NIT AP CSE

EPICS MINI PROJECT EP258

Rupesh Kumar Yadav
Sai Vikas

Superviser
Dr. SriLatha C

RIBS IDENTIFICATION AND DISESASE DETERMINATION

~Using Deep Learning Segmentation techniques

RIBS IDENTIFICATION

- Using Deep Learning to study the Structure and Positioning of Anterior and Posterior Ribs
- Chest radiography (chest X-ray or CXR) is an economical and easy-to-use medical imaging and diagnostic technique. The technique is the most commonly used diagnostic tool in medical practice and has an important role in the diagnosis of the lung disease
- Deep learning (DL) has shown superior performance to other methods in the segmentation and labeling of individual ribs

- A wide range of diagnostic tasks can benefit from an automatic system that is able to segment and label individual ribs on chest X-ray (CXR) images. To this end, traditional approaches exploited hand-crafted features to identify the ribs, but failed with anterior ribs. Recently, deep learning (DL) has shown superior performance to other methods in the segmentation and labeling of individual ribs

- VinDr-RibCXR a benchmark dataset for the automatic segmentation and labeling of individual ribs on CXRs has been used for reference

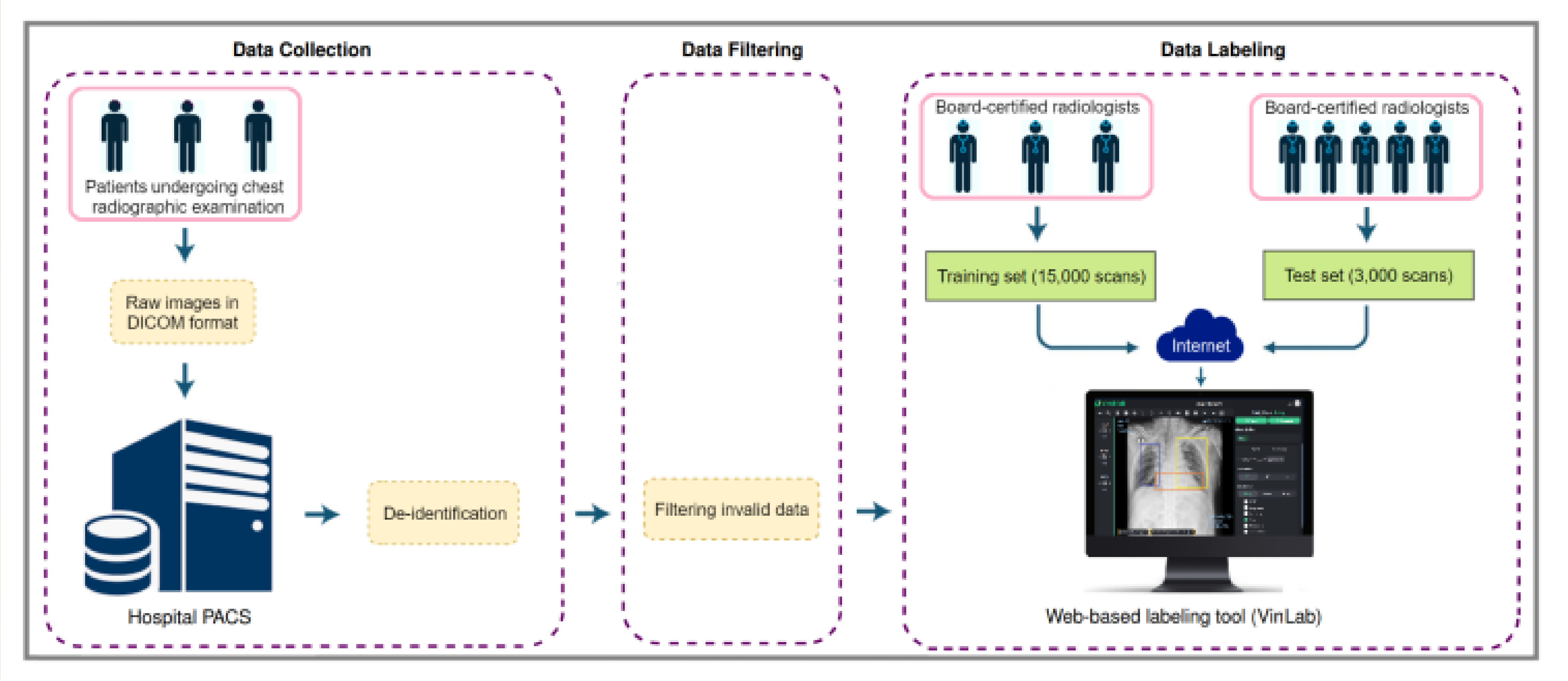
DISEASE DETERMINATION

- chest radiographs are widely used in the detection and diagnosis of the lung diseases, such as pulmonary nodules, tuberculosis, and interstitial lung disease. Chest radiography contains a large amount of information about a patient’s health

