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History of PACS in Asia

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ABSTRACT

First, history of PACS (picture archiving and communication system for medical use) in Japan is described in two parts: in part 1, the early stage of PACS development from 1984 to 2002, and in part 2 the matured stage from 2002 to 2010. PACS in Japan has been developed and installed by local manufacturers by their own technology and demand from domestic hospitals. Part 1 mainly focuses on quantitative growth and part 2 on qualitative change. In part 2, integration of PACS into RIS (radiology information system), HIS (hospital information system), EPR (electronic patient record), teleradiology and IHE (integrating healthcare enterprise) is reported. Interaction with other elements of technology such as moving picture network system and three dimensional display is also discussed. Present situation of main 4 large size hospitals is presented. Second, history of PACS in Korea is reported. Very acute climbing up of filmless PACS diffusion was observed from 1997 to 2000. The reasons for such evolution are described and discussed. Also changes of PACS installation and system integration with other systems such as HIS and role of them in radiological diagnoses in Korea since 2002 are described. Third, history in China is investigated by checking international academic journals in English and described as far as events are logically linked and consistently meaningful.

1. Introduction

A paper on PACS development in Asia was once published in 2003 [1]. However, the history of development and operation of PACS in Asia involving China has not been reported since then. Also no clinical evaluation of installed PACS in Asia has been performed. Consequently, we should know whether PACS is used because it is found to be cost-effective or merely because PACS is expected to be so. This question has to be discussed. Therefore the chronological evolution, development and clinical use of PACS should be traced for these 26 years right form 1984, and presented.

2. History of PACS in Japan

2.1. Materials and methods

Most statistical raw data were acquired by survey results carried out by a Japanese journal "Gekkan Shin-iryou" ("Monthly Bulletin of New Medicine") published by "ME Shinkou Kyoukai" (medical engineering promoting association) and Japan Industries Association of Radiological Systems. Back numbers of this Japanese journal published in Japanese were referred to, and necessary data were picked up, collected, compiled, edited, and presented graphically or in the form of timeline tables.

In part 1:

(1) Quantitative growth of PACS, such as the number of installations and size of systems was chronologically traced from year 1984 to 2002. These comprise small PACS units with less than four image display terminals (IDTs), medium-size PACS with >5 and <14 IDTs, and large-size PACS with >15 up to 1300 IDTs [1].
(2) The configuration of the large-size PACS was retrospectively figured out since 1984.
(3) Events in progress of PACS development in Japan from 1984 to 2002 were investigated. A baseline study was carried out in Osaka University Hospital to assess the PACS contribution to image diagnosis with HIS. The response time of image retrieval from PACS terminals was measured [2].
(4) Standardization activity in Japan which contributed to PACS development was looked into and described.

In part 2, qualitative change in PACS utilization was evaluated during 2002 and 2010.

(1) Qualitative factors which influenced PACS operation were picked up. These factors were integrated with RIS, HIS and EPR.

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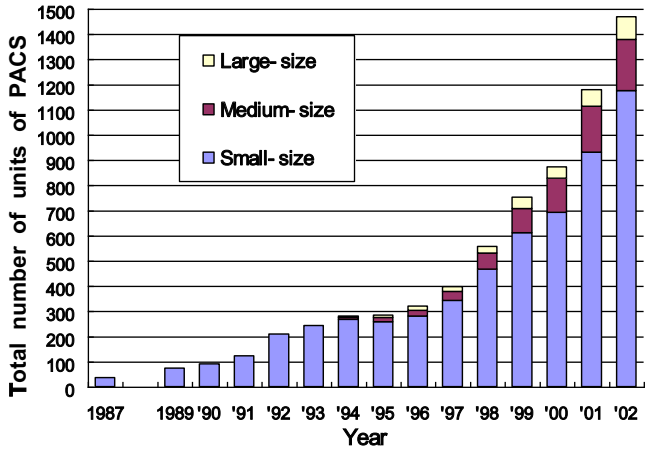

Fig. 1. Progress of PACS diffusion in Japan during years 1987–2002. Even small-size PACS of 1173 units in 2002 had function for image collection, storage, image processing, display, hard copy and image transmission through network. A rapid build-up of PACS installation was observed especially from 1997 to 2002. Continuous growing up of PACS diffusion from 2001 to 2010 in Japan is shown in Fig. 3.

(2) Interaction with other elements of PACS operation such as moving picture network system and 3D (three-dimensional) display was also searched.

2.2. Result

Part 1:

Fig. 1 shows the chronological change of PACS diffusion from 1987 to 2002 in Japan [3].

Even small-size PACS of 1173 in 2002 had function for image collection, storage, image processing, display, hard copy and image transmission through network.

Table 1 describes the present situation of large size PACS operation in Japan. Main 4 PACS are picked up [3].

The first experimental PACS and the first practical PACS were installed in Osaka University in 1984 [2] and in Hokkaido University Hospital in 1989, respectively. Note that most hospitals in Table 1 have several PACS servers. These servers were purchased from different vendors. The number of hospitals which had beds above 20 in 2002 was about 9000 in Japan. So that about 12.5% of hospitals had PACS in 2002.

Table 2 shows main progress from 1984 to 2002.

Japan began its own standardization activity such as MIPS (Medical Image Processing Standard) and ISAC (Image Save and Carry) in 1984 and this influenced PACS development in Japan. But soon in1990 these domestic standards were replaced by Japanese version of DICOM. Fig. 2 describes the history of standardization activity in Japan and even in Korea.

Concept of IHE (integrating healthcare enterprise) is now prevailing in Japan as IHE-J, and is contributing to PACS operation together with HIS and RIS.

Part 2:

Fig. 3 shows chronological change of number of hospitals equipped with PACS comparing with that utilize HIS, EPR and RIS [4].

Data between 2002 and 2006 in Fig. 3 were missing because the surveys were not carried out at that time. Fig. 4 shows chronological change of the number of hospitals which employ moving picture network systems and three dimensional display systems [4]. Fig. 1 shows the number of PACS systems while Figs. 3 and 4 shows the number of hospitals of PACS operation.

Table 1
Present situation of large size PACS operation in Japan.

No.	Hospital	Number of PACS servers	Number of connected modalities	Number of terminals	Integration with HIS, RIS and electronic patient record	Integration with teleradiology	Number of terminal for moving picture network systems	Number of terminal for three dimensional display systems	Since	Notes
1	Hokkai-do University	8	25	More than 1500	○	○	21	17	1988	First PACS Operation in Japan
2	Osaka University	6	28	More than 1500	○	○	4	22	1984	First PACS Experiment in Japan
3	Kyoto University	6	23	1400	○	○	20	22	1989	
4	Nagoya University	1	15	1250	○	○	14	11	1989	Tele-radiology coupling

Connected modalities mean on-line connected diagnostic machines such as CT, MRI, digital radiography, and ultra-sound. Recent growing up of flat panel detector radiography is the main tendency of image collection to PACS servers. Most of university hospitals are now equipped with teleradiology systems which enable us image retrieval and display from outside satellite hospitals as if they are inside images.