# Decomposing Disease Descriptions for Enhanced Pathology Detection: A Multi-Aspect Vision-Language Pre-training Framework

## Supplementary Material

## 1. Implementation details

**Evaluation metrics.** AUC, F1 and ACC are evaluated for classification tasks. The F1 score comprehensively evaluates the model's recall and precision, while ACC stands for Accuracy at a particular threshold. Following [17], we choose the binary prediction threshold for each class to maximize the F1 score with respect to that class. Subsequently, the ACC is evaluated under that threshold. On the other hand, the AUC score summarizes the model's performance across various thresholds and is useful for imbalanced datasets. The final scores are reported by computing the macro averages across all classes.

Dice and IoU metrics are utilized for segmentation tasks. Following [17], for zero-shot segmentation, we search the segmentation threshold with 0.005 interval and report the maximum Dice score the model can achieve.

**Model architecture.** Images are resized into $224 \times 224 \times 3$. We use the first four layers of ResNet50 [8] as our visual backbone ($f_{\text{visual}}$), and adopt an MLP layer to transform the output feature dimension into $d = 256$. The visual encoder outputs feature maps $\mathcal{V} \in \mathbb{R}^{14\times14\times256}$. For the report processing, we extract the entities with a pre-trained Named Entity Recognition (NER) module, as described in [11], and compute the entity embedding using a pre-trained ClinicalBERT [2], with a default embedding dim is $d' = 768$. We obtain 75 entities that most frequently appear in the reports, as indicated in [19]. For the visual aspect-query Transformer, we adopt 4 Transformer Decoder layers with 4 heads. For the loss weights $\alpha$ and $\beta$ of the contrastive loss $\mathcal{L}_{\text{cl}}$ and the supervised cross-entropy loss $\mathcal{L}_{\text{sup}}$, we set $\alpha = 0.1$ and $\beta = 1.0$ via empirical hyper-parameter tuning as discussed in Sec. 3. We set the weight $\gamma$ of the location contrastive loss $\mathcal{L}_{\text{loc}}$ as $\gamma = 1$ following MedKLIP [17]

For zero-shot classification, the model will use a supervised head to infer seen classes and use a contrastive head to recognize unseen classes. Algorithm 1 presents to pseudo-code to perform zero-shot inferencing using our dual-head Transformer model. Note that, we programmatically extract aspect descriptions from unseen diseases. The algorithm for disease aspect generation will be discussed in Section 2.

**Algorithm 1** Dual-head Transformer inference for seen and unseen classes

```
function INFERENCE(dual_model, classes)
    disease_aspects = get_aspect_descriptions(classes)
    healthy_aspects = get_aspect_descriptions(healthy_class)
    supervised_pred = dual_model.supervised_head(disease_aspects)
    contrastive_pred = dual_model.contrastive_head(disease_aspects, healthy_aspects)
    outputs = Empty List
    for class_idx ← 0 to len(classes) do
        if classes[class_idx] ∈ seen_classes then
            class_prediction = supervised_pred[class_idx]      ▷ Use supervised head for seen classes
        else
            class_prediction = contrastive_pred[class_idx]     ▷ Use contrastive head for unseen classes
        end if
        outputs.append(class_prediction)
    end for
    return outputs
end function
```

**Pre-training.** The entity extraction module and the text encoder use pre-trained networks. The visual encoder is initialized with ImageNet pretrained ResNet50, while the fusion module is trained end-to-end. We train on a cluster of 4 A100 GPUs with a batch size of 128 per GPU, leading to a batch size of 512 in total. The model is trained on 60 epochs, where the first 5 epochs are set for warming up. We use AdamW [12] optimizer with a cosine annealing scheduler. The initial learning rate is $1 \times 10^{-4}$ and decreased to the minimum of $1 \times 10^{-5}$ over the course of the training. The first 5 epochs are set for warming up, during which the learning rate linearly increased from $1 \times 10^{-5}$ to the initial

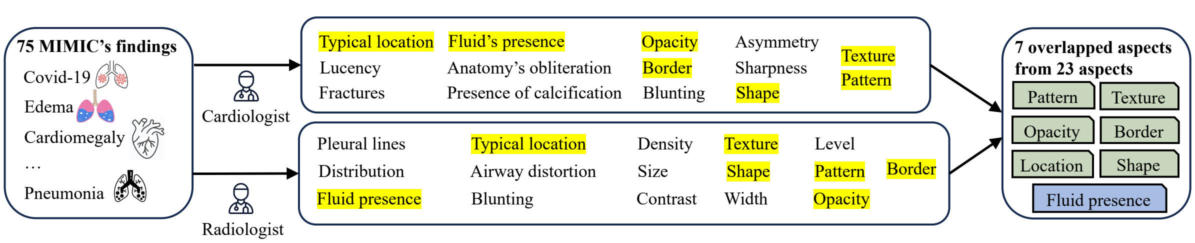


Figure 1. Two medical experts, a board-certified cardiologist and a radiologist, independently annotate visual aspects from 75 medical findings most frequently reported in the MIMIC dataset [19]. The seven in-consensus concepts (highlighted in yellow) are selected.

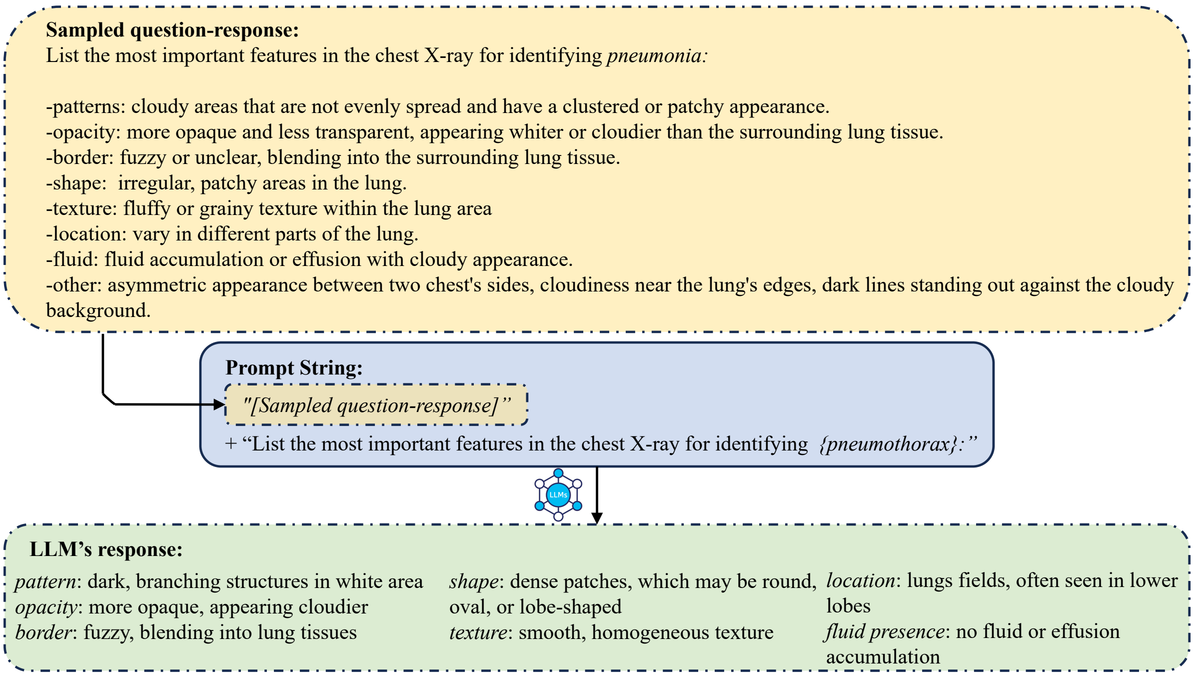


Figure 2. GPT-4 workflow to generate discriminative aspects' descriptions for each disease, using *pneumothorax* as an example. The yellow block shows the sampled response for the *pneumonia* prompt. By pre-pending this learning sampled response in the prompt (blue block), the GPT can mimic the style and format, and output the structured response describing discriminative features for 8 aspects (green block).

learning rate.

