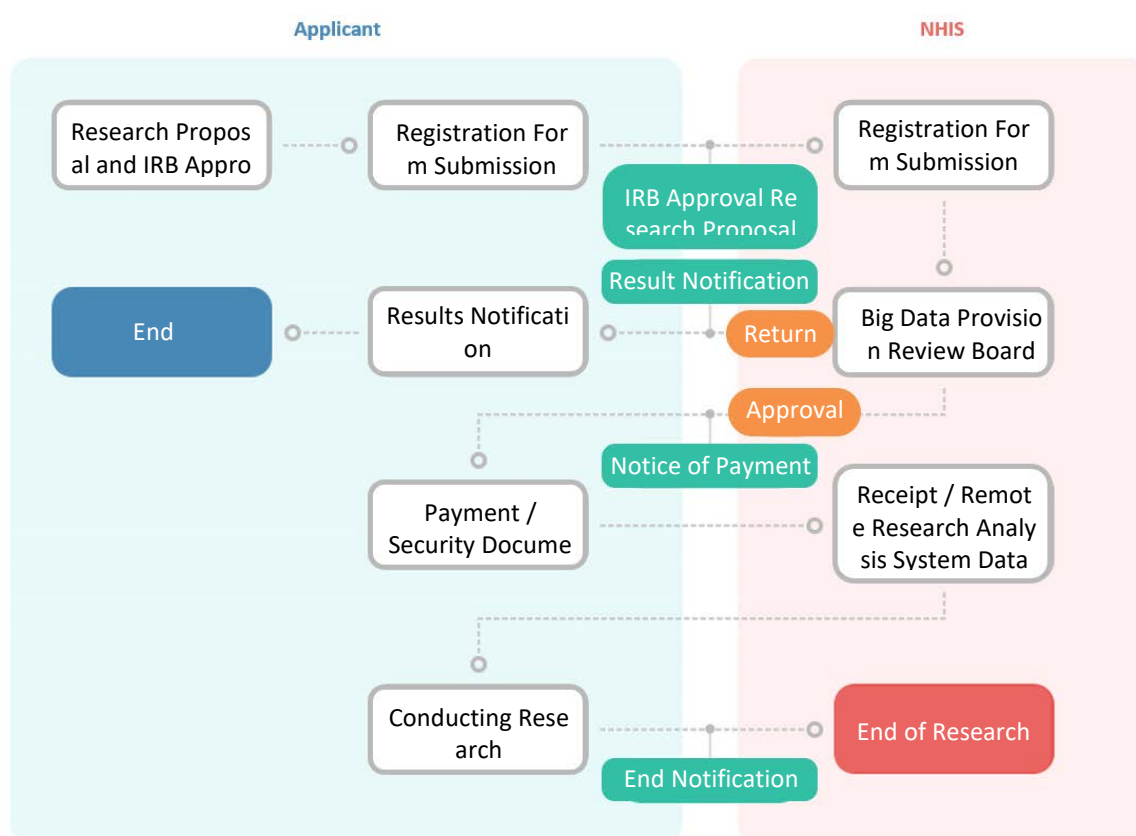
2) Storage Format and Security

The Health Insurance Big Data Operational Regulation stipulates that users must not be provided with national health information data if their use of the data would be against the public interest or if there is a possibility of infringing the interests of a third party. In particular, it is illegal to use data or research output for purposes other than research, to infringe on the rights of third parties by illegal use, to present significant obstacles to the performance of the NHIS, to violate the rights of the person whose data is used (e.g., changing the health information data into a form that can be re-identified by merging with other data), or to provide

information to third parties who have not been approved. If it is found that the data was sold or was not discarded after use, the user will be banned from accessing the data for 5 years.

3) Data Analysis

The NHISS has been actively used in academic and policy research. In addition, the HIRA's Healthcare big data System provides the public with data that is analyzed and refined from medical information and from data that medical facilities, pharmaceutical companies, and related organizations provide. Table 9 shows the status of public data in the healthcare sector in Korea.