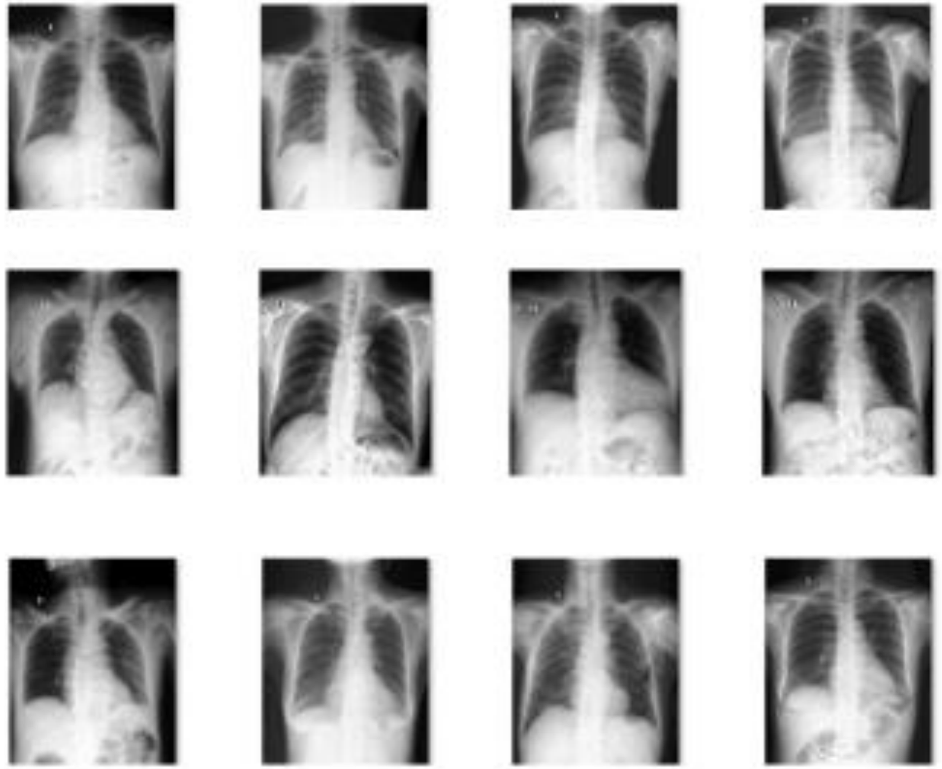
- Developing DL algorithms for this task requires annotated images for each rib structure at pixel-level. To the best of our knowledge, there exists no such benchmark datasets and protocols. Hence, we introduce a new benchmark dataset, namely VinDr-RibCXR, for automatic segmentation and labeling of individual ribs from chest X-ray (CXR) scans
- DICOM stands for Digital Imaging and Communications in Medicine. It is **a standard, internationally accepted format to view, store, retrieve and share medical images**. DICOM conforms to set protocols to maintain accuracy of information relayed through medical images

The building of VinDr-CXR datasetis divided into three main steps:

- **A** Data collection
- **B** Data filtering
- **C** Data labeling



THE BUILDING OF VinDr-CXR DATASET



Valid images

Outlier images

PUBLIC DATASETS FOR CXR INTERPRETATION

Dataset	Release year	# findings	# samples	Image-level labels	Local labels
JSRT[14]	2000	1	247[d,*]	Available	Available
MC[16]	2014	1	138[d,*]	Available	N/A
SH[16]	2014	1	662[d,*]	Available	N/A
Indiana[15]	2016	10	8,121[d,*]	Available	N/A
ChestX-ray8[10]	2017	8	108,948[•]	Available	Available[†]
ChestX-ray14[10]	2017	14	112,120[•]	Available	N/A
CheXpert[3]	2019	14	224,316[•]	Available	N/A
Padchest[11]	2019	193	160,868[•,*]	Available	N/A[††]
MIMIC-CXR[12]	2019	14	377,110[•]	Available	N/A
VinDr-CXR (ours)	2020	28	18,000[*]	Available	Available

