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Special Article

Picture Archiving and Communication System Introduced to a New Japanese Cancer Center Hospital

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Picture archiving and communication systems (PACS) have been widely introduced as a credible alternative to the traditional film-based radiological service. Shizuoka Cancer Center Hospital (SCCH) introduced PACS and hospital information systems as an alternative to the film- and traditional paper-based hospital system at the opening of the hospital. Using PACS, whole images and their reports can be available at any nearby terminal. Users can select the display format for monitor viewing on the bases of individual preference and navigate through cases by buttons and rollerballs on the mouse with easy handling and quick response. Most clinicians in SCCH evaluated such medical circumstances well. Filmless image management systems will become popular in all hospitals in the near feature. All staff in each hospital should investigate the merits and demerits of this system and how to introduce it effectively.

Key words: picture archiving and communication system – diagnostic radiology – clinicians – hospital information system – filmless system

The potential advantages of adoption of a filmless system for image review have been convincingly shown for several imaging techniques (1–6). Picture archiving and communication systems (PACS) can result in increased efficiency in data management, eliminate the encumbrances of film storage and retrieval, and facilitate rapid communication and remote relay of images. Thus, PACS have been widely introduced as a credible alternative to the traditional film-based radiological service and there have been a number of studies on PACS from Western countries. However, PACS has been prohibitively expensive for many organizations, as well as technically challenging. In Japan, PACS has not been implemented as widely as in other countries because of cost, technology and a unique medical insurance and reimbursement system. Recent commercially available systems have fallen in cost and provide familiar and easy-to-use interfaces for viewing images by applying up-to-date computer and network technologies. Our hospital, Shizuoka Cancer Center Hospital (SCCH), was newly established in September 2002 in response to the increasing number of cancer patients in Shizuoka prefecture in Japan. At the opening of the hospital, PACS and hospital information systems (HIS) were introduced as an alternative to the film- and traditional paper-based hospital system. All medical activities are electronically managed and recorded without films or papers.

The PACS used is SYNAPSE (Fujifilm Medical Co., Tokyo, Japan). The PACS handles about 3400 radiological examinations per month. Radiological ordering system and image and report reference system were installed in all terminals (about 400) of the hospital information system (HIS; HOPE/EGMAIN-EX, Fujitsu, Tokyo, Japan) (Fig. 1). HIS and PACS were connected by Internet technologies, and Internet Explorer (Microsoft, Redmond, USA) is used as the viewer system. From any terminal in the hospital, radiological images can be seen using the same operating system as the radiology department. To store the large amount of image data and to deliver the ordered images quickly, images are stored using redundant array of inexpensive disks (RAID) servers controlled by a storage area network (SAN) system with no local storage at the workstations and are retrieved from the storage servers on demand rather than being routed to the local workstation hard disk drive. Thus, the image retrieval time was approximately three to five seconds for any type of examination in any terminal of the hospital.

Filmless radiology systems may not be accepted by clinicians unless they provide benefits. Using PACS, whole images

