

Digital Preservation in Radiology.

Ensuring long-term accessibility of digital medical images

The rapid technological changes in today's information landscape have considerably turned the preservation of digital information into a pressing challenge. Be it digital images, documents, audio or video files, all require particular attendance when it comes to preserving them for long periods of time. Without appropriate measures, digital objects will be inaccessible in a very short time. A lot of different strategies often depending on the application area have been proposed to tackle this challenge. In medical imaging considerably large digital objects are produced, processed and archived in a networked environment where parts of the collection also have to be made accessible at short notice. In many European countries hospitals, radiologists and private clinics have the legal obligation to archive data for 30 years. Different standards for communication and storage exist in radiology including DICOM and HL7 to accomplish these high demands. However, additional efforts may be required to establish trusted repositories by utilizing risk assessment and compliance auditing for the respective archival systems.

Introduction

Systems managing patient information in general and medical images in particular have to meet high demands, from the medical point of view. Such systems must guarantee the accessibility of their stored information for very long periods of time due to strict legal obligations. In many countries radiographic images must be retained for 7 years, and 30 years respectively if they are relevant for diagnosis. In medical imaging, devices for storage and presentation of images are called PACS (Picture Archiving and Communication Systems); they communicate according to specific protocols and store data in an independent format. The most common format used for storing, handling, transmitting and printing is DICOM (Digital Imaging and COmmunications in Medicine).

Standards

DICOM is an open standard that has achieved wide acceptance amongst manufacturers of medical imaging equipment in recent years. This common protocol for communication and storage enables the integration of devices of different vendors such as scanners and ordinary servers into a PACS. But most importantly to the extent that the DICOM format is an 'open' standard it provides the basis for ensuring lengthy retention periods for information relevant to diagnoses which is covered by the standard – this includes images in addition to other patient information. PACS that use DICOM as storage format may thus be able to assure accessibility and interpretability of the data over the period of time regulated by law. Further information in digital form which may not be consulted for diagnostic reasons but are also used in the system such as spreadsheets, 3D visualisations or audio/video files are not part of the DICOM standard. These types of objects pose enormous challenges for digital preservation due to the diversity of files and potentially proprietary file formats. As these digital objects do not act as the basis for diagnosis, they are currently exempt from the legal obligation for long-term preservation which is limited to DICOM-type data only.

Further information and resources

The Open Archival Information System (OAIS) Reference Model (standard ISO 14721)
ssdoo.gsfc.nasa.gov/nost/isoas

Trustworthy Repositories Audit & Certification (TRAC): Criteria and Checklist
<http://bibpurl.oclc.org/web/16712>

Digital Repository Audit Method Based on Risk Assessment (DRAMBORA)
<http://www.repositoryaudit.eu>

nestor Kriterienkatalog version 1
<http://edoc.hu-berlin.de/series/nestor-materialien/2006-8/PDF/8.pdf>

The Digital Imaging and Communications in Medicine (DICOM) standard. DICOM enables standardised communication and storage of information in medical imaging.
<http://medical.nema.org>

Integrating the Healthcare Enterprise is an initiative by professionals in healthcare and industry to improve interoperability of medical devices. IHE organises so called Connectathons ('connectivity marathons') where manufacturers meet for interoperability testing of their systems.
<http://www.ihe.net>

PLATTER
<http://www.digitalpreservationeurope.eu/platter>

Plato / Planets Preservation Planning Workflow
<http://www.ifs.tuwien.ac.at/dp/plato>

PACS and OAIS

PACS are concerned with archiving DICOM records and should thus also conform to the OAIS (Open Archival Information System) standard. The OAIS reference model describes a system (with the functional entities Ingest, Archival Storage, Data Management, Administration, Preservation Planning, Access and Common Services) and its organisation that is responsible for the long-term preservation of information and making it available to a designated community. In addition to the common terminology the OAIS introduces, it defines a functional model, information flows, roles and responsibilities such as the defining actions in case of closure of the archive to ensure the continuance of the digital objects. Medical images and information should not be lost when a radiologist retires, or a clinic closes without a successor.

Trustworthy Repositories

As PACS exceptionally contain highly sensitive medical information, destined for long-term preservation, such systems should thus be audited to determine and ensure their trustworthiness. This can be done through the TRAC (Trustworthy Repositories Audit & Certification) checklist for an objective evaluation. Essential for a trusted digital repository is its awareness of threats and risks within the whole system and the strategies it has in place. Audited areas cover the organisational infrastructure, digital object management, and technical infrastructure and security. A similar approach to establish trust in a repository is the criteria catalogue published by the nestor working group.

Trustworthiness for PACS can also be accomplished using DRAMBORA (Digital Repository Audit Method Based on Risk Assessment) which uses risk assessment to identify strengths and weaknesses in a system and organisation. DRAMBORA follows a workflow consisting of six stages: (1) Identify organisational context, (2) document the policy and regulatory framework, (3) Identify activities, assets and their owners, (4) identify risks, (5) assess risks, (6) manage risks. This may further need to be complemented by consistent planning of preservation activities, following e.g. the PLATTER and Planets Preservation Workflow model.

Conclusion

While the challenges and legal obligations for preserving medical image data in the radiology sector are considerable, these can be met due to the high adherence to the open interchange standard DICOM. However, additional efforts may be required in terms of risk assessment and compliance auditing for the respective archival systems.