Table 9: Status of Public Data in Healthcare Sector

Classification	Institution in possession	Content	Disclosure status
Health insurance sample cohort DB	NHIS	-Qualification DB: NHI subscriber's and medical care assistance beneficiary's last name, sex, age group, region, socioeconomic variable, death, etc. -Care DB: Variables related to medical treatment, chronic diseases, prescriptions from medical care assistance claim document -Health examination DB: Key findings from health exams and life-style habits and behaviors, -Medical care institution DB: Medical care facility type, specialty, region, equipment and workforce-related data	Limited
Patient data set	Health Insurance Review and Assessment Service	-Sample data of individuals who have been treated for 1 year since the treatment date based on health insurance claims	Limited
Human bioresource	KCDC	-Human body derivatives (DNA, tissue, blood, urine), clinical (diagnosis, type of surgery, pathology examination result, blood test), epidemiology (sex, birthday, history of drinking and smoking), and heredity (single-nucleotide polymorphism, Copy Number Variation, Exome) information	Limited
Local healthcare information	Social Security Information Service	-Health programs and administrative work of national health facilities (public health center, public health clinic, public health unit), electronic medical record, information related	Undisclosed

		to medical care (medical history, examination results)	
Local community health survey	KCDC	-Local healthcare plan and health program evaluation utilization index: Health behaviors, health examinations and vaccinations, disease morbidity, medical use, accident and addiction, activity limitations and quality of life, use of health facilities, social and physical environment, cardiac arrest, education and economic activities	Disclosed
National Health and Nutrition Survey	KCDC	-Status and trends in health and nutritional status Health questionnaires on body measurement, obesity, hypertension examination, smoking, drinking, obesity and weight management and physical activity - Nutrition questionnaires such as food and nutrient intake status, diet habit, dietary supplements	Disclosed
Korea Health Panel	Korea Institute for Health and Social Affairs	-Panel analysis of individual health status, medical use and health expenditure factors, health behavior, medical needs, healthcare service demand behavior -Socioeconomic characteristics, purchase of medicine, economic activity, level of health, medication usage behavior, private health insurance, health supplements, health behavior	Disclosed

Source: Lee Yeon-Hee 2015
Notes: DB, database; KCDC, Korean Centers for Disease Control and Prevention

Figure 36 shows the linkage between healthcare data and RR data in the public and private sectors. In the public domain, genomic data, health insurance data, and survey data are managed in conjunction with birth and death registration and residential enrollment data but are not linked to private medical facilities' EMRs or individuals' healthcare data.

Figure 36: Data Linkage and Separation Between the Public and Private Sectors
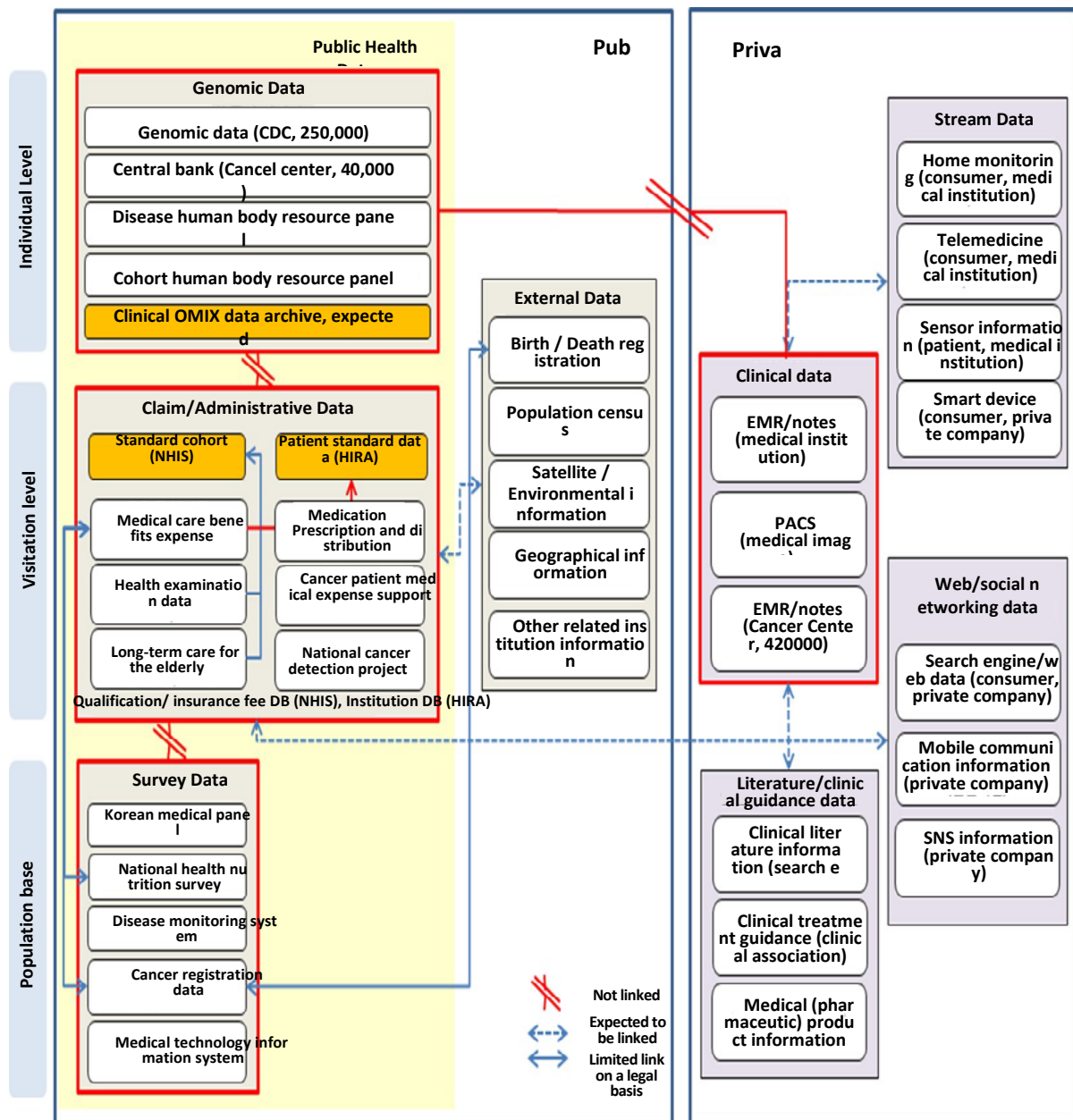
Source: Kang et al. 2015

