

# CARING Analytics Platform - CARPL

*Building the world's largest network of healthcare AI validation and deployment sites...*

*By Mahajan Imaging*

# Mahajan Imaging is one of India's leading medical imaging providers

- Introduced MRI into India
- 400,000 patients annually
- 9 centres – X-Rays to PET-CT
- 50+ radiologists
- Founded by Dr. Harsh Mahajan, Radiologist to the President of India, Padma Shri awardee

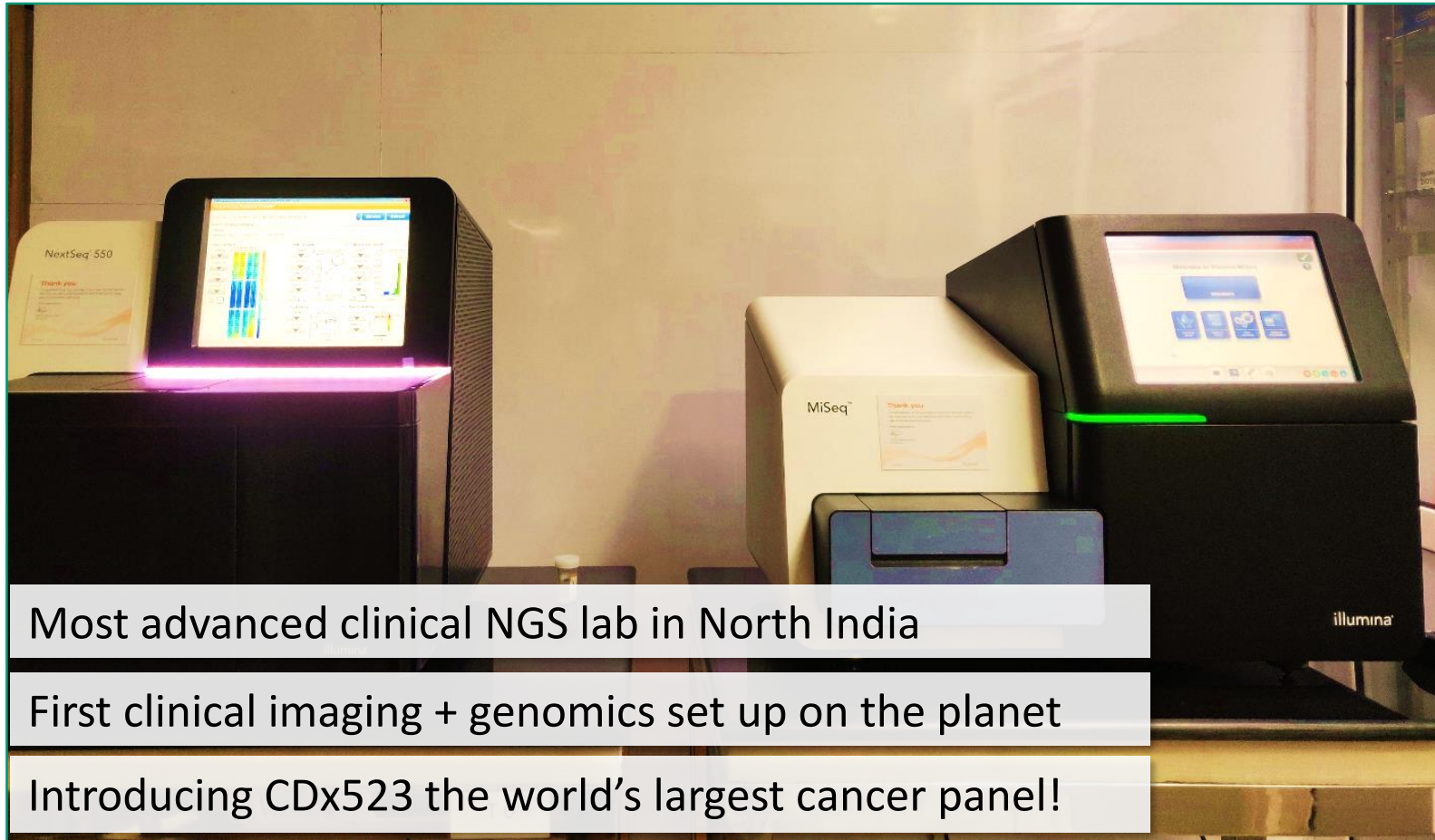


*India's first 3.0T Signa Architect 128 Channel System*

MI's technological prowess and unique approach to patient-care has ensured significant media interest



# Moving towards Integrated-Diagnostics – introducing genomics



Molecular Imaging



Molecular Pathology  
with Genomics



Integrated Diagnostics

CARING is a dedicated research division focussed on developing cutting-edge diagnostics products

**CARING**



Centre for Advanced Research in  
Imaging, Neurosciences & Genomics

## Deep learning algorithm for head CT scans: a retrospective study

Sasank Chilamkurthy, Rohit Ghosh, Svetlana Das, Pooja Rao, Prashant Warier

### Summary

**Background** Non-contrast head CT scans are commonly used to detect acute stroke symptoms. We aimed to develop a deep learning algorithm following key findings from these scans: subdural, extradural, and subarachnoid hemorrhages.

**Methods** We retrospectively collected scans from around 20 centres in India (Qure25k dataset) and used for validation (CQ500 dataset) was collected and development and Qure25k datasets. We used original clinical radiology report and for the Qure25k and CQ500 datasets, were primarily used to assess the algorithm's performance.

**Findings** The Qure25k dataset contained dataset consisted of 214 scans in the second batch (mean age 52 years; 84% of 0-92 (95% CI 0.91-0.93) for detection of 0-92 (95% CI 0.91-0.93) for intracranial; 0-92 (95% CI 0.91-0.93) for subarachnoid). On the CQ500 data 0-93 [0.87-1.00], 0-95 [0.91-0.99], 0-94 dataset were 0-92 (0.91-0.94) for calva effect, while AUCs on the CQ500 dataset

**Interpretation** Our results show that requiring urgent attention, opening up

**Funding** Qure.ai.

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### Introduction

