



Utrecht University

Faculty of Science

Department of Information and Computing Science

Master of Business Informatics

Seminar Medical Informatics

Telemedicine and Medical Images

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Agenda for today

ISO 13606 Standard Exercise

Telemedicine

- What is Telemedicine?
- Benefits
- Transmission modes
- Fields of application

Discussion about: Healthcare's Future is All Around Us

Medical Images

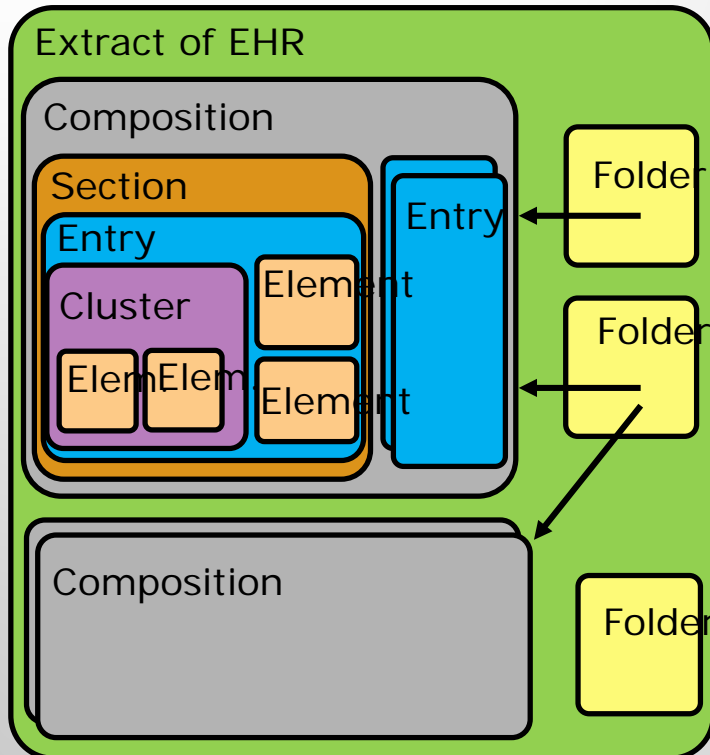
- What is Medical Imaging Informatics? What are PACS?
- Transitioning to PACS
- PACS Key Components
- PACS Workstations
- PACS Advantages and disadvantages

Assignment for next March 11th: Telemedicine solutions Workshop



ISO 13606 Standard: Archetypes Model

Exercise: Design an archetype of “Blood analysis report” including this information:



Blood analysis report

Laboratory measurement

- Red blood Cell Count (RBC) ($10^6/\text{mm}^3$)
- White blood Cell Count (WBC) ($10^9/\text{L}$)
- WBC Differential:
 - Neutrophils ($10^9/\text{L}$)
 - Lymphocytes ($10^9/\text{L}$)
 - Monocytes ($10^9/\text{L}$)
 - Eosinophiles ($10^9/\text{L}$)
 - Basophiles ($10^9/\text{L}$)

Blood pressure

- Blood pressure measurement (2 values systolic and diastolic)
- Mean arterial measure
- Position (Lying, reclining, sitting, standing)
- Patient status (Relaxed, after exercise, before exercise)
- Place of measure (Arm, leg, finger, intra-arterial)

Comments

What is Telemedicine?

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers" (WHO)





Benefits of telemedicine:

Provide timely and high quality medical care remotely

- **Costs reduction**
- **Remote delivery of medical care**
- **Better use of time**
- **Improved collaboration among physicians**
- **Improves patient satisfaction:**
 - Better access to specialty care
 - Less time lost
 - Fewer long distant trips

Telemedicine transmission modes

Asynchronous: Store and forward

Images and videos are saved and sent later

Synchronous: Real-time or live

Videoconferencing

Remote monitoring

Monitor patients for personal health information or disease management

Telemedicine fields of application

- Teleconsultation
- Telemonitoring
- Tele-expertise
- Tele-assistance



Teleconsultation

Enables a patient to consult a physician located elsewhere.