**Fine-tuning.** For the downstream tasks, we fine-tune the model which is initialized with the visual backbone of the vision-language pre-trained models. Specifically, for the image classification task, we adopt ResNet50 [8] and initialize its first four layers with the pre-trained visual encoder. For the image segmentation task, we use ResUNet [7] as the backbone and initialize its encoder with our pre-trained image encoder.

**Baselines.** We benchmark our model against recent state-of-the-art medical vision-language pretraining methods, including ConVIRT [20], GLoRIA [9], BioViL [4], BioViL-T [3], CheXzero [15], and MedKLIP [17]. MedKLIP [17] is a concurrent work, which excludes the contrastive loss between image and text features, while applying supervised learning for VLP by extracting the disease terms from reports. CheXzero [15] has shown to have better zero-shot diagnosis ability than radiologists. Since ConVIRT and GLoRIA are pre-trained on an in-house dataset, we re-train their models on the MIMIC-CXR dataset for a fair comparison. For BioViL, BioViL-T, CheXzero, and MedKLIP, we use the officially released models by the authors. For the zero-shot evaluation of each method, we use the prompts as specified by the authors from the corresponding methods.

## 2. Aspect generation pipeline

**Medical entity extraction.** Following a previous work [17], we adopt RadGraph [11] to extract entities (*i.e.*, diseases or any medical findings) in the reports. Given a report $\mathcal{R}_i$, RadGraph module $\phi$ extracts a triplet of $\{\text{entity}, \text{position}, \text{exist}\}$:

$$\phi(\mathcal{R}_i) = \{\text{entity}_t, \text{position}_t, \text{exist}_t\}, t \in [0, t_i]. \quad (1)$$

Here, "Entity" is the medical finding, and "Position" refers to the anatomical body location where the medical finding occurs, as mentioned in a radiology report. For example, the position can be 'right pleural', or 'middle right lobe'. From the triplet, we extract the medical entities $\text{entity}_t$ and its positive presence $\text{exist}_t$ for the report $\mathcal{R}_i$. In total, we obtain 75 entities that most frequently appear in the reports, as indicated in [19].

**Experts' aspect annotations.** We consult two medical experts, a board-certified cardiologist and a radiologist to independently annotate visual aspects from 75 MIMIC's medical findings, as shown in Fig. 1. Specifically, we ask them to identify a set of visual aspects that are *distinctive* and *representative* to classify the disease. Distinctiveness means that the aspects are useful to differentiate the target disease from the others. *Representativeness* means that the aspects need to be discriminative for classifying as many

Table 1. Comparison of Dice scores with other state-of-the-art methods on fine-tuning segmentation tasks. The additional results on Pneumothorax SIIM-ACR [1] are reported. For each disease, three data portions, 1%, 10%, 100% are adopted to show the performance change under different data amounts.

| Diseases | Pneumothorax [1] | | | Pneumonia [14] | | | Covid-19 Rural [6] | | |
|---|---|---|---|---|---|---|---|---|---|
| Data Portion | 1% | 10% | 100% | 1% | 10% | 100% | 1% | 10% | 100% |
| Scratch | 14.24 | 30.58 | 62.43 | 45.29 | 58.42 | 69.75 | 14.09 | 25.97 | 37.83 |
| ConVIRT [20] | 28.75 | 47.21 | 65.75 | 56.48 | 63.94 | 71.87 | 16.97 | 30.79 | 42.71 |
| GLoRIA [9] | 31.87 | 40.61 | 64.82 | 58.13 | 67.71 | 72.06 | 16.12 | 31.20 | 43.85 |
| BioViL [4] | 35.29 | 51.73 | 66.75 | 60.25 | 68.72 | 72.18 | 17.65 | 37.75 | 47.34 |
| MedKLIP [17] | 37.22 | 52.65 | 67.06 | 62.36 | 70.24 | 73.88 | 18.58 | 39.28 | 48.65 |
| Ours | **46.98** | **66.99** | **68.52** | **71.95** | **73.51** | **76.97** | **24.51** | **40.71** | **50.25** |

diseases as possible. Finally, to avoid annotation bias, we only select representative aspects that are in consensus between two annotated sets. To prevent missing other important aspects, we add an extra 'other' aspect as a placeholder for the GPT-4 model to fill in any distinctive features, useful to classify the target disease.

**LLM's aspect descriptions generation.** This section provides the pseudo-code to programmatically query aspect descriptions from an LLM, GPT-4[1]. We use the prompt "List the most important features in the X-ray image for identifying {target_disease}" to query the disease's discriminative features for each aspect. To enforce GPT to provide structured responses on all 8 aspects, we provide a sampled response for one disease so that GPT can mimic the style and the format. The sampled response will be pre-pended to the prompt string and used to query the LLM. Fig. 2 depicts the workflow of GPT-4 to extract aspects' descriptions for each disease. The pseudo-code to generate aspect descriptions from GPT-4 is presented in Algorithm 2. The list of aspect descriptions for 75 MIMIC findings after expert curations is shown in Table 4.

**Limitation discussion.** The aspects are not initially annotated by the medical experts, but by the large language model. Providing the pre-generated descriptions can potentially bias the medical professionals when they correct the annotations. Even though not having fully expert-annotated descriptions, the current post-processing expert-curated descriptions are sufficient to provide discriminative features to differentiate the diseases. The significant improvements over the state-of-the-art models (by up to 17.0%) on 7 downstream datasets across both zero-shot and fine-tuning settings support our claim.

## 3. Additional experimental results

**Fine-tuning on pneumothorax segmentation.** Table 1 shows the results when fine-tuning the vision-language models on the fine-tuning segmentation tasks, notably, the results on Pneumothorax-SIIM [1] are reported. Our model significantly outperforms the second-best model, MedKLIP, on 1% and 10% data portion. This shows the effectiveness of injecting prior knowledge in improving the model's transferability under a low data regime.

**Additional visual results of zero-shot segmentation.** Fig. 3 presents extra visual results of zero-shot visual grounding on Pneumonia [14] and Covid-19 [6] when using different state-of-the-art vision language models. Our proposed MAVL method yields more precise localization than other methods. While MedKLIP and BioViL miss the abnormal regions of Pneumonia in both two examples, our model accurately recognizes their presence. This shows that injecting descriptive visual aspects as in our proposed framework guides the model to recognize subtle pathological patterns in the images.

**Hyper-parameter tuning on weights of loss functions.** Our model has two hyper-parameters $\alpha$ and $\beta$, corresponding to the weights of the contrastive loss $\mathcal{L}_{\text{cl}}$ and the supervised loss $\mathcal{L}_{\text{sup}}$. Table 2 shows the zero-shot classification results when using different values of $\alpha$. The performance is comparably similar, indicating that the model is insensitive to the choice of $\alpha$ between 0.1 and 0.5. It is noted that increasing the value of contrastive loss yields slightly higher benefits to the unseen classes. The performance on the seen classes fluctuates more when setting a higher value $\alpha = 1.0$.

