Workshop: “Defining the Medical Imaging Requirements for a Health Center”

“Teleradiology and Networking”

April 17’ 2011
E-health and Telemedicine

“eHealth is the use, in the health sector, of digital data - transmitted, stored and retrieved electronically- in support of health care, both at the local site and at a distance.”

Through these applications, it is possible to take specialized care to primary health-care centres in remote areas and thereby broaden and improve the quality of the services they offer.

Primary health care is thus the main target of the eHCD programme

WHO, eHealth for Health-care Delivery.
STRATEGY 2004-2007
eHealth IS AN IMPORTANT OPTION FOR DEVELOPING COUNTRIES

The question is thus not whether eHealth should be a possibility for developing countries: It already is.

The main challenge is ensure that these options are used optimally and in a coordinated manner to achieve the desired effects and avoid resources being diverted from meeting basic needs.
By the time:

- **Store and forward (Asynchronous):**
  Involves the exchange of pre-recorded data between two or more individuals at different times.

- **Real Time (Synchronous):**
  Requires the involved individuals to be simultaneously present for immediate exchange of information, as in the case of videoconferencing.
Challenges in Telemedicine

- Implementing Telemedicine without proper planning, coordination and evaluation may affect the Health System in different ways.

- Given this case, it is important to not only praise the benefits of Telemedicine but also consider certain potential problems in order to avoid them.
Challenges in Telemedicine

- The following should be considered:
  - Security and confidentiality.
  - Reduced diagnostic precision of certain images.
  - The responsibility for diagnostics and treatment.
  - Resistance to change from within the organization.
  - Acknowledge the real needs of a population.
- Teleradiology is not appropriate if the available system does not provide images of sufficient quality to perform the indicated task.
- When is used to render the official interpretation, there should not be a clinically significant loss of data from image acquisition through transmission to final image display.
- For transmission of images for display use only, the image quality should be sufficient to satisfy the needs of the clinical circumstance.
The expert center model in teleradiology. The three modes of operation are telediagnosis, teleconsultation, and telemanagement.
Acquisition of Images

- Today, virtually all radiology equipments are fully DICOM compliant.
- Images can be stored on a network or a workstation in the DICOM format.
- Lossy and lossless compressions are possible, with varying degrees of loss of information, which may be acceptable depending on the modality and the clinical situation.
- Plain radiographs obtained nondigitally may need to be scanned.
Digital imaging

- a) Digital cameras with diagnostic quality
- b) Digital Scanner
- c) Laser Scanner
- d) Computed Radiology
Transfer of Images:

- In the early days, transfer of images was performed over telephone lines using modems, sometimes with speeds as low as 2,400 bps. Today, high-speed lines are available, allowing different centers to connect directly or over the Internet, for transmission of images. Images may be directly transferred or streamed, depending on the software being used.
<table>
<thead>
<tr>
<th>Image Type</th>
<th>Dimensions</th>
<th>Images/Exam Range</th>
<th>Exam Storage Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear medicine (NM)</td>
<td>$128 \times 128 \times 12$</td>
<td>30–60</td>
<td>1–2 MB</td>
</tr>
<tr>
<td>Magnetic resonance imaging (MRI)</td>
<td>$256 \times 256 \times 12$</td>
<td>60–3000</td>
<td>8 MB up</td>
</tr>
<tr>
<td>Ultrasound (US)*</td>
<td>$512 \times 512 \times 8$ (24)</td>
<td>20–240</td>
<td>5–60 MB</td>
</tr>
<tr>
<td>Digital subtraction angiography (DS)</td>
<td>$512 \times 512 \times 8$</td>
<td>10–40</td>
<td>4–10 MB</td>
</tr>
<tr>
<td>Digital microscopy</td>
<td>$512 \times 512 \times 8$</td>
<td>1</td>
<td>0.25 MB</td>
</tr>
<tr>
<td>Digital color microscopy</td>
<td>$512 \times 512 \times 24$</td>
<td>1</td>
<td>0.75 MB</td>
</tr>
<tr>
<td>Color light images</td>
<td>$512 \times 512 \times 24$</td>
<td>10–30</td>
<td>1.5–15 MB</td>
</tr>
<tr>
<td>Computed tomography (CT)</td>
<td>$512 \times 512 \times 12$</td>
<td>40–3000</td>
<td>20 MB up</td>
</tr>
<tr>
<td>Computed/digital radiography (CR/DR)</td>
<td>$2048 \times 2048 \times 12$</td>
<td>4</td>
<td>16 MB</td>
</tr>
<tr>
<td>Digitized X-rays</td>
<td>$2048 \times 2048 \times 12$</td>
<td>5</td>
<td>16 MB</td>
</tr>
<tr>
<td>Digital mammography</td>
<td>$4000 \times 5000 \times 12$</td>
<td>9</td>
<td>160 MB</td>
</tr>
</tbody>
</table>