Involved persons:

- Patient
- Requesting physician or nurse (op.)
- Requested physician

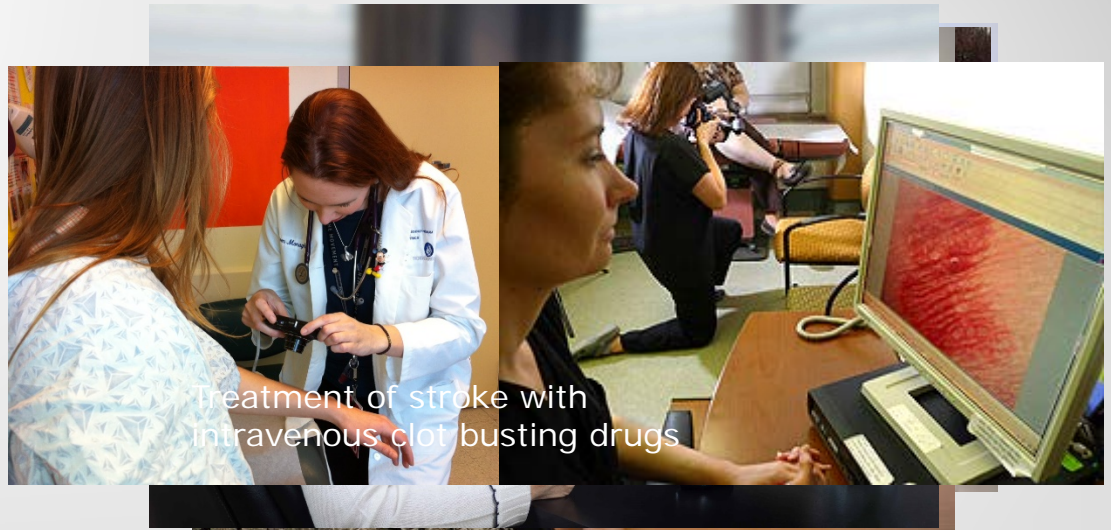
The use of a handheld camera or to perform a clinical examination may be required

Access to patient medical records is required



Teleconsultation: some examples

- Teleradiology
- Teleneurology
- Telepharmacy
- Telemental Health
- Teledermatology



Telemonitoring

Consists of the regular and automated transmission of clinical, radiological or biological data of patient.

Collected by patients or health professionals.

May lead to a treatment decision.

Data capture and transmission performed by:

- Implantable medical device
- External medical device
- External non-medical device

Data collected:

- Continuously
- At pre-programmed times of day
- During particular events

Data analyzed:

- Continuously
- Following an alert



Telemonitoring: some examples

- Pacemakers with telemonitoring functions
- Telemonitoring of at-risk pregnancies
- Telemonitoring of chronic conditions



Tele-expertise

Is a diagnostic or therapeutic activity based on a remote discussion between two or more physicians

Patient is not present: Asynchronous activity

Decisions are based on clinical and other data present in the patient's medical records

Generates a report signed by all practitioners involved



Tele-assistance

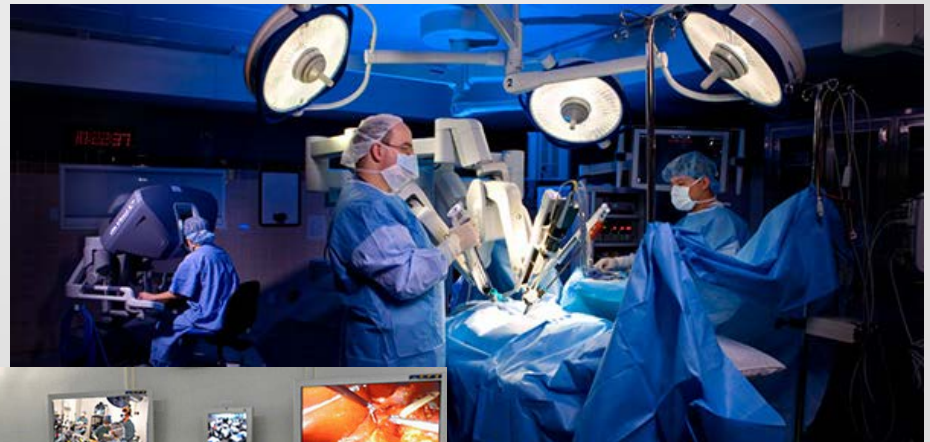
A healthcare professional helps another healthcare professional to perform a diagnostic or therapeutic act on a patient

