DICOM℠

Digital Imaging and Communications in Medicine

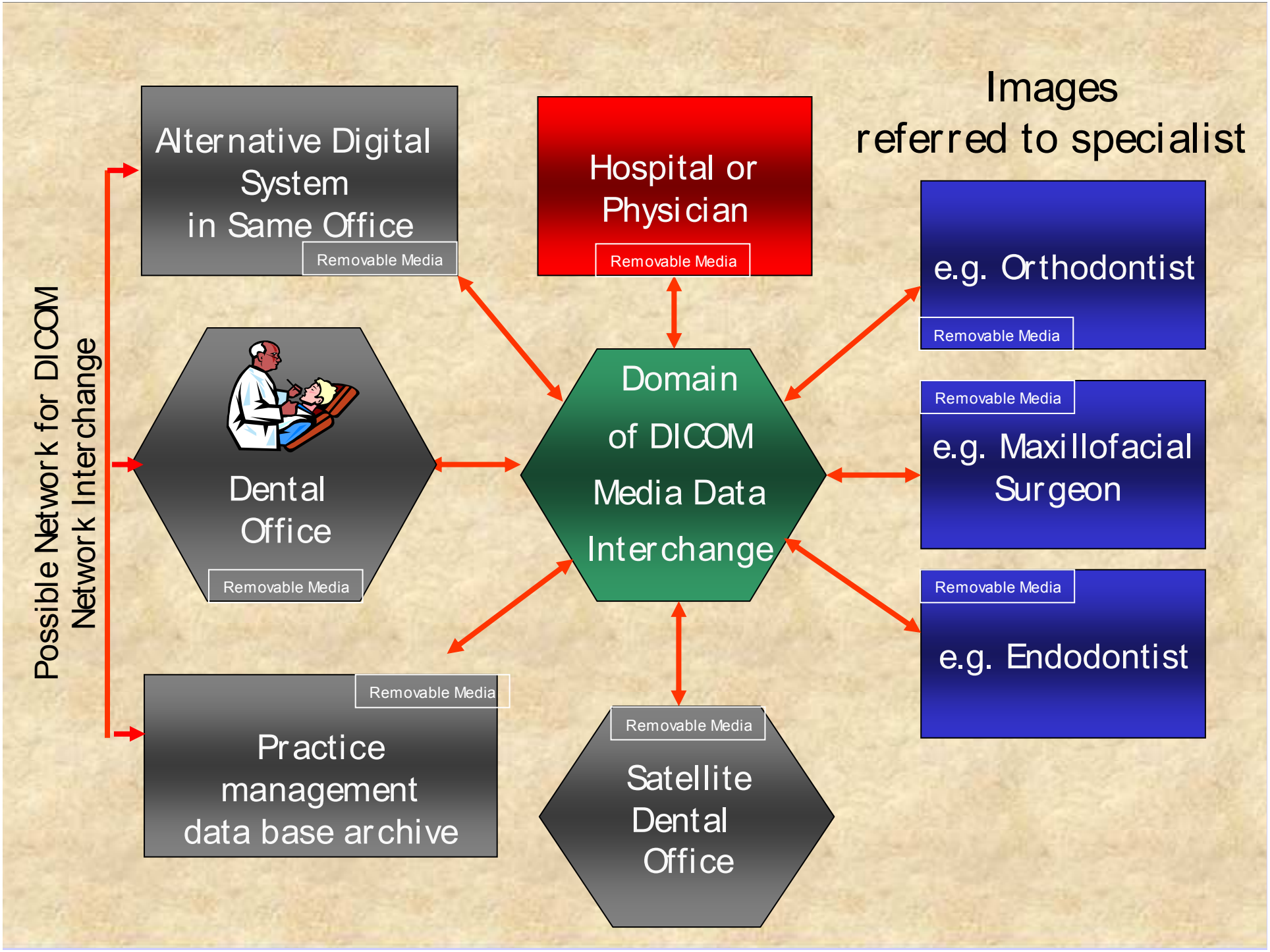
2nd International Congress, Budapest, 2005

