

## Current status and installation standard of dental PACS

Chang-Seo Park, Kee-Deog Kim, Hyok Park, Ho-Gul Jeong

Department of Oral and Maxillofacial Radiology, College of Dentistry, Yonsei University

### ABSTRACT

**Purpose** : Picture Archiving and Communication System (PACS) is difficult to implement in the best of situations, but evidence is growing that the benefits are significant. The aims of this study are to analyze the current status of full PACS and establish successful installation standard of dental PACS.

**Materials and Methods** : Materials and methods were based on the investigation of current working status and installation standard of PACS, and observation of variable issues to installation of dental PACS.

**Results** : By September 30, 2004, full PACS implementations in their facilities were 88.1% in specialized general hospitals (37 installations out of total 42 hospitals), 59.8% in general hospitals (144 installations out of total 241 hospitals), 12.3% in medical hospitals (116 installations out of total 941 hospitals) and 3.6% in dental hospitals (4 installations out of total 110 hospitals)

Only 4 university dental hospitals currently have installed and are operating full PACS. Major obstacle to wide spread of dental PACS is initial high investments.

**Conclusions** : Clinical environments of dental PACS differed from medical situation. Because of characteristic dental practice, the initial investments for dental PACS are generally much greater than those of medical PACS. Also new economic crisis makes users scruple. The best way to overcome these limitations is to establish an economic installation standard for dental PACS. Also the clear technical communication between the customer and the supplier before both sides are committed to the obstacles are critical to its success. (*Korean J Oral Maxillofac Radiol 2004; 34 : 175-8*)

**KEY WORDS** : Picture Archiving and Communication Systems; Dental Hospitals

The concept of PACS was first introduced to Korea in mid 1980's. The Korean society of PACS was founded in 1994 in order to promote the exchange of experiences and standardization efforts.<sup>1</sup>

During the past several years, advances in network technology has made PACS possible to interface to Hospital Information System (HIS) and Radiology Information System (RIS).<sup>2-8</sup> Development of a large-scale PACS requires very specialized technical knowledge and leadership which are rarely found in a group outside industry.<sup>9</sup>

The successful settlement of medical PACS in Korea can be a model of how a dental imaging field can be converted into digital environment in a relatively short period. Among the several factors that enabled this early settlement of PACS, technical development and support are believed to have contributed significantly. The aims of this study are to analyze the

current status of full PACS and establish successful installation standard of dental PACS.

### Materials and Methods

#### 1. Materials

Materials were based on the current working status of medical and dental full PACS and Request of Proposal (RFP) made by Yonsei University Dental Hospital (YUDH).

#### 2. Methods

The Korean PACS Society recommended guidelines for both hardware and the data management process, and hospitals that want to install PACS and qualify for the government reimbursement are expected to follow that guidelines.<sup>10</sup> The best vehicle for formal communication of requirements from customer to a PACS supplier is a clear specification. Methods were based on the analysis of architecture of PACS specifications and variable issues for installation of dental PACS.

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Correspondence to : Prof. Chang-Seo Park

Department of Oral and Maxillofacial Radiology, College of Dentistry, Yonsei University, 134 Shinchon-Dong, Seodaemun-Gu, Seoul, Korea

Te) 82-2-361-8876, Fax) 82-2-363-5232, E-mail) csp@yumc.yonsei.ac.kr

## Results

By September 30, 2004, full PACS implementations in their facilities were 88.1% in specialized general hospitals (37 installations out of total 42 hospitals), 59.8% in general hospitals (144 installations out of total 241 hospitals), 12.3% in medical hospitals (116 installations out of total 941 hospitals) and 3.6% in dental hospitals (4 installations out of total 110 hospitals). The first medical PACS in Korea was placed in clinical operation at Samsung Medical Center (SMC Seoul, Korea), 1,200-inpatient bed hospital, which was opened in 1994.<sup>11</sup> SMC expanded the system into the full PACS installation by the year 1996. As the PACS installation at SMC was successfully carried out, some large hospitals such as Seoul National University Hospital (SNUH, Seoul Korea) and Asan Medical Center (AMC, Seoul Korea) also began to develop their own PACS projects. The AMC, 2,200-inpatient bed hospital, also developed its own full PACS with investment of the company of Hyundai Information Technology (Seoul Korea).<sup>11</sup> Domestic PACS industry was greatly promoted by national policy of reimbursement for PACS exams in November 1999.<sup>12</sup> Domestic vendors have several characteristics of their PACS solution. Most of domestic vendors provide perfect solution for HIS/RIS/PACS integration using DICOM and Health level 7 (HL 7) standards or their own system, whereas foreign vendors provide partial solution.<sup>12</sup>