Patient is present: Synchronous activity

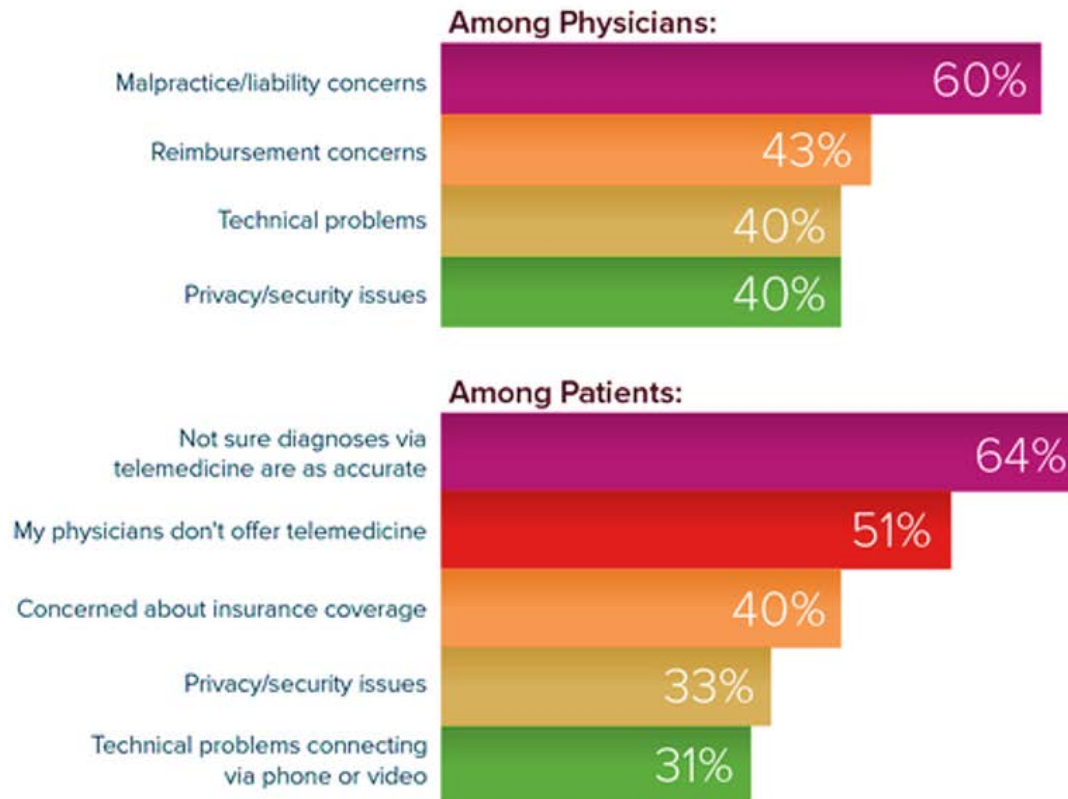
Remote imaging is needed.

All usual regulatory obligations still apply to tele-assistance

Example: Telesurgery



Barriers to Telemedicine



*Source: Medscape



Telemedicine: Key points and conclusions

- Almost all specialties now have telemedicine initiatives
- Virtual ICUs and chronic disease monitoring have gained in popularity
- To offer/get the proper diagnosis, the access to telemedicine, and the lack of reimbursement are the main barriers.



Give your opinion about Telemedicine

Healthcare's Future is All Around Us | Matt Levi | TEDxTacoma

1. About Ken's story... What do you think about the procedure carried on by the doctors? What are the benefits and disadvantages of this procedure?
2. About urgent care telemedicine service... Why people didn't use it during the first three months? What actions do you think they took to make it work?
3. Regarding the last health care service you received... If you could have received the health care service at home, would you prefer it? What kind of telemedicine would it be necessary?

What is Medical Imaging Informatics?

"It is the study and application of processes of information and communications technology for the acquisition, manipulation, analysis and distribution of medical image data"

What is Picture Archiving and Communication Systems (PACS)?

"It is a medical imaging technology which provides economical storage of, and convenient access to images from multiple modalities"

How these terms interrelate?