9. Summary

This section examined how personal information, including RR numbers, is used in preventive, treatment, and management systems.

The personalized health information service operates based on RR numbers. Individuals can track their own examination history and medical history through the NHIS website and use this information for their own health management. They can also receive customized health information through the system. RR numbers and authentication certificates are used simultaneously to confirm users' identity and to protect personal information.

RR numbers are used in the medical record sharing system in a limited way. This system is designed to make it difficult to identify individuals because various medical facilities handle sensitive information related to health that is accumulated in a central data repository. In the medical record, a unique number is used instead of the patient's RR number. A unique number is also used in all data management procedures, and system security devices are used to protect personal information.

Finally, the NHI's big data system excludes all means of identifying individuals, including RR numbers. In addition, data provided for academic and policy research purposes can be used only after rigorous institutional review board screening. The use is strictly limited if data are transformed into a form that can be used to identify an individual. Big data is characterized by the fact that individuals cannot be identified in any form.

Table 10: Use of RR Number for Healthcare Data Management

Classification	Individual health data management	Data management of medical institutions	Public use of health data
Program Stage	Provide customized health information	Medical record sharing system	Health insurance big data
Registration	Use of RR numbers for individual identification to login to personal health management system linked to health data that NHIS holds.	To register participating medical facilities and use medical record sharing service, it is necessary to sign and consent to provide personal information regarding exchange of medical information.	- Any keys such as RR numbers that can identify individuals are removed. - Researchers who want to conduct research using big data must submit their personal information and research plan to be approved.
Storage	System collects and uses personal information in accordance with Personal Information Processing and Protection Policy. Various measures are taken to ensure data security.	- Instead of sensitive identification information such as RR numbers that identify individuals, a unique number is assigned to for transmission of information such as care record summaries. - Individuals' medical records are stored in a distributed system rather than being kept in one place. -System operates in advanced general hospitals with information security system.	Use of data is strictly restricted if the user who was provided with data violates rules, such as using the data for purposes other than research or rearranging the database so individuals can be identified
Data analysis	Health-iN service links NHIS national health information database with data from the Ministry of Food and Drug Safety, the Korea Meteorological Administration, and the Ministry of Environment and integrates private social media information (e.g., tweets, blogs to determine risk trends of major disease and provide warning.	Data generated and accumulated in current medical record sharing system are not used for big data analysis purposes.	Results of academic and policy research using big data are open and shared to the public.

NHIS, NHI System

PART VI – CHALLENGES IN USE OF RRNS FOR UHC

A. THREATS TO PRIVACY AND PROTECTION OF PERSONAL INFORMATION

While it is performing a critical governance role as a foundation of UHC achievement, the Korean RR number system might also pose a serious threat to privacy because it could reveal a significant amount of personal information (Ko 2012). Sensitive personal information, such as RR number and fingerprint, is listed on the face of the RR card, so it can easily be used for crimes, harming individuals, society, and even the country (S. Kim 2011). In practice, various government offices and the private sector request RR numbers for personal identification, so personal information is often exposed unprotected. RR numbers are used for many reasons every day, such as verifying one's identity when entering school, starting a new job, purchasing or renting a house, or when undergoing surgery in the hospital (M. Kim 2011). Thus, RR numbers are closely linked to everyday life and are widely used, and in the information age, the range of use has been gradually increasing (Sung 2016).