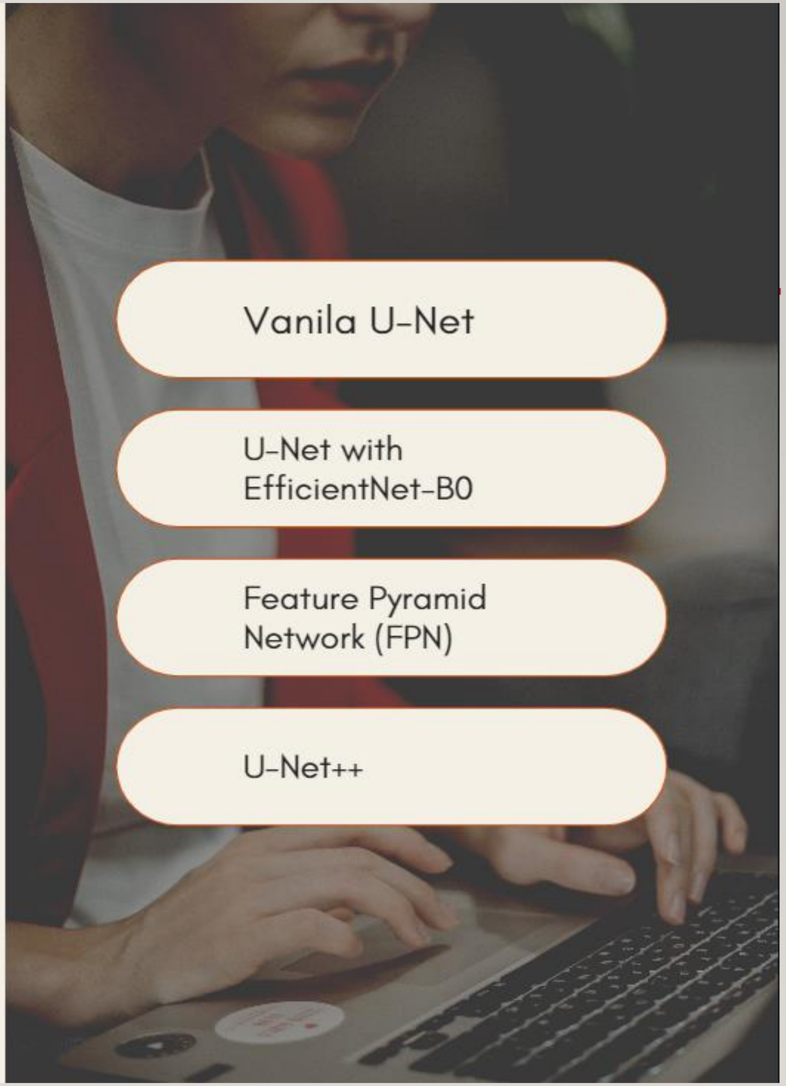
- Moderate-size datasets that are not applicable for training deep learning models

- Dataset namely VinDr-RibCXR, of 245 AP/PA CXR images for segmentation

  and labeling of individual ribs
- To develop and evaluate segmentation algorithms, the whole dataset into a training set of 196 images and a validation set of 49 images.

Various state-of-the-art DL-based segmentation models can be used for the task of individual rib segmentation and labeling

These models are well-known to be effective for many medical image segmentation tasks



Data set contains raw images in DICOM format

in-house web-based labeling tool called VinDr Lab that allows to segment individual ribs at pixel-level on DICOM scans

After Masking the Images are stored in JSON file

CONVOLUTIONAL NEURAL NETWORK(CNN)

- A Convolutional Neural Network (CNN or ConvNet) is a class of deep neural networks, that are typically used to recognize patterns present in images

- VanilaUnet ,FPN,U-net++,Unet with efficient netB0 are Fully Convolution neural network for image sematic segmentation

MODEL

Import segmentation_models_pytorch as smp

Model = smp.Unet(

encoder_name="resnet50",

encoder_weight=" imagenet",

channel_multiplier=1,

pooling="adaptive pooling"