Table 3 shows the hyper-parameter analysis on the weight of supervised loss $\mathcal{L}_{\text{sup}}$, $\beta$. First, the performance of zero-shot classification of seen classes suffers with a low value of $\beta = 0.1$. Second, the zero-shot classification results of unseen diseases are not sensitive to the choice of $\beta$. Increasing the $\beta$ higher than 0.5 also benefits unseen classes. This shows that directly training VL models with supervisory signals also increases the model's generalization on unseen classes. Yet, enforcing supervised learning with stronger signals with $\beta = 1.5$ can harm the generalization of new categories. This is because supervised learning yields compact feature space [18], which can be less flexi-

[1] https://openai.com/gpt-4

**Algorithm 2** Disease Aspect Description Generation

```
Define MIMIC_disease_list = [‘pneumonia’, ‘pneumothorax’, ‘edema’, ...]
Initialize disease_aspects_dict = {}
for each disease in disease_list do
    Define sample_question_resp = “List most important features to identify pneumonia:
     - opacity: ...
     - shape: ...”
    Define base_prompt = sample_question_resp + “List most important for identifying {}”
    Initialize generated_aspects_set = {}
    for disease in MIMIC_disease_list do
        prompt = base_prompt.format(disease)
        generated_aspects_descrip = GPT_API.generate_response(prompt)
        disease_aspects_dict[disease] = generated_aspects_descrip
    end for
end for
Return disease_aspects_dict
```

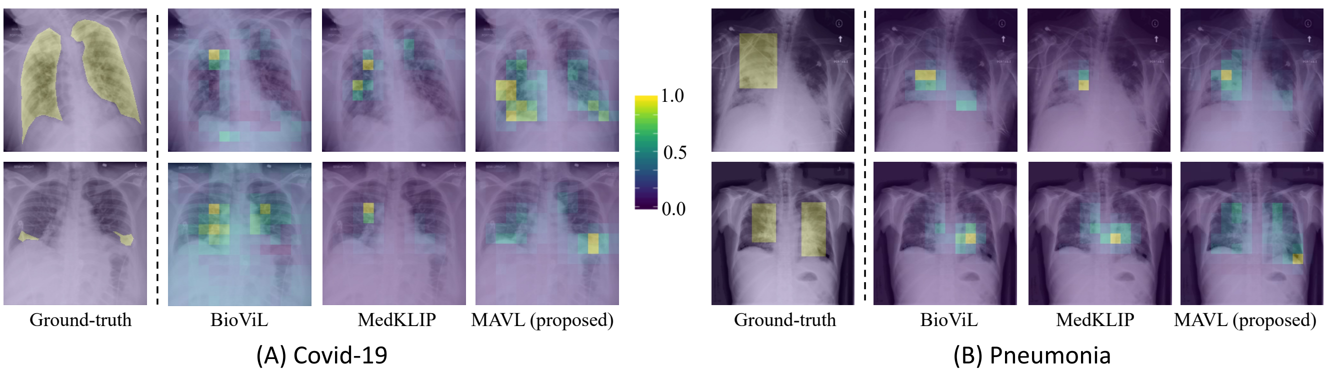


Figure 3. Zero-shot visual grounding results of different methods on Covid-19 (A), and Pneumonia (B). Column 1: Ground truth overlayed on the X-ray image. Column 2: Bio-VL [4]. Column 3: MedKLIP [17]. Column 4: Our proposed MAVL.

Table 2. Zero-shot classification results on 3 datasets with seen classes and 2 datasets with unseen classes when using different values of $\alpha$ for the contrastive loss. Here, $\beta$ is set to a default value of 1.0.

| $\alpha$ - $\mathcal{L}_{\text{cl}}$ | 0.1 | 0.25 | 0.5 | 1.0 |
|---|---|---|---|---|
| CheXpert [10] | 90.13 | 90.30 | 90.38 | 90.06 |
| ChestXray-14 [16] | 73.57 | 73.89 | 73.17 | 73.26 |
| RSNA [14] | 86.91 | 86.98 | 86.47 | 86.13 |
| Covid-19 CXR-2 [13] | 83.86 | 83.98 | 84.10 | 83.91 |
| PadChest-unseen [5] | 70.42 | 70.67 | 70.84 | 70.71 |

Table 3. Zero-shot classification results on 3 datasets with seen classes and 2 datasets with unseen classes when using different values of $\beta$ for the supervised loss. Here, $\alpha$ is set to a default value of 0.1.

| $\beta$ - $\mathcal{L}_{\text{sup}}$ | 0.1 | 0.5 | 1.0 | 1.5 |
|---|---|---|---|---|
| CheXpert [10] | 89.12 | 89.51 | 90.13 | 90.21 |
| ChestXray-14 [16] | 71.90 | 72.87 | 73.57 | 73.80 |
| RSNA [14] | 85.54 | 86.58 | 86.91 | 87.02 |
| Covid-19 CXR-2 [13] | 83.02 | 83.71 | 83.86 | 82.64 |
| PadChest-unseen [5] | 70.04 | 70.38 | 70.42 | 69.83 |

ble to adapt to new classes.

**Per-class results and visual segmentation results.** We analyze per-class AUC scores for zero-shot classification of 14 diseases in the ChestXray-14 [16] dataset. Fig. 4 that our method exceeds the former methods for almost all diseases, showcasing the effectiveness of leveraging pathological visual manifestations on fine-grained disease recognitions.

## References

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Table 4. List of generated aspects of MIMIC's medical findings after experts' curations.

| Findings | Aspect Descriptions |
|---|---|
| Normal | • Border: clear and smooth, with the edge of the lung tissue appearing as a thin, curved line against the ribs.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: fills the chest cavity, from just below the collarbones to just above the diaphragm.<br>• Opacity: balanced, neither too opaque (white) nor too transparent (dark).<br>• Other: symmetric appearance between two chest's sides; clear visibility of the heart, ribs, spine, and diaphragm; bronchial tubes and blood vessels are visible as white lines or tree-branch patterns against the darker lung tissue.<br>• Patterns: no cloudy or patchy areas, no concentrated white or black spots.<br>• Shape: lungs appear as two large, oval or triangular areas on either side of the heart.<br>• Texture: uniform with small, branching white lines representing the bronchi and blood vessels. |
| Clear | • Border: clear, sharp borders of the heart, lungs, and diaphragm.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: no abnormal shadows or spots in any part of the lung.<br>• Opacity: normal transparency, neither too white nor too dark.<br>• Other: symmetric appearance between two chest's sides; diaphragm and costophrenic angles are clearly visible; no abnormal growths or masses.<br>• Patterns: visible bronchial tree and vascular markings without any cloudiness.<br>• Shape: regular, well-defined shapes of the heart, lungs, and diaphragm.<br>• Texture: uniform, with no patchy or cloudy areas. |
| Sharp | • Border: clear and sharp, with a distinct separation from surrounding tissues.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: predictable based on the anatomical structure being viewed. for instance, ribs will be located on either side of the chest.<br>• Opacity: structures such as bones appear very bright or white on the x-ray due to their high density.<br>• Other: bones and other dense structures will stand out clearly against the darker, less dense lung tissue.<br>• Patterns: regular and symmetrical, following the natural pattern of the anatomical structure. for example, ribs will appear in parallel lines.<br>• Shape: sharp, well-defined shapes that follow the natural structure of the anatomical part, like the clear outline of a rib or the spine.<br>• Texture: smooth and uniform, without the patchy or speckled appearance seen in lung tissue. |
| Sharply | • Border: clear, sharp, and distinct, not blending into the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: varies, depending on the part of the lung or chest being examined.<br>• Opacity: normal, balanced transparency and opacity, neither too white nor too dark.<br>• Other: symmetric appearance between two chest's sides; clear lung fields; visible and defined structures such as ribs, heart, and major blood vessels.<br>• Patterns: regular and consistent, not patchy or irregular.<br>• Shape: clear, defined edges and shape, not fuzzy or blurred.<br>• Texture: smooth, regular, and consistent texture. |