Non-contrast head CT scans are commonly used emergency room for patients with head injury or for suggesting a stroke or rise in intracranial pressure. Wide availability and low acquisition cost make them a commonly used modality.<sup>1</sup> The percentage of annual US visits that involve a CT scan has been past few decades and the use of head CT for neurosurgical intervention is increasing.

The most critical, time-sensitive information can be readily detected on CT scan in haemorrhages, raised intracranial pressures. A key assessment goal in patients is exclusion of an intracranial bleed depends on CT imaging and its availability. Similarly, immediate CT scan interpretation is critical.

www.thelancet.com Published online October 11, 2018

## Unboxing Deep Learning Into a Deep Learning Framework

Vasanth

Ajay Kohli<sup>1</sup>, Vidur Mahajan<sup>2</sup>, Kevin Seals<sup>3</sup>, Ajit Kohli<sup>4</sup>, Saurabh Jha<sup>5</sup>

**Rationale and Objectives:** To explain the heat maps.

**Materials and Methods:** A 20-layer deep neural network predicted the malignancy risk of a nodular lesion to generate clinical attribution heat maps. Resource Initiative (IDC-IDR) dataset – bright areas inside nodules, peripheral scan planes juxtaposed with the nodules than nodule bright areas corresponding to malignancy risk.

**Results:** These six features were associated, which gave an 85% weighted average and 91.8% TP and 22.2% FP malignant whereas peripheral heat, heatmap.

**Conclusion:** We discuss the potential features aiding classification.

**Key Words:** Artificial Intelligence; Computer Vision; Radiology

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**Keywords:** artificial intelligence, Food and Drug Administration

doi.org/10.2214/AJR.18.20410

Received July 22, 2018; accepted after revision April 14, 2019.

