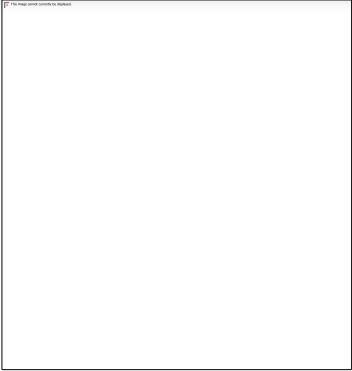


THE DICOM 2013 INTERNATIONAL CONFERENCE & SEMINAR

March 14-16

Bangalore, India



Mobile Teleradiology Using Handheld Devices – Enabling Immediate Diagnosis

Arjun Kalyanpur, MD, DABR

Chief Radiologist and CEO

Teleradiology Solutions





- 1. Background and perspective on teleradiology**
- 2. Mobile teleradiology enablers**
- 3. Value proposition/benefits**
- 4. Clinical scenarios/applications**
- 5. Security issues and limitations**
- 6. Validation studies and references**

Chang's Challenges 2001



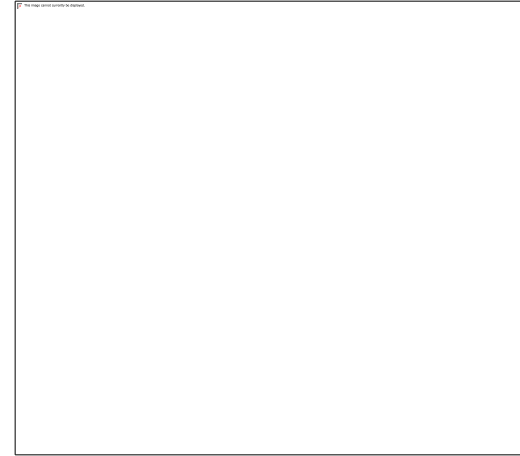
- Advances in imaging technology, although clearly desirable, inevitably result in ever-**increasing size and complexity of image data sets**.
- The healthcare enterprise is becoming more complex and **physically distributed**.
- Both referring physicians and patients have ever-**increasing expectations** with respect to service quality, timeliness, and convenience.
- Economic and **staffing constraints** will always be significant.

-Chang, RadioGraphics, 21, 1013-1014.

Challenges in Radiology 2013



- Increasing need for **emergency imaging**
 - Cancer, Heart Disease and Stroke on the rise
 - Crowded cities, more trauma
 - Standard of care demands immediate diagnosis

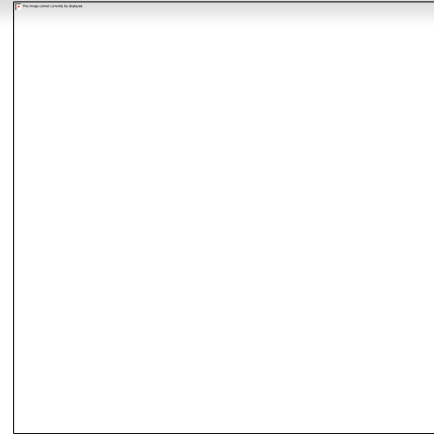


- Global **radiologist shortages** worsening

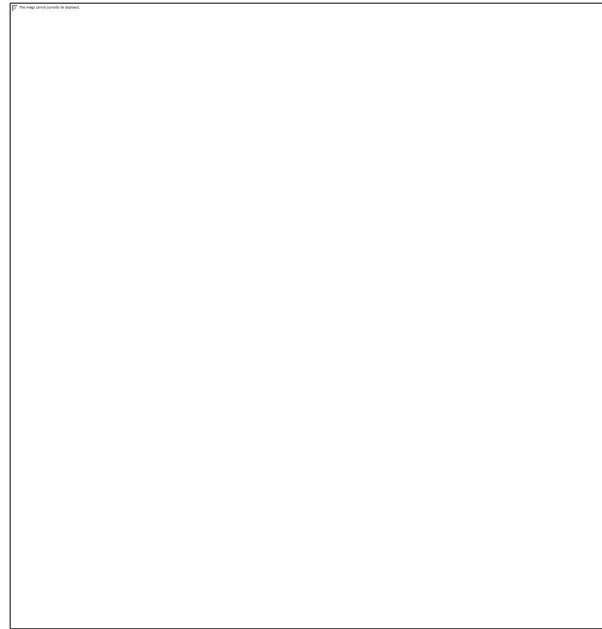
- Clinical colleagues need/expect to view images in **real time**

Behind every challenge is a corresponding opportunity

US 1:10,000
India 1:100,000
Indonesia 1:1,000,000
Zambia 1:10,000,000



The map cannot be displayed.