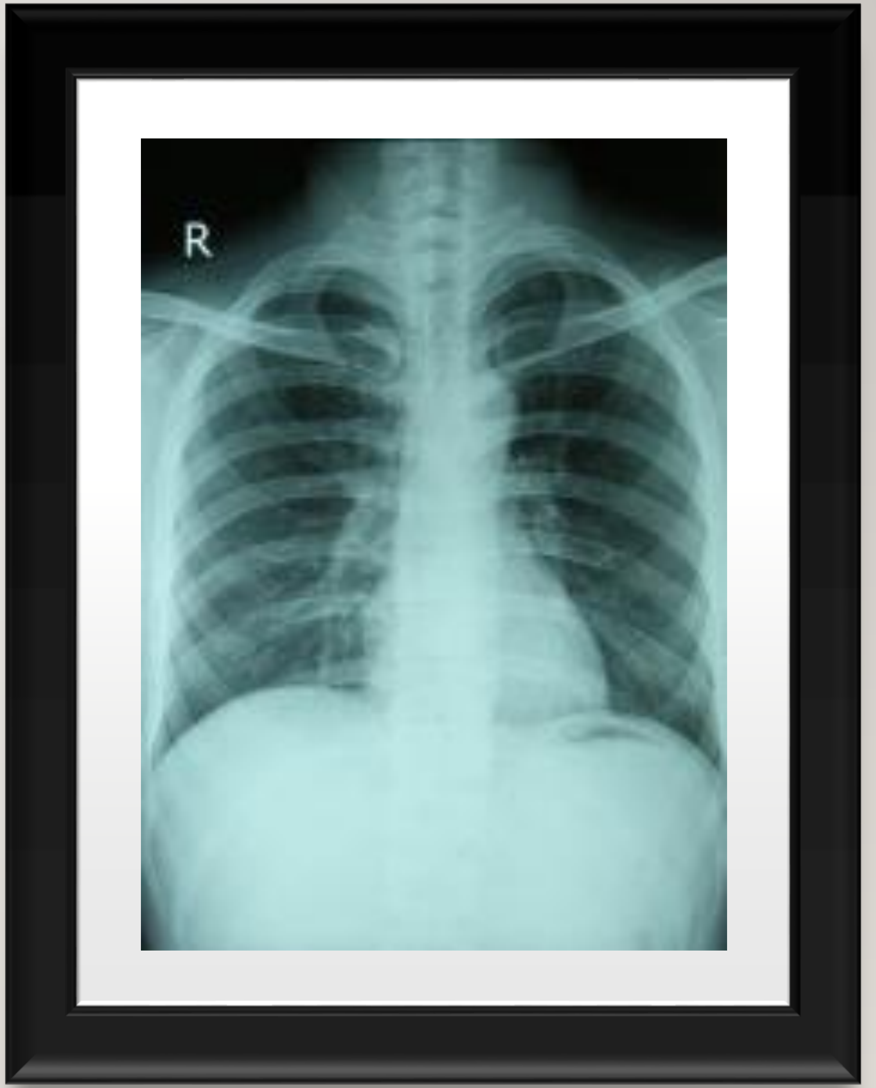
in_channels=cfg.DATA.INP_CHANNEL

)

POSTERIOR - ANTERIOR (PA)