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AJR/2018; 213:1-3

0895-8296/18/2134-1

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AJR:213, October 2019

## The Algorithmic Audit: Validating Radiology AI

Vidur

Centre for Advanced Research in Imaging and Genomics, Mahajan Imaging, Delhi, India

There is a plethora of AI algorithms. We present with the developed algorithm, the algorithms. The on data that the testing, deep learning implications of such algorithms.

### Introduction

Artificial Intelligence (AI), to the context of radiology, and replicate the visual and cognitive interpretation of those findings. large healthcare companies' tools to automate these tasks. tools are either in the domain of creation.

We present, based on our 'Audit' methodology which an algorithm, and share relevant performance of the algorithm. on validation of algorithms, a series of other steps which

### Prerequisites to the Algorithmic Audit

The availability of heterogeneous since testing on rare, but clinically relevant cases is crucial for

## CARING

### Product Launches & Demos

- **Sunday, November 25, 2018, 3:00PM, Mach** Outs of Doing Annotations so AI works – laur with CARING.
- **Thursday, November 29, 2018, 10:00AM, NV** Deployment – a universal platform developed radiology departments

### Scientific Presentations

- **Sunday, November 25, 2018**
- **Cardiovascular SPECT/CT, Z44**
- **10:55AM** - Evaluation of Role of F-18 FDG C-Imaging in Assessing the Therapeutic Benefit of Ventricular Systolic Dysfunction (Dr. Ritu Verm)
- **11:05AM** - A Comparative Analysis of My Atherosclerosis and Calcium Score on 64-Slice
- **11:35AM** - Medium and Large Vessel Vasculitis
- **Monday, November 26, 2018**
- **Novel Clinical PET, SPECT Tracers, Z44, 11:25** by 68Ga PSMA PET/CT in Patients with Biochemically Negative Prostate Cancer
- **Hepatobiliary: Diffuse Liver Diseases, Z10, 1:** Between Liver Stiffness and Esophagegastic Varices
- **Brain: Development, Z21, 3:00PM.** Neurocognitive Plasticity After Sight Onset Late in Childhood (Dr. Srinam Rajan)
- **Central Nervous System-PET/CT; PET/MR, Disease and Lewy Body Dementia: Similarities; Z39, 3:30PM.**

### Wednesday, November 28, 2018

- **General Pediatric Imaging, Z09, 9:00AM.** In-Bone-Age Estimation by Incorporating Radionuclide Venugopal
- **MR - New Techniques, Systems, Evaluation** Using Compressed-SENSE: A Comparison with (Dr. Srinam Rajan)
- **Neuroradiology - Techniques and Methods:** the Brachial Plexus Using Compressed-SENSE Shikha Panwar
- **Nuclear Medicine – Endocrine, Z44, 3:50P** Parathyroid Surgery: A 10-Year Institutional Experience
- **Thursday, November 29, 2018**
- **Musculoskeletal – Cartilage, Z15, 11:50AM** Quantitative Study (Dr. Srinam Rajan)
- **Fast 5, Arie Crown Theater, 1:30PM.** The MRI AI got it wrong (Dr. Vasantha Venugopal)

### Scientific Posters & Exhibits

- **Machine Learning-Image-based, Learning Center.** Improve Lung Nodule Detection by Combining Network and a Convolutional Neural Network (Chunduru)
- **Brain: Movement Disorders, Learning Center.** Findings and Clinical Staging of Parkinson's Disease: Initial Experience (Dr. Srinam Rajan)
- **Congenital Heart Disease, Learning Center.** IV Cardiothoracic Surgeons Want to Know? (Dr. Srinam Rajan)
- **Clinical Practice, Quality, and Safety, Learning Center.** Radiologist Should Know (Dr. Vidur Mahajan)