It's all about TAT

...Everything is 'stat'

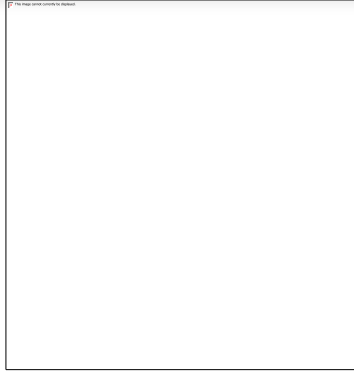
Potential solutions

- **To use technology innovation effectively**
- **To train more radiologists**
- **To work 24 x 7 x 365**
- **..... Cloning ?**

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Emergency Teleradiology



In emergency care situations

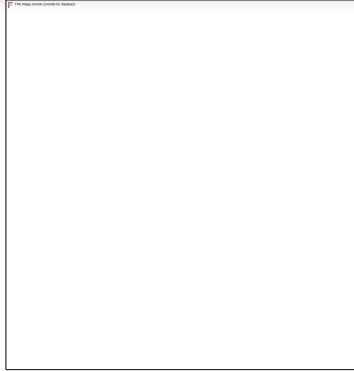
- **Web-based platform, centralized reporting**
- **Report available within 30 minutes- to anywhere in the world**
- **Makes the radiologist more efficient and productive**