Digital Imaging & Communications in Dentistry: DICOM and Interoperability

Allan G. Farman

ADA Representative to the DICOM Standard Committee
Co-Chair DICOM WG 22 (Dentistry)
Co-Chair ADA SCDI WG 12.1 (DICOM for Interoperability)

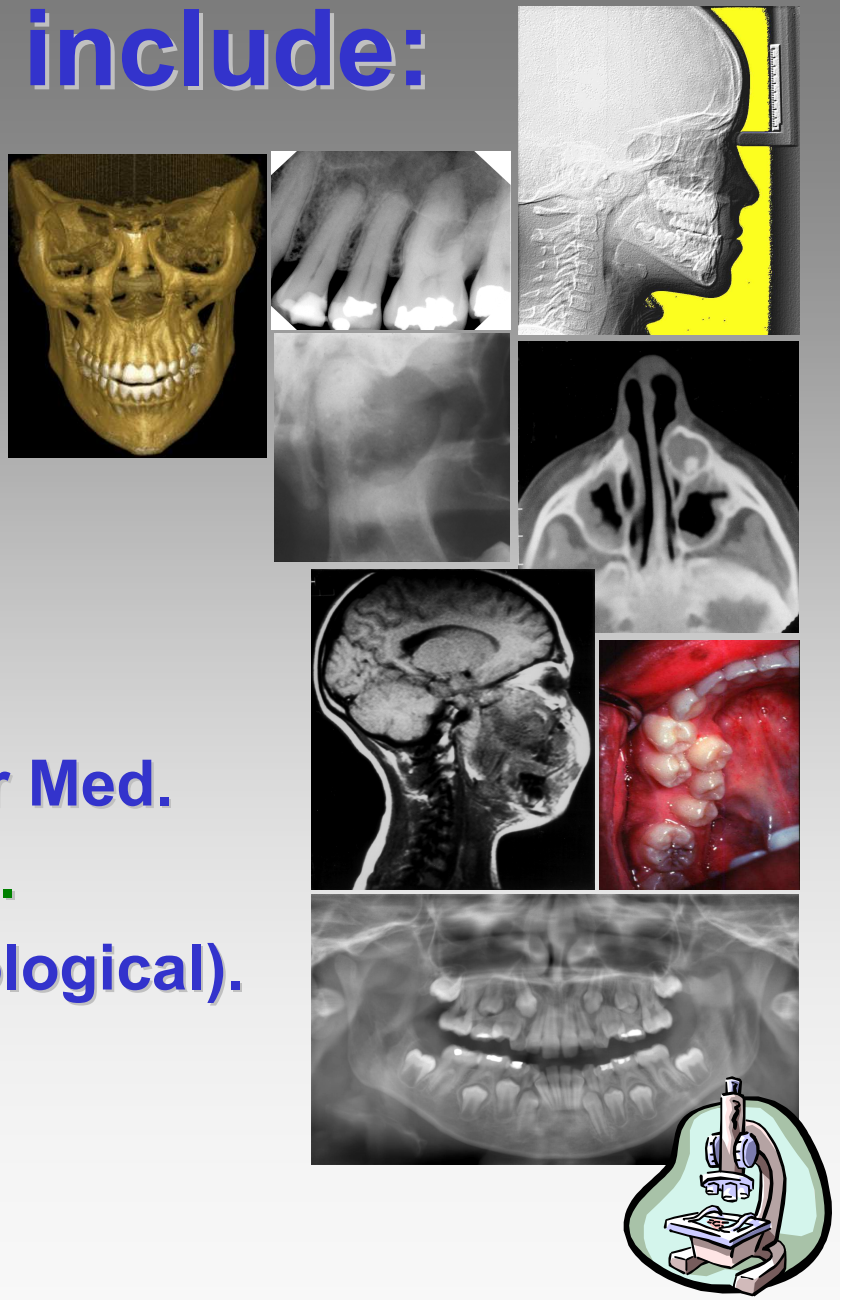
WHY EXCHANGE?