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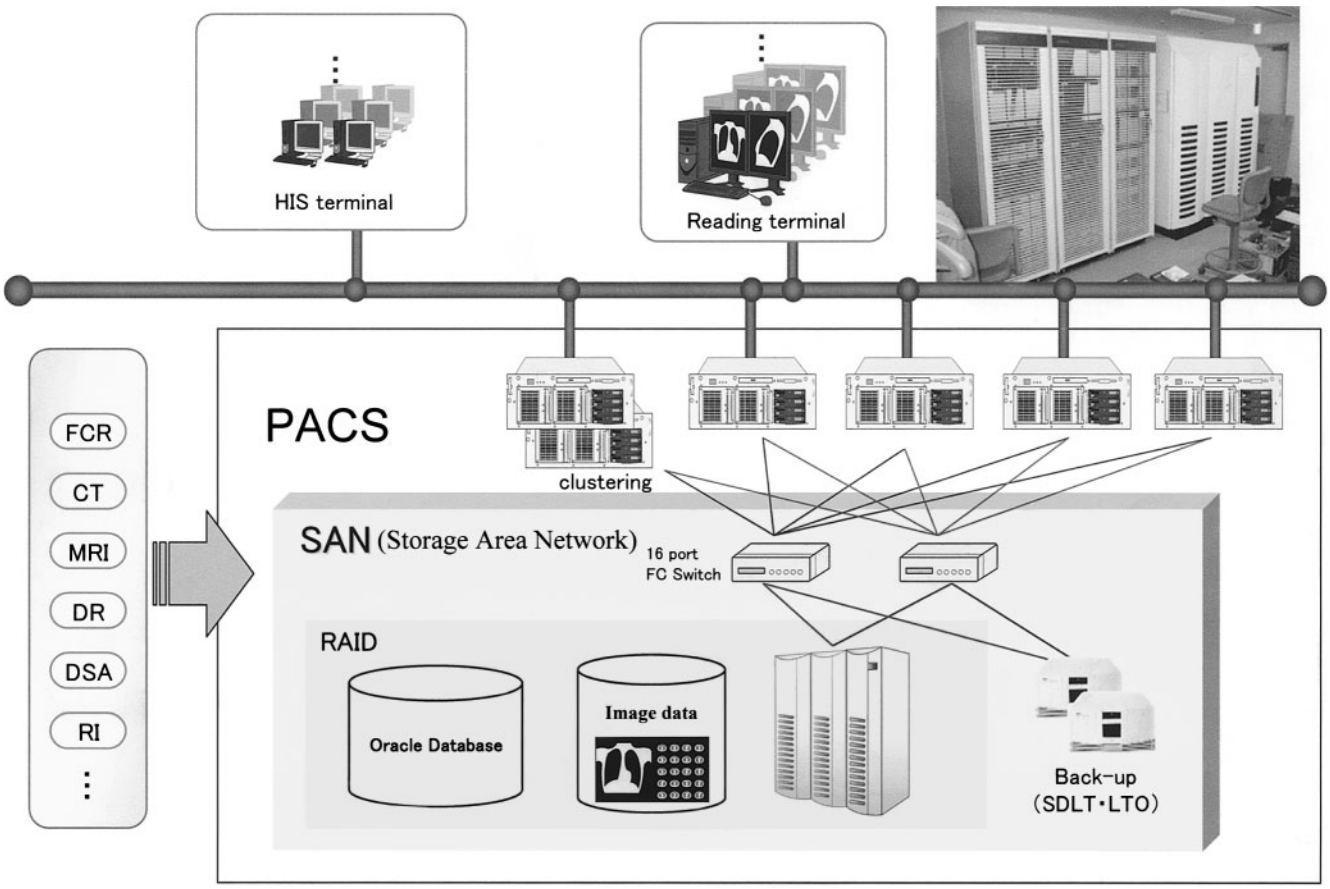

Figure 1. Picture archiving and communication system in Shizuoka Cancer Center Hospital.

and their reports can be available at any nearby terminal. Users can select the display format for monitor viewing on the bases of individual preference and navigate through cases with buttons and rollerballs on the mouse in contrast to physical movements of eyes, head and body to adjust to the images on films. In essence, a borderless integration between PACS and HIS, an easy interface, and a quick response for viewing images are essential for acceptance and preferential use by clinicians.

Several studies have compared PACS with conventional film-based systems and evaluated cost-effectiveness, observer performance, interpretation time and so on (1–6). However, to our knowledge, none to date has specifically investigated the assessment of PACS by clinicians other than diagnostic radiologists who use radiological images and reports to perform their clinical activities. To introduce and manage PACS, it must be agreed that PACS is better than a film-based system by all hospital staff; not only the diagnostic radiologists but also clinicians and administrators. To avoid adverse affects on patient care, acceptance by clinicians is especially necessary.

Two months after the opening of the SCCH, questionnaires about the experience of using the PACS were delivered to the clinicians employed by the SCCH with the exception of diagnostic radiologists. We asked the clinicians to evaluate PACS use and how they use the images and reports. The questionnaires were delivered to all 78 clinicians in the SCCH and 52 replies were returned. Table 1 shows the questions, response options and results. In classifying the clinicians, surgical staff were defined as 'doctor who performs surgery', e.g. surgeon, orthopedist, gynecologist, urologist, ophthalmologist, etc. Other clinicians who do not perform surgery were included as medical staff.