Publicly available clinical BERT embeddings. In *Clinical Natural Language Processing Workshop*, pages 72–78, Minneapolis, Minnesota, USA, 2019. Association for Computational Linguistics. 1

| **Findings** | **Aspect Descriptions** |
|---|---|
| Effusion | • Border: clear, sharp border along the top of the effusion.<br>• Fluid: fluid accumulation is the main feature, which causes a cloudy appearance.<br>• Location: typically located at the base of the lungs, between the lung and chest wall.<br>• Opacity: more opaque, appearing whiter or cloudier than the surrounding lung tissue.<br>• Other: possible displacement of other structures such as the heart or trachea; reduction in lung volume; and increased density at the base of the lung.<br>• Patterns: no specific patterns, effusion spreads out in the pleural space.<br>• Shape: typically appears as a meniscus, or curved shape, at the lung base.<br>• Texture: smooth texture, without any grainy or mottled appearance. |
| Pleural Opacity | • Border: borders may be well-defined or blurry, depending on the underlying cause of the opacity.<br>• Fluid: opacities can be caused by fluid accumulation, inflammation, infection, or a mass.<br>• Location: can be in any part of the lung.<br>• Opacity: appears as a white or light gray area on the x-ray, which is denser than the surrounding tissue.<br>• Other: may cause a change in the appearance or position of nearby structures, such as the heart, blood vessels, or airways.<br>• Patterns: may have a patchy or uniform appearance.<br>• Shape: can vary, but usually is irregular or round.<br>• Texture: usually appears solid, without a specific texture. |
| Pneumothorax | • Border: well-defined and sharp, often following the contour of the rib cage.<br>• Fluid: no fluid accumulation, the space is filled with air.<br>• Location: typically seen at the periphery of the lung, often toward the upper part.<br>• Opacity: less opaque and more transparent, often appearing darker than the surrounding lung tissue.<br>• Other: possible shift of the heart and mediastinum to the opposite side; visible pleural line; and reduced lung volume on the affected side.<br>• Patterns: absence of normal lung markings beyond the line of the collapsed lung, giving a 'black' or 'empty' appearance.<br>• Shape: a clear, distinct line indicating the edge of the lung, which has collapsed or become compressed.<br>• Texture: smooth, devoid of the usual markings seen in lung tissue. |
| Edema | • Border: fuzzy or blurred, gradually blending into the surrounding lung tissue.<br>• Fluid: fluid accumulation or effusion with cloudy appearance.<br>• Location: usually affects both lungs and often located at the lung's base.<br>• Opacity: more opaque, and less transparent, appearing like a cloudy or hazy spot.<br>• Other: increased vascular markings, increased heart size, and increased lung volume.<br>• Patterns: uniform density with a b̈at-wingör b̈utterflyp̈attern.<br>• Shape: typically spreads out irregularly, not in a clear, defined shape.<br>• Texture: fine, grainy, or mottled texture within the cloudy area, looking like small, speckled spots. |

[3] Shruthi Bannur, Stephanie Hyland, Qianchu Liu, Fernando Perez-Garcia, Maximilian Ilse, Daniel C Castro, Benedikt Boecking, Harshita Sharma, Kenza Bouzid, Anja Thieme, et al. Learning to exploit temporal structure for biomedical vision-language processing. In *CVPR*, pages 15016–15027, 2023. 2

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| Findings | Aspect Descriptions |
|---|---|
| Atelectasis | • Border: clear or sharp border if there is a total collapse, blurry if partial.<br>• Fluid: fluid accumulation or effusion may be present if atelectasis is due to a blockage.<br>• Location: can be anywhere in the lung, but often near the middle.<br>• Opacity: more opaque, and less transparent, appearing as a dense or white area.<br>• Other: the diaphragm, heart, and trachea may shift towards the affected side; the affected lung may appear smaller; ribs may be closer together on the affected side.<br>• Patterns: no specific patterns. the collapsed area is generally uniform in appearance.<br>• Shape: can be irregular depending on the part of the lung that has collapsed.<br>• Texture: denser, more solid-looking texture in the collapsed area. |
| Tube | • Border: clear and sharp, distinctly separate from the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: depending on its purpose, it could be in the trachea (breathing tube), in the chest cavity (chest tube), or inserted into a blood vessel (central line).<br>• Opacity: can be very opaque, appearing white against the darker lung tissue.<br>• Other: metal markers may be present; can be seen entering or exiting the body; may be connected to outside equipment.<br>• Patterns: no specific patterns, it appears as a straight line or curve.<br>• Shape: generally straight and cylindrical, like a straw or tube.<br>• Texture: smooth with no grainy or mottled texture. |
| Consolidation | • Border: margins are often indistinct, blending into the surrounding lung tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can occur anywhere in the lung but often seen in lower lobes.<br>• Opacity: more opaque, and less transparent, often appearing whiter or cloudier.<br>• Other: possible shift in mediastinum (central organs) towards the affected side if volume loss is present, asymmetric appearance between the two sides of the chest.<br>• Patterns: no specific patterns, but can show an 'air bronchogram' – dark, branching structures within the white, dense area.<br>• Shape: irregular, dense patches which may be round, oval, or lobe-shaped.<br>• Texture: smooth or homogeneous texture within the affected area. |


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| Findings | Aspect Descriptions |
|---|---|
| Abnormality | • Border: irregular or indistinct, not clearly defined against the surrounding area.<br>• Fluid: unexpected fluid accumulation or effusion with a cloudy appearance.<br>• Location: any area of the lung where it does not match its counterpart on the other side.<br>• Opacity: unusual whiteness or darkness compared to surrounding lung tissue.<br>• Other: asymmetry between the two sides of the chest; unexpected objects or shadows; changes in the size or shape of the heart or major blood vessels; or changes in the position of the diaphragm or mediastinum.<br>• Patterns: unusual patterns or clusters of opacity that do not follow regular lung structures.<br>• Shape: unexpected or irregular shapes in areas where lung tissue should be.<br>• Texture: unusual texture, either too smooth or too uneven compared to normal lung tissue. |
| Enlarge | • Border: clear but expanded, extending beyond the normal boundary of the heart.<br>• Fluid: no specific fluid accumulation related to the heart enlargement.<br>• Location: centered in the chest, between the two lungs.<br>• Opacity: more opaque and less transparent, appearing whiter than the surrounding tissue.<br>• Other: widening of the mediastinum (the space between the lungs where the heart is located); displacement of the bronchi, trachea or esophagus; and compressing or pushing the lungs to either side.<br>• Patterns: the enlarged heart will look like a silhouette, its shape clearly outlined against the lighter lung tissue.<br>• Shape: the heart will appear larger and broader than normal, often taking up more than half of the chest's width.<br>• Texture: dense and solid, similar to the surrounding lung tissue. |
| Tip | • Border: clear and sharp, distinctly separating it from the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be located anywhere in the chest, depending on the type of tip.<br>• Opacity: more opaque and less transparent, appearing as a small, bright and dense spot.<br>• Other: metallic appearance, can be seen as a small, bright, and dense spot against the lung's dark background.<br>• Patterns: no specific patterns, usually a single, isolated spot.<br>• Shape: usually round or oval, similar to the tip of a needle or a pin.<br>• Texture: smooth and uniform, without any changes or irregularities. |
| Low | • Border: the borders of the lungs may appear closer to the center of the chest.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: entire lung region.<br>• Opacity: normal or less opaque, depending on the cause of the low lung volume.<br>• Other: flattened diaphragm, narrowed intercostal spaces, the ribs may appear closer together, and the chest may appear smaller.<br>• Patterns: no specific patterns, but the lung fields may appear condensed.<br>• Shape: the heart and mediastinum may appear larger due to the reduced size of the lungs.<br>• Texture: normal texture in the lung area. |