Possible Network for DICOM Network Interchange
Alternative Digital System in Same Office
Removable Media
Hospital or Physician
Removable Media
Images referred to specialist
e.g. Orthodontist
Removable Media
Dental Office
Removable Media
Domain of DICOM Media Data Interchange
Removable Media
e.g. Maxillofacial Surgeon
Removable Media
e.g. Endodontist
Removable Media
Practice management data base archive
Removable Media
Satellite Dental Office
Removable Media

WHY DICOM?

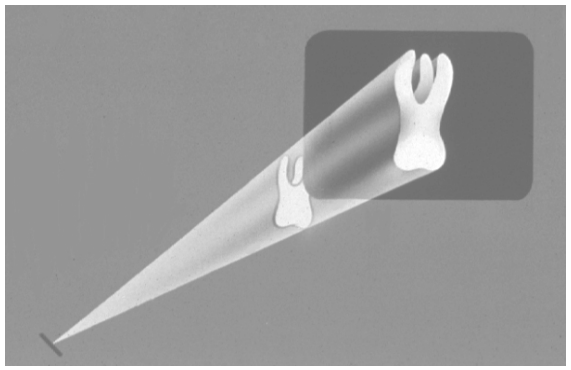
Digital images can include:

- Intra-oral radiography.
- Panoramic radiography.
- Cephalometric radiography.
- Skull and sinus radiography.
- Tomography.
- CT, CBCT, MRI, PET, Nuclear Med.
- Intra-oral photography/video.
- Microscopy (surgical & histological).

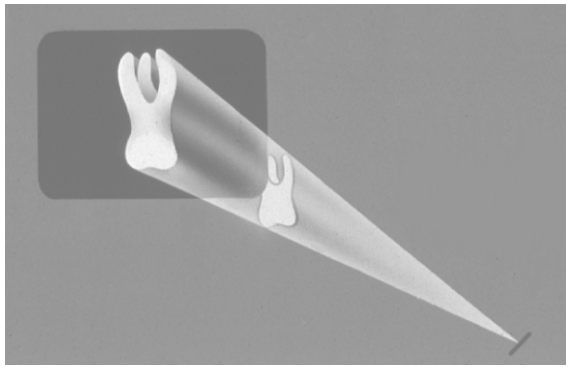


INCREASING DIGITAL OPTIONS

INTRAORAL X-RAY OPTIONS



IP



FILM

CMOS

CCD

CMOS

CCD

DIGITAL PANORAMIC OPTIONS

SECONDARY CAPTURE

Scanner

Digital camera.

PHOSPHOR PLATE

DenOptix (Gendex)

Paxorama HS and DEXpan (Orex)

Digora PCT (Soredex)

ScanX (Air Techniques)

