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Background and Data Configuration Process of a Nationwide Population-Based Study Using the Korean National Health Insurance System

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Background: The National Health Insurance Service (NHIS) recently signed an agreement to provide limited open access to the databases within the Korean Diabetes Association for the benefit of Korean subjects with diabetes. Here, we present the history, structure, contents, and way to use data procurement in the Korean National Health Insurance (NHI) system for the benefit of Korean researchers.

Methods: The NHIS in Korea is a single-payer program and is mandatory for all residents in Korea. The three main healthcare programs of the NHI, Medical Aid, and long-term care insurance (LTCI) provide 100% coverage for the Korean population. The NHIS in Korea has adopted a fee-for-service system to pay health providers. Researchers can obtain health information from the four databases of the insured that contain data on health insurance claims, health check-ups and LTCI.

Results: Metabolic disease as chronic disease is increasing with aging society. NHIS data is based on mandatory, serial population data, so, this might show the time course of disease and predict some disease progress, and also be used in primary and secondary prevention of disease after data mining.

Conclusion: The NHIS database represents the entire Korean population and can be used as a population-based database. The integrated information technology of the NHIS database makes it a world-leading population-based epidemiology and disease research platform.

Keywords: National Health Insurance; National Health Insurance Service; Population-based data; Korea

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INTRODUCTION

History of the Korean Health Security system

Following the 'Medical Insurance Act' legislation in 1963, medical insurance societies for companies with more than 500 employees and insurance societies for public officials and private school employees were introduced in 1977. In addition to the expansion of coverage to smaller companies, universal coverage of the self-employed by medical insurance societies in rural and urban areas was implemented in 1988 and 1989, respectively. Based on the 'National Health Insurance Act' enacted in February 1999, all medical insurance societies were integrated into a single insurer in 2000. The single insurer was the National Health Insurance Corporation (NHIC). The single system was implemented to improve management efficiency and to achieve equity among insurance funds in relation to financial burden and other managerial issues [1-3]. In the same year, the separation of prescribing and dispensing drugs was also implemented. In 2008, the long-term care insurance (LTCI) system was introduced to alleviate the financial burden on unpaid family caregivers, helping elderly Koreans with difficulties performing the activities of daily living or housework due to geriatric diseases [4].

National Health Insurance system
National Health Insurance program

There are three main healthcare programs for universal coverage in Korea: National Health Insurance (NHI), Medical Aid (MA), and LTCI. The NHI program covers the whole population as a social insurance benefits scheme with the following features: it is compulsory and it provides short-term insurance; compulsory contributions are made according to ability to pay. The NHI program classifies individuals as either employees or self-employed. The MA program is managed by the Korean government. It is a public assistance scheme that secures the minimum livelihood of low-income households and assists with self-help by providing medical services [5]. The LTCI program is based on the principle of social solidarity. The program provides benefits for a period of at least 6 months.

NHI structure

There are three main regulators of the healthcare system in Korea: the Ministry of Health and Welfare (MOHW) and the National Health Insurance Service (NHIS), formerly NHIC (in 2013, NHIC changed its name into NHIS), and Health Insurance Review Agency (HIRA). MOHW supervises the NHI program through the formulation and implementation of poli-
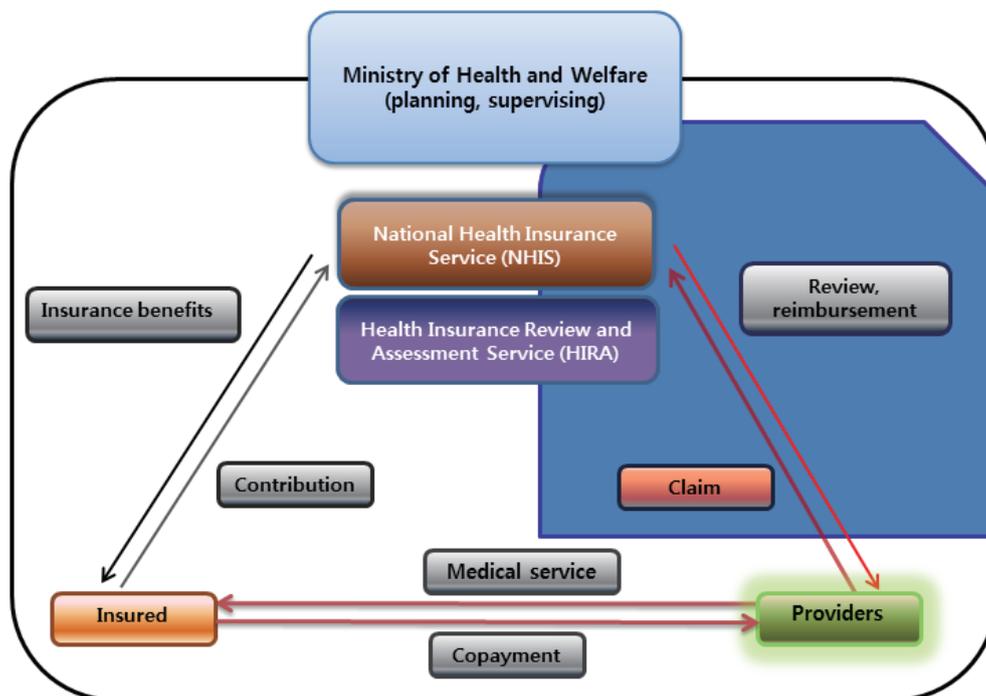

