Introduction of Teleradiology in Korea

Hyung Sik CHOI*

Abstract

Many Korean hospitals have been installing filmless PACSs (Picture Archiving and Communications System) for 15 years. IT technology of Korea is a brilliant development, as the broadband communication network like ADSL, VDSL or wireless LAN is very popular and spread out in Korea nationwide. Those two technical fields are key infrastructures for the distribution of teleradiology. Some Korean radiologists have been doing remote reading service beyond space and time. But, currently the distribution of teleradiology in Korea is a beginning phase and its market is slowly growing due to arguments of medical doctors and delayed medical legislation for teleradiology. The purpose of this paper is to introduce the past and the current situation of teleradiology in Korea as well as my clinical experiences. I believe that this article would be helpful to many Japanese experts who pray for a proliferation of teleradiology distribution.

Key words: Teleradiology, Teleradiologist, PACS, Telemedicine


1. Background

1) General information of PACS in Korea

In South Korea, there are 42,082 medical hospitals and clinics (10,749 institutions located in Seoul) and 287,401 patients’ beds. Among them, 132 are large hospitals having more than 400 patients’ beds (approximately 200,000 examinations per year or more) and 267 are small hospitals having 100 to 400 beds [1, 2].

I presented the historical growth of filmless PACS in Korea at SPIE 2001. During the growing phase of PACS market, there was a great proliferation of mini-PACS distribution in Korea and many Korean PACS vendors and the university hospitals put their efforts in research and development to create a digital radiology environment. In the maturing phase, the medical insurance reimbursement on PACS has become a turning point for a rapid growth in filmless PACS market [3].

According to the Korean Society of Medical Informatics, the rate of filmless PACS installation of hospitals in Korea climbed to 47.1 percent, surpassing the previous record of 9.4 percent in ten years ago. About 90 percent among tertiary hospitals like university hospitals install and operate filmless PACSs clinically, and about 80% among general hospitals and about 20 percent among small hospitals are on clinical operation of PACSs. Meanwhile the case of clinics may be very lower [4].

2) Education and medical insurance system of Radiologists in Korea

Korean education and training system of radiologists is pretty similar to American system. After they receive medical doctor licenses and serve internship for one year and radiology residentship for four years, they must pass medical test for specialist to get board certifications of radiologist. Through additional fellowship for a few years, they become qualified subspecialty radiologist such as neuroradiology, chest, cardiac, bone and joint, abdomen, genitourinary, mammography, pediatric and interventional radiology.

About 2000 radiologists are registered to the Korean radiological society in the country: More than half located in Seoul while the rest worked in the metropolitan areas. The radiologists are working only 54 people out of metropo-
lis. The most of subspecialist radiologists are working for the university hospitals or tertiary hospitals. There are a few radiologists working for general hospitals without subspecialty. The part of the radiologists run the private radiology clinic. As things stand most of small hospitals don’t have radiologist on site.

There is one medical insurance company in Korea called National Health Insurance Corporation. The Korean medical insurance is a fee for service system with a unified medical bill policy that is determined and controlled by the government. Korean medical insurance reimbursement system on radiological examination is similar to the Japanese one.

The bills of radiological examination include radiological examination and reading fee at once. Reading fee holds about 30 percent of the radiological examination fee. When the examination is interpreted by radiologist board, it pays additionally 10 percent of radiological examination fee with incentive. In case of the United States, reading fee and radiological examination fee are separately billed to patients through medical insurance company. But Korean radiologist cannot issue bills for reading fee like American radiologists.

Consequently the reading fee over teleradiology cannot be requested separately to medical insurance company in Korea. Reading service contracts are needed between referring hospitals and teleradiologists because the hospitals get reimbursed by medical insurance company.

2. Teleradiology in Korea

1) The past and the current of teleradiology

Clinical application of teleradiology in Korea was discussed since early year 2000. Based on national IT infrastructure and distribution of PACS, hospitals became to have needs of teleradiology because of lack of radiologists in Korea and increasing numbers of radiological examination. Teleradiology clinics have performed substantially special teleradiology jobs since the Korean medical law was revised in October 2003. But the law does not allow doctor to patient care remotely using internet but allows doctor to doctor consultation called telemedicine. There is no specific nomination about teleradiology.