Particularly, the connectivity and integration of the CRVS system to the healthcare information system can be the most serious threat to personal privacy. Health information comprises diverse information on personal identity and health status. Personal information, such as name, PINs, and telephone number, distinguishes individuals' identities. Health information also contains health data that are either self-reported or obtained from medical facilities, which includes information about health insurance, medical conditions, health management, and death records and information from examinations and medical treatments (Jun 2006). Health information is one of the most private types of personal data, and unwanted disclosure of it to other people seriously violates the person's personal or financial privacy. It is often impossible to repair the damage, so protecting this information is very important (Bang et al. 2014).

Leakage of personal health data can cause more serious harms than that of other types of personal information as the potential extent and range of damage that theft of personal health information causes are greater than from the theft of other types of personal information. Also, as health data are frequently used for academic research and statistical reports, personal data collected and stored for the primary purpose of treating individuals might be used for various secondary purposes. (Bang et al. 2014). Cases of personal information leakage in the healthcare sector concern individuals, healthcare facilities, and government agencies attacked for profit, through negligence, and by computer viruses.

Table 11 shows several examples of health data leakage that occurred recently in Korea.

Table 11: Examples of Health Data Leakage in Korea

Type	Description
NEHCA Leakage	**In 2011, six hospitals leaked patients' personal data to the National Evidence-based Healthcare Collaborating Agency (NEHCA)[a]** Six hospitals gave the NEHCA their patients' names, RR numbers, and residential addresses. The NEHCA illegally used personal data for research purpose. The NEHCA gave the data to the Health Insurance Review and Assessment Service, requested links to the individuals' health records, and used that data for research.
Hospital websites Intrusion	**Malicious codes extract personal data and target the healthcare sector (2015)[b]** Recent attempts to extract personal data have targeted medication-related Internet sites using malicious codes to infect hospital websites. These virtual intrusions aimed to steal personal financial information.
Seoul Metropolitan City Government Leakage	**Seoul Metropolitan City government exposed personal data of 150 quarantined individuals with Middle East Respiratory Syndrome (MERS) (2015)[c]** The Seoul Metropolitan City government leaked personal data of quarantined individuals with Middle East Respiratory Syndrome, such as their names, addresses, and telephone numbers. A vast amount of personal data were linked to the self-quarantine notice on the Seoul government's website, and individual personal data were indiscriminately disclosed.
Chungwon city Leakage	**Personal data of families of individuals with Middle East Respiratory Syndrome were leaked in Chungwon city[d]** Personal data of individuals with Middle East Respiratory Syndrome and their families, including their names, addresses, and telephone numbers, were leaked, which caused secondary damage to the people, such as verbal abuse directed at the victims. The reference materials distributed to executives were leaked online and instantly spread via social networking. Data on the individuals' children, grandchildren, and extended families were revealed, which caused psychological and material damage to the families.

[a]http://medipana.com/news/news_viewer.asp?NewsNum=72829&MainKind=A&NewsKind
=5&vCount=12&vKind=1
[b] http://www.docdocdoc.co.kr/news/articleView.html?newscd=2015011300031
[c] http://www.seoul.co.kr/news/newsView.php?id=20150610001010
[d] http://news.mk.co.kr/newsRead.php?year=2015&no=566151

In addition, there was a reported incidence of health insurance big data being given to pharmaceutical companies and insurance companies[13.] The MOHW expanded 16 health insurance big data analysis centers with a database that had a large amount of personal information collected during the operation of a health insurance business. Under the Personal Information Protection Act, sensitive information such as health data cannot be used or provided to third parties for purposes other than the specified purpose or without the individuals' consent. However, the MOHW, the NHIS, and the Health Insurance Review and Assessment Service permitted sensitive information to be used without consent because they processed the sensitive information anonymously. This is a problem because anonymous data can be linked to the individuals' identities through re-identification.

B. ESTABLISHMENT OF LAWS AND REGULATIONS FOR PROTECTION OF PERSONAL INFORMATION

Legal standards should be established to improve national health data security; guidelines are needed on handling anonymous health information. To address and respond to the threats to personal information, several laws and regulations have been enacted and implemented to protect personal information in the public and private sectors (Table 12).

