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."

WHO, eHealth for Health-care Delivery.
STRATEGY 2004-2007

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- 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

Teleradiology and networking

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- **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.

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- 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.

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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.

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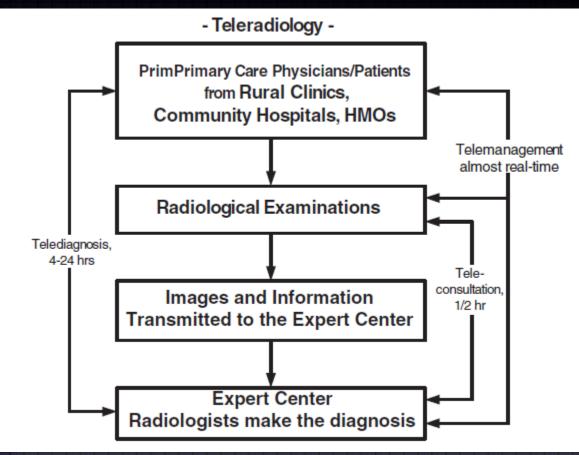
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ACR Standard

- 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.
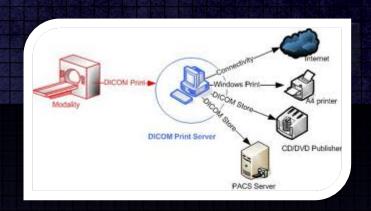
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- Teleradiology -

PrimPrimary Care Physicians/Patients
from **Rural Clinics,**
Community Hospitals, HMOs

Radiological Examinations

**Images and Information
Transmitted to the Expert Center**

**Expert Center
Radiologists make the diagnosis**

Telemanagement
almost real-time

Tele-
consultation,
1/2 hr

Telediagnosis,
4-24 hrs

The expert center model in teleradiology. The three modes of operation are telediagnosis, teleconsultation, and telemanagement.

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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

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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.

	One Image (bits)	# of Images/Exam	One Exam ination
Nuclear medicine (NM)	$128 \times 128 \times 12$	30–60	1–2 MB
Magnetic resonance imaging (MRI)	$256 \times 256 \times 12$	60–3000	8 MB up
Ultrasound (US)*	$512 \times 512 \times 8$ (24)	20–240	5–60 MB
Digital subtraction angiogrpahy (DS)	$512 \times 512 \times 8$	15–40	4–10 MB
Digital microscopy	$512 \times 512 \times 8$	1	0.25 MB
Digital color microscopy	$512 \times 512 \times 24$	1	0.75 MB
Color light images	$512 \times 512 \times 24$	4–20	3–15 MB
Computed tomography (CT)	$512 \times 512 \times 12$	40–3000	20 MB up
Computed/digital radiography (CR/DR)	$2048 \times 2048 \times 12$	2	16 MB
Digitized X-rays	$2048 \times 2048 \times 12$	2	16 MB
Digital mammography	$4000 \times 5000 \times 12$	4	160 MB

* Doppler US with 24-bit color images.

[Huang, 2004]

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TABLE 14.5   Time Required to Send a 10-MB X ray or a 40-MB CT Study in the San Francisco Bay Area with T1 and ATM (OC3) (No Compression)

	One X-Ray Exam 2K × 2.5K × 2 byte (10 MB)		One CT Study (40 MB)	
	One image	Two images	One study	One current + One historical
T1 (1.5 mbits/s) realization 100 KB/s	100 s (1.6 min)	200 s (3.9 min)	400 s (6.7 min)	800 s (13.4 min)
ATM (155 mbits/s) realization 60 mbits/s (7.5 MB/s)	1.3 s	2.7 s	5.3 s	10.7 s

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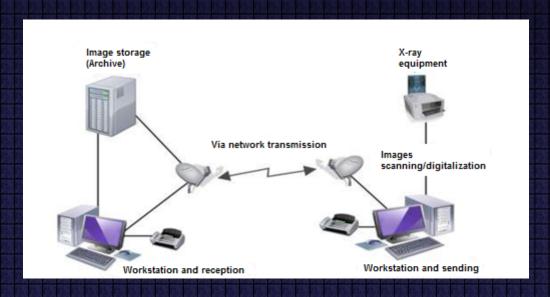
Viewing of Images:

- 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.
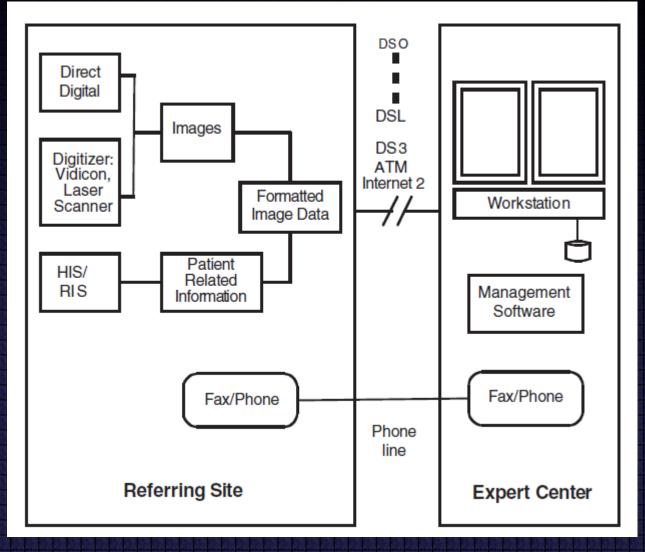
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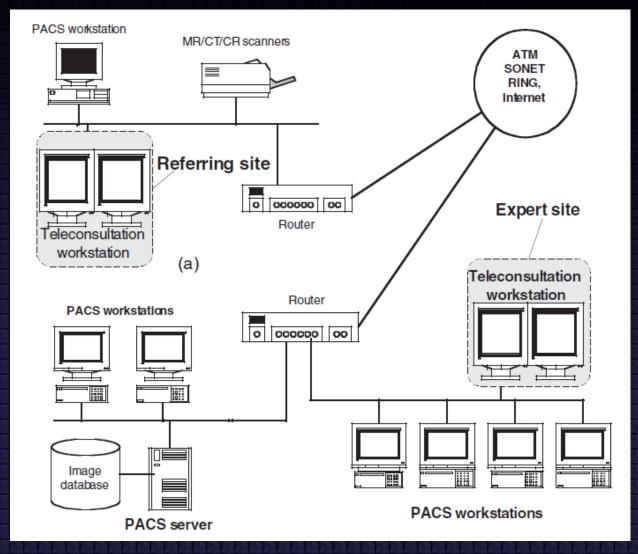April 17-20 - Porto Alegre - RS - Brazil

Basic System Components

- A basic teleradiology system consists:

  1. An image-sending station
  2. A transmission network
  3. A receiving/image review station

Parameters	Characteristics
Communication	Asynchronous / Interactive
Information	Radiography Images and texts
Service	Medical diagnosis
Quality	High resolution (typical 2.048 x 2.048 x 12 bits)
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

Information Security

- 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

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Medical – Legal Topics

- 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

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Ultrasound Image Transmission via Camera Phones

- 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.

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Ultrasound Image Transmission via Camera Phones

- 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.

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- **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.

Ultrasound Image Transmission via Camera Phones

- ## 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.

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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.
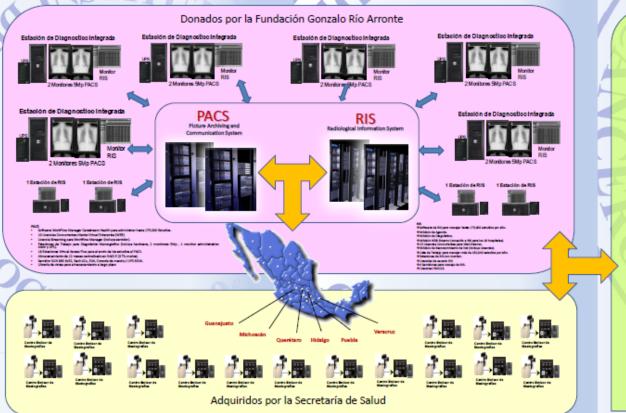
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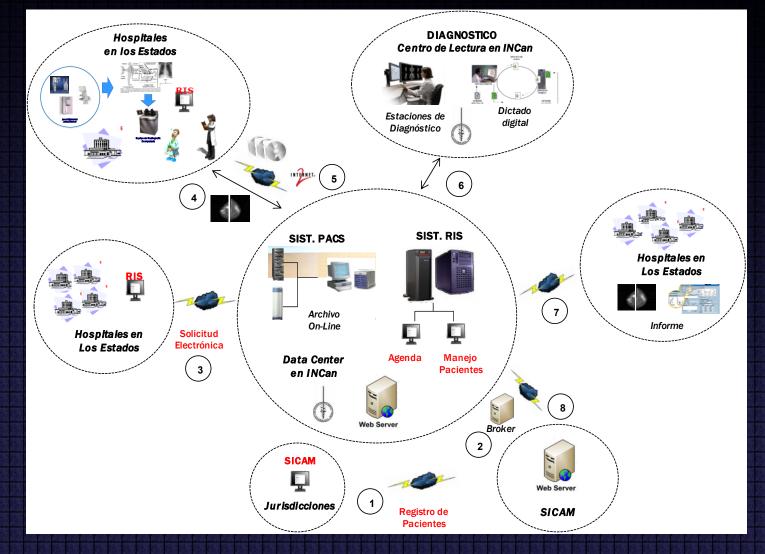
Mexican Breast Cancer Screening Program

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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.

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Training

- 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

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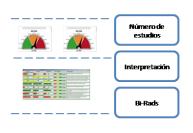April 17-20 - Porto Alegre - RS - Brazil

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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.

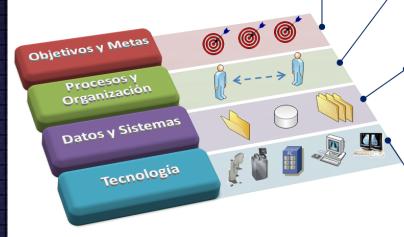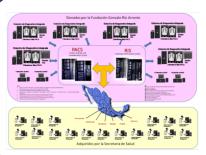- 5. Lack of quality control: equipment, radiological, etc.

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Modelo de Arquitectura Empresarial de TI

Objetivos y Metas
Procesos y Organización
Datos y Sistemas
Tecnología

The future... It's now

Image courtesy of the Society for Computer Applications in Radiology