HIR

Healthcare Informatics Research

Health Insurance Claim Review Using Information Technologies

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Objectives: The objective of this paper is to describe the Health Insurance Review and Assessment Service (HIRA)'s payment request (PARE) system that plays the role of the gateway for all health insurance claims submitted to HIRA, and the claim review support (CRS) system that supports the work of claim review experts in South Korea. **Methods:** This study describes the two systems' information technology (IT) infrastructures, their roles, and quantitative analysis of their work performance. It also reports the impact of these systems on claims processing by analyzing the health insurance claim data submitted to HIRA from April 1 to June 30, 2011. **Results:** The PARE system returned to healthcare providers 2.7% of all inpatient claims (97,930) and 0.1% of all outpatient claims (317,007) as un-reviewable claims. The return rate was the highest for the hospital group as 0.49% and the lowest rate was found in clinic group. The CRS system's detection rate of the claims with multiple errors in inpatient and outpatient areas was 23.1% and 2.9%, respectively. The highest rate of error detection occurred at guideline check-up stages in both inpatient and outpatient groups. **Conclusions:** The study found that HIRA's two IT systems had a critical role in reducing heavy administrative workloads through automatic data processing. Although the return rate of the problematic claims to providers and the error detection rate by two systems was low, the actual count of the returned claims was large. The role of IT will become increasingly important in reducing the workload of health insurance claims review.

Keywords: Health Information Technology, Medical Informatics, Clinical Informatics, Medical Information Science

I. Introduction

The Health Insurance Review & Assessment Service (HIRA) is the sole nationwide third party administrator (TPA) providing health insurance claims review and assessment services for the national health insurance program in South Korea. The HIRA is an agency that operates independently in providing those professional services.

In 1997, there was one health insurance (HI) company for both government officials and private school teachers, 227 HI companies for community residents, and 139 HI companies for private company employees. Multiple insurance

companies dealt with health insurance and the claim reviews were done solely by the National Federation of Medical Insurance (NFMI) which was a union of insurance companies in Korea. But the Korean government undertook the reform of health insurance in 1999. The National Health Insurance Act was enacted, and HIRA was established soon after in 2000. The reform mandated that hundreds of existing insurance companies be unified into one single insurer named the National Health Insurance Corporation (NHIC). The reform also created an independent organization to conduct HI claim review and assessment services with objective review guidelines [1], and with this provision, HIRA took over all the responsibilities of the NFMI.

The working mechanism of the national health insurance system is as follows: Individuals pay a health insurance premium to the NHIC and receive healthcare services from health care providers with small copayments. After providing healthcare services to patients, the providers submit healthcare claims to HIRA. HIRA reviews the claims and sends the review results to both the NHIC and the providers. The NHIC reimburses the healthcare providers.

HIRA has a complex organizational structure. It has one headquarters, one research institute, and 7 branch offices. There are 1,711 employees as of 2012. Sixty three percent of the employees are physicians, pharmacists, nurses, and health care specialists. HIRA has one central assessment committee, which is composed of at most 21 committee members. It also has a central review committee, which is composed of 41 subcommittees based on 41 medical specialties. In addition, each of the 7 branch offices has 18 local review and assessment committees. Local committees have more than 5 committee members. There were 1,042 physicians as committee members as of 2011.

HIRA also interacts with many healthcare providers in Korea. There are 82,933 healthcare providers (or healthcare organizations) including 44 tertiary hospitals, 317 general hospitals, 1,381 small hospitals (>30 beds, <100 beds), 27,816 clinics, 994 long-term care facilities, 21,057 pharmacy stores, 31,324 dental clinics as well as public health centers, clinics of oriental medicine, and so on. In 2011, 1,327 million insurance claims were reviewed, and the amount of reimbursement payment was approximately 46.3 billion US dollars.

HIRA processes a large number of health insurance claims coming from many healthcare providers. Adopting and using various information technologies was a rational choice for HIRA. Claim management heavily dependent on human resources has a fundamental problem dealing with appropriate claim processing when complex organizational issues are involved [2]. Claims review and assessment processes impose heavy administrative costs on handling HI claims [3-5]. IT infrastructure solutions have tremendous potential for creating safe and effective work processes [6]. However, there has been a paucity of studies describing the kinds of information technologies and their performance used by TPAs that deal with insurance claims. By examining specific information technologies, we can learn lessons about those technologies and their operational performance.