Table 12: Laws and Regulations for Protection of Personal Information

Types	Laws and Regulations	Content
Government records	Act on the Protection of Personal Information Maintained by Public Institutions	Regulations on the duties and rights of data managers and public institutions while handling personal information
	Enforcement Decree of the Official Information Disclosure Act	Regarding undisclosed or partially disclosed personal information
	Republic of Korea, Resident Registration Act	Reading or issuing copies or abstracts of RR and use of computerized data
	Statistics Act	Protecting confidentiality of individuals and corporate entities
	Act on the Inspection and Investigation of State Administration	Limit inspections and investigations to reduce privacy violations
	State Public Officials Act	Protection of confidentiality
Healthcare data	Framework Act on Health and Medical Services	Protection of healthcare privacy

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[13] http://www.rapportian.com/news/articleView.html?idxno=28549

	Medical Service Act	
	Infectious Disease Prevention Act	
	Act on Prevention of Acquired Immunodeficiency, Internal Organs, etc. Transplant Act	Prohibition of leakage of personal data and protecting confidentiality
	Mental Health Act	
	Mother and Child Health Act	
	Emergency Medical Service Act	
	Pharmaceutical Affairs Act	
	Enforcement Decree of Bioethics and Safety Act	Protection of genetic information
Consumer information	Act on Promotion of Information and Communications Network Utilization and Information Protection, etc.	Regulations on handling personal information by information and communication service providers
	Use and Protection of Credit Information Act	Regulations on handling personal credit information by private sector entities and reading and inquiry for correction by credit information subjects
	Act on Real Name Financial Transactions and Guarantee of Secrecy	Confidentiality of financial transactions
	Securities and Exchange Law	Prohibits leaking or providing data
	Act on the Protection, Use, etc. of Location Information	Collection of location information, scope of provision and prevention of misuse and abuse
	Banking Law, Attorney-at-law Act, Notary Public Act, etc.	Protection of confidentiality obtained in business

Source: Jung, BK, 2008

Some of the laws are explained in more details below.

● **The Personal Information Protection Act**

Collection and use of personal information are frequent in all aspects of Korean society because of the advancement of the information age and the increased potential financial gains from personal data. There is room for improvement in personal information protection and processing standards. The Personal Information Protection Act (PIPA) stipulates the principles for handling personal data in the public and private sectors, which conform to those at the international level (figure 37). It aims to protect the privacy of the public and ensures the public's right to protection of personal information. According to

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the PIPA, personal information is information about a living individual that identifies the individual through name, RR number, or image (the information cannot identify specific individuals, but it can identify them when combined with other information). The PIPA restricts collection of personal information without consent, collection of sensitive or minimal necessary personal information, use of personal information for purposes other than the consented purpose, and illegal registration of patients and identification through RR numbers.

Figure 37: Legislation Regarding Personal Information Protection
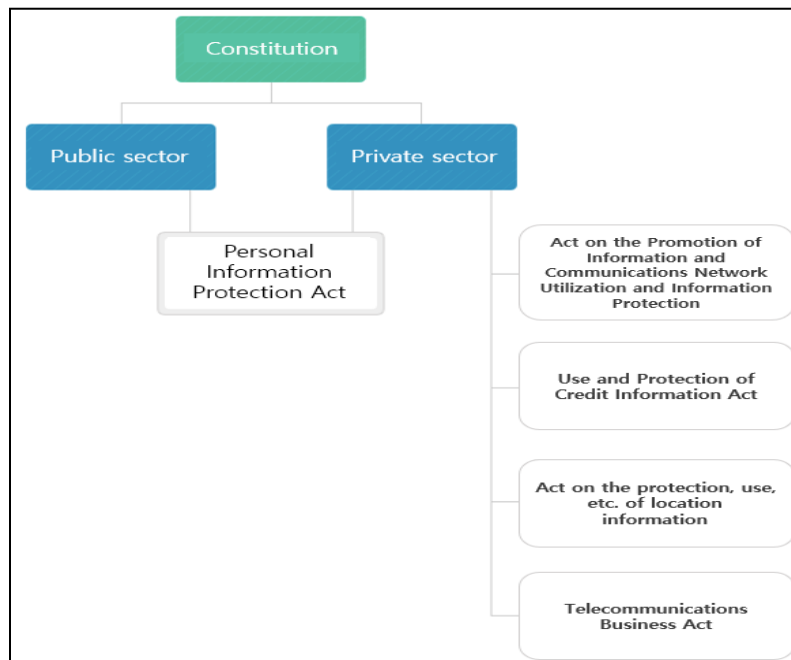
Source: Personal Information Protection Commission Webpage, Introduction of Personal Information Protection Law[14]

- **The Information and Communication Network Act**

The Information and Communication Network Act promotes the use of information and communication networks while protecting the personal information of individuals who use information and communication services. It aims to improve public welfare by creating an environment in which information and communication networks can be used safely.