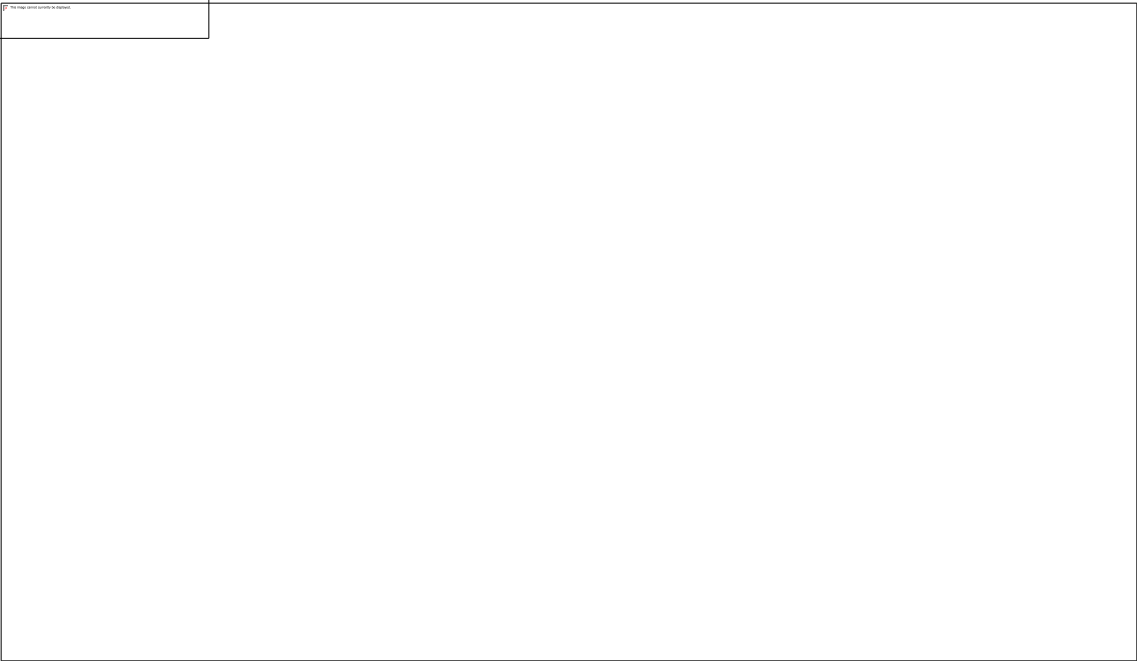
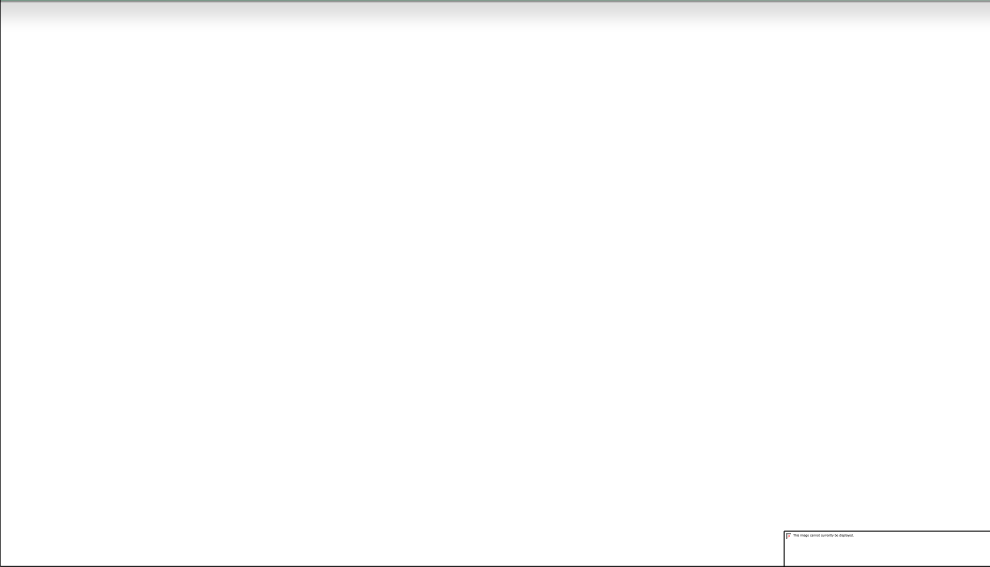
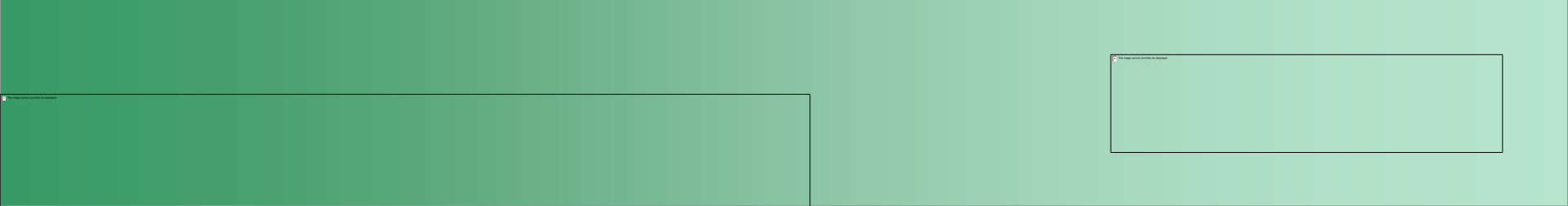


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Teleradiology Technology

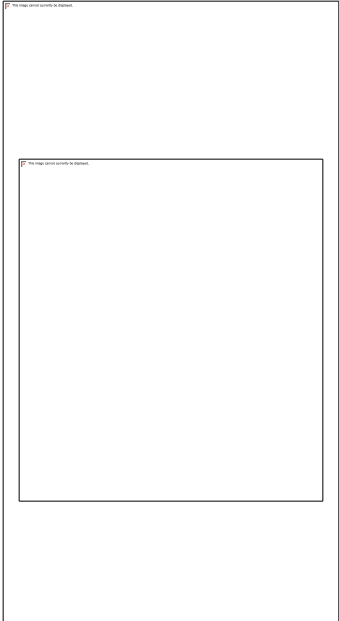


- **Workflow - process efficiency**
- **Collaboration - communication efficiency**
- **Mobility - access efficiency**