Fig. 1. Operational structure of the National Health Insurance program.

cies. NHIS is a nonprofit organization and a single insurer that manages the NHI program. The NHI is responsible for managing enrolled and insured individuals and their dependents (spouse, direct lineal ascendants or descendants, and unmarried brothers or sisters), collecting of contributions and setting medical fee schedules. HIRA has a quality control role and evaluates healthcare performance and reviews medical billing and claims. HIRA also determines whether health care services are medically necessary and ensures that the services are delivered to beneficiaries at an appropriate level and cost [6]. Fig. 1 shows the "operational structure of the NHI program" [7].

Medical coverage of NHI

All Koreans residing in Korean territories are covered under one of the following three categories: employee insured, self-employed insured, and medical aid beneficiary [8,9]. Because the NHI program is mandatory for all Korean citizens, except for those with low incomes, health care providers cannot deny NHI patients and the enrollees are required to pay monthly contributions. The contribution to NHI is calculated based on an employee's wage and is paid by the company's employer. In the case of the self-employed, the cost is calculated based on the household income, property, income, vehicle(s) owned, age, and gender.

Types of insurance benefits

Although NHI covers the whole population as a compulsory scheme, not all items of healthcare are covered by the program. The aim is to cover the prevention and treatment of sickness and injury that result from daily life and childbirth. The program also covers health promotion and rehabilitation. NHI provides the same benefits package regardless of the contributions made, which are determined by the individual's ability to pay.

The benefits are granted both in-kind and in cash. The in-kind health benefits consist of health care benefits and check-ups. Health care benefits include diagnosis, tests, drugs, medical materials, treatment, surgery, preventive care, rehabilitation, hospitalization, nursing, and transportation provided by health care institutions in the treatment of disease, injuries, and so on. In the NHI program, the insured pay an average of 30% of the total medical costs related to almost all health care benefits. To discover and treat disease early and improve health, the NHI provides regular health check-ups and a cancer screening program. All insured Koreans who are at least 40 years old and

their dependents can receive biannual health checks without cost. Under the cancer program, eligible people can receive examinations for the following specific cancers: cervical cancer for females aged 30 or older, stomach and breast cancer for those 40 or older, colon cancer for those 50 or older, and liver cancer for those aged 40 or older and considered a high-risk group for liver cancer based on the benefit details over the last 2 years. The individual is responsible for 10% of the cost.

There are two categories of items that do not have any coverage: (1) any medical services, drugs or materials provided or used for diseases that do not cause serious problems in daily life or work (simple snoring, fatigue, etc.); and (2) treatments that do not improve essential physical functions (e.g., plastic surgery, freckle removal, urogenic, and gynecological diseases that cause no problems in everyday life, treatment for narcotic addiction, orthodontics, etc.) [7,10]. In terms of financial coverage, copayments are applied for all medical procedures depending on the level of medical care received and whether the procedure was inpatient or outpatient [7].