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| Findings | Aspect Descriptions |
|---|---|
| Unremarkable | • Border: clear and sharp borders of the lungs, heart, and diaphragm.<br>• Fluid: no fluid or effusion accumulation, no cloudy appearance.<br>• Location: heart and lungs are positioned normally, and the diaphragm is at the right level.<br>• Opacity: normal and even, neither too white nor too dark.<br>• Other: symmetric appearance between two chest's sides; normal size and positioning of the heart; clearly visible bronchial tubes and blood vessels; no signs of abnormalities or disease.<br>• Patterns: even distribution of lung markings, no patches or spots.<br>• Shape: clear and regular outline of the heart, lungs, and bones.<br>• Texture: uniform and smooth texture of the lungs, indicating normal air-filled spaces. |
| Intact | • Border: clear and distinct borders of lungs, heart, and bones.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: lungs, heart, and bones are in their correct positions.<br>• Opacity: well-balanced opacity, not too white or too dark.<br>• Other: symmetric appearance between two chest's sides; clear rib cage; normal heart size; normal lung volume.<br>• Patterns: evenly spread vascular markings, no abnormal clusters or patches.<br>• Shape: regular, symmetrical shape of lungs and heart.<br>• Texture: smooth, even texture with no abnormal spots or patches. |
| Stable | • Border: clear and well-defined borders of the lungs, heart, and diaphragm.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: all organs and structures in their expected locations.<br>• Opacity: normal transparency, neither too opaque nor too clear.<br>• Other: symmetric appearance between two chest's sides; no irregular or unusual dark or light areas.<br>• Patterns: no unusual or abnormal patterns.<br>• Shape: normal shape of lungs, heart, bones, and other structures.<br>• Texture: smooth, even texture with no unusual spots or patches. |
| Free | • Border: sharp, clear, and distinct line separating the air from other tissues.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be found in various locations, but often seen beneath the diaphragm, around the lungs, or in the chest cavity.<br>• Opacity: less opaque and more transparent, appearing darker compared to other tissues.<br>• Other: asymmetrical appearance between two sides of the chest; visible outline of certain structures like the diaphragm, heart, or lung lobes due to the air outlining these structures.<br>• Patterns: no specific pattern, often appears as a darker or empty space.<br>• Shape: irregular or uneven in shape.<br>• Texture: smooth, without any texture or pattern, similar to an empty space. |


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| Findings | Aspect Descriptions |
|---|---|
| Pneumonia | • Border: fuzzy or unclear, blending into the surrounding lung tissue.<br>• Fluid: fluid accumulation or effusion with cloudy appearance.<br>• Location: vary in different parts of the lung.<br>• Opacity: more opaque and less transparent, appearing whiter or cloudier than the surrounding lung tissue.<br>• Other: asymmetric appearance between two chest's sides, cloudiness near the lung's edges, dark lines standing out against the cloudy background.<br>• Patterns: cloudy areas that are not evenly spread and have a clustered or patchy appearance.<br>• Shape: irregular, patchy areas in the lung.<br>• Texture: fluffy or grainy texture within the lung area, similar to a snowy tv screen. |
| Line | • Border: clear and well-defined, unlike the fuzzy or unclear borders of some other findings.<br>• Fluid: no fluid or effusion accumulation along the line.<br>• Location: can be anywhere, but often seen running vertically or horizontally across the lung field.<br>• Opacity: may vary from opaque to slightly transparent, depending on the material of the line.<br>• Other: lines can be tubes, wires, or other foreign objects; they stand out against the lung tissue and bones as they are often more opaque.<br>• Patterns: lines typically don't have a pattern per se, but multiple lines may cross or intersect.<br>• Shape: straight or curved, but always elongated and narrow.<br>• Texture: smooth and consistent along the length of the line. |
| Congestion | • Border: borders are not clear, blending into the surrounding tissue.<br>• Fluid: possible fluid accumulation or effusion with a cloudy appearance.<br>• Location: often affects both lungs and often located in the lower parts of the lungs.<br>• Opacity: increased opacity, appearing as a whiter or less transparent area.<br>• Other: increased lung volume, increased vascular markings, and possible signs of heart enlargement.<br>• Patterns: non-uniform, patchy distribution of opacity.<br>• Shape: irregular, not clearly delineated.<br>• Texture: grainy, uneven, or mottled texture within the lung area. |
| Catheter | • Border: clear and sharp, distinct from the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation along the catheter line.<br>• Location: depending on the type of catheter, it may be seen entering the body at various points and extending into specific organs or vessels. for example, a central venous catheter often enters at the neck or chest and extends towards the heart.<br>• Opacity: catheter appears very bright or white in comparison to the surrounding tissues.<br>• Other: may have associated hardware, such as ports or discs, visible.<br>• Patterns: straight or slightly curved line, depending on the path the catheter takes through the body.<br>• Shape: long, thin, tube-like structure.<br>• Texture: smooth and consistent, with no grainy or patchy appearance. |

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| Findings | Aspect Descriptions |
|---|---|
| Cardiomegaly | • Border: the borders of the heart may appear rounded or bulging outwards.<br>• Fluid: there may be fluid accumulation around the heart or in the lungs.<br>• Location: the heart is located centrally in the chest.<br>• Opacity: the heart area appears more opaque and less transparent, appearing as a large, white, central mass.<br>• Other: the silhouette of the heart may occupy more than half of the chest's width, making the mediastinum appear wider. the blood vessels may also appear enlarged.<br>• Patterns: no specific patterns, but the overall size and shape of the heart is larger and rounder than normal.<br>• Shape: the heart appears larger than normal, often extending beyond the normal boundaries.<br>• Texture: the texture of the heart doesn't change, but the shape and size are what indicate cardiomegaly. |
| Fracture | • Border: the edges of the fracture are typically sharp and irregular.<br>• Fluid: there may be surrounding soft tissue swelling but no fluid or effusion accumulation within the bone.<br>• Location: can occur in any part of the chest, including the ribs or collarbone.<br>• Opacity: the fracture area will often appear whiter or more opaque than the surrounding tissue.<br>• Other: there may be multiple fractures; the bone ends may overlap or be driven into each other; there may be changes in the alignment of the bone structures.<br>• Patterns: the fractured bone may be displaced or move out of its normal alignment.<br>• Shape: an abnormal, irregular line or break in the continuity of the bone.<br>• Texture: the area around the fracture may be jagged, rough, or splintered. |
| Air | • Border: clear or sharp, especially if air is trapped within a normally solid structure like lung tissue.<br>• Fluid: absence of fluid or effusion accumulation.<br>• Location: can be in various parts of the chest, including the lungs, pleural space, or mediastinum.<br>• Opacity: less opaque or more transparent, often appearing darker or even black.<br>• Other: asymmetric appearance between two chest's sides; dark area; contrast between air-filled spaces and surrounding tissues; hollow, tubular structures in the lung can appear more prominent if filled with air.<br>• Patterns: no specific patterns, typically appearing as clear, dark areas on the x-ray.<br>• Shape: no specific shape, as air can fill different structures in the chest.<br>• Texture: smooth, consistent, and homogenous area without speckles or spots. |
| Tortuous | • Border: clear and distinct, following the path of the blood vessel.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be anywhere in the lung where blood vessels are present.<br>• Opacity: normal or slightly less opaque, the focus is on blood vessels rather than lung tissue.<br>• Other: blood vessels may appear larger or thicker; there might be a gradual change in the vessel's direction.<br>• Patterns: the vessel follows a winding or irregular path, rather than a direct or straight one.<br>• Shape: blood vessels appear twisted or coiled, not following a straight line.<br>• Texture: clear and smooth, as it is the vessel's route that is of interest. |