Society for Imaging Informatics in Medicine



Medical Imaging Informatics

- Could belong to Biomedical informatics or Radiology
- It studies every facet of imaging to improve patient's care:
 - Acquisition
 - Storage
 - Interpretation
 - Sharing
- How **imaging data moves throughout the medical enterprise** and **how it interacts** with electronic health records, computer-aided diagnosis software and health organizations.
- Important to have knowledge of workflow, networks, security, data quality, hardware and software, but also radiology and some medical basis

Medical Imaging Informatics

Transitioning to PACS



- No need for film processing
- Could be seen also in a remote location
- No developing costs of money and time
- Storage was simplified
- Facilitates image retrieval

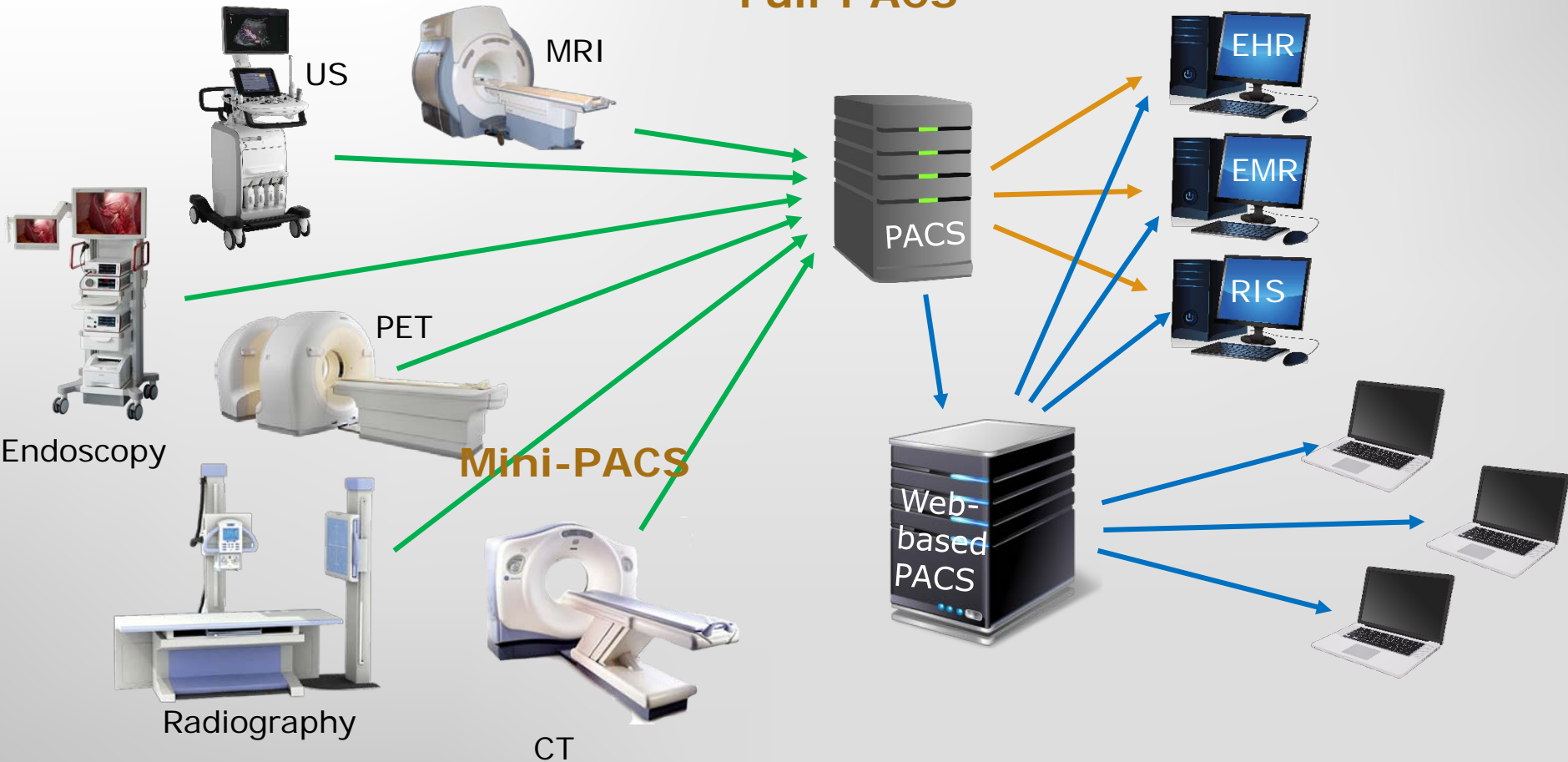


- Extensive initial costs
- Physicians still wanted images in films
- First, radiography images were scanned
- Later, radiology rooms needed to be upgraded
- More comprehensive and fast network is needed
- Need of computer-based archiving → PACS
- Proprietary imaging formats → DICOM standard