### Invited Talk at ECR 2019

- **Thursday, February 28, 2019, 10:15 | AI Theatre** at GE Booth
- **Success Factors | Vidur Mahajan**

### Scientific Oral Present

- **Wednesday, February 27, 2019, 11:42hrs | SS213 | CT Image** cone-beam CT scans in patients with Chikungunya virus in outbreak | Abhay Aryan
- **Thursday, February 28, 2019, 10:54hrs | SS611 | MS and D** cases of Chikungunya virus in outbreak | Abhay Aryan
- **11:18hrs | SS605 | Machine** processing and deep learning ligament: is it the game changer? | Are radiologists bad teachers consensus-defined labelling a | Are radiologists bad teachers consensus-defined labelling a | Are radiologists bad teachers consensus-defined labelling a
- **Friday, March 01, 2019, 10:38hrs | SS1013 | Innovati** Towards Virtual MR Imaging: images using convolutional neural networks | Are radiologists bad teachers consensus-defined labelling a | Are radiologists bad teachers consensus-defined labelling a
- **11:18hrs | SS1005a | Hot Topic** | Are radiologists bad teachers consensus-defined labelling a | Are radiologists bad teachers consensus-defined labelling a
- **11:34hrs | SS1005a | Hot Topic** | Opening the "Black Box": radiologist characterization | Vasantha Venugopal

### Saturday, March 02, 2019

- **10:55hrs | SS1405 | Imaging** linking large unorganised imaging learning algorithms | Vidur Mahajan
- **11:10hrs | SS1410 | Knee Im** CartiGram and the complement | Srinam Rajan
- **11:18hrs | SS1410 | Knee Im** muscles around knee joint on MR | Srinam Rajan
- **14:56hrs | SS1511 | Neuroc** autoimmune encephalitis: etiology and treatment | Ethel Belho
- **16:40hrs | SS1605 | Machine** prostates segmentation in MRI | Rafael Gonzalez
- **Sunday, March 03, 2019, 11:34hrs | SS1811a | Parkins** variant of Alzheimer's disease SPECT scan | Ethel Belho
- **14:00hrs | SS1907 | Imaging** in assessing MRI signs of endometriosis: prior domain knowledge | Srinam Rajan
- **14:16hrs | SS1905a | Machir** as normal/abnormal using a machine learning algorithm | Srinam Rajan
- **15:21hrs | SS1910b | Spine** weighted imaging for visualisation | Srinam Rajan

### Voice of EPOS at ECR 2019

- **Wednesday, February 27, 2019, 12:00 – 13:00 | Voice of EPOS** & Annotation Tools for Radiologists | Vidur Mahajan
- **Thursday, February 28, 2019, 14:00 – 15:00 | Voice of EPOS** radiologist should know | Vidur Mahajan