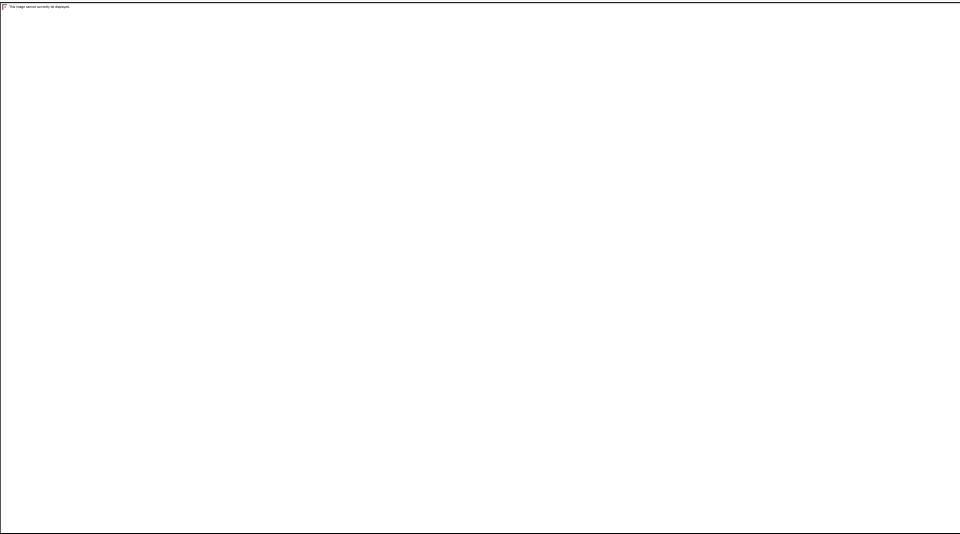
The Next Frontier: Mobile Teleradiology



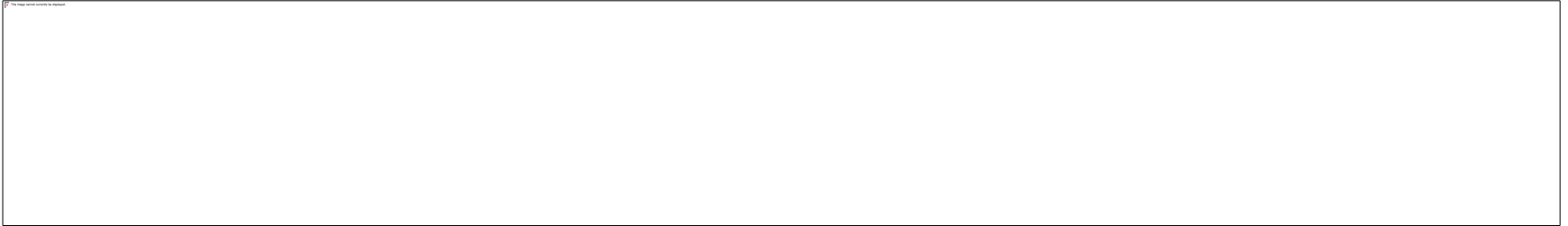
TO



Mobile Utilization Trends



Smartphone Usage by Docs



Greater than 85% of respondents used a smartphone, of which the iPhone was the most popular (56%).

The most commonly used app types were drug guides (79%), medical calculators (18%), coding and billing apps (4%). The most frequently requested app types were textbook/reference materials (average response: 55%), classification/treatment algorithms (46%) and general medical knowledge (43%).

The clinical use of smartphones and apps will likely continue to increase, and we have demonstrated an absence of high-quality and popular apps despite a strong desire among physicians and trainees.

This information should be used to guide the development of future healthcare delivery systems; expanded app functionality is almost certain but reliability and ease of use will likely remain major factors in determining the successful integration of apps into clinical practice.

Recent Enablers of mobile teleradiology

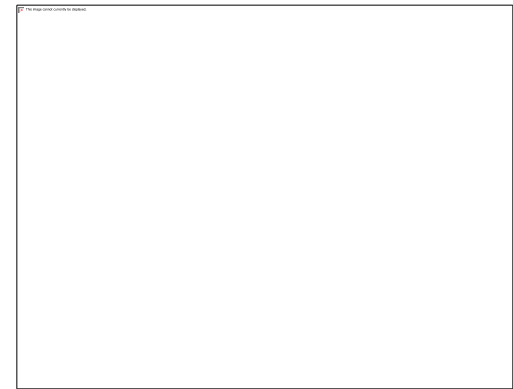


- **Mobile devices with high resolution monitors**
- **Internet cloud**
- **3G wireless connectivity**

Mobile Screen Resolution



- The iPad's 9.7-inch display provides 1024 x 768-pixel resolution at 132 pixels per inch (PPI). The larger display allows images to be displayed at their native resolution.
- The iPad has a maximum luminance of 270 cd/m², which is higher than the average of 150-200 cd/m² seen in commercially available displays

