LOW COST EDUCATIONAL PACS

A “DO IT YOURSELF GUIDE TO CREATING A LOW COST, WEB-BASED PACS FOR RADIOLOGY EDUCATION, RESEARCH OR QUALITY ASSURANCE”

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DISCLOSURES:

• The authors have no relevant disclosures
PROBLEM

• Traditional radiology teaching requires one-on-one time between a learner and an attending with a dynamic viewing system (e.g. PACS).

• Textbooks and most online resources offer only a single snapshot or select few images for each case; this is far removed from the way a case is actually read.

• For those times when a mentor is not available, an improved learning environment would incorporate a dynamic viewing system to help simulate the clinical environment, coupled with an evaluation and feedback system.
APPROACH

• In order to allow for enhanced asynchronous teaching, we need a dynamic viewing environment (PACS) coupled with a didactic and evaluation tool.

• By asynchronous teaching, we mean the teacher and learner are still interacting, but not necessarily at the same time; the teacher may craft lessons and feedback, and the learner may review the lessons and feedback, but these events are not simultaneous.

• Most PACS storage and viewing environments are expensive, and are contained within the clinical silo. In order to bypass this limitation, we searched for low cost/free systems.
A METAPHOR: THE FILM FESTIVAL

Our requirements are very similar to those encountered when displaying films for critics at events such as Sundance. We need...

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... and then, it’s time for the show!
THE THEATER
(COMPUTER AND OPERATING SYSTEM)

• Our Hardware: Intel core i7 15.5Gb memory, 1Tb hard drive
  • (We repurposed an unused workstation, but a lower end machine would work too)

• Our operating system: CentOS Linux 6.8
  • (Any other Linux should also work)
  • Linux Advantages: Ability to run on older hardware, low cost (free!), wide range of free software available. Generally more stable than Windows platforms.
  • Linux Disadvantages: Less familiar to many audiences than Mac or Windows.

• Don’t forget your “theater staff” – you need someone able to set up and maintain your computer.
  • If you have basic Unix expertise or are willing to learn, this can be you. Alternatively, IT staff can be a great resource.
ROADS AND GATES
(NETWORK AND FIREWALL)

• It’s important for your guests to have access... but don’t let in the hackers!
• Decision point: Computer within the hospital firewall, or outside?
  • If inside, will be better protected from threats, but invisible from outside
  • If outside, will be exposed but have more universal access
• Keep your computer’s network configuration and software updated!
• Tip: A non-standard internet port reduces the likelihood of targeted attacks
  • (A “secret knock” lets in the audience.)
THE PROJECTOR
(THE PACS SERVER AND DICOM VIEWER)

• In order to view a study, two components are needed: The film archive (the PACS server), and a projector (the DICOM viewer).
• We need something low-cost or free, and accessible via standard web browser
• It’s important that it’s either already known to your users, or easy to learn
• We chose the Orthanc PACS server and Orthanc DICOM viewer ...
THE FILMS
(THE DICOM FILES)

• And of course, your film festival needs something to show!

• We chose teaching cases from our patient files, and anonymized them.

• You could also consider using cases that are freely available online, such as from the visible human project or other sources
THE SCORE CARDS
THE QUIZ SYSTEM

• To incorporate questions and feedback, you need a way to quiz and to collect answers.
• You could choose to host it yourself, or to use an online quiz/survey company.
• We chose to use the Qualtrics product, as we had an institutional license.
  • Other online survey companies such as SurveyMonkey could be used as well, many of which are free to use.
• Free quiz software also exists for Linux, and could co-exist with your other software.
TIME FOR THE SHOW!

Example case: subcortical infarct identification on T2 WI:
• Link to the T2 image stack is embedded in the quiz

Yale Qualtrics Survey Tool

Where is the stroke?

http://172.21.211.66:5555/web-viewer/app/viewer.html?series=25d722b6-8e4be5ad-f8d74a57-70268e71-d2c01474

- Left Insula
- Right Parietal Lobe
- Right Occipital Lobe
- Cerebellum
ARCHITECTURAL SUMMARY (OUR EXAMPLE)

- Hospital Firewall
- Linux Firewall
- ORTHANC PACS
- ORTHANC VIEWER
- QUALTRICS
- ANONYMIZED CASES

Computer with Linux (CentOS)

LEARNER’S COMPUTER
THANKS

• Thank you to:
  • The Yale Radiology and Biomedical Imaging Staff
  • Our Patients
  • The CentOS developers (and all Linux developers!)
  • The Orthanc and Orthanc web viewer developers
  • The gdcn developers (DICOM anonymization software)