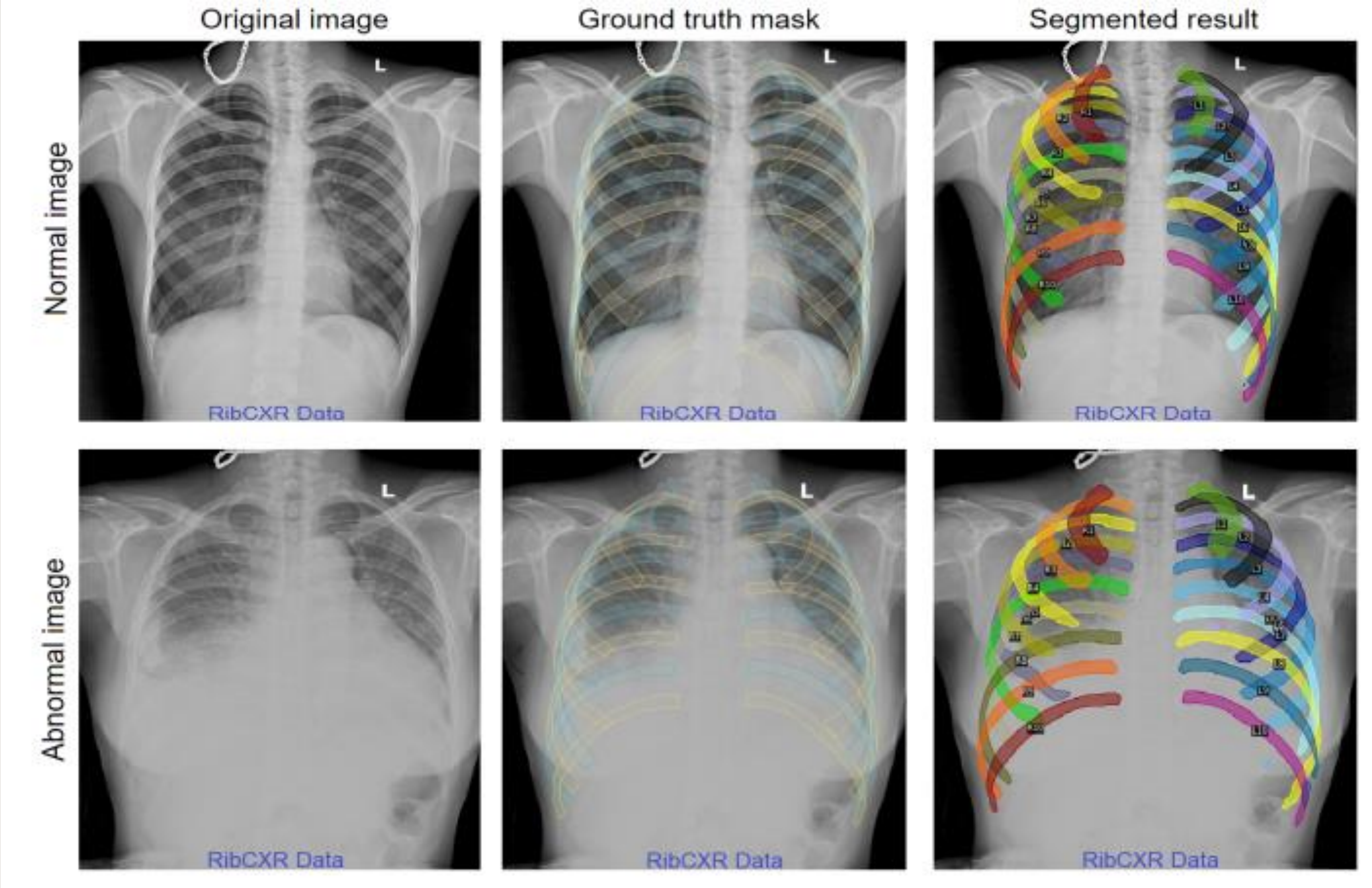
To obtain the front view

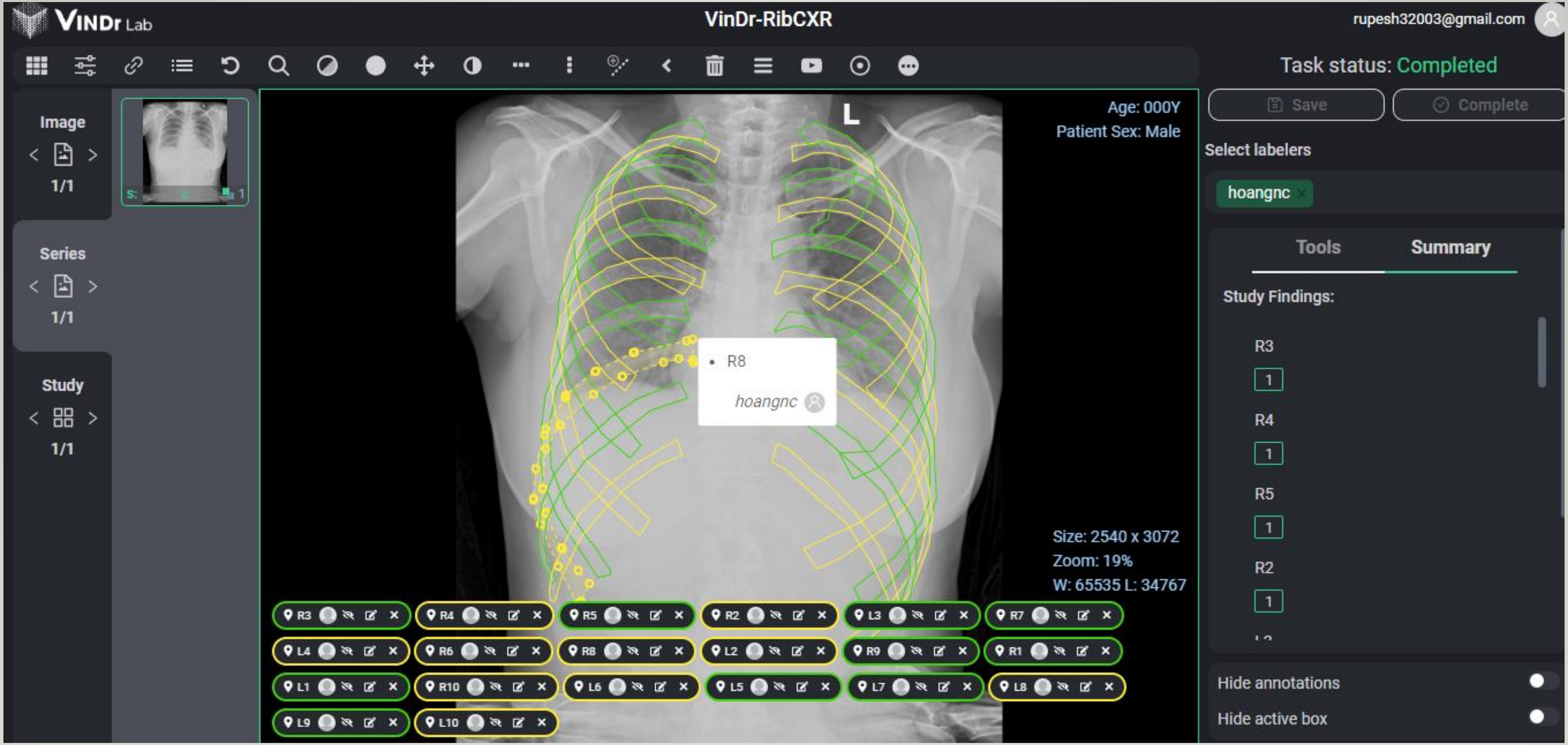
Posterior - Anterior (PA). This is the most common and preferred type of chest X-Ray. Posterior - anterior refers to the direction of the X-Ray beam travel.; i e. X-Ray beams hit the posterior part of the chest before the anterior part.