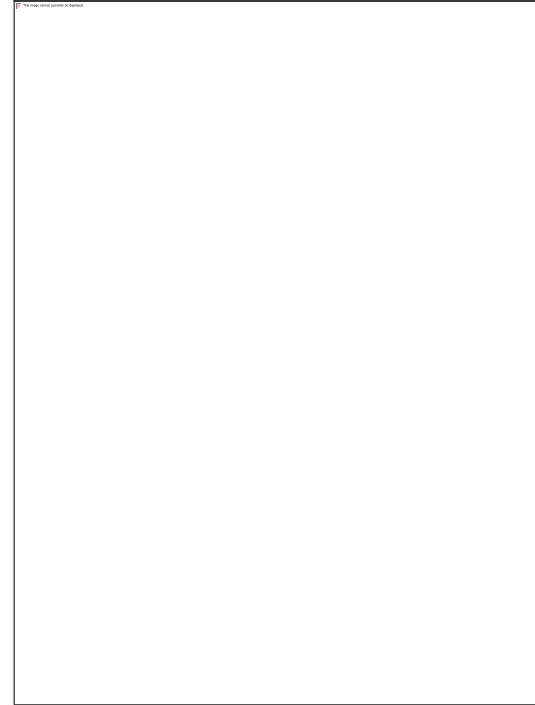
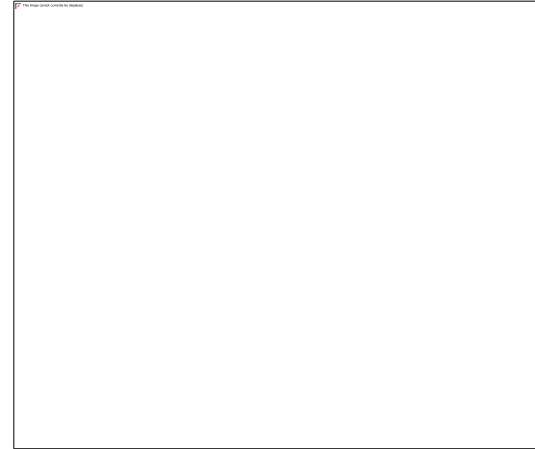


Viewer features



➤ Radiologist can zoom and adjust the window level, contrast and brightness of the image

➤ Actual DICOM data and not just JPEG snapshots.



Cloud-based Teleradiology

- **Extreme Redundancy**
- **Universal Access**
- **Cost Savings**
 - Eliminates high infrastructure setup costs
 - Pay-per-use model

3G wireless broadband

- **3rd generation mobile telecommunications**
- **Packet switching technology**
- **About 10x the speed of 2G (20 Mbps)**
- **Wireless dongle or SIM**

Advantages

- **Immediate diagnosis**
- **Highly portable**
- **Increased radiologist productivity**
- **Collaborative approach**
- **Improved clinician access to reports**

- **Early and more accurate treatment**
- **Potentially lifesaving**
- **Training potential...**

Phone versus Tablet



- **Tablet**

- **more optimal for use by a radiologist in the emergency preliminary read setting**

- **Smartphone**

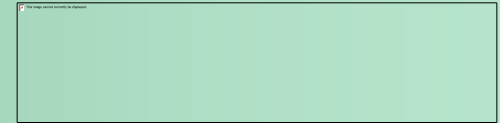
- **better utilized by a clinician**

- **For secondary review of a patient image already interpreted by a radiologist**