CARING

RSNA 2019  
SEE POSSIBILITIES  
TOGETHER

GLOBAL PLATFORM FOR DEVELOPMENT  
TESTING & DEPLOYMENT OF ADVANCED  
RADIOLOGY ANALYTICS

BOOTH #11337A

### SCIENTIFIC ORAL LECTURES

- **SUN, 12/01/2019, 11:25AM #SS05AB** DR. HARSH MAHAJAN
- Difference in the Spectrum of Metastatic Disease on 68Ga PSMA PET/CT after Radical Prostatectomy and after Radical Prostatectomy in patients of Carcinoma Prostate with Biochemical Recurrence.
- **TUE, 12/03/2019, 11:40AM #S406A** DR. VASANTHA K VENUGOPAL
- Can AI generate clinically appropriate X-Ray reports? Judging the Accuracy and Clinical Validity of Deep Learning-generated Test Reports as Compared to Reports generated by Radiologists: A Retrospective Comparative Study
- **TUE, 12/03/2019, 03:30PM #SS03AB** DR. VIDUR MAHAJAN
- Establishing Normative Kidney Sizes for a Large Developing Country's Adult Population Using Big Data: A Study of 30,000 Ultrasound Scans Yields a Potential Gender and Age-Related Difference.
- **WED, 12/04/2019, 03:30PM #E353B** DR. VASANTHA K VENUGOPAL
- Deploying Deep Learning for Quality Control: An AI-assisted Review of Chest X-rays Reported as "Normal" in Routine Clinical Practice.
- **WED, 12/04/2019, 03:30PM #S102CD** DR. SRIRAM RAJAN
- Evaluating the Complementary Role of Pseudo-STIR in Assessment of Hypertensive Marrow Lesions as Compared to T2-STIR.
- **FRI, 12/06/2019, 10:50AM #E450B** DR. SRIRAM RAJAN
- Making Spine MR Reports More Clinically Appropriate: A Questionnaire-Based Survey of Sub-Specialty Spine Surgeons.
- **FRI, 12/06/2019, 10:40AM #E353B** DR. HARSH MAHAJAN
- Mediastinal Lymph Nodal Staging by 18 F FDG PET CT in Patients with Co-Existing Carcinoma Lung and Tuberculosis: A Tertiary Care Centre Experience.

### INVITED LECTURES

- **MON, 12/02/2019, 10:30AM #E351** DR. HARSH MAHAJAN
- India Presents: Artificial Intelligence in Indian Radiology: We are all Set!
- **THUR, 12/05/2019, 10:30AM** DISCOVERY THEATRE DR. HARSH MAHAJAN
- Patient-centric Radiology: How a Radiologist Can Serve as the Focal Point of Communication between Patients, Technologists and Clinicians

### SCIENTIFIC POSTERS

- **SUN, 12/01/2019, 01:00-01:30 PM** LEARNING CENTER DR. VIDUR MAHAJAN
- Getting AI Ready for Deployment: Tuning Algorithms to Specific Sites Using a Single Chest X-Ray Image.
- **SUN, 12/01/2019, 12:30-01:00 PM** LEARNING CENTER DR. HARSH MAHAJAN
- Spectrum of Autoimmune Limbic Encephalitis on FDG PET/CT.

### POSTER EXHIBITS

- **ALL DAY | LEARNING CENTRE**
- Practical Guide for Deployment of AI Solutions in Clinical Environment: How Did We Do It?
- How to Lie with Statistics: Things to Keep in Mind While Evaluating a Deep Learning Claim.
- Building Robust ML Models Using Federated Learning: The Future of AI Deployment.
- Circulating Tumor DNA (ctDNA) – A Potential Adjunct to FDG-PET Imaging in Cancer Follow Up.
- Next Generation Sequencing for the Practicing Radiologist.

### HANDS-ON EXHIBIT

- **ALL DAYS LEARNING CENTER** SALIL GUPTA
- Tips and Tricks on Basic Programming Tools for Radiologists to Handle DICOM Data. (Meet the presenter for a guided session at 12noon and 4pm everyday)