When information service providers protect, collect, and use their users' personal information, they should inform users of the reason for collecting and using their personal information, the items to be collected, and the period of storage and use of the data. Providers should obtain consent from each user. In addition, personal information collected this way must not be used for purposes other than those to which the user has

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[14] http://pipc.go.kr/cmt/not/inf/notlawintro.do

agreed. Additional consent should be obtained when a description of the user, purposes of use, and items being obtained are shared with third parties. The provider must identify the relevant policies on handling personal data and disclose this information to users so that they can access it easily. Providers also must take technical and administrative steps to prevent the loss, theft, alteration, or damage of personal information. Numerous aspects of protection of personal information are emphasized in the Information and Communication Network Act.

- **Act on the Protection of Personal Information Maintained by Public Institutions**

This act is intended to protect the rights and interests of the public and ensure the required conduct of public affairs by determining what the necessary steps are for handling personal data processed using public institutions' computers. Because most national-level data have been computerized, and a national administrative network has been implemented, this act focuses on preventing unintended consequences of data handling, such as unauthorized use of personal information and invasions of privacy due to unauthorized access.

C. De-identification of Personal Information

In addition, it is necessary to develop appropriate substantive and technological devices and apparatuses for de-identification. De-identification refers to any activity that increases the difficulty of identifying an individual through any means, such as deleting some or all information that might identify the individual from the collected data or replacing some of the information with personal attributes (Ko et al. 2015). Linking data items to prevent personal information from being stolen could be defined as an example de-identification. De-identification of personal data can allow more frequent use of personal information and activate personal information for research as strictly controlled in the 2011 PIPA, but it does not eliminate the risk of re-identification. (Ko et al. 2015).

Table 13 shows some guidelines to protect personal information by de-identification in Korea.

Table 13: Guidelines for Protection of Personal Information by De-idenfication

Charact er-istics	Guidelines				
	Privacy protection in accord with sharing of	Casebook of personal data de-identification for use of big data	Big data privacy protection	Self-assessm ent of propriet y of personal	De-identificati on for use as big data

	the public data			**data de-identification**	
Disclosure date	September 2013	May 2014	December 2014	December 2014	May 2015
Administrative departments or institutions	• Ministry of the Interior and Safety	• Ministry of Science, Information and Communication Technology and Future Planning • National Information Society Agency	• Korean Communications Commission	• Ministry of the Interior and Safety • National Information Society Agency	• Ministry of Science, Information and Communication Technology and Future Planning • National Information Society Agency
Application	• Public	• Public • Private	• Public • Private (primarily information service providers)	• Public • Private	• Public • Private
Content	• Summary of Basic policy • Compliance process • Methods of de-identification	• Summary • De-identification steps for big data uses • De-identification cases	• Purposes • Definitions • Protection of personal information • Collecting and using disclosed data • Sharing data with third parties	• Summary • Re-identification and risk factors • Risk management for re-identification	• Summary • Laws and corrective actions for sectoral personal data • Practical uses of de-identification

D. STRENGTHENING THE PROTECTION OF PERSONAL INFORMATION IN THE HEALTHCARE SECTOR

The rapid development of information and communication technologies, science, and healthcare technologies has expanded interest in healthcare services and improvement

in quality of life. In addition, rapid development of healthcare informatization has enabled people to obtain better healthcare services. Nevertheless, failure to prevent or counteract the adverse effect of informatization might lead to security threats that are more serious than in other fields. When personal health data are not appropriately managed and are leaked, it is likely that consequences and harming effects are likely more problematic than theft of another type of information (Jung 2008). In addition to the PIPA and the Information and Communications Network Act, other laws regarding health stipulate methods of handling documentation and important personal information. Sharing or leaking documents and other personal information to organizations without the individuals' consent is prohibited. Table 13 shows laws that are enacted to protect personal health data.

Nevertheless, regulations for comprehensive privacy protections and the security of personal health data in Korea are not comprehensive. In 2011, healthcare facilities became subject to revision of the PIPA, but the PIPA provides general coverage that does not address the specifics of the healthcare sector (Bang et al. 2014). To protect personal health data, all healthcare facilities follow the PIPA because it applies to all public and private organizations, but in many cases, the PIPA and the Medical Service Act are relevant because of the specific data that healthcare facilities hold. Inconsistent, ambiguous legal language has caused confusion. An independent healthcare information protection law should be enacted soon regarding management of patient data (Bang 2014; Jung 2008).