- **To assist in treatment planning**

- **For accessing patient reports**

SCENARIO A

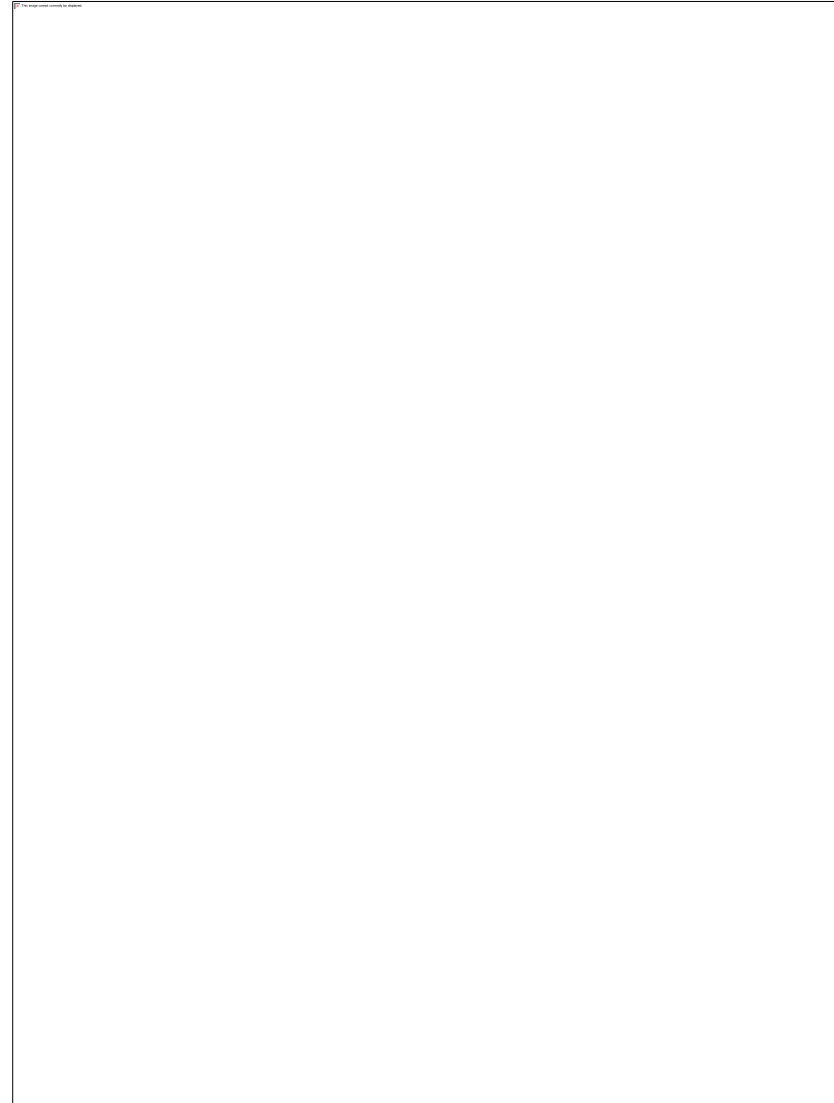


- **Patient presents with chest pain and shortness of breath**
- **Radiologist has left the hospital**
- **Technologist sends the images to the cloud**
- **Images are viewed on mobile device by radiologist**
- **Diagnosis – pulmonary embolism**
- **Radiologist calls back the physician in the hospital and confirms diagnosis**
- **Heparin treatment is administered**

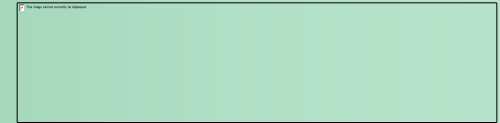
SCENARIO B



- **Patient presents with headache after a motorcycle accident**
- **Radiologist detects a subdural hematoma on CT and calls the neurosurgeon who is seeing patients in clinic**
- **Neurosurgeon views images on his mobile and determines that surgery is necessary**
- **Patient shifted to the OR for emergency surgery**



SCENARIO C



- Patient presents with acute onset left sided weakness
- Stat CT scan is performed
- Radiologist in hospital detects early stroke and calls neurologist
- Neurologist views images on smartphone and confirms indication for thrombolysis, advises in-house Medical officer
- Thrombolysis is administered



Role of iPad validated in:



- 1. CT Brain: Acute stroke, intracranial hemorrhage**
- 2. MRI Brain : Stroke**
- 3. Chest radiographs – pneumothorax, lung nodule detection, tube placement, pulmonary TB**
- 4. Chest CT – pulmonary embolism**

Other benefits



Kerbside consults, clinical rounds

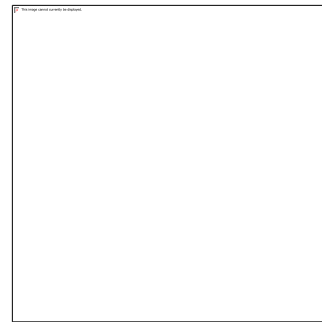
Voice recognition integration



Are tablets secure?