The first dental PACS was placed at Won Kwang University dental hospital using enterprise PACS, followed by Seoul National University Dental Hospital. Now dental PACS is currently installed and operating on 4 university dental hospitals. Fortunately health insurance reimbursement to dental PACS commenced in February 2004. The image qualities of intraoral digital sensors almost reach the level of film-based image quality, but there are not many PACS vendors which have interests in improvement of dental digital environments.

## Discussion

### 1. Architecture of PACS Specifications

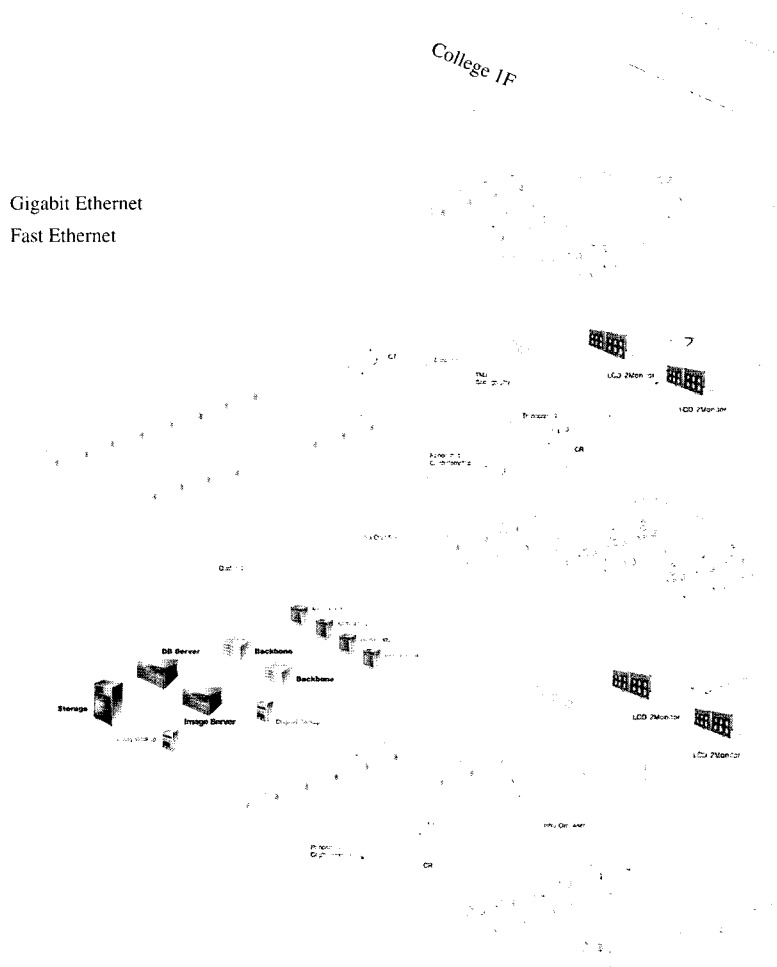
PACS architectures have generally been classified into two configurations based on how and when they root images.<sup>9</sup> In a shared file system PACS, all the images are stored centrally. In a distributed file system PACS, the images may be distributed across one or more storage systems. In addition, each workstation has its own cache of local image storage from which images are viewed. These two architectures will be growing together in the future.<sup>9</sup>

Major components of PACS constitute storage system, network, database, archive system, hospital information system interfaces, image acquisition systems, image display

workstations and monitors, hard copy printing and film printers, telecommunications, web servers and workstations, clinical treatment and study support, and obstacle counter-measure.