The objective of this paper is to introduce HIRA's IT infrastructure mainly focusing on the payment request (PARE) system and claim review support (CRS) system, and to describe their operational performance (the PARE system and the CRS system are called as "Jinreubee Chung-gu System" and "Jinreubee Simsa System" respectively in Korean language. But this study uses each term with "PARE" system and "CRS" system for the convenience of expression and delivery of clear meaning of the word). It is hoped that describing two of HIRA's core systems and their performance will help other international agencies conducting the health insurance reviews by providing a bench mark for comparison.

II. Methods

The first part of the methods section introduces HIRA's overall IT infrastructure, the information flow of the health insurance claims data, and the two core claims screening systems. The second part of methods section briefly explains how the data were collected to portray the two systems' performance.

1. Introduction of Two Systems

1) System and network structure
HIRA's IT systems are installed in one headquarters and 7 branch offices. Although the size of hardware of the overall system in each location is different, the system architecture is similar. The core systems consist of a system for the exchange of HI claims and another for the review of the claims.

These two systems are supported by several sub-systems: reimbursement guidelines, fee schedule, drug prices, medical supplies, and drug utilization review. Each system is constructed with a dual backbone to secure the continuity of services and disaster recovery. The fundamental communications system uses an asynchronous transfer mode (ATM) router and duality of communications lines in order to improve stability of the system. Operating systems have system, network, and follow-up monitoring for network obstacles using a short message service that allows the system managers and operators to do security checks and to fix problems (Figure 1).
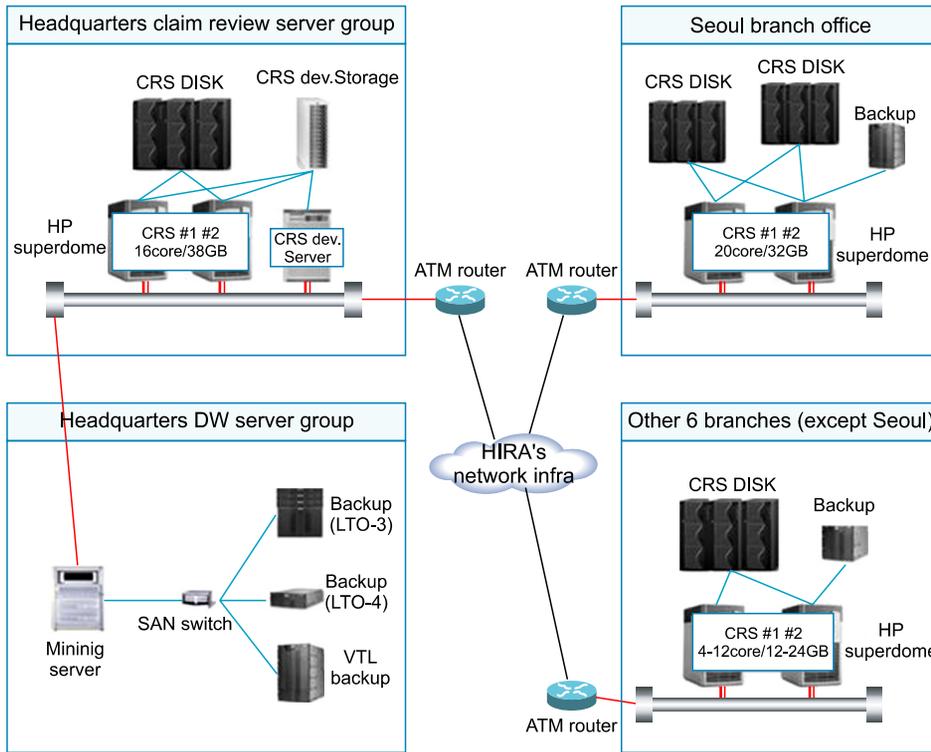
Figure 1. System structure. CRS: claim review support, DW: data warehouse, SAN: storage area network, HIRA: Health Insurance Review and Assessment Service, ATM: asynchronous transfer mode.
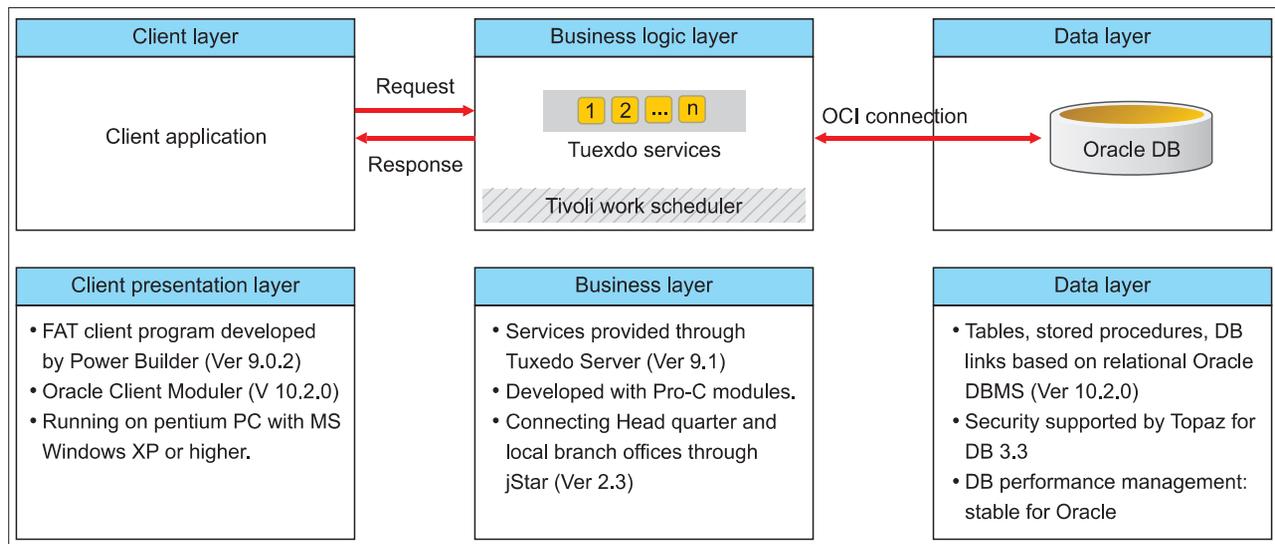