- ✓ Tablet applications for Radiology need to ensure they use the **SSL protocol or VPN** for transferring the medical images and the access to these images is **login controlled**.
- ✓ The images are **not actually stored** on the Tablet but are always accessed from the server through the login based interface. Login timeout restricts the amount of time that the images are physically displayed on the device's monitor.
- ✓ Ultimately it is the responsibility of the radiologist or physician to ensure the **physical security** of his/her portable device



Limitations



➤ **Given the small screen size it is difficult to view two series simultaneously or compare the current study with the prior.**

➤ **It is somewhat difficult to measure very small lesions, esp those under 5 mm in size. As a result, the size of a ureteric calculus can be overestimated**

-Source: Internal survey of TRS radiologists

FDA Approved Apps



➤ MIM software

- Mobile MIM
- Feb 2011 (CT, MRI), Dec 2011 (US, CR)
- can be “sub-optimal” for viewing detailed images

➤ Aycan Medical Systems

- Aycan viewer
- September 2012
- should only be used for primary diagnosis when a full workstation is not available

Source: <http://mobihealthnews.com>

An ever-increasing Number of Apps?



- Depending on the intended use, the FDA may treat each type of device as a unique product, requiring its own review and clearance.
- Android is an open-source operating system that runs on dozens if not hundreds of different products from multiple manufacturers, each with differing display characteristics—and there are multiple versions of Android, too.
- It would be prohibitively expensive to seek FDA approval on all the popular Android devices

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Mobile teleradiology: Taking healthcare delivery to the next level

February 24, 2011

December 2010

As seen in the Western world over the past two decades, teleradiology has revolutionised emergency radiologic diagnosis minimising the waiting time for outpatient radiologic reports. It is now also making significant impact on raising the quality of diagnosis in remote areas. The convergence of these two trends is bringing up another paradigm shift in the form of mobile teleradiology.



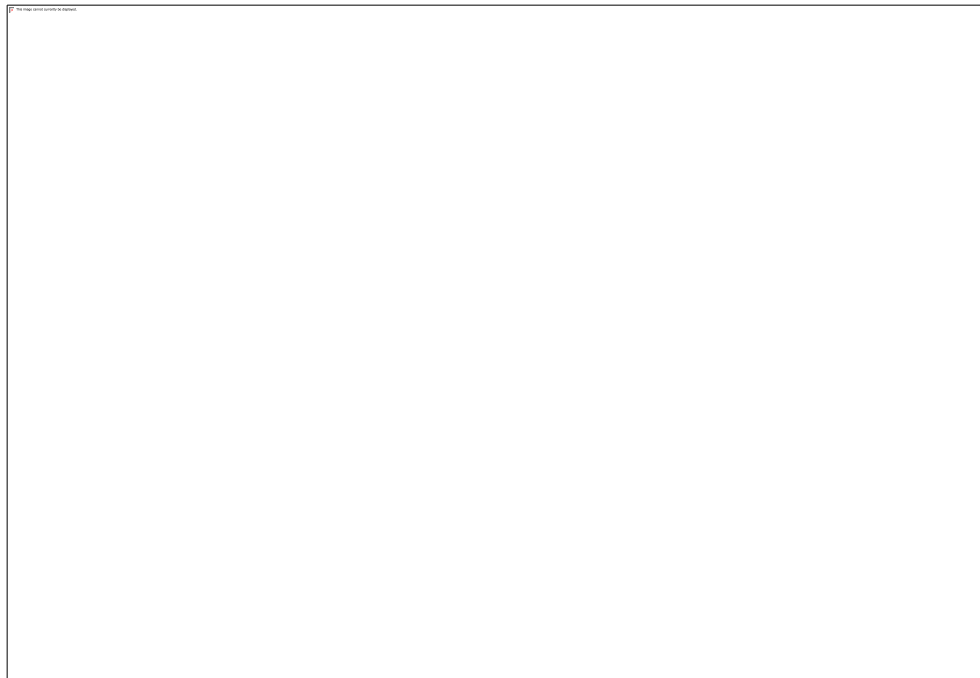
Imagine a patient at a hospital in a tier 2 city being brought into the casualty with a head injury caused by an accident. The Computed Tomography (CT) scan is obtained immediately and reported by the radiologist. At the same time, the images are flashed onto the mobile device of the neurosurgeon who is examining a patient at his clinic in another part of the city. The neurosurgeon sees on the scan that the



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<http://modernmedicare.co.in/1092/taking-healthcare-delivery-to-the-next-level.html>



MEDIA FOCUS

<http://mobihealthnews.com/10894/study-app-as-accurate-as-imaging-workstation-for-stroke-diagnoses/>