There are three well-known teleradiology clinics in Korea: Shigong, X-ray21 and I-rad. Those clinics had begun the clinical reading service using internet from the late of 2002. They thought that teleradiology was a medical business controlled by the Korean law of medicine so that they opened clinics to perform reading job using internet. A teleradiology clinic has some full-time radiologists less than five and a number of part-time radiologists. Number of annual examinations interpreted by the clinic is about 200,000 examinations. The medical facilities of requesting teleradiology reading service are mostly occupied small hospitals which are lack of radiologists. By the way, public hospitals, clinics, public health centers and university hospitals sometimes request the teleradiology reading service in case by case.

2) Current issues on discussion

The group to support the revitalization of teleradiology says that the teleradiology is valuable in the point of business and economics, considering the current high level IT infrastructure and medical technology like PACS. It will promote better medical service to rural areas that lack medical and public health services and be an alternative of lack of radiologists in those fields. The majority radiologists talk teleradiology is an unavoidable general trend of medicine in digital age. Also the government will promote telemedicine through relaxation rather than the regulation on it.

Nevertheless the Korean radiological society proposed some issues on discussion. As the teleradiology service market grows, there could be some side effects like serious competitions among radiologists, responsibility of the wrong interpretation, diagnostic assurance of ultrasound and fluoroscopy examinations and insurance reimbursement of reading fee, etc [5].

(1) Competitive reading fee: Reading fee of external radiological examinations is not structured distinctly so that it can be negotiable autonomously between teleradiology clinics and requesting hospitals. Thus teleradiology clinics may propose competing price as common. It is actually hard to realize how each clinic collects reading fee differently so that the price competition among those clinics may occur under the circumstances.
2. Job security: The serious argument against teleradiology is based on the job security of radiologists. The small or general hospitals installing PACS can request teleradiology service rather than hiring full-time radiologists on site. Eventually, radiologists may have hard time finding full-time jobs as many hospitals have a burden on personnel expenses of hiring them.

3. The quality of diagnostic accuracy: The diagnostic accuracy of teleradiology is worried so that teleradiologists are responsible for obtaining the required medical liability insurance. Particularly, there are some arguments against teleradiology reading of ultrasound and fluoroscopy examination. The reason is those examinations require on-site real time motional images which are acquired by direct patient contact during examinations.

4. Lack of legislation supplementing the Korean law of medicine: In June of 2006, at the public forum of the Korean radiological society, a governor spoke that Korean government plans to more actively support the knowledge based core industry such as teleradiology and studies short term and long term plans for it. Their innovative healthcare service team is enacting the law of medical IT regulations. Especially the government is reviewing and studying insurance reimbursement for PACS and EMR, the suitable teleradiology reading fee, separation of reading fee from current examination fee, etc [5].

3. A case of Shigong Teleradiology

1) A case of Shigong Telerad
The system overview of Shigong teleradiology is shown in Fig. 1. Table 1 is a list of system configuration of Shigong teleradiology.

2) My experience of teleradiology
Beyond space and time, teleradiologists can provide a range of specialties normally unavailable to the independent imaging center or small hospital, certified radiologists in subspecialties for second opinions, access of qualified radiologists in areas with regional shortages of radiologists. Through the service, hospitals and clinics can reduce turnaround time on stat and emergency studies and get coverage during periods of seasonal peaks not requiring a full-time addition to staff.

Teleradiologists work as virtual radiology group to keep in specialty reading service and improve quality of diagnostic accuracy and productivity. For example, after retirement, a neuroradiologist hired by a general hospital will have to read whole body radiology examination as a general radiologist. But, if he works with specialty teleradiologists, he can keep going his subspecialty. He can get remote subspecialty reading supports from teleradiologists beyond space and time.

![Fig. 1 System configuration of Shigong Telerad.](image-url)
Table 1 The system configuration of Shigong teleradiology.