Figure 2. Software composition.

2) Software composition

The application software supporting HIRA's daily business is structured in three tiers: a client layer for daily users, a business layer for work processes, and a data layer for claims data storage. This improves repair and maintenance of the system by separating the user interface (UI) from the work processes. The business layer uses a Tuxedo server and applications developed with pro-C. The UI for resolving the customer requests is a fat client developed with the fourth generation programming language (4GL), PowerBuilder.

The data layer is supported by Oracle database management system (DBMS). Each DB is connected and shared by using DB_Link (Figure 2).

3) Data storage structure

Data storage at the headquarters and Seoul branch office has dual back-up space and the remaining branch offices have their own storage with back-up space. HIRA sought to construct input/output (I/O) decentralization after considering the characteristics of the claim data and the volume of HI

claims.

HIRA's database contains all the health insurance claims for the population of 50 million people for a five-year period in conformance with governmental recommendations. The database contains 475 TB of data and the number of source code sets of the two systems is 36,000 (Table 1).

4) Overall information flow

HIRA has been developing and operating information systems for the efficient management and maintenance of the national health insurance system. The two systems that are of interest to this report are the PARE system and CRS system that are the systems for receiving insurance claims in the form of electronic data from healthcare providers and for supporting review experts' claim review.

The PARE system and the CRS system are two different levels of claims screening systems that address different issues. The PARE system addresses "syntax" of claims in checking for inappropriate coding and missing information. The CRS system works only on those claims that pass the PARE system's screening. A brief description of the two systems' functions will be explained in the following section.

Figure 3 presents the overall information flow through HIRA's systems including the two core systems for receiving the health insurance claims and supporting health insurance claim review. The specific explanation on the two core systems is as follows.

Table 1. Data storage features

Items	Quantity	Note
Number of machines for review, DW & DUR systems	101	HP, IBM, etc.
Sizing of storage for review, DW & mining, etc.	475 TB	HITACHI, EMC, etc.
Number of source code sets for review, portal	36,000	Program languages: C, Java, etc.