ADD ON / RETROFIT CCD

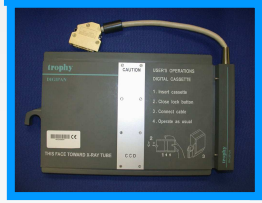
Schick Technologies CDRPan

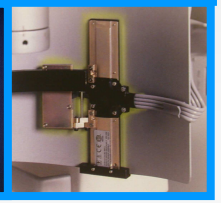
Kodak Trophy Digipan

Signet DXIS

Dent-X Eva Ortho Pan

Lightyear Digital Panoramic





INTEGRATED DIGITAL

Kodak 8000 Digital Panoramic

Gendex Orthoralix 8500 DDE
and 9200 series

GE Dental OP 100D

Planmeca ProMax Dimax3 and Proline XC Dimax3

Soredex ScanoraD and Cranex ExcelD

Morita Veraviewepocs

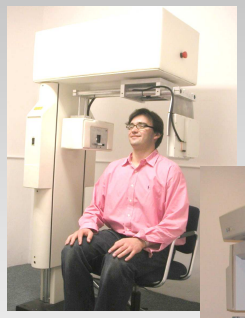
Sirona Orthophos XG

CONE BEAM CT

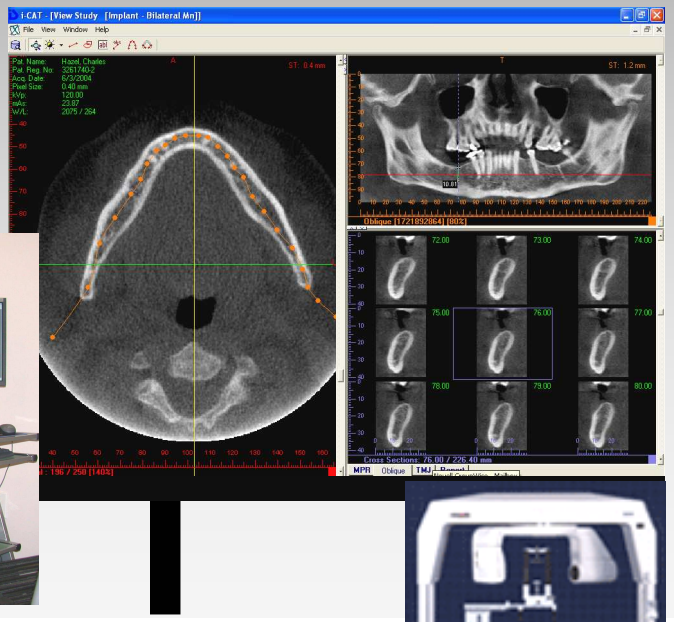
NewTom QR 2000

Hitachi MercuRay

CB Throne



Xoran/ISI iCAT (Ann Arbor, MI/Hatfield, PA)



J. Morita 3DX Accuitomo

Asahi Roentgen PSR9000N

Efficiency: ***Integration of different modalities in one dental office.***

Portability: ***Exchange of images between dental practitioners needed when patients move or require specialist care.***

Integrity: ***Attributes uniquely identify the patient, procedure, procedure date and protect image integrity.***

Digital Imaging and Communications in Medicine

The DICOM Standards Committee	
WG-01: Cardiac and Vascular Information	WG-12: Ultrasound
WG-02: Projection Radiography and Angiography	WG-13: Visible Light
WG-03: Nuclear Medicine	WG-14: Security
WG-04: Compression	WG-15: Digital Mammography and CAD
WG-05: Exchange Media	WG-16: Magnetic Resonance
WG-06: Base Standard	WG-17: 3D
WG-07: Radiotherapy	WG-18: Clinical Trials and Education
WG-08: Structured Reporting	WG-19: Dermatologic Standards
WG-09: Ophthalmology	WG-20: Integration of Imaging and Information Systems
WG-10: Strategic Advisory	WG-21: Computed Tomography
WG-11: Display Function Standard	WG-22: Dentistry
	WG-23: Application Hosting

NEW ADDITION WG-24: Surgery

WG-22 (Dentistry)

Secretariat:	American Dental Association (ADA)
Secretary:	Sharon Stanford stanfords@ada.org
Co-Chair:	Allan G. Farman, BDS, PhD (odont), DSc (odont), Univ. Louisville agfarm01@louisville.edu
Co-Chair:	John Goyette, Schick Technologies jgoyette@schicktech.com
Date of Last Update:	November 22, 2004

Scope:

To address all issues relating to imaging and reporting of image-based studies in dental applications.

Roadmap:

The implementation of dentally relevant objects (e.g. DX, IO, SC, SR) will be emphasized in dental care environments. Specifications within DICOM are needed to promote image interoperability between digital imaging systems for dentistry. Coordinated education and demonstration projects for vendors and users are essential to achieve broad adoption of the standard in dentistry. Extensions/refinements to existing objects will be introduced to accommodate existing and emerging digital imaging and related techniques used in dentistry.