| Findings | Aspect Descriptions |
|---|---|
| Lead | • Border: clear, sharp, and distinct.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be anywhere, depending on where the lead entered the body.<br>• Opacity: more opaque and less transparent, appearing as bright white spots or lines.<br>• Other: metallic density; may appear as isolated spots or lines; asymmetry between the two sides of the chest; lead objects can cast a shadow or appear brighter than bones.<br>• Patterns: no specific patterns, though lead pellets may cluster together.<br>• Shape: typically round or oval if it's a pellet, or long and thin if it's a line.<br>• Texture: smooth, consistent, and dense. |
| Disease | • Border: the edges of the lungs and other structures may be blurred or sharp, depending on the disease. for example, in emphysema, the borders of the lungs may be less distinct due to the breakdown of lung tissue.<br>• Fluid: if there is fluid in or around the lungs, it can indicate disease. for instance, pleural effusion, which is excess fluid between the layers of the pleura, can be seen in conditions like pneumonia or heart failure.<br>• Location: some diseases may affect specific parts of the lungs. for instance, tuberculosis often affects the upper lobes of the lungs.<br>• Opacity: depending on the disease, some areas of the lungs may appear more opaque (whiter) or less opaque (darker) than normal lung tissue.<br>• Other: additional signs of disease<br>• Patterns: certain diseases can cause specific patterns on the x-ray. for instance, a 'honeycomb' pattern may indicate interstitial lung disease.<br>• Shape: the shape of the lungs and other structures in the chest may be altered. for example, tumors may appear as round, oval, or irregularly shaped masses in the lungs.<br>• Texture: changes in texture can also indicate disease. for example, fibrosis can cause a coarse, irregular texture in the lung tissue. |
| Calcification | • Border: well-defined, sharp, and clear, making the calcified area stand out.<br>• Fluid: typically, no fluid or effusion accumulation.<br>• Location: can occur anywhere in the lungs, but often seen near the heart or major blood vessels.<br>• Opacity: more opaque, appearing brighter or whiter than surrounding tissues.<br>• Other: may be associated with other signs of lung disease or damage, such as fibrosis or scarring.<br>• Patterns: scattered or clustered depending on the cause.<br>• Shape: can vary, but often appears as small, round or irregularly shaped spots.<br>• Texture: dense, hard texture that stands out against softer lung tissue. |
| Prominence | • Border: clear and well-defined, highlighting the prominence of the structure.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: depends on the prominent structure. for example, if a blood vessel is prominent, it will appear in the lung fields; if the heart is prominent, it will appear in the center of the chest.<br>• Opacity: normal or slightly enhanced, not as white as pneumonia or as dark as pneumothorax.<br>• Other: the structure appears larger or more noticeable than usual, such as prominent blood vessels, a large heart, or bulging ribs.<br>• Patterns: no specific patterns, but the structure is more noticeable.<br>• Shape: the shape of the structure is more noticeable or larger than usual.<br>• Texture: normal texture, but the structure appears more pronounced or swollen. |

| Findings | Aspect Descriptions |
|---|---|
| Device | • Border: clear and sharp, as metals have a high density that creates a clear contrast with the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: depends on the device. endotracheal tubes are in the trachea, chest tubes are in the chest wall, pacemakers are in the chest close to the heart, stents are in the blood vessels.<br>• Opacity: typically metallic and very bright white, standing out against the surrounding tissue.<br>• Other: wires or tubes can be seen extending from the device, connecting it to the outside of the body or to other organs. devices might also be attached to the bones or the heart.<br>• Patterns: linear for tubes, box-like for devices like pacemakers, circular or elliptical for stents.<br>• Shape: depends on the device. tubes are long and linear, pacemakers are small and box-like, stents are cylindrical.<br>• Texture: smooth, with uniform density. |
| Engorgement | • Border: the borders of the blood vessels will be clearer and more pronounced.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: typically seen in the blood vessels of the heart and lungs.<br>• Opacity: more opaque, appearing denser or whiter compared to surrounding areas.<br>• Other: enlarged heart, prominent pulmonary artery, and increased lung volume.<br>• Patterns: blood vessels may appear more prominent or crowded, particularly around the heart.<br>• Shape: no specific shape, but the blood vessels of the lung and heart appear larger.<br>• Texture: the blood vessels will appear as thicker, denser lines. |
| Inserted central catheter | • Border: clear and sharp, as the catheter is a solid object.<br>• Fluid: no fluid or effusion accumulation related to the catheter.<br>• Location: inserted in the upper arm and travels towards the large vein above the heart.<br>• Opacity: the catheter appears as a bright, distinct, white line.<br>• Other: may be coiled or kinked in some situations; the catheter's tip should ideally be located at the junction of the superior vena cava and the right atrium in the heart.<br>• Patterns: follows the route of the veins, seen as a white line within the darker vein.<br>• Shape: linear and long, extending from the insertion site towards the heart.<br>• Texture: smooth and consistent, different from the surrounding tissue. |
| Clip | • Border: clear and sharp, distinctly different from the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be found anywhere, but usually seen in the lung or heart area if it's a surgical clip.<br>• Opacity: very opaque or bright white, standing out against the surrounding tissue.<br>• Other: may cast a shadow or appear as a foreign object on the x-ray.<br>• Patterns: no specific patterns, as it is an artificial object.<br>• Shape: often small, rectangular or round, depending on its type.<br>• Texture: smooth and solid, with no texture similar to lung tissue. |

| Findings | Aspect Descriptions |
|---|---|
| Elevation | • Border: normal or clear borders of lung tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: displaced structures, like diaphragm or heart, shifted upwards.<br>• Opacity: normal or unchanged opacity.<br>• Other: increased space below the diaphragm; the heart may appear elongated or stretched; structures like the stomach, liver, or spleen may be pushed down.<br>• Patterns: normal lung patterns, but structures present in abnormal positions.<br>• Shape: displacement or shifting of structures, such as the diaphragm or the heart.<br>• Texture: normal or unchanged texture of the lung tissue. |
| Expand | • Border: clear and well-defined, but may seem stretched or expanded.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: entire lung area, but especially noticeable near the edges.<br>• Opacity: less opaque and more transparent, appearing darker.<br>• Other: increased lung volume, ribs may appear more spaced out, diaphragm may appear flattened due to the lung's expansion.<br>• Patterns: normal lung patterns, but with the overall lung area appearing larger.<br>• Shape: lungs appearing larger or inflated.<br>• Texture: normal lung texture, but with possibly more air spaces visible. |
| Nodule | • Border: well-defined edges that clearly separate it from the surrounding lung tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be found anywhere in the lung.<br>• Opacity: more opaque or whiter than surrounding lung tissue.<br>• Other: size typically less than 3 cm in diameter, uniform in density, can have a hollow or "cavitary" appearance.<br>• Patterns: solitary, isolated spot that stands out from rest of the lung tissue.<br>• Shape: round or oval shape.<br>• Texture: dense, with a consistent texture. |
| Wire | • Border: clear, sharp, and solid line.<br>• Fluid: no fluid or effusion accumulation related to the wire.<br>• Location: can be anywhere depending on where the wire is placed.<br>• Opacity: appears very bright, often white.<br>• Other: stands out against the dark background of lung tissue; it may cross over bones and organs.<br>• Patterns: usually follows a regular linear or curved pattern.<br>• Shape: straight or curved line depending on the shape of the wire.<br>• Texture: smooth and consistent texture. |

| **Findings** | **Aspect Descriptions** |
|---|---|
| Pleural Fluid | • Border: sharp and well-defined, as fluid collects in confined spaces such as the pleural cavity.<br>• Fluid: visible fluid accumulation or effusion, appearing as white or cloudy areas.<br>• Location: typically found at the base of the lung or in the pleural cavity, which is the space between the lung and the chest wall.<br>• Opacity: more opaque and less transparent, appearing whiter or cloudier.<br>• Other: displacement of structures, such as the trachea or heart, away from the fluid. the fluid-filled area can also cause the nearby lung tissue to appear compressed or collapsed.<br>• Patterns: fluid levels can appear as horizontal lines, or as a meniscus (curved line) when the fluid is in the pleural cavity.<br>• Shape: can vary, but often appears in the shape of a crescent or a horizontal line at the base of the lung.<br>• Texture: smooth and homogeneous, similar to a body of water on a calm day. |
| Degenerative | • Border: may become blurred or irregular in areas of bone loss or destruction.<br>• Fluid: typically does not involve fluid accumulation.<br>• Location: can occur in any bone or joint, but common locations include the spine, hips, and knees.<br>• Opacity: variable, can appear more opaque in areas of calcification or bone spur formation.<br>• Other: asymmetry between sides; bone spurs or outgrowths; changes in the shape or alignment of bones or joints; and reduced joint space in areas of cartilage loss.<br>• Patterns: no specific patterns, but may see areas of increased density in areas of calcification or bone growth.<br>• Shape: may show irregular or altered shapes of bones or joints.<br>• Texture: varies, can have a rough or uneven appearance, particularly in areas of joint space narrowing. |
| Pacemaker | • Border: clear and sharp, distinct from the surrounding tissue.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: typically located in the upper left or right chest, just below the collarbone. the leads are visible as thin, bright lines extending into the heart.<br>• Opacity: visible metallic object, brighter and more opaque than the surrounding tissue.<br>• Other: wires (leads) are visible from pacemaker to the heart; the device may be seen under the skin; no lung tissue or bone abnormality associated with it.<br>• Patterns: no specific pattern, but the device and leads are distinct and visible.<br>• Shape: rectangular or rounded, depending on the type of pacemaker.<br>• Texture: smooth, solid, and shiny appearance. |
| Thicken | • Border: sharp or blurry, depending on the stage and severity of the condition.<br>• Fluid: absence or presence of fluid can vary, depending on the underlying condition.<br>• Location: can occur anywhere within the chest cavity, including the lungs and heart.<br>• Opacity: more opaque and less transparent, often appearing whiter or denser than the surrounding tissue.<br>• Other: increased size or mass in the chest, distortion of surrounding structures, or presence of nodules or tumors.<br>• Patterns: may present as concentrated areas of increased density or diffuse thickening throughout the lung.<br>• Shape: can be linear, irregular, or circular, depending on the underlying condition.<br>• Texture: rough or uneven texture, similar to a thick layer of paint. |