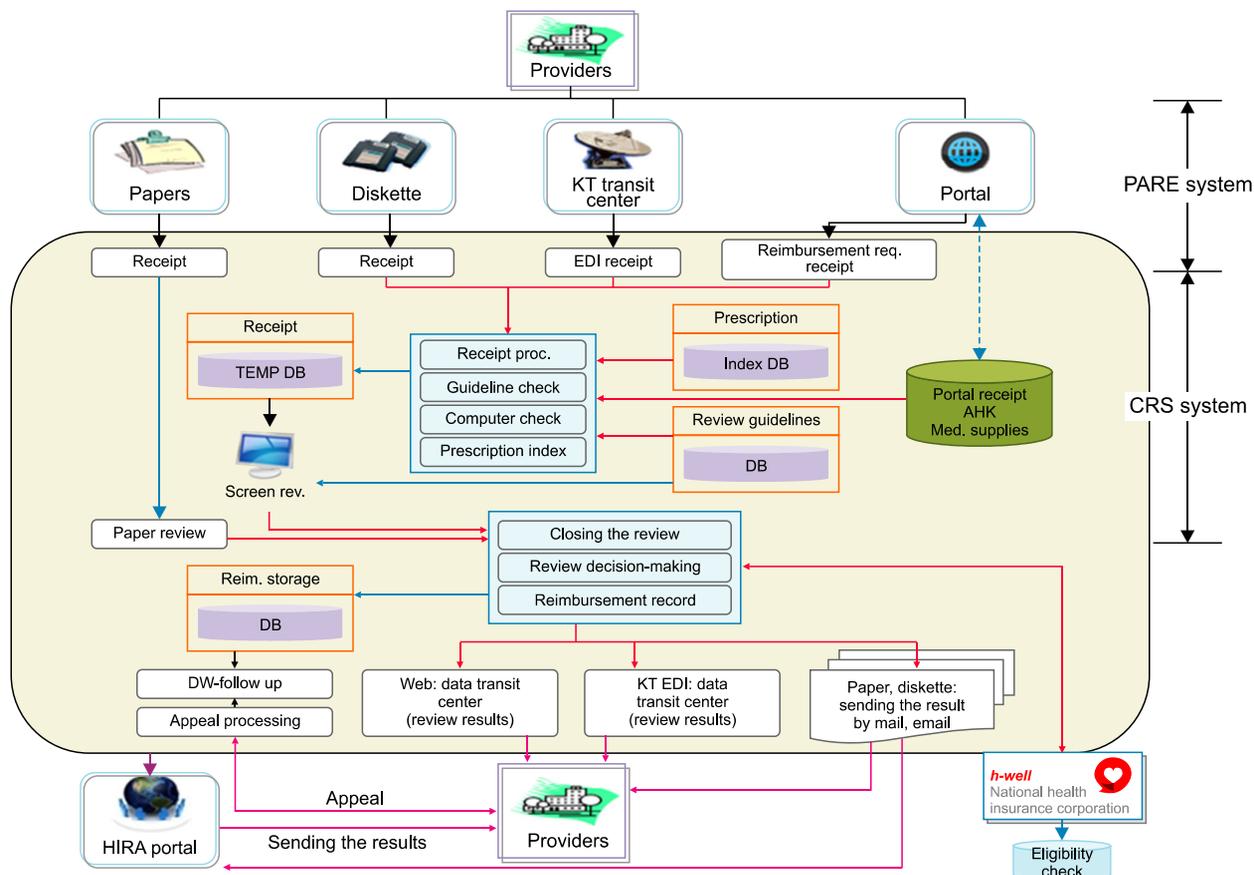DW: data warehouse, DUR: drug utilization review.

Figure 3. Information flow of claim data processing [7]. CRS: claim review support, EDI: electronic data interchange, HIRA: Health Insurance Review and Assessment Service, PARE: payment request.

(1) Payment request system of HIRA

HIRA's PARE system receives the claims in the form of electronic data interchange (EDI) from healthcare providers via portal services. Using the PARE system, healthcare providers file a claim and its specification documents in order to receive reimbursement for services. Heath care providers also get to review the results through the portal service connected to the PARE system.

Healthcare providers can file claims in the form of paper, diskette, and EDI. Currently 99% of providers are using EDI and less than 1% are using the other methods. The claim form and its EDI contents are encrypted, compressed, and sent to the HIRA's relay center where all the claim data are gathered. All the information received by PARE system is automatically transferred from the relay center to the database systems of the headquarters and 7 local branch offices depending on the location of healthcare providers. Each claim is decrypted and decompressed and then loaded into a temporary database in its original form (Figure 4). After that, all the claims data are ready for processing in the CRS system. The notice of check-up is processed in the reverse direction

to providers through the relay center by PARE system.

(2) Claim review support system of HIRA

HIRA's claim review support (CRS) system is an information system that performs automatic screening on HI claims for errors, missing items, miscalculations, and so on, and sends the results to the staff reviewers or returns the un-reviewable claims to providers. In detail, the HI claim data loaded into the HIRA's CRS system are screened through the five stages and then the results are stored into the temporary database. The five stages of automatic data processing are composed of writing, verification, guidelines, drug utilization review (DUR), and disease-specific check-ups (Figure 5).