Raising the DICOM Standard

2003 2004

DICOM WG22 (Dentistry)

ADA WG 12.1 (DICOM & Interoperability)

STANDARDS DEVELOPMENT

DICOM WG22/DICOM Standard Committee/National Electrical Manufacturers Association

DICOM Supplement 92

Media Application Profile for Dentistry

STANDARD DEVELOPMENT

WG 22 Future Plans

- ***Dental Image e-mail attachments – proposes new zip extension (.dcz)***
- ***Multi Frame Dx Standard for Cone Beam CT***
- ***Dental Visible Light Annex***

RM ~ NSR ~ MWL

DICOM
FUNCTIONAL PROFILES

Various profiles may be found in combinations according to manufacturer specifications.

DICOM Removable Media (RM)

The DICOM Removable Media requirement provides ability to exchange entire dental grayscale radiographic studies between practitioner using removable media such as a CD. The requirement provides for the ability to both read and write valid DICOM datasets as defined in the DICOM (Supplement 92) Media Application Profiles for Digital Radiographic Images in Dentistry. The CD should also contain a viewer that provides basic display capabilities plus an optional print functionality.

DICOM Network Storage and Retrieval (NSR)

The DICOM Network Storage and Retrieval requirement provides for the ability to store dental grayscale radiographic images studies from an image acquisition device (client) to a network image DICOM archive (server). It also provides for the ability to search the image DICOM archive for a specific dental radiographic exam using attributes such as patient name, patient ID, study date of exam, retrieve the images and display them for diagnostic review.

DICOM Modality Worklist (MWL)

The DICOM Modality Worklist is predominantly used by large dental practices with multiple providers. This requirement provides for the ability to request a dental radiographic examination be performed on a specific patient. Patient demographic information is also transferred, which will then be used by the individual taking the radiographic examination. The purpose is to provide for efficient workflow from ordering to acquisition of radiographic examination.

ADA SCDI

American Dental Association

Standards Committee on Dental Informatics

Vendors - Users - Interested Parties

IADMFR – Don Tyndall
AAOMR – Jie Yang
CARS Foundation – Allan G. Farman
AAO – Bill Harrell

TECHNICAL REPORT

American Dental Association
Standards Committee on Dental Informatics (SCDI)

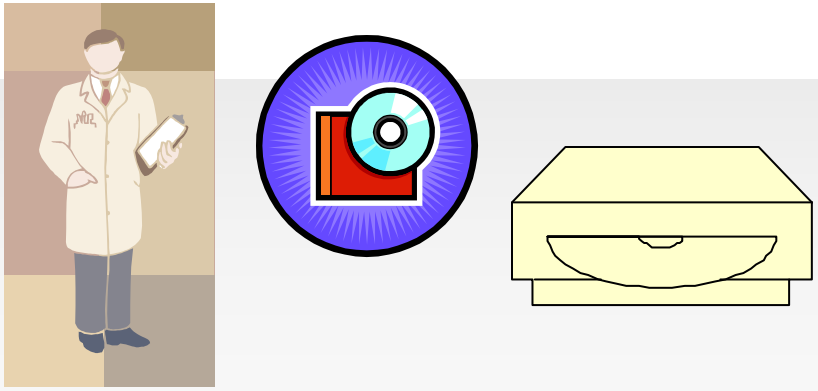
TR 1023 Implementation Requirements for DICOM in Dentistry

Sample ADA SCDI TR 1023

USE CASES

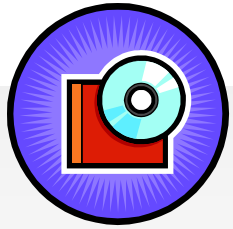
Use Case #1: Interoperability without digital radiographic equipment using DICOM Removable Media (RM).

This use case scenario demonstrates the use of DICOM RM as a means of communicating diagnostic radiographic images to a practitioner who does not have a digital imaging system.