Table 14: Protection of Personal Health Data Under Korea's Legal Mandate

Law	Examples of types of personal data and key information
Medical Service Act	Medical certificate (e.g., registration number, serial number, name, RR number, address, telephone number, diagnosis, treatment, disease classification number) Prescription (e.g., health service institutional code, name, RR number, health service facility, service provider, disease classification number) Medical records (e.g., name, address, telephone number, RR number, symptoms, diagnosis, treatment)
Medical Care Assistance Act	Medical care assistant application (e.g., type of healthcare assistant, institutional code, name of facility, name and RR number of the head of household, name and RR number of the recipient, address, name and class of disease, healthcare facility) Notice of eligibility qualification (e.g., code number and name of facility, code number of administrative office, name and RR number of householder, name and RR number of recipient of care) Medical care assistant (e.g., information on householder and dependents, assistance records)
National Health Insurance Act	Medical insurance card (name, date(s) of treatment, institutional code number) Medical care payment bill (e.g., registration number, date of registration, name and RR number of the patient, code number and name of healthcare service facility, type of diagnosis, date of prescriptions) Application form of health insurance payment for period (registration number, date of registration, name, RR number, address, payer's telephone number, registration details)
Infectious Disease Control and Prevention Act	Infectious disease report (e.g., name, RR number, telephone number, employment, sex, address, disease, date of occurrence, diagnosis) Vaccination certificate (e.g., name, date of birth, sex, address, name of vaccination) Medical treatment confirmation (e.g., name, date of birth, address, disease, doctor's notes)
Emergency Medical Service Act	Emergency patient referral (e.g., name, date of birth, address of patient; name, address, telephone number of protector; time of arrival; patient status before treatment)

	Substitute payment for emergency medical treatment expense (code, name, telephone number, address of the healthcare service facility; name, RR number, telephone number, address, zip code of patient; bank account number for substitute payment)
Prevention of Acquired Immunodeficiency Syndrome Act	Notice of medical examination (serial number; name, RR number, address of recipient; purpose of examination; date of examination; name of healthcare facility)
	HIV/AIDS report (e.g., report number, sex, date of birth, date of initial diagnosis, doctor's notes, cause of death)
	AIDS examination registration book (e.g., serial number, date of examination, personal information)
Internal Organs, etc. Transplant Act	Registration for waiting list for organ transplantation (name, RR number, address, registration details)
	Registration for organ donation (registration number; registration date; donor name, RR number, telephone number, email address, address; registration details)
	Results of brain death investigation (name, RR number, address, information for healthcare service facility; name and RR number of investigator)
	Notice of organ transplantation (e.g., patient's name, date of birth, address, telephone number; names of transplanted organs)
Bioethics and Safety Act	Consent form for embryo creation (e.g., consent form number; name of healthcare service facility creating embryos; name, date of birth of infertility patient; spouse's name, date of birth; doctor's name)
	Consent form for reproductive cell donation (e.g., name of healthcare service facility creating embryos; donor's name and date of birth; spouse's name and date of birth)
	Consent form for research uses (e.g. consent form serial number; name of healthcare service facility creating embryos; donor's spouse's name and date of birth; information on embryos)

PART VII – CONCLUSION

The Korea CRVS system is functioning as the most critical governance tool that can expand the Korean healthcare system's capacity to achieve UHC. Because the national government has many broad responsibilities, such as national defense, internal security, taxation, polling, social welfare, and census enumeration, appropriate and direct management of administrative duties relevant to personal data are reasonable and justified through identifying residency relationships and clarifying population dynamics. The present system in Korea assigns RRNs to individuals as permanent and consistent UIDs containing large amounts of personal information to all Korean citizens, which it then uses for a wide variety of purposes in the public sector (Ko 2012).

Similarly, by linking people to the healthcare system and integrating people's data to those in other systems, RRNs are playing a pivotal role that expands the capabilities of the Korean healthcare system in achieving UHC. Indeed, RRNs are the connector that links between and across individuals, healthcare facilities, technologies, and the NHI system, via internet and mobile. By linking people to government administrative system, RRNs allow people to be registered as users, notified of services and benefits that they are entitled to, their health behaviors including healthcare service uses recorded into the system and managed and provided feedback based on their records. RRNs assist people to prevent and manage acute and chronic diseases by providing information, sending warnings, notes, and feedbacks on necessary actions and behaviors. Also, RRNs are used to identify the vulnerable population who are eligible for various government assistance programs that promote their health when they are pregnant, had a birth, or when children are in needs of better nutrition. RRNs can be used as a critical tool for epidemiological investigation when there is an outbreak of infectious disease. With RRNs, people maintain their immunization records and health records which they can pull out from home through the internet.