* Doppler US with 24-bit color images.

[Huang, 2004]
<table>
<thead>
<tr>
<th></th>
<th>One X-Ray Exam 2K × 2.5K × 2 byte (10MB)</th>
<th>One CT Study (40MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One image</td>
<td>Two images</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One study</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One current + One historical</td>
</tr>
<tr>
<td><strong>T1</strong> (1.5 mbits/s)</td>
<td>100 s (1.6 min)</td>
<td>400 s (6.7 min)</td>
</tr>
<tr>
<td>realization 100 KB/s</td>
<td>(1.6 min)</td>
<td></td>
</tr>
<tr>
<td><strong>ATM</strong> (155 mbits/s)</td>
<td>1.3 s</td>
<td>5.3 s</td>
</tr>
<tr>
<td>realization 60 mbits/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7 s</td>
<td>10.7 s</td>
</tr>
<tr>
<td></td>
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Viewing of Images:

- Image viewing requires a workstation that can display high-resolution images. Many software programs are currently available, which allow viewing, manipulation, measurements, three-dimensional reconstructions, etc.

- The viewing software should allow reporting and storage, and transmission of the reports as well.
A basic teleradiology system consists:

1. An image-sending station
2. A transmission network
3. A receiving/image review station
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Asynchronous / Interactive</td>
</tr>
<tr>
<td>Information</td>
<td>Radiography Images and texts</td>
</tr>
<tr>
<td>Service</td>
<td>Medical diagnosis</td>
</tr>
<tr>
<td>Quality</td>
<td>High resolution (typical 2.048 x 2.048 x 12 bits)</td>
</tr>
</tbody>
</table>
| Capture and shipment station| Electrical power generation unit  
Digital radiographic image capture equipment  
Server (PC) to manage image traffic  
Communications network connection interface |
| Transmission speed          | 128 Kbs / 2.0 Mb / 155 Mbps                                                       |
| Communication Networks     | Telephone Network with basic ADLS or lines RDSI of 128 Kbs:  
asynchronous and low resolution images.  
Telephone Network with ADLS premium or lines RDSI of 384 Kbps:  
asynchronous and medium resolution images.  
2 Mbps RDSI: asynchronous and high resolution images  
ATM from 10 to 155 Mbps: interactive and high resolution images. |
| Compression / Decompression| JPEG  
Wavelet                                                                           |
| Communication Standard     | DICOM v3  
DICOM v10 Image Distribution                                                        |
| Remote Consultation Workstation| Communication network connection interface  
Digital monitor: average resolution 2,000 x 2,000 x 12 bits  
Photographic quality printer |
| Applications               | X-rays, Mastography, Ecography, Computed Axial Tomography, Nuclear Magnetic Resonance |
Tele-radiology systems must have security protocols for networks and software, to protect confidential patient data. The security and privacy of information systems is clearly sub classified in:

- Physical Security
- Access Control
- Encryption (Use VPN)
- Electronic Signatures and Authentication
In Mexico, there is currently a lack of a legal framework for Tele-Radiology development.