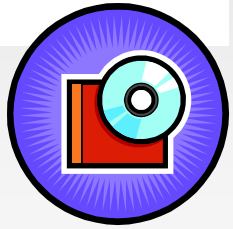
Use Case #1: DICOM Removable Media (RM).

- A new patient arrives, with a CD containing images from the previous dentist. The images are in DICOM format and a basic DICOM viewer application is included on the disk.
- The Basic DICOM Viewer contains basic functionality such as magnification, window/level and invert gray scale, and optional non-DICOM printing. From now on, the Basic DICOM viewer will just be called a viewer.
- Using his office PC, the dentist loads the CD into his computer and the viewer automatically loads with a display of the patient's demographic data along with a list of all radiographic examinations sent from the previous dentist.



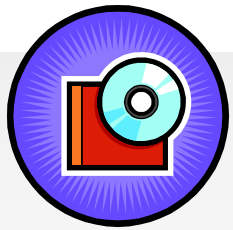
Use Case #1: DICOM Removable Media (RM).

- Using the viewer the dentist is able to display the radiographic images for interpretation and diagnosis.
- The images from the DICOM CD can be retained as part of the patient record. If the viewer has print capability, the dentist may print the images, including patient information, from the CD for hard copy documentation. This print capability will not produce diagnostic quality images.
- The dentist may make additional radiographs to aid diagnosis before treating the patient.



Use Case #2: Interoperability between different vendor's digital radiographic equipment using DICOM Removable Media (RM).

This use case scenario demonstrates the use of DICOM RM as a means of transferring diagnostic radiographic images between dental practices with different vendor's digital imaging systems.



Use Case #2: DICOM Removable Media (RM).

- A new patient arrives with a CD containing DICOM images that were obtained using a digital imaging system. The CD contains several intra-oral images as well as a panoramic radiographic image.

- The dentist imports the DICOM images into his digital imaging system from the CD. The imported images and all associated data (patient demographics, imaging equipment, image information, etc.) are added to the database allowing the use of his own imaging system. The dentist views the images to see which images have been obtained and to potentially schedule radiographic images to complement them.

Use Case #2: DICOM Removable Media (RM).

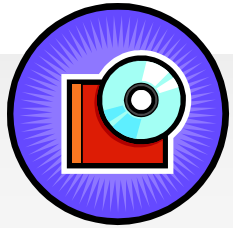
- The dentist decides to obtain two additional images on his digital system.

- The dentist compares the previous images with the newly acquired images and archives both the new and old images on his local database/archive.

- The dentist decides to refer the patient to a specialist for appropriate care. A new DICOM CD with the old and new images is generated. This newly generated CD has a basic viewer, as described in use case #1, in case the receiving specialist does not have a DICOM viewer available.

Use Case #3: Conversion of radiographic image archive from one vendor's digital imaging system to another's using DICOM Removable Media (RM).

This use case scenario demonstrates the use of DICOM RM as a means of converting an entire dental practice radiographic image archive between different vendor's digital imaging systems, thereby maintaining the dentist investment in digital imaging.

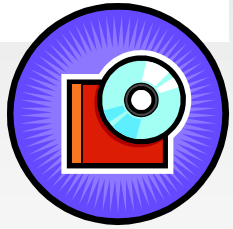


Use Case #3: DICOM Removable Media (RM).

- A dentist decides to buy a new digital imaging system which is from a different manufacturer than the one he/she currently owns.

- The dentist wishes to transfer all of his radiographic examinations from one vendors system to another's.

- The dentist selects groups of patient examinations from his current imaging system and archives them to CDs or other removable media (such as DVDs or removable hard drive) using DICOM.



Use Case #3: DICOM Removable Media (RM).