Research

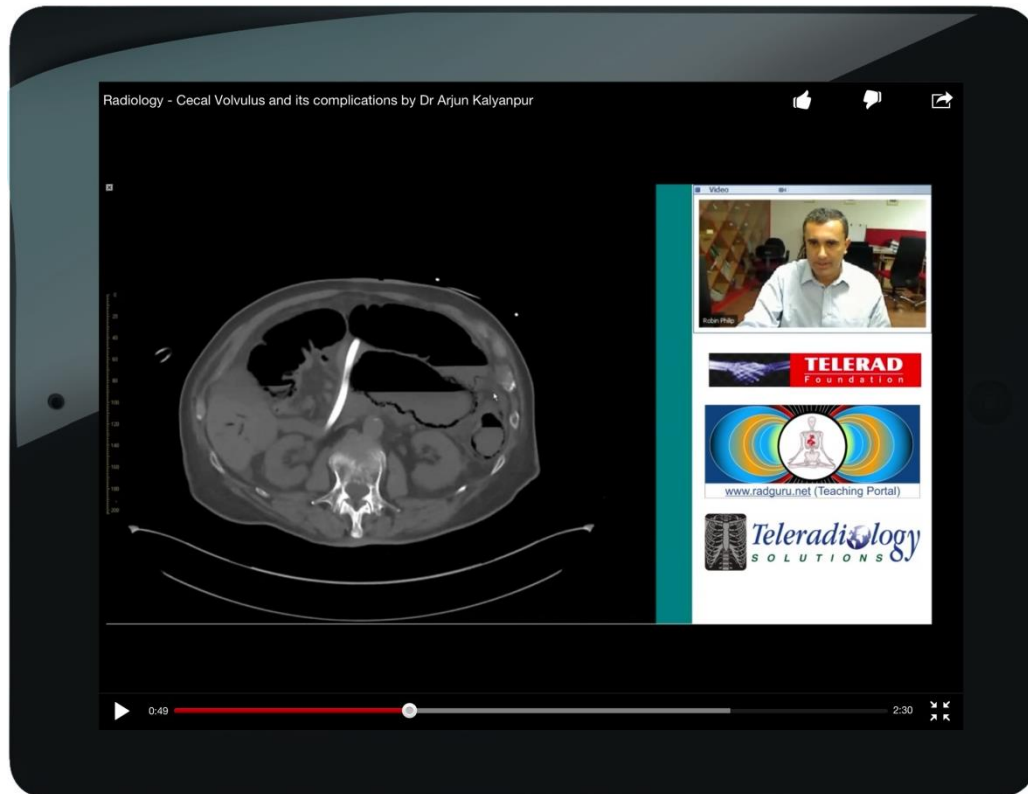


- Toomey RJ, Ryan JT, McEntee MF, Evanoff MG, Chakraborty DP, McNulty JP, et al. Diagnostic efficacy of handheld devices for emergency radiologic consultation. AJR February 2010;194(2): 469-74.
- Mitchell JR, Sharma P, Modi J, Simpson M, Thomas M, Hill M, Goyal M. A Smartphone Client-Server Teleradiology System for Primary Diagnosis of Acute Stroke. J Med Internet Res 2011;13(2):e31
- iPad 2 and iPhone 4: Is It Feasible to Assess Acute Stroke Using an Apple Mobile Device? Fernando Garcia Garcia MD, PhD et al presented at RSNA 2011
- First among Equals: Comparison of Image Quality between iPad and PACS Workstation for Detecting Pneumothorax on Chest Radiographs. Supriya Gupta MBBS et al presented at RSNA 2011
- Utility of mobile device in the detection of intracranial hemorrhage; Kumar S, Sandeep HV, Sridhar PG, Kalyanpur A. Presented at the 65th annual conference of the Indian Radiological & Imaging Association; Jan 28-31, 2012; Hyderabad, India.

The Challenge : Radiologist shortages



Technology Innovation: Mobile E-learning on the Tablet

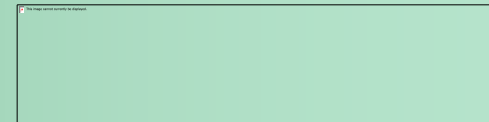


Conclusions



- **Teleradiology is today an established paradigm in healthcare delivery, and plays a critical role in emergency medical diagnosis**
- **Using Mobile technologies allows for shorter report TAT, collaboration, and clinician participation**
- **Mobile technologies can also be used to leverage E-learning in radiology, obviating shortages of teaching faculty**

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