Reimbursement flow

As shown in Fig. 1, the insured, the healthcare providers and the regulators of the healthcare system, including MOHW, NHIS, and HIRA, collaborate to operate the Korean NHI system. By providing healthcare to the insured, the healthcare providers can submit healthcare costs to NHIS. The claim costs are determined according to a coding system of disease and each medical treatment service. The coding system of disease follows diagnostic codes as per the International Classification of Diseases, 9th to 10th revision, clinical modification, ICD-10-CM code [11]. The claim data are sent to HIRA, which reviews the claims for reimbursement [6]. Finally, NHIS redeems their expenses paid and pays for healthcare service costs by paying healthcare providers or healthcare institutions. Therefore, nationwide claim data are collected by this review process operated by HIRA and is known as 'health insurance claiming data.' The claimed costs are reimbursed through fee-for-service for all services and referral levels. The physician fee is calculated by multiplying a resource-based relative value score for each treatment by the unit price.

Healthcare delivery system

The aim of the healthcare delivery system is to utilize healthcare services efficiently and to prevent patients from clustering at tertiary care hospitals. In principle, patients can select any

practitioner or any medical care institution. If a patient wants to receive medical care from a tertiary care hospital, the patient has to present a referral slip issued by a doctor who works for an institution other than a tertiary care center. Exceptions to these referral channels are emergency medical care, rehabilitation, childbirth, medical service for a hemophiliac, family medicine, and dental care.

METHODS

Study population

The baseline study population is all insured Koreans residing in Korean territories. These people are divided into three categories: NHI program for employee and self-employed groups and medical aid beneficiaries. The MA program is managed by the Korean government and is a public assistance scheme to secure the minimum livelihood of low-income households and to assist with self-help by providing medical services. As shown in Table 1 [12], 100% of the Korean population is covered by the Korean NHI system. In 2013, the NHI system covered 97.2% (n=49,989,620) of the population and the MA system covered the remaining and 2.8% (n=1,458,871) of the population.

Sources for data procurement

Subjects were identified from either the NHIS or HIRA databases. The HIRA database contains medical claims data for the entire Korean population as a result of the NHI system.

Quality of NHIS database

As described earlier, NHIS is a nonprofit organization and a single insurer that is responsible for operating a health insurance program. The NHIS manages the enrollment of the in-

Table 1. 100% health insurance coverage for the Korean population by the National Health Insurance Service

Classification	Coverage population, 1,000 persons (%)	
Year	2010	2013
Total	50,581 (100.0)	51,449 (100.0)
NHI		
Subtotal	48,907 (96.7)	49,990 (97.2)
Employee insured	32,384 (64.0)	35,006 (68.0)
Self-employed insured	16,523 (32.7)	14,984 (29.2)
Medical aid beneficiaries	1,674 (3.3)	1,459 (2.8)

Modified from National Health Insurance Service [12].

sured and their dependents and the collection of contributions. Based on the law, the NHIS may also perform compulsory financial collections from the insured. The data collected for this operation is called 'qualification and contribution data'.

As described in the introduction, health care providers submit reports about the medical services performed to HIRA, which is equivalent to a quality control department that provides a review of the medical costs incurred. These 'health insurance claiming reports' from healthcare providers contain information on the diagnosis and status of outpatients and inpatients. Additionally, the reports contain information related to drugs, such as the name, dosage, prescription date and periods, and method of administration. The reports also contain information on the use of laboratory and imaging tests.

Protection of personal information

The NHIS and HIRA provide data without the individual identifier, in accordance with the Act on the Protection of Personal Information Maintained by Public Agencies. Thus, the database included an unidentifiable code representing each individual. There are data concerning patient age, gender, diagnosis, and lists of prescribed drugs.

RESULTS

Data assessment

We obtained information on patient demographics, medical utilization/transaction information, insurer's payment coverage, and patient's deduction from the following databases: responsibility of payment and contribution of the insured database, claim database, health check-up database, and long-term insurance database.

The responsibility of payment and contribution of the insured database includes the following information: personal identification number (which is not a social identification number), sex, age, types of qualification (employee health insurance, self-employed health insurance, or MA program), date of birth, date of death, region where the insured applied for the NHI program, and disability and its type (if present).