Writing check-up is the first stage of the claim screening process in the system and automatically screens the claim for omissions, errors, duplication, and so on. If 30% of all specification fields are missing or inappropriate, then the computer system diagnoses the claim as one that is not able to be reviewed. Those are returned to the health care providers for corrections. This process is necessary to prevent further errors after the first stage of claim screen process.
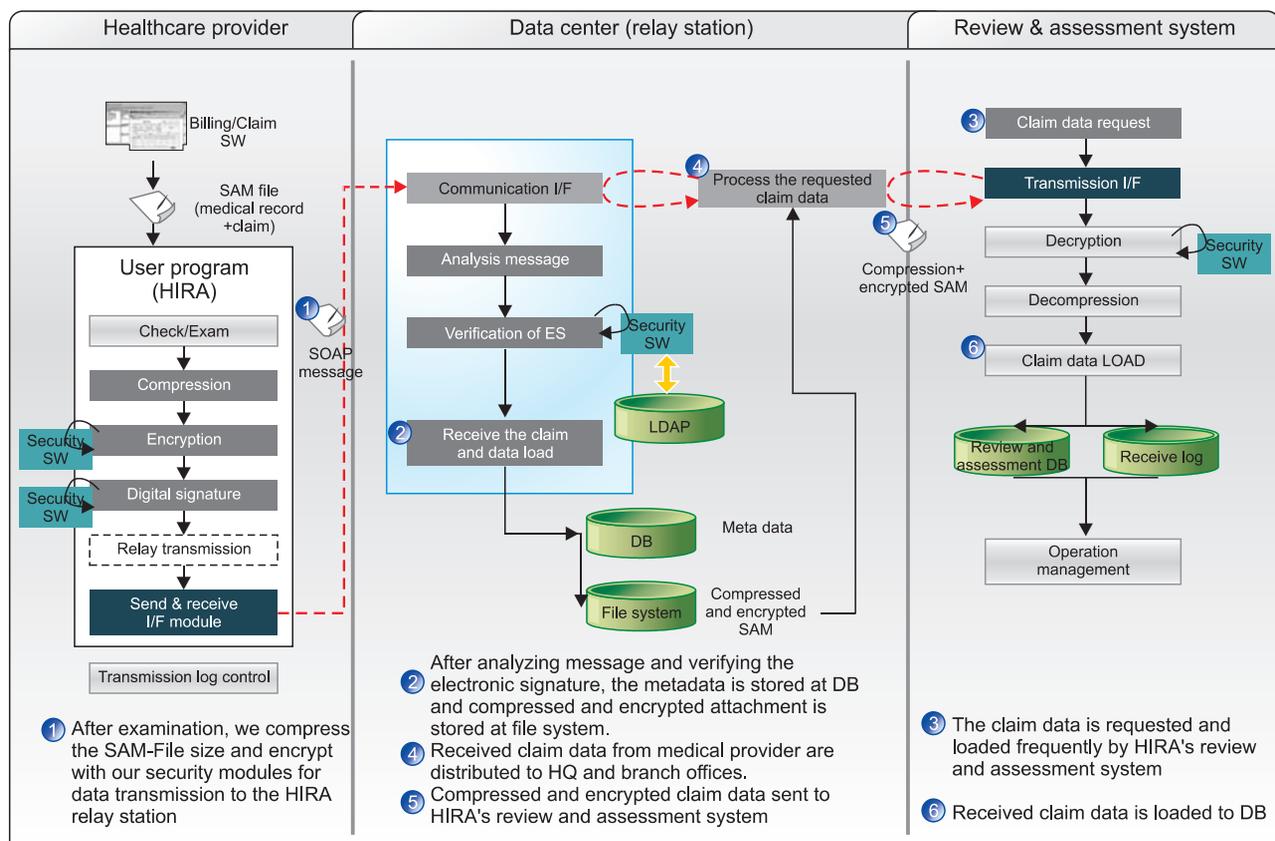

