The Conquest Hospital Picture Archiving and Communications System Development, 1992 to 1999

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Conquest Hospital was a UK regional development site for a pre-Digital Imaging and Communications in Medicine (DICOM) picture archiving and communication system (PACS). The initial system was installed in mid 1992. Identification has been made of data transfer, ergonomic and single point of failure issues in the original PACS, which was called "iLAN." This has informed respecification of a DICOM/HTML PACS, the first stages of which have been hospital renetworking and installation of new DICOM 3.0 computed radiography/fluorography and computed tomography/magnetic resonance imaging segments. Final PACS elements are at contract stage. Plans are being completed for linkage of PACS to a clinical information system to create a comprehensive electronic patient record system.

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HISTORY

The project^{1,2} was to inform the specification of low-cost PACS and define PACS' problems, by direct operational observation. Image data were captured and archived satisfactorily. Image reporting folders were compiled manually and sent for reporting to Sun Sparc (Sun Microsystems, Mountain View, CA) viewstations. Radiologists were able to request ad hoc images directly from archive. The associated UNIX-based radiology information system (RIS) shares the Sparc 10 server and utilized a SYBASE (Emeryville, CA) relational database also, but has a personal computer (PC) Windows (Microsoft, Redmond, CA) interface. Data transfer issues, ergonomic problems, and single point of failure identification from the original iLAN PACS has informed respecification for a DICOM/hypertext mark-up language (HTML) PACS, the first stages of which have been hospital renetworking and installation of new DICOM 3.0 computed radiography (CR)/fluorography and computed tomography (CT)/magnetic resonance imaging (MRI) segments.

The initial system as in 1995 is described in Fig 1. The most satisfactory interface was the CR

review device, which also acted as a Transmission Control Protocol/Internet Protocol (TCP/IP) route designator. Radiographers reviewed CR images, accepted/exported or rejected/deleted them, and had a choice of routing to the PACS archive only or to the PACS archive plus either the Emergency Room or orthopedics workstations. The 8-bit depth CR review station accepted images preprocessed by firmware, but offered no further functionality apart from image rotate, export, or delete. Process flow was found acceptable by technicians. Experiences with this system have been described.³

The PC-based frame grabbing devices in digital fluoroscopic rooms functioned with excellent high signal to noise ratios, but patient demographics had to be reentered. Each image was transferred as a separate file. Image quality was satisfactory, but the slowness of the interface led to resistance to use. The use of a Sun network file system disk cross mount to the CT scanner for image transfer worked and the images were excellent. However, image overlays were stored separately from images and failed to be captured. This was not acceptable to radiologists.

Some nuclear medicine images could be directly transferred to PACS and their quality was acceptable. Other nuclear medicine graphical data could not be transferred as no suitable standard was available. The failure to provide a comprehensive service led to abandonment by the radiologists who did not wish to use two separate systems.

The CR PACS was in continuous use between late 1993 and mid-1996. More than 20,000 CR full 10-bit depth images were soft-copy reported. The single CR unit was seen as a significant single point of failure—there were minor to major breakdowns of the device and routine maintenance also took the unit out of service. Digitization of films was slow and demanded additional staffing resources; there-

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Fig 1. iLAN configuration in 1995.

fore, it was not used during periods of CR nonavailability, nor for retrospective digitisation of the existing hard-copy film archive.

A significant proportion of the problems experienced arose from the limited PACS communication standards in the early 1990s. A proposal to use a DICOM communication “shell” around the existing entities was rejected, as this would not have permitted the use of the full complement of DICOM Service Classes and Information Objects. The origi-

nal code had been written as a “top down” suite of programs and conversion of the system to DICOM was regarded as nonfeasible. Respecification of the system was necessary. This took 18 months of intensive work by the Project Team.

RESPECIFIED DICOM/INTRANET PACS

Phase 1 of the new PACS now links three new CR units, digital fluorography, and angiography. The database communication capabilities of Philips

Fig 2. New DICOM PACS phase 1—the CR/fluorography segment.

Fig 3. Outline of final configuration of new hospital-wide DICOM/Worldwide Web/CIS PACS (courtesy of Imation UK Ltd).

Easyvision stations (Philips Medical, Eindhoven, Netherlands) are used and images from any unit can be viewed on any of three Easyvisions. There is unidirectional input of ASCII data from the present RIS to the CR User panels (USITs), which can IP "ping" to their associated Easyvision (Fig 2). Phase 2 is due for completion December 1998. It links the new Siemens (Erlangen, Germany) AR.Star CT, a Picker Polaris 1.0T MRI scanner, and a Picker Vistar workstation (Picker International Inc, Cleveland, OH).

Phase 3 to link nuclear medicine imaging, ultrasound, mobile image intensifiers and film digitizers and provide a new image archive, Intranet server and reporting and review stations is at the final

contract stage with Imation (Cemax-Icon, Fremont, CA) in December 1998. Phase 3 will provide an Intranet server capable of distribution of DICOM images viewable using a Java viewer applet^{4,5} and will be the optimal pathway to achieve hospital wide PACS at minimal cost (Fig 3). A preferred supplier (Shared Medical Systems UK, Basingstoke, UK) proposes a new clinical information system (CIS) and, as a final stage of PACS, we will develop direct access to the PACS intranet server by icon shortcut from the CIS menu bar. Both the PACS and new RIS will be interfaced to the patient administration system (PAS), which will be the master demographic database, to ensure uniform accurate patient demographic data.

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