Most PACS have two levels of storage systems: an on-line, short-term storage system and a long-term storage system. Customers have to decide how many images they want to be able to access on-line. This is best thought of in terms of time-depth. Short-term storage system is on-line storage system for rapid access to image. Long-term storage system should bring up sufficient storage capacity of image for minimum 5 years without help of maintenance manager. PACS network is constituted with switched Gigabit and Ethernet switching for a basis. Suppliers should describe the network infrastructure which can support diagnosis, examination and web workstation on the bid specification (Fig. 1). A full PACS database is a very sophisticated component.<sup>9</sup> In sense, any PACS data base models the imaging operation of that part of the hospital which it serves.<sup>9</sup> The basic object which most systems manage is the exam. Exams contain images and, in some implementations, diagnostic reports. They also have statuses and a host of other parameters which, for example, group them into meaningful categories or describe how are to be displayed.<sup>9</sup> The idea of an archive is to store images for as long as they might be needed. Generally, this is much longer than can be cost-effectively supported by the technologies used in the on-line storage system. The external information systems to which a PACS is usually interfaced are the HIS and RIS. From the perspective of the PACS supplier, the preference is to interface only to the system which handles order entry requisitions and reports and to have that system handle communication with the other one. Digital Image Communication in Medicine (DICOM) conformance statement should be presented, including all DICOM function of PACS. DICOM Query/Retrieve Service Class Provider (SCP) is described to support the query function for the studies, series and images loaded in the storage system. It is usually difficult for the PACS supplier to estimate the cost of connecting third-party modalities to a PACS because the customer is frequently not exactly sure what he has.<sup>9</sup> DICOM is the preferred interface. In order for the DICOM interface recommended to work to full advantage, the modality systems customers wish to connect to PACS must support the corresponding interface. To accomplish this, customers need to include DICOM requirements in modality procurement. PACS, EMR and OCS should be connected with each other. Information change of OCS should be informed to the PACS and EMR, PACS supplier should clearly describe which infor-

Fig. 1. YUDH PACS network.



mation is necessary.

Almost every PACS needs a film digitizer to capture reference films from the film archive and to acquire new studies from other institutions. There are two basic applications for image display work stations: primary diagnosis and clinical review.<sup>9</sup> The physical requirements (for example, the number and size of the monitors) are different for the two applications. There is a hospital of thought which says that the user interfaces and the basic functionality must also differ. PACS suppliers offer laser film printers connected to the network through interfaces sometimes called camera servers or spoolers which should support the high-quality and general printers in the department of radiology. There are numerous telera-diology applications. Communication performance requirements vary widely with the application.<sup>9</sup> Where speed is important and volume is substantial, the communication costs can be quite high, so careful attention must be paid to the

usage of the link and to compression of the image data. Web server and web page interfaced with PACS information are supplied through Local Area Network (LAN). In the personnel computer provided by suppliers, interface to the web server is possible using the Navigator or Microsoft Internet Explorer. It should be possible that clinician investigate the images and reading results through the screen of OCS. Training and supporting function for the clinical study should be presented. Back-up, non-obstacle and nonstop operation for 24 hours should be described. When the disorders occurred, measures for localization of obstacle effect and recurrence prevention should be clearly presented.

## 2. Issues from Dental PACS installation

Many dental hospitals now consider integrating a PACS. Clinical environments of dental PACS were some different

from medical situation. Because of complicated dental practice, the initial investments for dental PACS are generally much more than that of medical PACS. There are not many PACS vendors which have interests in improvement of dental digital environments. Cost-justification is the most important issue to dental hospital administrators when purchasing a PACS. The initial benefits will be happened at 4-5 years after PACS implementation, based on the national health insurance reimbursement. Fortunately health insurance reimbursement to dental PACS commenced in February 2004, but late economic depression makes users scruple. The image quality of intraoral digital sensors almost reach the level of film-based image quality, but the volume of intraoral Charge-Coupled Device (CCD) sensor gives the patient inconvenience. Adolescence of available digital radiographic appliances and software may not be able to fully satisfy the customer's desire.

The best time to start that communication between a customer and PACS vendor is at the time of the RFP.<sup>9</sup> The first part of an RFP should describe the project. The idea is to write a summary so that supplier can quickly grasp the scale of the investment and opportunity. The size of the hospitals, the numbers of floors in each building, the locations of the key departments, the size of the radiology department, the total number of dental unit chairs, the number of procedures per year and plans for expansion of the facilities or procedure volume should be described.<sup>9</sup> The best way to overcome these limitations is to establish a ideal installation standard of dental PACS. The clear technical communication between the customer and the supplier before both sides are committed to the above issues are critical to its success. Understanding and

timely implementation of continuously evolving international standards will be much help to dental PACS development.

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