Figure 4. Information flow of the payment request data. HIRA: Health Insurance Review and Assessment Service, SAM: sequential access method, SOAP: simple object access protocol, LDAP: lightweight directory access protocol, ES: electronic signature, I/F: interface.
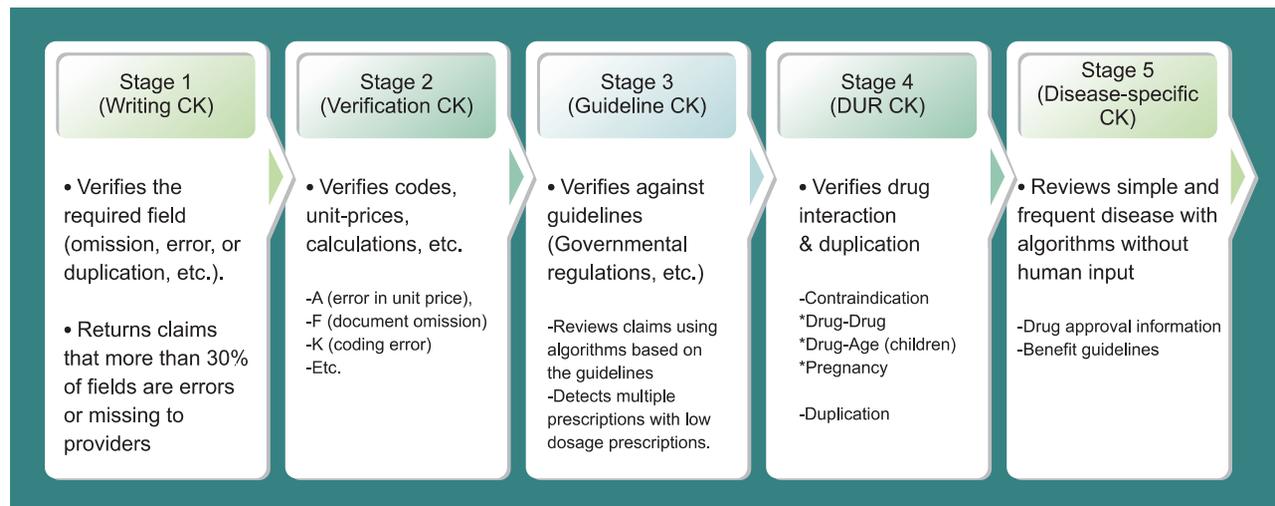
Figure 5. Five stages of automatic data processing procedures [7]. CK: check-up, DUR: drug utilization review.

Verification check-up is the second stage that determines whether a claim has any problem with codes, unit prices, calculation of fee schedules using the master fee schedule, drug price, and medical supply files. If it finds any problems, it informs the staff reviewers of the cause of the problem or the required rate adjustment with tag message. Claims are not returned to health care providers in this verification check-up or later stages.

Guideline check-up is the third stage in which the system screens on whether the services in the claims are properly filed and provided to the patients following governmental rules, regulations, and benefit reimbursement guidelines. These results are relayed to the staff reviewers with several messages for modifying the amount of the reimbursement requested.

DUR check-up is the fourth stage where the possibilities of inappropriate use of medications such as drug-drug interactions, use of drugs for pregnant women, drug and age interactions are checked. DUR check-up is aimed at preventing the improper use of drugs and reducing the adverse events of drugs for patient safety.

Finally, disease-specific check-up is the last stage of the automatic claims screening. It screens the claim on whether health care services for specific diseases are provided correctly following the payment reimbursement guidelines. It focuses on simple and frequent diseases and applies the benefit reimbursement guideline rules to detect any errors or problems in the claims. The system adjusts the reimbursement rate or produces a view of the results with cause of the errors or problems and creates tags identifying those errors.

Claims with problems identified in any of the 5 stages of screening are flagged and forwarded to the staff reviewer experts for investigation. At the end of this process the re-imbursement amount and its reasons for rate adjustment are sent to the health care providers and to the NHIC for payment.

2. Data Collection Methods

The study analyzed the health insurance claim data submitted to HIRA from April 1 to June 30, 2011. Ideally the healthcare services associated with those claims should also occur at the same time periods. However, submission of the HI claims to HIRA tends to be a little bit behind of actual service occurrence. Some claims may represent services delivered before the period began and some for services delivered during the period may have not been submitted by the end of the period. However, it is thought that this fact did not significantly affect the study results because this study was examined the claim return rate and error detection rate which should not be affected seriously by these types of claims. This study included all the HI claims coming from any healthcare facilities including pharmacy stores and community health centers. Annual data were used for background information.

III. Results

1. Basic Information on HIRA's Two Core Systems

Table 2 presents basic information concerning the data processed by HIRA. The number of the HI claims in 2009 and 2011 were 1,281 and 1,327 million cases, respectively, which was a 3.6% increase since 2009. The amount of reimbursement to healthcare providers during the same period was 39.6 and 46.3 billion USD, respectively, which was a 16.9% increase since 2009. The number of providers was 82,688 in 2011, which increased by 3.0% since 2009.