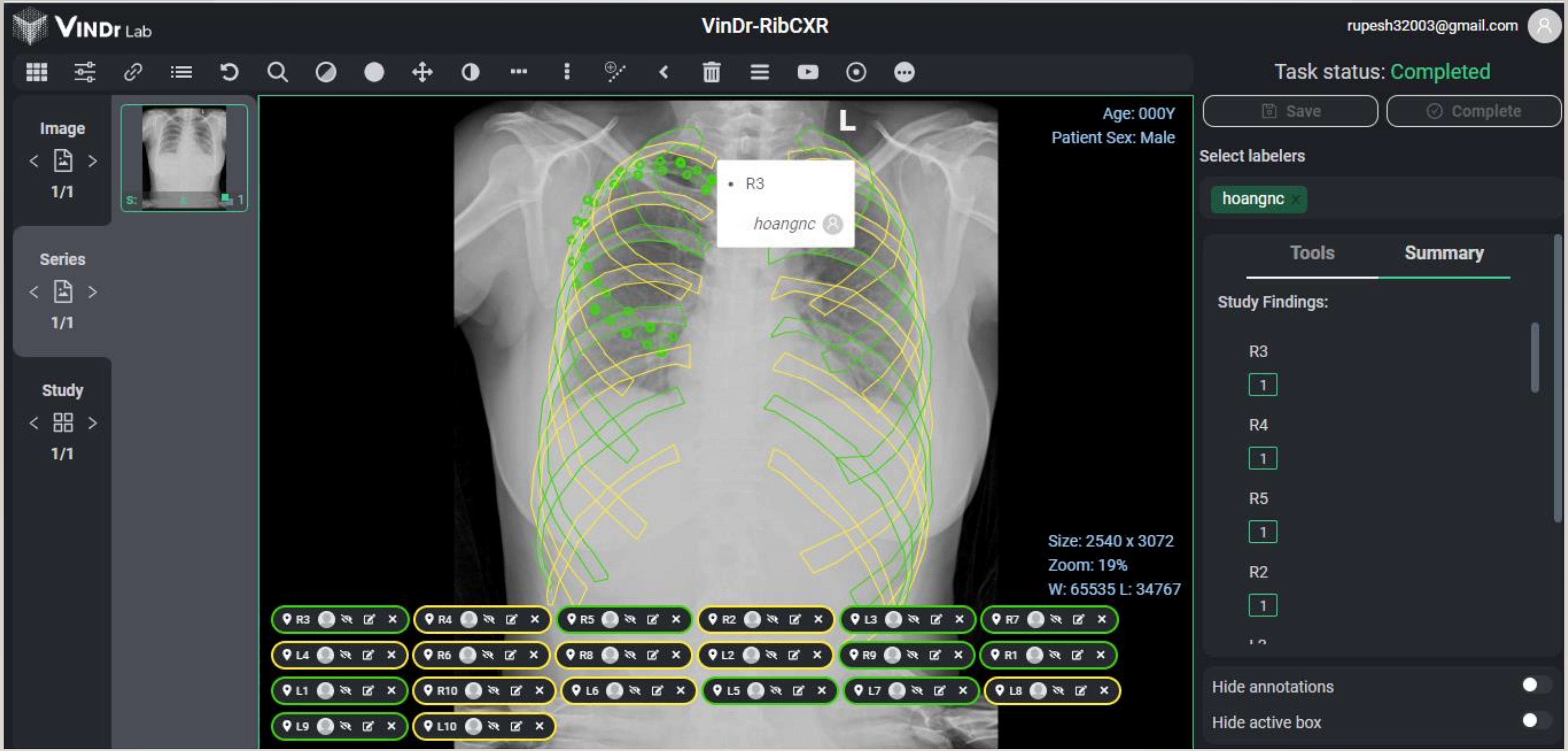
ANTERIOR - POSTERIOR (AP)

This type of chest X-Ray is generally less preferred because the image of the heart and mediastinum is less clear and focused in this projection