The clinicians were employed with the knowledge that medical activities in the SCCH would be managed by a filmless and paperless system, although none of them had any experience in such hospital management systems. Thus, 15.4% of them had been concerned that PACS could not be managed well. However, after the use of PACS, almost all of them appreciated this type of image-viewing system. Of all 52 clinicians, 50 (96.2%) evaluated the integration between the PACS and HIS as good or passable. Also, the handling of PACS was scored as easy or passable by 51 (98%). The response to view the images was not as highly evaluated as the system integration or the handling, but only four clinicians felt that the response was slow (7.7%). We think that borderless integration into HIS, easy handling and quick response for viewing images is essential for PACS. In this research, these factors were well appreciated by clinicians. Most clinicians in the SCCH evaluated such medical circumstances well. Differences between the medical and surgical staff were evaluated by chi-squared test and there was no significant difference in any question.

Table 1. Questions about picture archiving and communication system (PACS) to clinicians

	Medical staff	Surgical staff	Total
	n = 23	*n* = 29	*n* = 52
1. Before opening the hospital, what did you think of the filmless system of medical imaging (PACS)?			
A. acceptable	13 (56.5)	21 (72.4)	34 (65.4)
B. either will do	6 (26.1)	4 (13.8)	10 (19.2)
C. not acceptable	4 (17.4)	4 (13.8)	8 (15.4)
2. Using the PACS after the opening of the hospital, how do you assess it?			
A. excellent	16 (69.6)	25 (86.2)	41 (78.8)
B. passable	7 (30.4)	3 (10.3)	10 (19.2)
C. poor	0	1 (3.4)	1 (1.9)
3. How effective do you feel is the integration between the PACS and the hospital information system?			
A. good	11 (47.8)	10 (34.5)	21 (40.4)
B. passable	11 (47.8)	18 (62.1)	29 (55.8)
C. bad	1 (4.3)	1 (3.4)	2 (3.8)
4. How is the PACS to handle?			
A. easy	9 (39.1)	13 (44.8)	22 (42.3)
B. passable	14 (60.9)	15 (51.7)	29 (55.8)
C. difficult	0	1 (3.4)	1 (1.9)
5. How is the response to view the images?			
A. speedy	7 (30.4)	7 (24.1)	14 (26.9)
B. passable	15 (65.2)	19 (65.5)	34 (65.4)
C. slow	1 (4.3)	3 (10.3)	4 (7.7)
6. Which file do you open at first, an image or a report?			
A. images	15 (65.2)	21 (72.4)	36 (69.2)
B. report	6 (26.1)	4 (13.8)	10 (19.2)
C. depends on case	2 (8.7)	4 (13.8)	6 (11.5)
7. How do you use a report of the images?			
A. as a diagnostic guideline	12 (52.2)	11 (37.9)	23 (44.2)
B. as a reference	10 (43.5)	17 (58.6)	27 (51.9)
C. not use	1 (4.3)	1 (4.3)	2 (3.8)

The ability to directly transfer images from the devices that initially create the images to a PACS can eliminate many of the time-consuming processes associated with traditional film-based systems (Fig. 2). In the SCCH, clinicians can view images just after transfer to the PACS at any nearby terminal without printing and transferring films. In such a situation, the usage of images and their reports may change. About 70% of clinicians opened the image file first. This was mainly due to the difference between arrival times of images and reports. Unfortunately, the report-making delay cannot be completely avoided even though radiologists' productivity and report-turnaround time are improved by using PACS (1–4).