| Findings | Aspect Descriptions |
|---|---|
| Marking | • Border: clear but not sharp, as they are usually small and thin.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: spread throughout the lungs, but more prominent near the heart and major blood vessels.<br>• Opacity: usually appears darker against the lighter colored lungs.<br>• Other: increased visibility or density of these markings may suggest certain diseases such as pulmonary edema, fibrosis, or chronic bronchitis.<br>• Patterns: branching or web-like pattern, often following the paths of the blood vessels.<br>• Shape: thin and linear, similar to small branches or tree roots.<br>• Texture: smooth, not chunky or patchy like other lung abnormalities. |
| Scar | • Border: the borders can be clear and sharp if the scar is old or well-defined; however, they can be fuzzy or blurred in the case of a new scar.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can be found anywhere in the lung but often near the place of injury or infection.<br>• Opacity: scar tissue often appears more opaque and less transparent, showing up as a lighter or whitish area.<br>• Other: the size, shape, and appearance of the scar may change over time; may cause distortion or displacement of adjacent structures.<br>• Patterns: no specific patterns, scar tissue appears as an isolated lighter patch.<br>• Shape: usually a round or irregular patch, it might also appear as a linear or band-like structure.<br>• Texture: typically smoother and denser than the surrounding lung tissue. |
| Hyperinflate | • Border: the border of the lungs may be pushed outwards, towards the rib cage.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: affects the entire lung area.<br>• Opacity: normal or slightly less opaque, with increased transparency.<br>• Other: increased lung volume, the heart may appear vertically oriented or elongated, the spaces between the ribs may appear larger than normal.<br>• Patterns: more space between the ribs, and the diaphragm may appear flattened.<br>• Shape: expanded or enlarged size of the lung fields.<br>• Texture: normal or slightly less dense. |
| Blunt | • Border: may be sharp if there's a fracture, or blurred if there's a contusion.<br>• Fluid: potential fluid accumulation, or hemothorax, if there's internal bleeding.<br>• Location: can occur anywhere based on the impact site, often seen in chest wall, ribs, or lung fields.<br>• Opacity: varying opacity depending on the injury, may appear more opaque due to damage or accumulated fluid.<br>• Other: fractured ribs may appear as sharp, jagged lines. lung contusions could appear as cloudy, opaque areas. the shape of the chest cavity may also change due to the blunt force.<br>• Patterns: no specific patterns as it depends on the type and severity of injury.<br>• Shape: may show irregular shapes due to fractures or contusions.<br>• Texture: could vary, potentially grainy or mottled due to internal damage. |

| Findings | Aspect Descriptions |
|---|---|
| Loss | • Border: depending on the type of loss, the border may be clear and sharp or irregular.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can occur in various parts of the lung.<br>• Opacity: less opaque and more transparent, often appearing darker.<br>• Other: asymmetric appearance between two chest's sides; dark area; sharper contrast between the lung and the ribs; reduced lung volume.<br>• Patterns: absence of normal lung patterns, like bronchi or vessels.<br>• Shape: depending on the type of loss, the shape may be irregular or missing entirely.<br>• Texture: smooth, empty, or hollow texture in areas where there should be lung tissue. |
| Widen | • Border: clear and sharp, as it's usually a structural change and not a lesion or disease.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: could be anywhere depending on what structure is widened (e.g., widened mediastinum, widened pulmonary artery).<br>• Opacity: the area of interest appears more solid and less transparent than the surrounding tissue.<br>• Other: a widened structure will often cause a displacement or compression of its neighboring structures. this can cause a change in the shape or position of these structures, making them appear abnormal.<br>• Patterns: no specific patterns, but the structure in question will appear larger than normal.<br>• Shape: enlargement or expansion in an area that should be narrower.<br>• Texture: no specific texture, but rather a dimensional change. |
| Collapse | • Border: clear and sharp boundaries, especially if the collapse is complete.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: can occur in any part of the lung.<br>• Opacity: more opaque and less transparent, appearing whiter compared to surrounding lung tissue.<br>• Other: possible shift of the heart, trachea, and major bronchi towards the affected side; increased visibility of the ribs and the diaphragm on the side of collapse.<br>• Patterns: no specific patterns, but the affected lobe or segment is shrunk in size.<br>• Shape: area of collapse may appear as a linear, wedge-shaped, or rounded opacity depending on the extent of collapse.<br>• Texture: dense, solid texture in the collapsed area. |
| Density | • Border: well-defined borders may suggest denser tissues, while fuzzy or blurred borders can indicate less dense tissues.<br>• Fluid: fluid appears denser or whiter than air-filled spaces, but less dense than bone or other solid tissues.<br>• Location: high density often appears in bones and heart, while low density typically seen in the lungs.<br>• Opacity: the denser the tissue, the whiter or brighter it appears on the x-ray image.<br>• Other: dense areas may cast shadows or obscure other structures on the x-ray image.<br>• Patterns: abnormal patterns in tissue density can indicate diseases or conditions such as tumors or fibrosis.<br>• Shape: irregular or unusual shapes can suggest abnormal tissue density.<br>• Texture: texture can vary depending on the type of tissue; for example, bone appears very dense and white, while air-filled lungs appear darker. |

| Findings | Aspect Descriptions |
|---|---|
| Emphysema | • Border: clear and sharp lung borders.<br>• Fluid: no fluid or effusion accumulation.<br>• Location: often spread evenly throughout the lungs, but more pronounced in upper lobes.<br>• Opacity: less opaque and more transparent, often appearing darker.<br>• Other: flattened diaphragm, increased lung volume, widened spaces between the ribs, and decreased heart size.<br>• Patterns: dark areas of the lung, reduced vascular markings.<br>• Shape: the lungs may appear larger or over-inflated.<br>• Texture: thin, sparse lung tissue, loss of normal markings. |
| Aerate | • Border: entire lung field is clear with sharp, defined borders.<br>• Fluid: no fluid or effusion accumulation is seen.<br>• Location: spreads evenly throughout the lungs.<br>• Opacity: normal, balanced opacity, not too white or too dark.<br>• Other: symmetric appearance between two chest's sides; clear, defined rib and heart outlines.<br>• Patterns: no specific patterns, no patchy or cloudy areas.<br>• Shape: lungs appear clear and well-defined with normal contours.<br>• Texture: smooth, even texture throughout the lung area. |
| Mass | • Border: the edges may be well-defined in some cases, but they can also be irregular or spiculated.<br>• Fluid: there may be fluid accumulation or pleural effusion in some cases, which appears as an additional layer of opacity on the lung's edge.<br>• Location: can occur anywhere in the lung, but often seen near the hilum (the central part of the lung where the bronchi and blood vessels enter).<br>• Opacity: typically more opaque and less transparent, appearing as a dense, white or gray mass.<br>• Other: enlarged lymph nodes in the mediastinum (the area between the lungs), loss of volume in a part of the lung, or displacement of other structures in the chest.<br>• Patterns: single or multiple masses or nodules. the tumor may also cause collapse of the lung or airway obstruction, leading to an area of increased opacity.<br>• Shape: irregular, round or oval shape. can also look like a spiculated mass, which means it has spikes or points sticking out.<br>• Texture: solid, dense, and uniform texture within the mass. |
| Crowd | • Border: borders of the individual bronchovascular structures may become less distinct due to their increased density and crowding.<br>• Fluid: no typical fluid or effusion accumulation.<br>• Location: typically affects both lungs and can occur in any part of the lung.<br>• Opacity: no significant changes in opacity, but closer inspection may show more white or dense areas due to congested vessels.<br>• Other: an overall increased density and crowding of the lung structures, often associated with conditions that lead to fluid accumulation or inflammation, such as heart failure or pneumonia.<br>• Patterns: no specific patterns, but the overall appearance of the lung fields may be more chaotic or cluttered.<br>• Shape: no characteristic shape, but the normal structures of the lung such as the bronchi and vessels may appear more crowded or denser.<br>• Texture: texture of the lung field may appear more cluttered or chaotic due to the increased density of the bronchovascular structures. |