In this application, the most common problems are:

- Confidentiality
- Professional responsibility
- Ethical standards
- Legal issues
Ultrasound is a modern imaging technique, which delivers no radiation and does not require injection of any chemicals to enhance visualization.

Unlike other imaging modalities, ultrasound can reach locations that are inaccessible to plain X-rays, CT, and MRI.

Another unique and important difference of ultrasound is the requirement for the operator to know a considerable amount regarding ultrasound use and image acquisition, in order to perform studies.
However, many focused ultrasound applications, which may make a life and death difference or improve medical system efficiency, can be performed by personnel with limited training and experience; thus, review of the images or even video may be helpful.

It is in these scenarios that transmission of ultrasound images and video via camera phones become revolutionary.
Potential Uses

There are a multitude of potential uses for ultrasound transmission over camera phones.

Types of scenarios likely to benefit are not limited to but include remote locations, disaster scenes, battlefields, cruise ships, ground and air ambulances, and expeditions.
Challenges

- The first and foremost is having access to a network on which the camera phone can transmit data.

- Image resolution and size are important issues to consider. Unlike a hazy and pixilated image of one’s friend at a birthday party or the out-of-focus picture taken of a celebrity at a dark restaurant on a camera phone, a picture intended for medical interpretation has several requirements. The image or video must speak for itself.
Conclusion

The potential use of camera phones for ultrasound image transmissions significant and is growing on a regular basis, as more robust emergency systems are developed to respond to both natural and unnatural disasters. In addition, ultrasound remains the only medical imaging system that can be easily moved to the point of care, where the patient can be evaluated rapidly and critical decisions regarding transfer and treatment can be made.
Mexican Breast Cancer Screening Program

Teleradiology and Networking

Ing. Sandra Rocha
Centro de Enseñanza e Interpretación en Imagen de Mama

Donados por la Fundación Gonzalo Río Arronte

PACS: Picture Archiving and Communication System
RIS: Radiological Information System

Adquiridos por la Secretaría de Salud

Teleradiology and Networking
Ing. Sandra Rocha
EQUIPOS ANALÓGICOS

CR

Equipo de Radiografía Computada

Hospitales en los Estados

Solicitud Electrónica

Informe

Hospitales en Los Estados

SIST. PACS

SIST. RIS

Data Center en INCan

Archivo On-Line

Agenda

Manejo Pacientes

Web Server

SICAM

Jurisdicciones

Registro de Pacientes

Web Server

SICAM

Broker

Diagnóstico

Centro de Lectura en INCan

Estaciones de Diagnóstico

Dictado digital

INCan

Centro de Lectura en INCan

INCan

Manejo Pacientes

Informes

Brocker
Requirements established

- Maintenance program for the mammography unit
- Complies with the national standards
- Human resources (technical, social worker, administrative, telecommunications engineer)
- Internet to sent the clinical and demographic information.

• Transmission line, to send pictures or courier to ship disks.
Different people were trained in this program:
- Appropriate radiological techniques for the acquisition of the studies.
- Appropriate use of the CR
- Administrative and social workers to obtain medical and family history.
- Physicians in the use of RIS and PACS systems.
- Administrative in remote unit to obtain the interpretation result.
Delays

1. Change of directors or central authorities
2. Lack of information from the Ministry of Health to the remote station
3. Lack of resources, No internet, No (VPN)
4. Lack of knowledge (authorities unaware of the condition of equipment which have not preventive maintenance, corrective and only the poor condition of these.
5. Lack of quality control: equipment, radiological, etc.
Modelo de Arquitectura Empresarial de TI

Objetivos
Indicadores
Metas
Proyectos

Procesos
Actividades
Procedimientos
Flujos de Trabajo
Políticas

Aplicaciones
Servicios
Datos
Formatos
Estadísticas

Infraestructura
Sitios
Activos
Servidores
The future... It’s now