The claim database consists of four detailed categories, including general information on specification (20T), consultation statements (30T), diagnosis statements determined by the International Classification of Diseases 10th revision (ICD-10; 40T), and detailed statements about prescriptions (60T). Each data table is designated by the letters 20T, 30T, 40T, 60T which

consist of unique number table delimiter and T is referred to "table". Payment specification (20T) describes the following information: personal identification, health and medical care institution, principal diagnosis, first additional diagnosis, days of medical care, date of medical care commencement, number of visiting days, insurer and deduction payment, and so on. The consultation statement (30T) provides detailed information on the medical examination and treatment such as medical care, in-hospital administration of medicine, procedures, surgery, and so on. The diagnosis statement (40T) includes principal di-

agnosis and up to nine additional diagnoses. The detailed statement of prescriptions (60T) for the outpatient is a specification of prescription claims including the following: name of drug, date filled, days of supply, quantity dispensed, and price of each drug (Table 2).

As described above, the NHI program provides the benefits of a periodic health check-up program and a cancer screening program. The health check-up program allows data to be collected for the health check-up database. Each examinee must complete a standard questionnaire in this health check-up pro-

Table 2. Components of claiming data in the National Health Insurance Service

20T	30T	40T	60T
Payment specification	Consultation statement	Diagnosis statement	Detail statement of prescription
Personal identification	Medical examination and treatment such as:	Principal diagnosis from 1st to 9th additional diagnoses	Name of drug
Health and medical care institution			Date
Principal diagnosis	Medical care		Filled days
1st additional diagnosis	In-hospital administration of medicine		Supply
Days of medical care			Quantity dispensed
Commencement date of medical care	Procedure Surgery		Price of each drug
No. of visiting days			
Insurer and deduction payment			

20T, 20 table, consist of unique number delimiter; 30T, 30 table, consist of unique number delimiter; 40T, 40 table, consist of unique number delimiter; 60T, 60 table, consist of unique number delimiter.

Table 3. The data characteristics according to the National Health Insurance Service program

Characteristic		Qualification and contribution data	Health insurance claiming data	Health check-up data	Long-term care insurance data
Demographic information	Sex	O	O	O	O
	Age	O	O	O	O
	Region	O			O
	Family information	O			O
	Presence of handicap	O			O
	Death	O			O
	Type of qualification	O			O
	Contribution amount (incomes)	O			O
Medical use	Medical service use		O	O	
	Medical costs		O		
Diseases information	Chronic diseases		O	O	O
	Accident/Poisoning		O		
	Health check-up			O	
	Cognitive function			O	O
Lifestyle and habits	Smoking			O	
	Alcohol			O	
	Obesity			O	
	Exercise			O	
Basic laboratory data				O	

gram. Thus, we can collect information for each examinee regarding past medical history, current medications, and lifestyle habits, such as drinking, smoking, exercise, and diet. In addition, we can collect information on anthropometric measurements, such as height, weight, body mass index, and blood pressure. Furthermore, several basic laboratory tests are performed in this health check-up program, including the following: urinalysis, hemoglobin, fasting glucose, lipid parameters (total cholesterol, triglycerides, high density lipoprotein cholesterol and low density lipoprotein cholesterol), creatinine, liv-

er enzymes, hepatitis virus status, and simple chest radiograph.

The data in the long-term insurance database includes information on the presence of geriatric diseases and the cognitive function of the beneficiaries. Table 3 summarizes the data characteristics according to the NHIS program.

DISCUSSION

By applying the assumption of a hierarchy of health care actors and functions to the 27-box matrix established by Wendt et al.

