Artificial Intelligence in Radiology

India Perspective

Anjali Agrawal, MD
Consultant, Teleradiology Solutions
Secretary, Society for Emergency Radiology-India
Current Challenges in Radiology

- Increasing imaging volumes
- Shortage of radiologists
- Demand-supply mismatch
- Increasing expectations
- Diminishing reimbursements

- Europe --- 12:100,000
- USA --- 10:100,000
- Singapore – 1: 20,000
- Japan – 1: 35,000
- **India - 1: 100,000**
- Nepal – 1: 200,000
- Bangladesh – 1: 1,000,000

Kalyanpur A. Commentary-radiology in India: the next decade. Indian J Radiol Imag 2008
Levin DC, Parker L, et al. Recent trends in imaging use in hospital settings: implications for future planning. JACR2017
BURN OUT!!
Only 1 CT scanner, 2 radiologists for a tribal population of 1 million
International Teleradiology: Boon or a bane?

16 Countries and over 100 hospitals in the United States
AI Improves Entire Radiology Workflow

From acquisition to prognosis

- Acquisition
- Image Reconstruction
- Processing Visualization
- Pathology Detection
- Analysis
- Diagnosis CAD
- Treatment Prognosis

https://subtlemedical.com/
Image Acquisition

- Decrease imaging time
- Decrease radiation dose
- Decrease contrast dose
- Reduce artifacts
Algorithms can be developed to enhance noisy, grainy undersampled MRI images produced in shortened time frames.

Potential to reduce time spent in the MRI scanner by up to 2/3rds!

Increase patient throughput.
T2 AI Products

1. AI Platform to Assist Radiologist for Screening Mammography Programs
2. Diagnostics Assistant for Radiologist to identify critical clinical findings for improved accuracy.

- AI Platform to Prioritize Positive Cases with Critical Values
- AI Platform for Emergency Radiology to Assist Radiologist in Ischemic / Hemorrhagic strokes
Detection of Intracranial Hemorrhage using Artificial Intelligence Algorithms

Developing Artificial Intelligence Algorithms for Detection of Intracranial Hemorrhage. Anjali Agrawal, Prashant Akhawat, Arjun Kalyanpur
European Society of Emergency Radiology Annual Meeting, Poland, October 2018
AI Integrated with Workflow for Triage and Assist

Critical findings highlighted with color code and with a tooltip summary
Neural Assist™ - Detection Capabilities (ER Setting)

Midline Shift & Mass Effect

Brain Hemorrhage
IPH, IVH, SAH, SDH, EDH, Small Hemorrhagic Contusions, Mutil-compartmental Hemorrhage

Location, Area, Size, Shape, Volume

Bleed and Infarct Annotations

Ischemic Strokes
Acute / Subacute Infarct

Skull Fracture
Linear Fracture

Artifact Elimination

Neural Assist

Structured Report
MammoAssist Detection Capabilities

- Lesion Analysis
  - High & Iso Density lesions
  - Fibroadenoma Size & Shape Analysis

- Location & Density
  - Measurements, Location, Count, Annotations

- Bilateral Asymmetry
  - Focal Asymmetry

- Calcification Analysis
  - Micro & Macro, Vascular, Clustered Calcification – Amorphous

- BI-RADS Categorization

- Breast Parenchyma Composition
  - Type 1: Entirely Fat
  - Type 2: Scattered Fibro Glandular
  - Type 3: Heterogeneously Dense
  - Type 4: Dense Fibro Glandular

- Architectural Distortion

- Lymph Nodes
  - Auxiliary & Abnormal Lymph Nodes

- Bilateral Asymmetry
  - Focal Asymmetry

- Calcification Analysis
  - Micro & Macro, Vascular, Clustered Calcification – Amorphous

- Automated Structured Reporting, Multiple Languages, PACS Integration
Size, Shape, Location Density

Lesion
Shape: Partially Round
Size: 2.398 cm x 1.560 cm
Density: High Dense
Location: Superior Middle

Lesion
Shape: Partially Round
Size: 4.030 cm x 2.530 cm
Density: High Dense
Location: Middle Lateral

Macro Calcification
Count: 1
Size: 2.401 cm x 2.250 cm
Location: Middle Lateral
Pleural Effusion

Validation and fine tuning of the Computer Aided Diagnosis of Pulmonary Tuberculosis Model for the Indian Subcontinent. DJ Christopher, CMC Vellore; Brejesh Lall, IIT-Delhi; Anjali Agrawal, TRS

Height Difference
Lung Bottom Curvature
Lower Lung Intensity Variation
Automated CxR screening for TB

- 80 million CxR s in India - majority unreported by a radiologist, delayed reporting (up to 15 days), errors of up to 25%!
Intelligence Augmentation - Fracture detection

Sensitivity 91.5% aided and 81% unaided. Specificity 94% vs 88% unaided
Relative reduction in misinterpretation rate of 47%

Lindsey R, et al. Deep neural network improves fracture detection by clinicians. PNAS September 2018
Core and first line diagnostic imaging modality

Challenges- High inter- and intra-operator variability and limited image quality control

Opportunities- miniaturization of devices, growth in compute power

Point-of-care applications- real-time scan, portable, no radiation, no special infrastructure

Brattain L J, et al. Machine Learning for Medical Ultrasound: Status, Methods, and Future Opportunities. Abdom Radiol April 2018
“Smart” Technology on a Chip
Technology can only enable, intent is key!
Female foeticide as an unintended consequence

The three deadliest words in the world:

"It's a girl."
Challenges

- “Black box” systems not trained on Indian data
Quality control and monitoring

Challenges
Our team:

Sincere thanks-
Dr Arjun Kalyanpur and
Mr Prashant Akhawat
Artificial Intelligence in Radiology

India Perspective

anjali.agrawal@telradsol.com