MAHAJAN IMAGING  
From X-Rays to Molecular Imaging

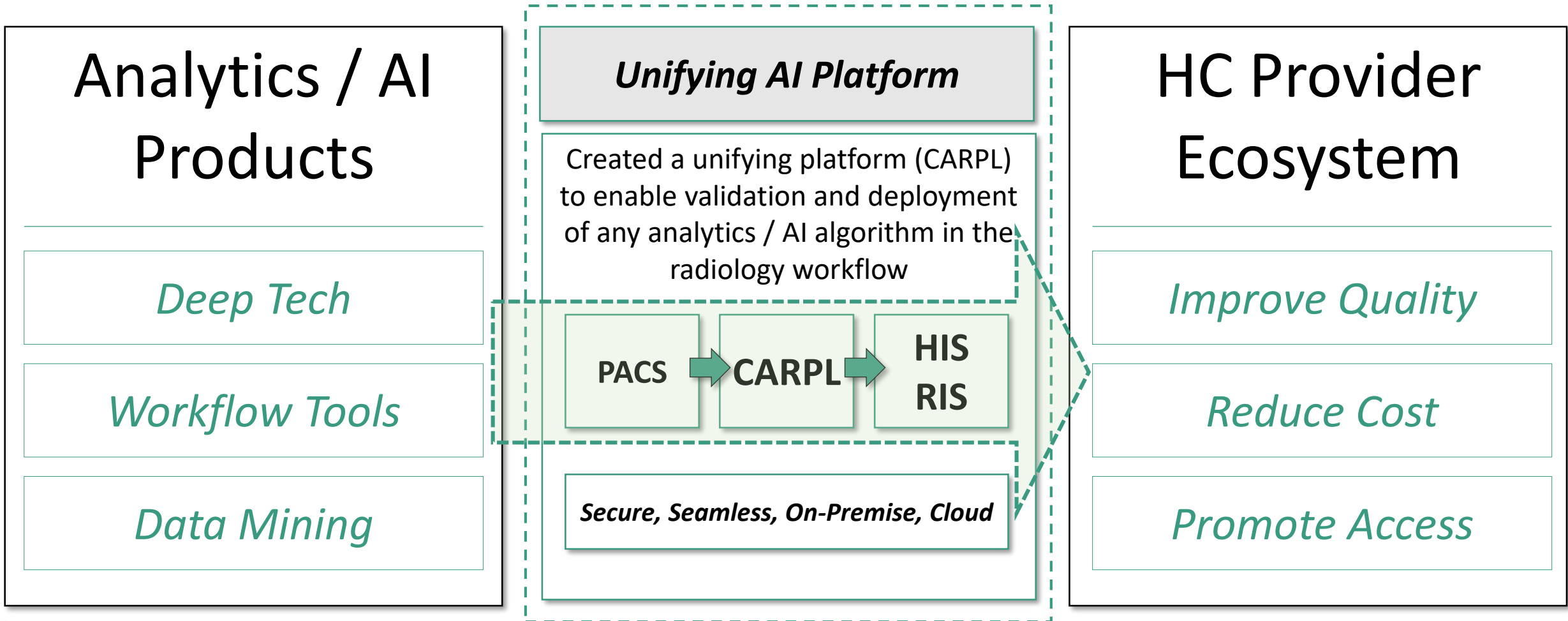


# CARPL is expanding these capabilities to the entire Indian healthcare ecosystem!



*The first five CARPL systems deployed at Mahajan Imaging, New Delhi*

# CARPL integrates AI / Analytics companies and products from across with worlds with radiology providers





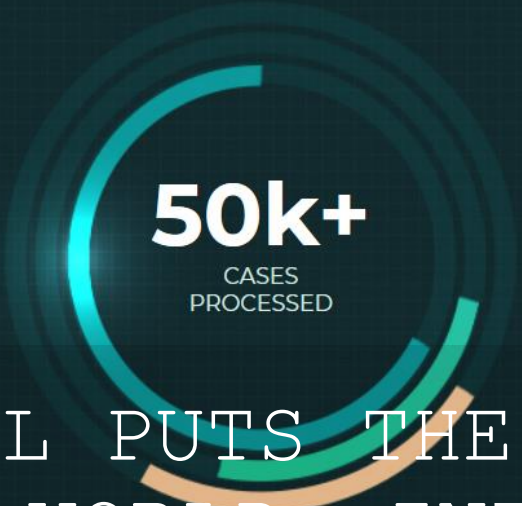


\$ 3.0 CREDITS LEFT!