- **After the installation of the new digital imaging system, the dentist imports the DICOM radiographic examinations into his new system from the DICOM removable media.**

- **The imported images and all associated data (patient demographics, imaging equipment, image information, etc) are added to the database allowing the use of its own viewer to display the images for interpretation.**

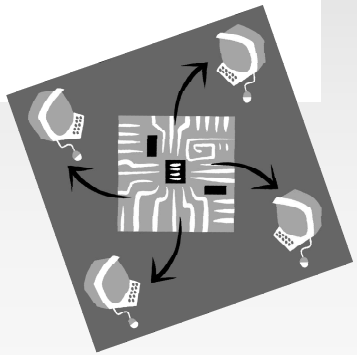
Use Case #4: Interoperability between a dental practice using conventional film radiography and a specialty dental practice with digital radiography using DICOM Network Storage and Retrieval (NSR).

This use case scenario demonstrates the use of DICOM NSR and DICOM RM as a means of integrating both conventional film-based and digital radiography.

Use Case #4: DICOM Network Storage and Retrieval (NSR).

- A new patient arrives at a dental specialist office with conventional film intra-oral and extra-oral radiographs. The receptionist creates a new record for the patient in their digital imaging system and scans these films with a x-ray film scanner. The scanned images are stored to the DICOM server.

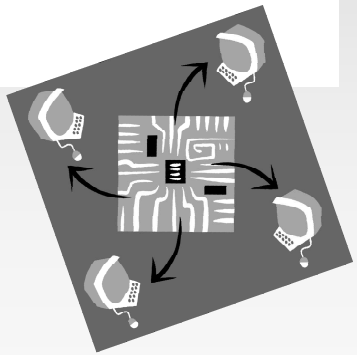
- The specialist, using his/her digital imaging system, performs a DICOM Query and retrieves the appropriate images from the local server using DICOM Retrieve.



Use Case #4: DICOM Network Storage and Retrieval (NSR).

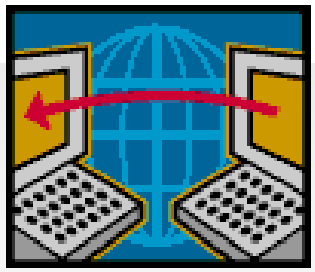
- Additional digital extra-oral and/or intra-oral images are taken. The dentist views the images on his workstation.

- The receptionist creates a DICOM RM CD with a copy of the complete set of images for the patient to take back to her referring general practitioner. This CD has the capabilities as previously discussed.



Use Case #5: Communication of digital radiographic images between a private practitioner and an interested third-party using DICOM Storage and Retrieval (NSR).

This use case scenario demonstrates the use of DICOM NSR as a means transmitting digital radiographic studies between dental practices using a secure third-party DICOM server.

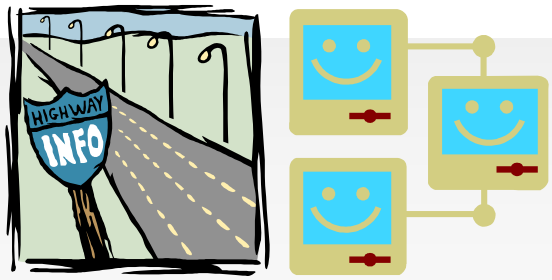


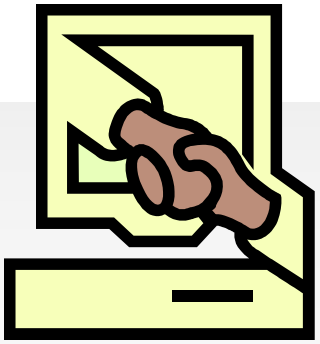
Use Case #5: DICOM Network Storage and Retrieval (NSR).

- After a clinical and radiographic examination of the patient, a dentist determines that a referral to a specialist is required to address the chief complaint.

- The dentist selects the digital radiographic study that supports the diagnosis and transfers the study to a secure third-party DICOM server using DICOM NSR.

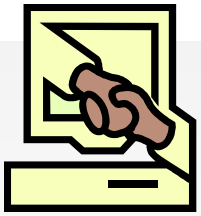
- The specialist, using his/her digital imaging system, performs a DICOM Query and retrieves the appropriate images from the third party DICOM server using DICOM Retrieve.