Collectively, individual data that are tracked and combined using RRNs can work as healthcare big data that can assist the development of health policies and programs. Globally, one of the most exciting and intriguing challenges in the healthcare sector these days is how to integrate numerous technologies, facilities, and programs to create an enabling health care system and connect people to the system so that they can fully utilize and benefit from the integrated system. Similarly, by integrating data from different sources and utilizing the vast amount of healthcare data, the Korea healthcare system can apply a comprehensive and innovative approach to prevent and cure diseases and promote human health. Generation and integration of healthcare data, either in the form of individual and private information on his/her health as well as publicly available and integrated big data on the epidemiological health status of a population, is becoming a valuable tool that can expand the existing capabilities of medicine and healthcare services. Both at an individual level as well as the public level, for effective use of information that is generated from various places in various formats, the Korea CRVS system is working

as a tool that connects not only people to the system but also a data system to another one.

Increasingly, healthcare data are considered to be a critical tool for producing added values for biotech research and industries. Therefore, it became essential to set a national vision and plans on how to utilize healthcare data best. In Korea, there have been several projects and programs to promote healthcare data utilization, but they are still in a state that lacks coherent and consistent policies that provide clear directions for future development.

At the same time, sufficient attention to the integration of healthcare data scattered in various places in different formats is necessary. Currently, most of the efforts are concentrated on developing and utilizing data; however, it is also essential to clean, standardize, connect and integrate the data scattered in various places. Integration of data is an area where public policies can make an impact. Development of infrastructure and related policies should be a consideration of the government.

As much as it facilitates utilization and integration of various networks and data systems among Ministries and public/private institutions, it also can pose significant threats of unprotected data use and invasion of privacy. RR numbers are linked to various kinds of personal data and can enable computer matching that links records across databases, so it is necessary to consider developing and distributing separate and distinct identification tools to supplement the current RR number system. It is necessary to seek legal remedies to minimize the likelihood of privacy violations caused by the leakage or theft of RR numbers while attending to the purpose of the current RR system (Ko 2012). Providing temporary serialized numbers that minimize identification as much as possible in each area that requires individual identification would one way to address the problem (Ko 2012). Distinct identification numbers might be assigned in each administrative area. PINs, such as driver's license numbers, healthcare insurance numbers, passport numbers, student numbers, deposit account numbers, and credit card numbers, have been used to in addition to RR numbers (Kwon 2004).

Also, with the growth of the Internet of Medical Things (IoMT), existing health IT architecture is struggling to keep systems secure and safe. Blockchain solutions have the potential to be the infrastructure that is needed to keep health data safe and secure. In this new model, the user has a sole control over his data and the power to grant access to specific healthcare providers and/or healthcare entities for communication and collaboration in disease treatment and prevention. The problem of privacy in e-prescription, which is currently being piloted in Korea, may also be solved through this technology. The decentralized nature of the blockchain combined with digitally signed transactions ensures that an adversary cannot pose as the user or corrupt the network as that would imply the adversary forged a digital signature or gained control over the majority of the network's resources. In the future, it is expected that a well-developed UID system

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related to health and welfare will link to the blockchain technology and use it more safely and efficiently.

While minimizing the damage to personal privacy, a simple national identification system would allow for easy, appropriate assessment of population dynamics and management of administrative affairs including UHC implementation. By linking, integrating, and providing feedback, a UID system, RRNs in Korea, is expected to facilitate the current health care system to expand its capabilities of achieving UHC.

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This paper is a comprehensive case study on how the Korean civil registration and vital statistics (CRVS) system facilitates achievement of universal health coverage (UHC) in the Republic of Korea. The case study briefly summarizes the resident registration system—the main part of the Korea CRVS system—and the health care system in Korea; it provides an overview of UHC-related problems from the perspective of three major stakeholders: patients, providers, and government. It presents case studies illustrating how the Korean Resident Registration Number (RRN) system facilitates implementation of UHC in Korea, including three main areas of health service provision (prevention, treatment and management, and health care data usage). It discusses key considerations for UHC implementation using RRNs, focusing on personal information protection and use of health care data in UHC implementation; and, it presents lessons learned and provides a conclusion of the study.

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