Table 4. Dispersion of OECD healthcare system

No.	Healthcare system type	R	F	P	Cases
1[a,c]	National Health Service	St	St	St	Denmark, Finland, Iceland, Norway, Sweden, Portugal, Spain, UK
2[a,d]	Nonprofit National Health System	St	St	So	
3[a,c]	National Health Insurance	St	St	Pr	Australia, Canada, Ireland, New Zealand, Italy
4[b,d]	State-based mixed-type	St	So	St	
5[b,d]	State-based mixed-type	St	Pr	St	
6[b,d]	State-based mixed-type	So	St	St	
7[b,d]	State-based mixed-type	Pr	St	St	
8[a,d]	Etatist Social Health System	St	So	So	
9[b,d]	Social-based mixed-type	So	St	So	
10[b,c]	Social-based mixed-type	So	So	St	Slovenia
11[a,d]	Social Health System	So	So	So	
12[a,c]	Social Health Insurance	So	So	Pr	Austria[e], Germany, Luxembourg, Switzerland[e]
13[b,d]	Social-based mixed-type	So	Pr	So	
14[b,d]	Social-based mixed-type	Pr	So	So	
15[a,d]	Etatist Private Health System	St	Pr	Pr	
16[b,d]	Private-based mixed-type	Pr	St	Pr	
17[b,d]	Private-based mixed-type	Pr	Pr	St	
18[a,d]	Corporatist Private Health System	So	Pr	Pr	
19[b,d]	Private-based mixed-type	Pr	So	Pr	
20[b,d]	Private-based mixed-type	Pr	Pr	So	
21[a,c]	Private Health System	Pr	Pr	Pr	USA[g]
22[b,d]	Completely mixed-type	St	Pr	So	
23[a,c]	Etatist Social Health Insurance	St	So	Pr	Belgium, Estonia, France, Czech Republic, Hungary, Netherlands, Poland, Slovakia, Israel[e,f], Japan[f], Korea[e]
24[b,c,d]	Completely mixed-type	Pr	St	So	
25[b,c,d]	Completely mixed-type	Pr	So	St	
26[b,c,d]	Completely mixed-type	So	St	Pr	
27[b,c,d]	Completely mixed-type	So	Pr	St	

R, regulation; F, financing; P, provision; St, state; So, societal actors; Pr, private actors.
[a]Indicates plausible, [b]Indicates implausible, [c]Indicates empirically existent types, [d]Indicates missing types, [e]Only relative majority in financing, [f]Only relative majority in service provision,[g]Until 2013.

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[13], the number of plausible healthcare system types shrinks to 10 (Table 4, Fig. 2) and there are various insurance systems depending on each national circumstances (Table 4) [13,14]. The compulsory nature of the Korean NHI system (established in 1989) means that the system provides universal coverage. NHI is a single insurer that manages the NHI program. It was one of the earliest adaptive organizations to exercise leadership in information technology (IT) among public institutions by strengthening and converging with the latest IT. Universal coverage made the NHIS database the best national indicator of health issues and has easy annual updates. Although NHIC fulfilled its public roles by building an information system in health policies, it did not fully provide scientific research data through cooperation with academic societies. The Korean Diabetes Association (KDA) and its members now face a demand to continually acquire new knowledge and conduct research using the public large-scale information system. Recently, the NHIS signed an agreement to provide open access to the databases with KDA for the benefit of Korean subjects with diabetes at 9th June 2014 [15].