Table 2. Brief overview of data processing capacity

Year	2009	2010	2011
No. of population (thousand)[a]	49,182	49,410	49,779
No. of claim reviewed (million)[b]	1,281	1,307	1,327
Medical service fee (billion USD)[b]	39.6	43.9	46.3
No. of medical institutions	80,270	81,681	82,688

[a]From [8]. [b]From [9]. Currency exchange rate of USD1.00:KRW1,100.

Table 3. Proportions of the health insurance claims returned to the providers by the type of healthcare services (April, May, and June of 2011)

Category	No. of initial claim receipts (a)	No. of claims returned (b)	Return rate (b / a × 100, %)
Inpatient	3,610,317	97,930	2.71
Outpatient[a]	366,682,916	317,007	0.09
Total	370,293,233	414,937	0.11

[a]Including pharmacy stores.

Table 4. Proportion of the health insurance claims returned to the providers by the facility types (April, May, and June of 2011)

Category	No. of initial claim receipts (a)	No. of claims returned (b)	Return rate (b / a × 100, %)
Tertiary hospitals	9,418,808	23,542	0.25
General hospitals	16,027,066	38,048	0.24
Small hospitals[a]	19,543,849	95,066	0.49
Clinics & the others[b]	325,303,510	258,281	0.08
Total	370,293,233	414,937	0.11

[a]Small hospital represents medical facilities accommodating 30 or more, but less than 100 beds. [b]Including pharmacy stores.

2. Detection Rate of the Claims as Un–Reviewable Claim by Service Types

Table 3 shows proportions of the HI claims returning to the providers by the types of healthcare services. Total number of cases analyzed was 370,293,233 cases for a three-month period and 99% of them were outpatient claims. The number of claims returning to the healthcare providers in inpatient and outpatient groups was 97,930 and 317,007 cases, respectively. The return rate was higher in inpatient as 2.71% compared to outpatient 0.09%. The return rate of the claims in inpatient group was much higher than that of outpatient group.

3. Detection Rate of the Claims as Un–Reviewable Claim by the Facility Type

Proportions of the health insurance claims returning to the providers by the facility type are presented in Table 4. The number of the HI claims returning to the healthcare providers for a three-month period was the highest in clinics (258,281 cases) and the lowest in the tertiary hospitals (23,542). However, the return rate was the highest in small

hospital claims (0.49%) and the lowest in clinics and others including pharmacy stores (0.08%).

4. Error Detection Capacity of the CRS System

Table 5 shows that HIRA's CRS system plays a crucial role in the claims review process; especially in detecting the claims having any errors or problems in the unit price, calculation of the payment amounts, benefit reimbursement guidelines, and so on. For the inpatient group, the overall proportion of claims with errors or problems was 23.1%. The detection rate at the guideline check-up stage was the highest at 17.7% and lowest in DUR check-up stage at 0.1%.

The error detection rate on the claims in the outpatient group (2.9%) was lower than that of the inpatient group (23.1%). The error detection rate was the highest at guideline check-up stage (2.2%) and the lowest at DUR check-up stage (0.001%). Although the overall detection rate was lower in the outpatient group than the inpatient group, the total number of claims was 13 times higher in the outpatient group than the inpatient group.

Table 5. Error detection capacity of the CRS system by service type (April, May, and June of 2011)

Category	Automatic data processing check-up stage	Total no. of claim receipts (a)	Any flags found at each stage (b)	Proportion of the claims with any flags (b / a × 100, %)
Inpatient		3,584,448		
	Verification check-up		89,886	2.51
	Guideline check-up		632,704	17.65
	DUR check-up		2,229	0.06
	Disease-specific check-up		102,689	2.86
	Total	3,584,448	827,508	23.09
Outpatient		366,450,352		
	Verification check-up		1,123,385	0.31
	Guideline check-up		8,075,482	2.20
	DUR check-up		2,405	0.00[a]
	Disease-specific check-up		1,584,067	0.43
	Total	366,450,352	10,785,339	2.94

CRS: claim review support, DUR: drug utilization review.
[a]0.001%.

IV. Discussion

This study is one of the first descriptions of HIRA's IT-based claims review process that examines its performance. Although there have been some studies reporting on adopting information technology for improving organizations' managerial efficiency [10], there has been lack of studies reporting TPA use of information technologies.

Given the large and increasing number of claims, if HIRA mainly depended on professional review experts for all the review processes, it is probable that the reviewers would not be able to deal with the heavy workloads. Galbraith [11] argues that an organization must increase capacity as information processing demand increases. Many hospitals have adopted various information technologies for providing healthcare services including electronic medical record systems and clinical decision support systems [12-15]. HIRA's decision to adopt various information technologies to deal with the increase of their HI claims is in line with this approach.