Reports are utilized by clinicians in many ways regardless of film-based or filmless system. More than half of the clinicians used reports as a reference, not as a diagnostic guideline. They evaluated the images by themselves, rather than following the report alone. Clinicians are in direct contact with patients and evaluate their conditions and backgrounds. When clinicians examine a patient, such information should be added to the radiological evaluation of images. This may reduce the risk of misdiagnosis and be useful in selecting a preferable treatment. Thus, we agree with this type of usage. To meet the higher needs of clinicians, to prepare clinically useful reports more promptly is more important for radiologists in PACS management systems compared to traditional film-based systems. In the SCCH, when a report is made, we radiologists refer to clinical information using a HIS terminal near the reporting terminal, contact clinicians directly if need be, and try to generate a reliable report as quickly as possible.

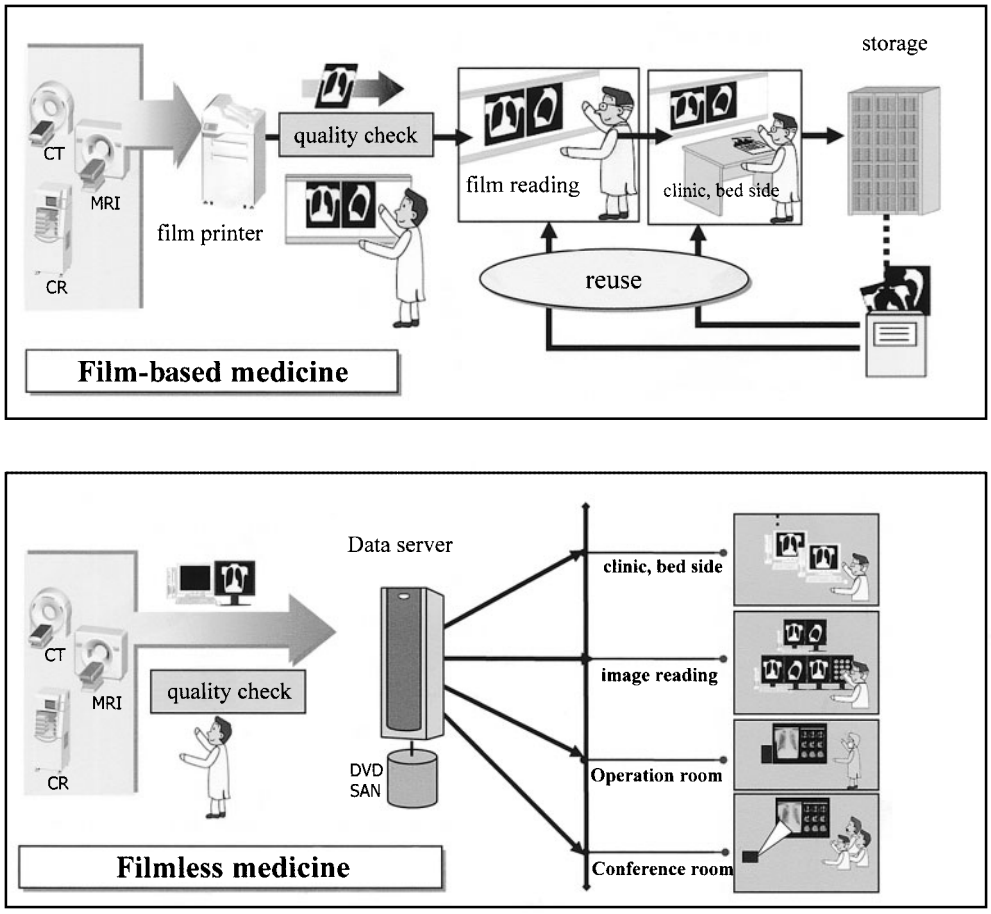

Figure 2. Film-based medicine and filmless medicine.

We were not able to assess whether the introduction of PACS resulted in improved quality of patient care or affected patient outcome. However, most clinicians accepted PACS and did not sense any adverse effect on their patients' care. The objectives and management system are unique to each facility, area and country, and our experience could thus not be directly applied to another hospital. Nevertheless, medical circumstances are dramatically changing in various fields. We believe that filmless image management systems will become popular in all hospitals in the near feature. All staff in each hospital should investigate the merits and demerits of this type of system and how to introduce it effectively. Diagnostic radiologists must take leading roles in such projects.

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