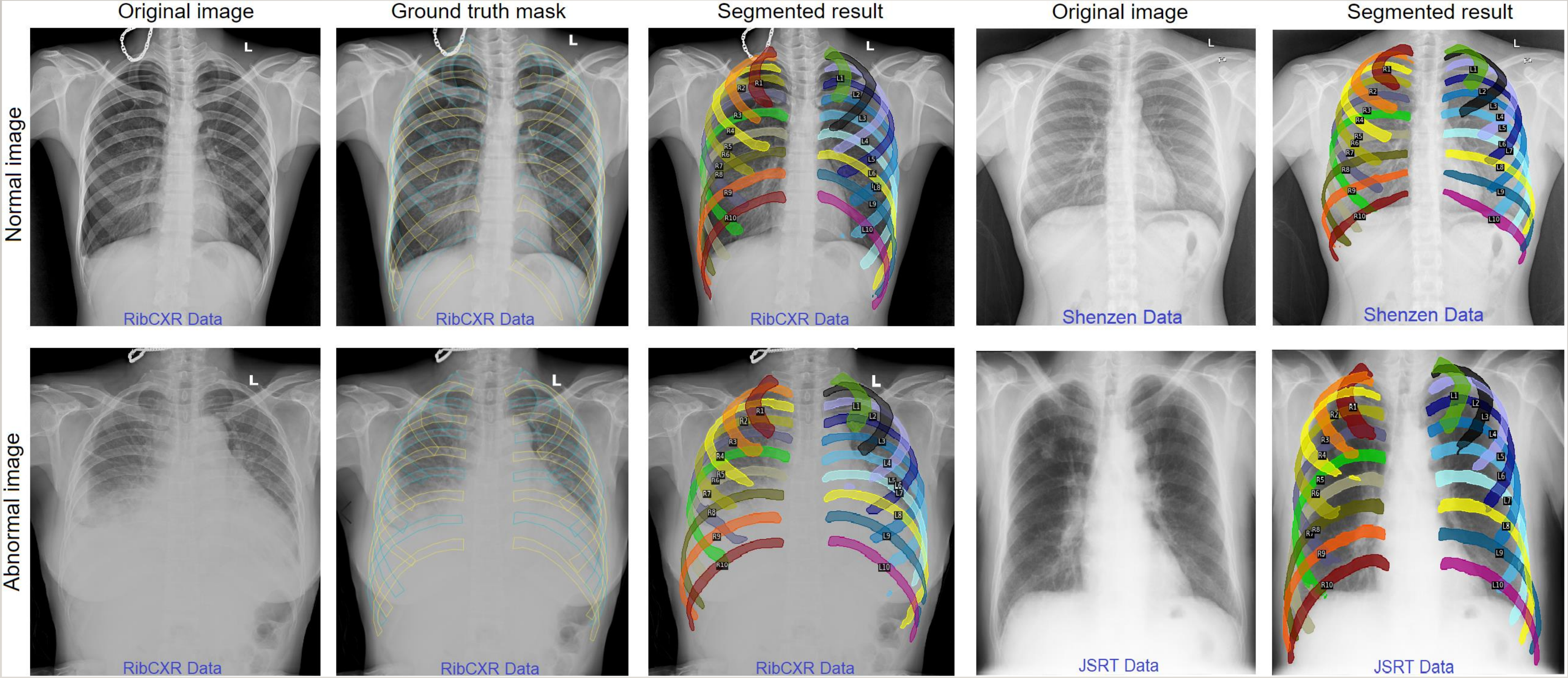

Original image
Ground truth mask
Segmented result
Normal image
Abnormal image
RibCXR Data
RibCXR Data
RibCXR Data
RibCXR Data
RibCXR Data
RibCXR Data