PACS

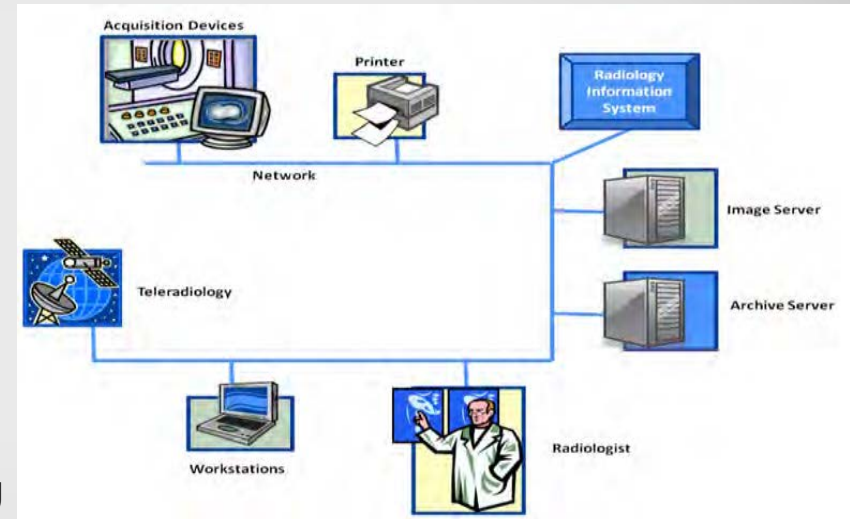
Full-PACS

Mini-PACS

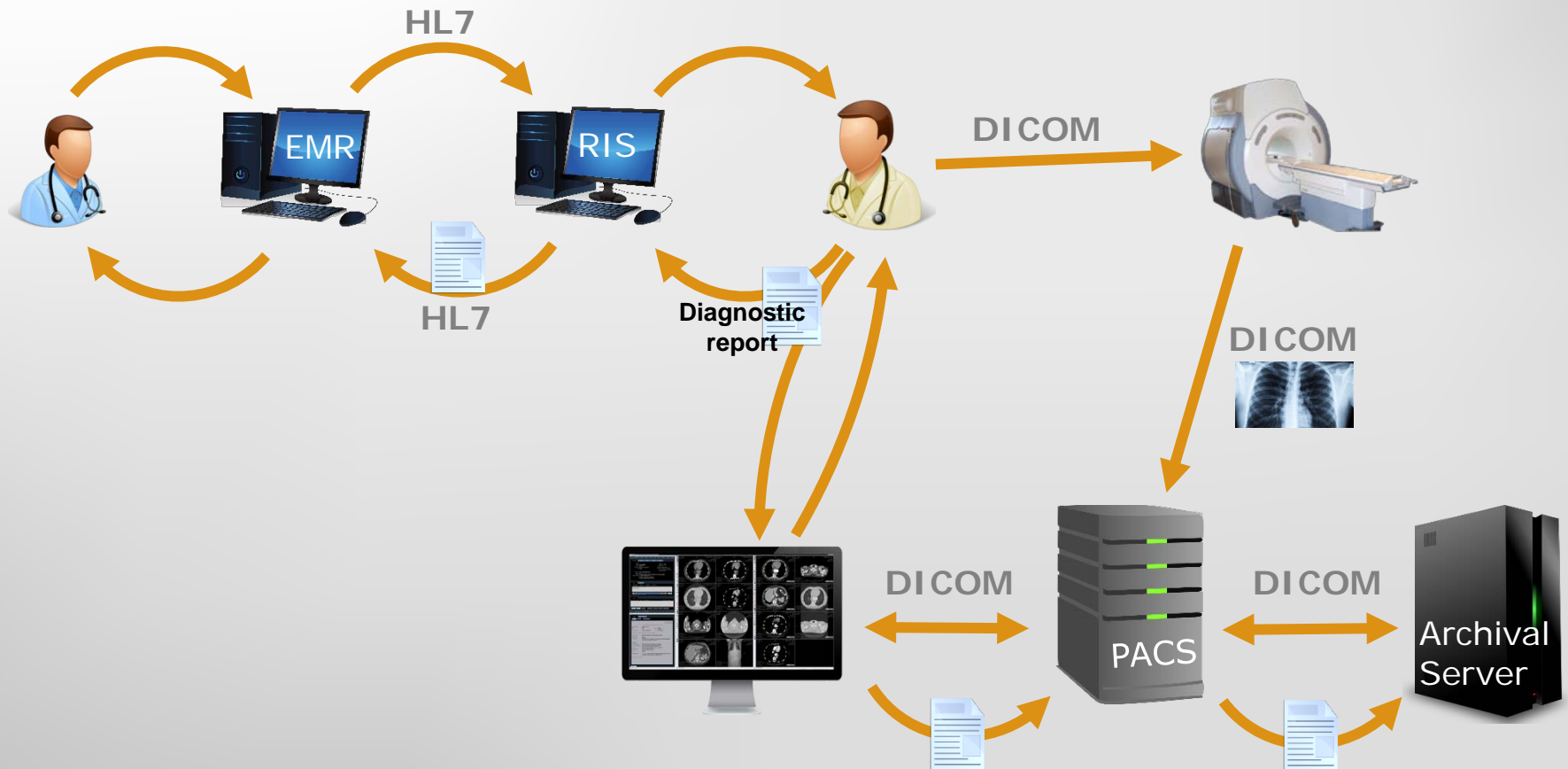


PACS Key components

- **Digital acquisition devices:** Image sources (CT, MRI, Ultrasound scanners)
- **The Network:** Ties the components together
- **Database server:** High speed and robust central computer to process information
- **Archival server:** Server responsible for storing images and backups
- **Radiology Information System:** System that maintains patients information, scheduling, billing and interpretations
- **Workstation or soft copy display:** Contains software and hardware to access the PACS
- **Teleradiology:** The ability to remotely view images



Typical PACS Workflow



PACS Workstations

- Zoom-in feature for close-up detail
- Ability to rotate images in any direction
- Text button to see the report
- Mark-up tool: Adds text, measures the size and ratios of objects
- Measures angles
- Measures the square area of a mass or region
- Adds an arrow
- Right click on the image and short cut tools appear
- Compare images
- Export an image to: Teaching file, CD-ROM, hard drive, USB drive, save to clipboard
- Create a video





PACS Advantages and disadvantages

- Replaces a standard x-ray film archive
- Allows for remote viewing and reporting
- Incorporation of medical images into an EHR
- Images can be archived and transported on portable media
- Integrate images from other specialties
- Can be web-based and use "service oriented architecture"
- Zoom feature and huge manipulation possibilities
- View the same image from different locations
- Rapid retrieval of digital images for interpretation and comparison with previous studies
- Fewer "lost films"
- Digital reports jointly with the digital image