This study found that the PARE system's claims return rate was less than 3%, which seems to be low. This might be because most providers were familiar with the filing methods for HI claims. Their previous experiences might have reduced the return rates. It is also possible that since HIRA supplies various program solutions to providers, the providers themselves could screen the claim form for errors before submitting it to HIRA. All these factors might contribute to a lower return rate of the claims from the PARE system.

The number of claims returned to the providers due to errors in the form was higher in the inpatient group than in the outpatient group. One possible explanation for the lower outpatient rejection rate might be that it included a very large number of pharmacy claims which were relatively simple to construct and for which there already existed well developed systems that could construct these claims. If the pharmacy claims were excluded, then the rejection rate might be much more similar to the inpatient rate. The low return rate of clinic sites including pharmacy stores shown at Table 4 indirectly supports this speculation. Another possible explanation is that there might be fewer rules for outpatient than inpatient claims. Practically, the rules for the inpatient groups are indeed more complex than those of outpatient. These could be possible reasons for the difference of the rejection rate between inpatient and outpatient areas.

The return rate of the claims was the highest in the small hospitals group. In terms of complexity, the work processes of tertiary and general hospitals tend to be more complex. As a result, the filling forms and rules pertaining to the submitted claims are expected to be complex as well. The return rate should be higher in tertiary and general hospitals than small hospitals. Unlike this speculation, the study result shows that the claim return rate of small hospitals was higher than tertiary or general hospitals. A possible explanation for this finding would be that smaller hospitals' IT infrastructure dedicated to filing of the HI clams might not be as well resourced as those of tertiary hospitals and general hospitals. This might contribute to the high return rate of small hos-

pitals' insurance claims than those of tertiary and general hospitals. Regarding this issue, further study is necessary to elucidate the reason of high return of insurance claims in small hospitals.

This study also analyzed the detection rate of HI claims by automatic data processing procedures after the first stage of automatic data process named the writing check-up stage. Overall study results show that the rate of detecting any problems in the claims was higher in the inpatient groups than in the outpatient groups. Two possible explanations mentioned above might be also applicable for this study result, namely the effect of pharmacy claims and the number of computerized rules in the system. However, further study is needed to establish clear explanations for this issue as well.

One interesting finding was that detection rate of problems in the claims was the highest in guideline check-up. The next highest detection rate was verification check-up followed by DUR check-up. The rate was the lowest for disease specific check-up. This finding was similar to both the inpatient and outpatient areas. This might be because HIRA used various algorithms concerning benefit reimbursement guidelines in the guideline check-up stage for both the inpatient and outpatient groups. This kind of algorithm is similar in both inpatient and outpatients areas. This might result in the similar detection rates between two different service areas.

This study has two limitations. Interpretation of the study results should be confined to the Korean population. This study could not exclude pharmacy claims from outpatient claims due to some technical issues concerning data extraction.

This study is an exploratory study on the work performance of information technologies used in the review of the HI claims. Looking at it as an example of adopting information technologies for the HI claim review, this study argues that there are many opportunities for domestic and international TPA and HI companies to use information technologies to improve processes of HI claim review.

As expected, HIRA's IT systems critically contributed to reduce the heavy workloads of insurance claim review process. HIRA has been developing various computing algorithms to reduce workload using computer system for some time. Although the rate of returning the problematic claims to providers and flagging the claims with errors or problems through automatic data processing was low, the actual count of the returned claims was quite large. Without using information technology, HIRA would confront heavy administrative workloads coming from the claim review process.

This study suggests several things based upon these results. First, it is necessary for HIRA to further develop various computing algorithm increasing the initial return rate because this can reduce unnecessary work procedures after the initial submission of the health insurance claims. There is ample room to improve managerial efficiency using information technologies [16]. Second, review work on the insurance claims should focus on the inpatients rather than the claims for outpatients because the amount of payment per claim to healthcare providers, generally speaking, is higher in inpatient groups. Third, it is also recommended that HIRA adopt other reimbursement methods such as diagnosis-related groups to reduce the volume of HI claims. Fourth, HIRA should use more information technologies in the claim review processes to improve its work performance.

In conclusion, it would be a rational choice for HIRA to invest its resources in the information technologies that support HI claim review. Adopting various information technologies could result in a significantly reduced medical review billing period and reduced administrative costs, which will increase efficiency and effectiveness of the HI claim review and assessment process. This study empirically shows that there are many administrative processes that can be improved by adopting information technologies.

Conflict of Interest

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

Acknowledgments

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