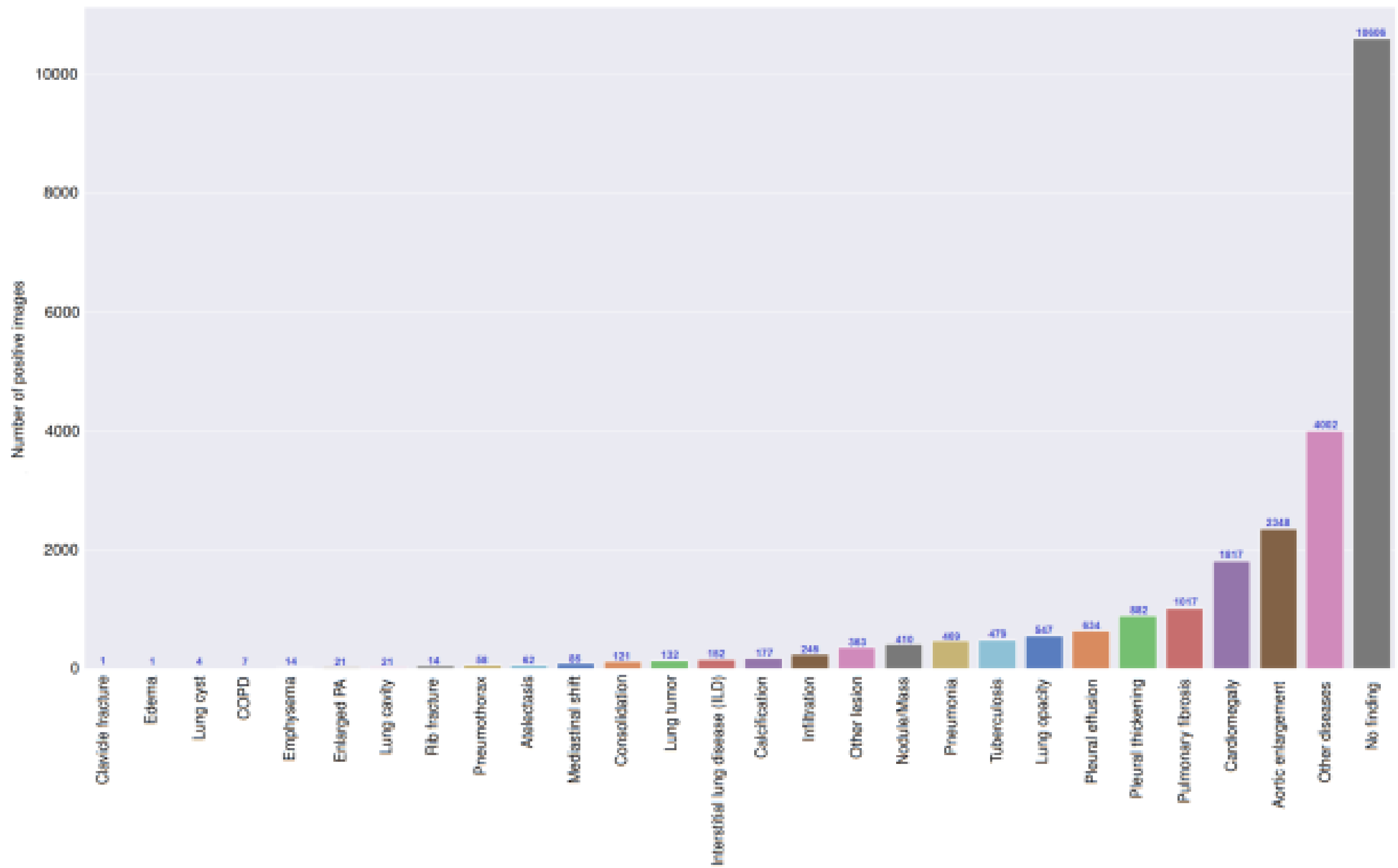
VinDr Lab
VinDr-RibCXR
rupesh32003@gmail.com
Task status: Completed
Save
Complete
Select labelers
hoangnc
Tools
Summary
Study Findings:
R3
1
R4
1
R5
1
R2
1
Hide annotations
Hide active box
Image
1/1
Series
1/1
Study
1/1
Age: 000Y
Patient Sex: Male
L
R8
hoangnc
Size: 2540 x 3072
Zoom: 19%
W: 65535 L: 34767
R3
R4
R5
R2
L3
R7
L4
R6
R8
L2
R9
R1
L1
R10
L6
L5
L7
L8
L9
L10


VINDr Lab
VinDr-RibCXR
rupesh32003@gmail.com
Task status: Completed
Save
Complete
Select labelers
hoangnc
Tools
Summary
Study Findings:
R3
1
R4
1
R5
1
R2
1
Hide annotations
Hide active box
Image
1/1
Series
1/1
Study
1/1
L
Age: 000Y
Patient Sex: Male
R3
hoangnc
Size: 2540 x 3072
Zoom: 19%
W: 65535 L: 34767
R3
R4
R5
R2
L3
R7
L4
R6
R8
L2
R9
R1
L1
R10
L6
L5
L7
L8
L9
L10

Validating Segmentation results using various DataSets :-



The Figure shows segmentation and labeling results of the Nested U-Net on some representative cases from the validation set of VinDr-RibCXR and external datasets including JSRT and Shenzen.


Number of positive images
10000
8000
6000
4000
2000
0
Clavicle fracture
Edema
Lung cyst
COPD
Emphysema
Enlarged PA
Lung cavity
Rib fracture
Pneumothorax
Atelectasis
Mediastinal shift
Consolidation
Lung tumor
Interstitial lung disease (ILD)
Calcification
Infiltration
Other lesion
Nodule/Mass
Pneumonia
Tuberculosis
Lung opacity
Pleural effusion
Pleural thickening
Pulmonary fibrosis
Cardiomegaly
Aortic enlargement
Other diseases
No finding

PERFORMANCE RESULTS:-

Table 1: Segmentation performance on the validation set of VinDr-RibCXR.

Model	Dice	95% HD	Sensitivity	Specificity
U-Net	.765 (.737–.788)	28.038 (22.449–34.604)	.773 (.738–.791)	.996 (.996–.997)
U-Net **w.** EfficientNet-B0	.829 (.808–.847)	16.807 (14.372–19.539)	.844 (.818–.858)	.998 (.997–.998)
FPN **w.** EfficientNet-B0	.807 (.773–.824)	15.049 (13.190–16.953)	.808 (.773–.828)	.997 (.997–.998)
U-Net++ **w.** EfficientNet-B0	.834 (.810–.853)	15.453 (13.340–17.450)	.841 (.812–.858)	.998 (.997–.998)

The effectiveness of the segmentation models was evaluated by Dice score, 95% Hausdor distance (95% HD), sensitivity, and specicity.

Thankyou