- View an image back and forth like a movie "stack mode"
- Quicker reporting back to the requesting clinician
- Digital imaging allows for computer aided detection (CAD)
- Increased productivity

- Cost: Open source and "rental PACS" are alternatives
- Expense and complexity to integrate with hospital and radiology information systems and EHRs
- Lack of interoperability with other PACSs
- Bandwidth limits may require network upgrades
- Different vendors may use different DICOM tags to label films
- Workstations may require upgrades if high resolution monitors are necessary

Assignment for next March 11th: Telemedicine solutions Workshop

Assigned students:

- Marit Bentvelzen
- Jasper van den Berg
- Stamatis Kantiloros
- Alquin Nooteboom
- Boyd van Lavieren

Each assigned student:

1. **Select a paper** of aprox. 8 pages about a Telemedicine solution and send it to y.burriel@uu.nl **before Wednesday at 13.00**. During the afternoon all selected papers will be published on course's website.
2. **Prepare a presentation** of **7/8 minutes** about the paper and include some questions (at least 2) at the end of the presentation to challenge the audience and activate the discussion.
3. Join with the other assigned students and **prepare 1 or 2 group activities** to make during the last 30 minutes of the session. These activities should be related to the solutions presented.



Assignment for next March 11th: Telemedicine solutions Workshop

Each no-assigned student:

- 1. Read all the selected papers and prepare some questions or comments** (at least 2) per paper to discuss them after the presentation. Try to be critical and/or creative.
- 2. Send the questions/comments using this form before Monday**
<https://goo.gl/forms/K69vIahNqXzFe1ZG3>

See you next week!