<table>
<thead>
<tr>
<th>Teleradiology Server</th>
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<tbody>
<tr>
<td><strong>Hardware</strong></td>
<td>Fujitsu TX200 with Xeon 3.0 GHz CPU and 1 GB RAM</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>About 1.2 TB RAID using 6 hard disks of 300 GB</td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>OS: Windows 2000 server</td>
</tr>
<tr>
<td></td>
<td>Database: MS SQL 2000 server</td>
</tr>
<tr>
<td></td>
<td>Application: PPS (PACSPLUS server) and PPWeb (PACSPLUS web server) of Medical Standard</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Intense 24 hour security, fulltime security personnel, access control, locked server cabinet</td>
</tr>
<tr>
<td><strong>VPN</strong></td>
<td>Cisco VPN hardware (CVPN3005-E/FE-BUN, CVPN3005-MEM-KIT 64 MB memory upgrade kit)</td>
</tr>
<tr>
<td><strong>Internet backbone</strong></td>
<td>A dedicated 20 Mbps network line of Korean telecommunication</td>
</tr>
<tr>
<td><strong>DICOM gateway</strong></td>
<td>Three PC-based DICOM gateways to receive DICOM 3 images from referring medical facilities. Their software is PPE (PACSPLUS Engine) of Medical Standard.</td>
</tr>
<tr>
<td><strong>Compression</strong></td>
<td>10:1 lossy compression for CR and DR images, 2:1 lossless or 10:1 lossy compression for CT and MR images.</td>
</tr>
</tbody>
</table>

Referring hospitals and teleradiologists

Telerad gateway only for hospitals

| **Hardware** | Usual desktop PC and laptop |
| **Software** | PPW (PACSPLUS Viewer) and/or web browser for PPWeb server of Medical Standard |
| **VPN**      | Cisco VPN software (CVPN3005-SW-47-K9) |
| **Internet backbone** | Usual DSL line of 100 Mbps bandwidth in maximum |

* VPN: Virtual private network

When a radiologist is traveling for business or vacation, he or she can perform reading job when the internet access of broadband communication like DSL or wireless LAN is available. On the contrary, if internet service is not available, he or she can ask another teleradiologist to read. Synthetically, radiologists can improve their life quality using teleradiology as they can expand their practice while living the lifestyle of their choice.

In my experience of teleradiology during travel, I usually collaborate with specialty radiologists as mentioned above and use digital reading aids like e-atlas, e-book and e-gamut in my laptop that is illustrated in Fig. 2. For teleradiology reading, I prefer to dual monitors of high resolution monochrome with desktop PC at my office, but during travel, I use usual a monitor of low resolution grayscale or color with my laptop. They are illustrated in Fig. 3.

Fig. 2 An example of e-atlas for a reading aid.
Fig. 4 and Fig. 5. The latter requires somewhat longer reading time than the former because of more frequent window-leveling and zooming. Using instant messenger, I can communicate with on site clinicians and technologists to obtain more patient and examination information and provide better radiological consultation to clinicians remotely that is illustrated in Fig. 6.

For the more stable and faster growth of teleradiology business nationwide, some issues need to be clarified: privacy protection of patient, further detail legislation of medicine, medical insurance reimbursement for teleradiology reading, unlimited competitions among teleradiologists, radiologists’ anxiety due to job security, better communication tools between clinicians and radiologist, and etc.
4. In conclusion

There is outstanding infrastructure for Korea teleradiology. The propagation rate of filmless PACS is very high and IT technology becomes very popular at office and home. Moreover hospitals recently rely on radiological exams for the patient care. Due to congestion of examination numbers, it is short of radiologists so that teleradiology is much in demand rapidly.

But, teleradiology business is very slowly growing currently. Even though the Korean law of medicine approves telemedicine, there is lack of following government regulation and suitable guideline for teleradiology. As some radiologists have doubts of job security due to teleradiology, it seems not easy to get consensus about teleradiology among the society of radiology. To promote teleradiology business, we need the interdisciplinary leader group necessary to set up guideline and promote legalization of teleradiology including medical insurance reimbursement for teleradiology reading fee.

References

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Dr. Choi received MD from Yonsei University, in 1982 and his board certification of diagnostic radiology at Severance hospital Yonsei University in 1986. He was an instructor of Yonsei University with chest radiology subspecialty. After the visiting scientist of University of Washington, he became the PACS manager of Samsung Medical Center and implemented the first large scale filmless PACS in Korea. As an expert of PACS and teleradiology, he founded Mediface (currently Infinitt Co.) and is currently working at Medical Standard, Inc. as the president.