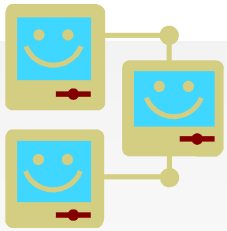




Use Case #5: DICOM Network Storage and Retrieval (NSR).

- The specialist imports the DICOM images into his digital imaging system. The imported images and all associated data (patient demographics, imaging equipment, image information, etc.) are added to the database allowing the use of his own imaging system.
- The specialist views the images to see which images have been obtained and to potentially schedule radiographic images to complement them. The specialist decides to obtain two additional images on his digital system and completes the treatment.
- The specialist's radiographic study can be returned to the referring general practitioner by the same mechanism.





Use Case #6: Interoperability between a dental practice management system and a digital radiography system using DICOM Modality Worklist (MWL).

This use case scenario demonstrates the use of DICOM MWL as a means of integrating information from a dental practice management system to a digital imaging system.

Use Case #6: DICOM Modality Worklist (MWL).

- A new patient arrives at a large dental institution for a dental examination. Patient demographic information is obtained and a new record is created in a dental practice management system.

- A preliminary clinical examination of the patient indicates the need for a panoramic and a complete radiographic survey of the patient's dentition.

- Using the dental practice management system the radiographic studies are ordered.

Use Case #6: DICOM Modality Worklist (MWL).

- The patient is taken to the radiology clinic. Upon arrival, the dental assistant retrieves patient demographic and the requested studies from the institution's patient management system using DICOM Modality Worklist.

- A new record is created in the DICOM digital imaging system and the intra-oral images are acquired as well as panoramic which can be stored back at the DICOM archive.

- The dentist who ordered the studies retrieves images from the DICOM archive for display and interpretation.

That is why dentistry needs Interoperabilty NOW…

DICOM Connecting Dentists

EDUCATION

American Dental Association Demonstration Projects

Interoperabilty NOW…

DICOM Connecting Dentists

Celebrating the Community of Dentistry

San Francisco (2003)

ADA Pavilion Booth #1309

Name _____

Badge Number _____

DICOM
Connecting Dentists

Daily Prize Drawing for Tungston 2 Palm Pilot

ADA DICOM Working Group 12.1 is holding a daily drawing for a Tungston 2 during the three day Technical Exhibit.

If you wish to become eligible to enter the drawing, you must visit each of the booths of the DICOM demonstration's sponsoring vendors, listed below.

When all vendors have stamped your card, bring it back to the DICOM demonstration booth #1309 and deposit in the bowl.

1234	Air Techniques
5678	Dentrix Dentsply
1234	Gendex
5678	Dexis
1234	Eagle Soft
5678	Instrumentarium

1234	Medicor
5678	Orex
1234	Planeca
5678	Practice Works
1234	Schick
5678	Sirona

Interoperability NOW .....

DICOM Connecting Dentists.

Adstra
Dentrix
Dexis
GE/Instrumentarium
Gendex
Kodak Dental
Patterson/EagleSoft
Planmeca
Schick
Sirona
Soredex

ADA 04
Orlando

DICOM

ADA.

Interoperability NOW .....

DICOM Connecting Dentists.

DICOM

Digital Imaging and Communication in Medicine.

For ADA Philadelphia (Oct 2005)

- Initial validation with modified AGFA DICOM Test Tool set up on NEMA/WG22 FTP site
- Images uploaded by participating vendors to NEMA FTP site
- DICOMDIR created (SCDI WG 12.1)
- David Clunie Final validation – no DICOM errors permitted

ADA05 Philadelphia
FORGING OUR FUTURE

Activity Sponsored by:

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DICOM℠
Digital Imaging and Communications in Medicine
ADA

Acknowledgment:

Dr. David Clunie freely donates his time and talents to test and validate DICOM images provided by the participating vendors.

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