Based on the lessons learned through past experiences in analyzing the Korea National Health and Nutrition Examination Surveys by KDA and its members, we have attempted to present the history, structure, contents, and a way to use data procurement in the Korean NHI system. The goal is to improve our understanding of the NHI database that contains the payment responsibility and contribution of the insured database, claim database, health check-up database, and long-term insurance database. However, there are some limitations in the use of these databases. These data do not include uninsured events and only represent the services covered by the NHI. The data may not be consistent with actual diagnosis because it is basically made for claim purposes. The consumption of over-the-counter drugs without medical prescription also cannot be determined using these databases. Previous studies showed that approximately 28% of total healthcare expenditure occurred in the non-reimbursed field. Additionally, only approximately 70% of primary diagnosis codes concurred with medical records and clinical diagnosis made by different subjective diagnostic criteria [16,17]. For these reasons, NHIS data might not reflect the genuine utilization pattern and should be validated [18]. Metabolic disease is incurable chronic disease such
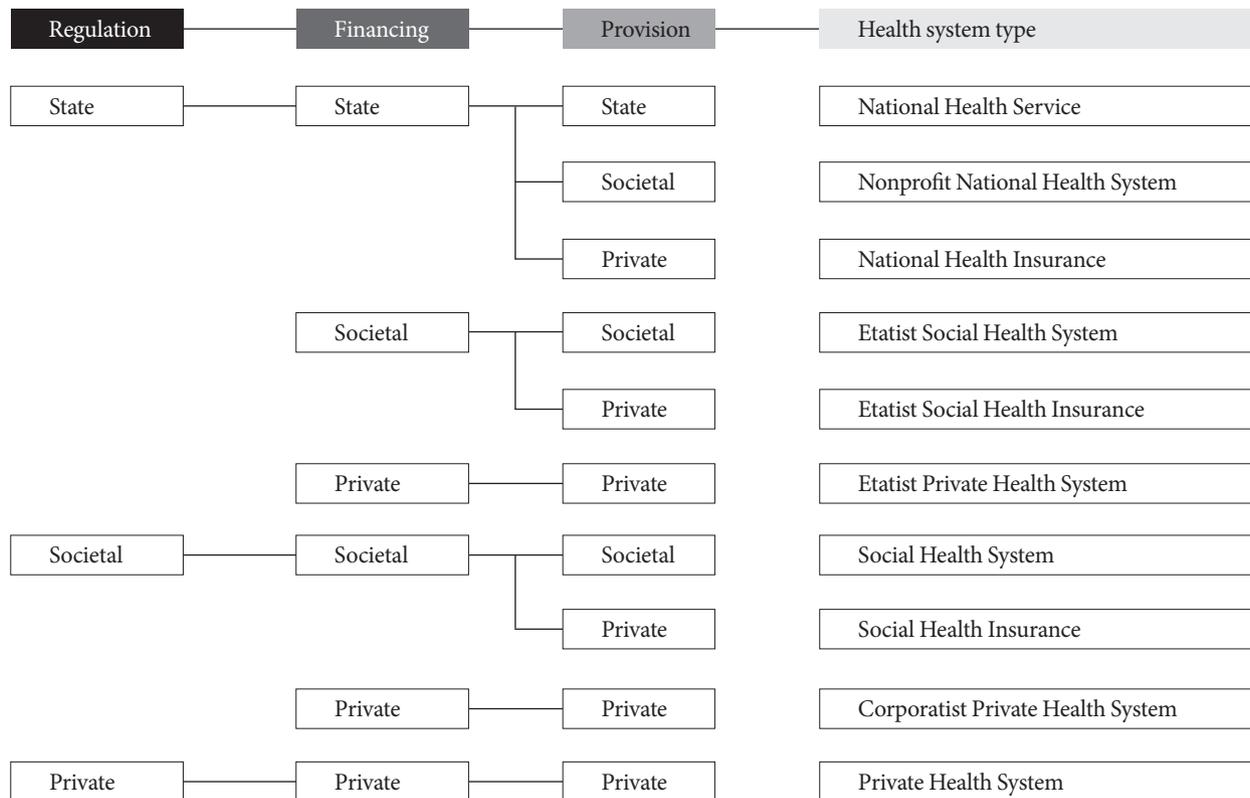

Fig. 2. Plausible healthcare system types.

as diabetes, hypertension, etc., which is life-long after onset and produces various complications. Also, these diseases are more common with aging and give us persistently serious physical, psychological, and socioeconomic burden. There has been growing problem in aging society like our country. The Japanese Ministry of Health, Labour and Welfare (MHLW) is the main institution that conducts several surveys and collects health-care data. The MHLW has conceptualized the implementation of the National Claims Database, which is tasked to evaluate the government's Medical Care Expenditure Regulation Plan starting from 2008 which has two main targets: the prevention of lifestyle diseases and the shortening of the hospital length of stay. Japanese MHLW is for use in policy planning and decision making. Korea also began to use these data partially. Previous studies on osteoporosis [19,20] and gastric ulcer [21] were reported with using NIHS claim database shared with HIRA's database. Identification of the target population was based not only on the diagnosis code but also on the disease-specific interventions received by the patients [18]. NHIS data is based on mandatory, serial population data, so, this might show the time course of disease and predict some disease progress, and also be used in primary and secondary prevention of disease after data mining. There are various assignments in the field of diabetes, following as: from prevalence/incidence, mortality rate and cause, type/amount/cost of drug usage, changing trend in treatment modality, to outcome evaluation of the treatment with delta changes in indicators such hospitalization, mortality, complications in diabetic patients, and so on.

In conclusion, the NHIS database represents the entire Korean population and can be used as a population-based database. The integrated IT of the NHIS database makes it a world-leading population-based epidemiology and disease research platform.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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