HELLO ROHIT TANEJA

WELCOME TO **DASHBOARD**

ROHIT TANEJA



**20K**  
X-RAY DONE



**15K**  
CT SCAN DONE



**15K**  
MRI SCAN DONE

CARPL PUTS THE POWER OF AI, FROM ALL OVER THE WORLD, INTO THE HANDS OF THE DOCTORS

**VALIDATION**

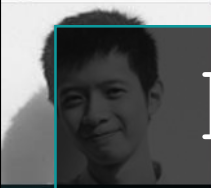
TOTAL ALGORITHMS  
**5** [CLICK TO VIEW](#)

TOTAL PROJECTS  
**6** [CLICK TO VIEW](#)

TOTAL DATASETS  
**9** [CLICK TO VIEW](#)



CASES VALIDATED

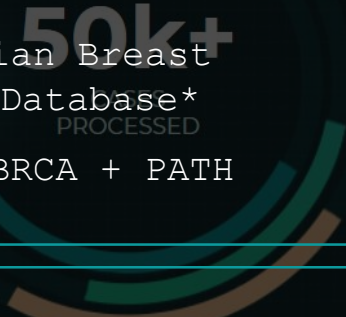


# DEVELOP

## MERGING IMAGING & GENOMICS

The Indian Breast Cancer Database\*

MAMMO + BRCA + PATH



## GENOMICS FOR INDIA

Precision Medicine Markers for Cervical Cancer\*

TOTAL ALGORITHMS

5

CLICK TO VIEW →

TOTAL PROJECTS

6

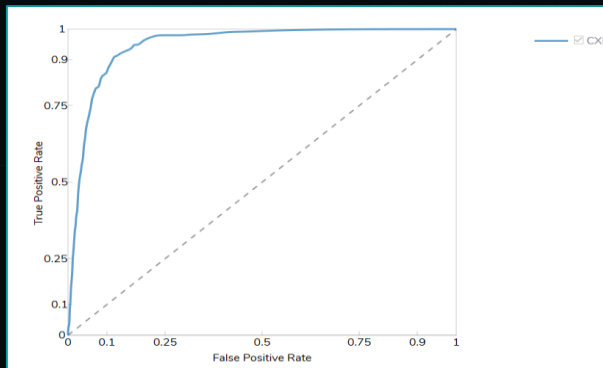
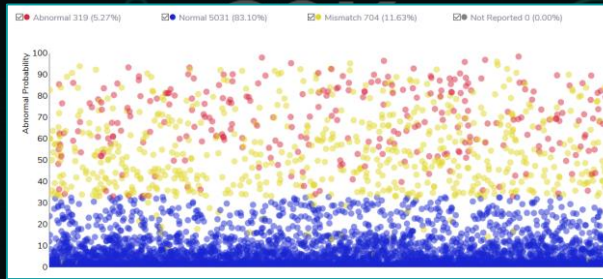
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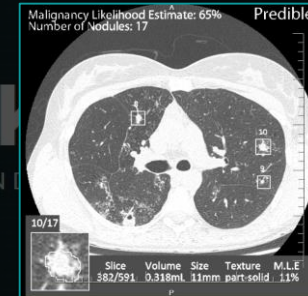
# TEST

## CLINICAL VALIDATION OF AI FOR TUBERCULOSIS DETECTION



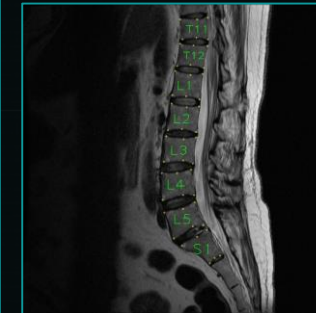
# DEPLOY

## LUNG CANCER



ID	Slice	Volume	Size	Texture	M.L.E.
4	312	0.106ml	10mm	solid	4%
6	361	0.288ml	10mm	part-solid	28%
8	377	0.14ml	10mm	solid	8%
9	379	0.03ml	9mm	solid	4%
10	380	0.318ml	11mm	part-solid	11%
12	418	0.34ml	10mm	solid	7%
13	419	0.308ml	10mm	part-solid	6%
15	434	0.259ml	8mm	solid	5%
16	443	3.373ml	30mm	solid	9%
17	473	1.061ml	10mm	part-solid	5%

## AUTOMATED SPINE MRI



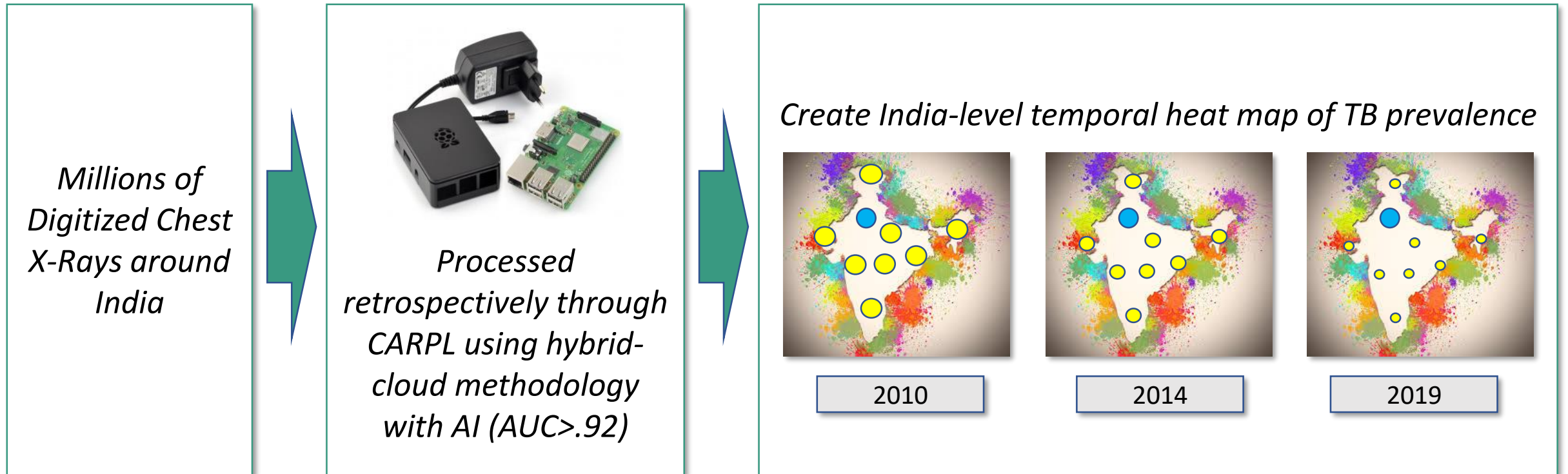
Disc Level	SC Diameter (mm)	Disc Height (mm)
T10-T11		
T11-T12		7.74mm (Normal)
T12-L1	17.23mm (Patent)	9.92mm (Normal)
L1-L2	17.93mm (Patent)	10.38mm (Normal)
L2-L3	18.63mm (Patent)	9.85mm (Normal)
L3-L4	18.63mm (Patent)	12.11mm (Normal)
L4-L5	17.93mm (Patent)	13.09mm (Normal)
L5-S1	12.00mm (Patent)	10.71mm (Normal)

30%

10%

CT SCANS X RAYS MR SCANS

# Potential Projects – Country Level Population Mapping for Tuberculosis



*CARPL can enable a previously impossible task of parsing through millions of X-rays in a matter of days – overhaul the approach to public health - give policy makers the opportunity to monitor disease-burden in real-time, at a fraction of the cost!*

# Imagine the possibilities when all global healthcare providers are 'clinically connected'...



- *Enabling access to AI*
- *Creating global disease level databases*
- *Enabling precision medicine through genomics and integrated diagnostics*
- *Population health management*

CARING is nothing but a group of clinicians and technologists who have come together to accelerate the adoption of advanced analytics tools in medicine – we understand your concerns as we serve patients ourselves.

CARPL – For Radiologists, By Radiologists