| Findings | Aspect Descriptions |
|---|---|
| Infiltrate | • Border: fuzzy, unclear, blending into the surrounding lung tissue.<br>• Fluid: may or may not have fluid or effusion accumulation, depending on the cause of the infiltrate.<br>• Location: can occur in any part of the lung.<br>• Opacity: more opaque and less transparent, appearing as a cloudy or hazy area.<br>• Other: asymmetric appearance; can be seen as singular or multiple spots, isolated or diffused areas.<br>• Patterns: cloudy areas that are not evenly spread and have a patchy or reticular appearance.<br>• Shape: irregular, not clearly defined, and tends to blend into surrounding lung tissue.<br>• Texture: grainy, patchy, or uneven texture within the cloudy area. |
| Obscure | • Border: the edges may be unclear or fuzzy, blending into the surrounding lung tissue.<br>• Fluid: may or may not show fluid accumulation, depending on the underlying issue.<br>• Location: can be anywhere in the lung, depending on where the issue is.<br>• Opacity: the affected area will be less transparent, appearing as a cloudy or shaded area.<br>• Other: changes in size or shape of lung structures; asymmetry between the two sides of the chest; presence of foreign bodies or masses. note: the term ”obscure” isn't specific to a particular disease or finding. it generally means that an area is hard to interpret or understand on the x-ray due to overlapping structures, poor image quality, or a complex underlying issue. therefore, the features can vary widely.<br>• Patterns: may show non-uniform or irregular patterns within the affected area.<br>• Shape: could be irregular and not well-defined, depending on the underlying issue.<br>• Texture: can be different from the surrounding lung tissue, appearing denser or more grainy. |
| Deformity | • Border: irregular or unusual borders, not clearly defined or straight.<br>• Fluid: no specific fluid accumulation related to deformity itself.<br>• Location: can be anywhere in the chest, but often affects the spine or ribs.<br>• Opacity: varies depending on the type of deformity. some areas may be more opaque or less transparent.<br>• Other: disproportionality between different parts of the chest, misalignment of the spine or ribs, asymmetry between two sides of the chest.<br>• Patterns: abnormal patterns, such as twisted or curved lines, or areas of unusual density.<br>• Shape: abnormal shape of the chest, spine, ribs, or other parts of the chest. it might appear twisted, curved, or irregular.<br>• Texture: varies depending on the type of deformity. some areas may have a different texture than the surrounding tissue. |
| Hernia | • Border: clear, distinct, and well-defined.<br>• Fluid: no fluid or effusion accumulation unless the hernia is strangulated, which might show fluid-filled bowel loops.<br>• Location: depends on the type of hernia, but commonly near the abdomen or diaphragm.<br>• Opacity: can vary, but often appears as a darker, round or oval shape in the chest or abdomen area.<br>• Other: displacement of adjacent structures, for instance, pushing the lung tissue away; can also see the presence of bowel loops or fat within the chest.<br>• Patterns: usually a single, isolated shape, but can also appear as multiple shapes if there are multiple hernias.<br>• Shape: typically round or teardrop-shaped.<br>• Texture: it can appear empty or filled, depending on the contents of the hernia. |

| Findings | Aspect Descriptions |
|---|---|
| Drainage | • Border: clear and sharp, showing the outline of the draining tube.<br>• Fluid: fluid accumulation or effusion may be seen near the tube, but it usually decreases over time as the drainage process continues.<br>• Location: anywhere within the chest cavity; often seen near the lung's periphery, but can also be central, depending on where the drainage tube is placed.<br>• Opacity: variable depending on the drained fluid but generally appears less opaque than the surrounding lung tissue.<br>• Other: presence of the radiopaque line of the drainage tube, and possible decrease in size of any previously noted fluid collections or lung opacities.<br>• Patterns: no specific patterns, the drainage tube appears as a clear tubular structure.<br>• Shape: tubular with a clear defined shape, often showing a hollow interior.<br>• Texture: smooth texture within the tube and around it. |
| Distention | • Border: clear and sharp, but the structures may appear larger or more pronounced.<br>• Fluid: no fluid or effusion accumulation unless distention is due to a disease that causes fluid buildup.<br>• Location: can affect any part of the chest, including the heart, lungs, or diaphragm.<br>• Opacity: normal or slightly more opaque, depending on the cause of the distention.<br>• Other: increased size of certain structures; displacement of structures; overall crowded appearance.<br>• Patterns: no specific patterns, but there may be displacement of structures.<br>• Shape: enlargement of certain structures, such as the heart, lungs or diaphragm.<br>• Texture: smooth or uniform, but the overall lung field may appear crowded or compressed. |
| Shift | • Border: no specific border changes related to shift.<br>• Fluid: may be present, particularly if the shift is due to a large pleural effusion (fluid around the lung) or pneumothorax (air in the chest outside the lung).<br>• Location: a shift usually refers to the movement of the mediastinal structures away from their usual central position and could be towards any part of the chest.<br>• Opacity: no specific opacity changes related to shift.<br>• Others: the diaphragm, which should be a mirror image on both sides, may also appear displaced or elevated on the side of the shift. there may also be evidence of lung collapse or atelectasis on the side opposite to the shift.<br>• Patterns: asymmetry between the two sides of the chest, with the mediastinal structures appearing closer to one lung than the other.<br>• Shape: the mediastinal structures (heart, trachea, major vessels) may appear shifted or off-center.<br>• Texture: no specific texture changes related to shift. |
| Stent | • Border: sharp and clear, distinctly separating the stent from the surrounding tissue.<br>• Fluid: no fluid accumulation or effusion.<br>• Location: usually located in the region of the heart or major blood vessels.<br>• Opacity: more opaque and less transparent, appearing as a bright white line or tube.<br>• Other: symmetric appearance, contrast between the bright stent and the darker surrounding tissues, clear visibility of the stent's entrance and exit points.<br>• Patterns: no specific patterns, just a distinct, linear structure that stands out against the darker background.<br>• Shape: clear and defined shape, often straight or slightly curved, resembling a small pipe or tube.<br>• Texture: smooth and uniform, with no variations or irregularities. |

| Findings | Aspect Descriptions |
|---|---|
| Pressure | • Border: normal or distorted depending on the cause.<br>• Fluid: possible fluid accumulation or effusion if the pressure is caused by a mass or tumor.<br>• Location: may affect any part of the chest, depending on the source of pressure.<br>• Opacity: depending on the cause, can vary from normal to more opaque or transparent. for instance, lung collapse due to pressure would appear more opaque.<br>• Other: displacement of structures, such as the heart or trachea; possible rib deformities or fractures if pressure is due to trauma.<br>• Patterns: no specific patterns, changes would be related to the cause of pressure.<br>• Shape: abnormalities such as a shift in the position of the mediastinum or diaphragm, or changes in the size and shape of the lungs.<br>• Texture: usually normal unless there is a lung collapse or fluid accumulation. |
| Lesion | • Border: may have a well-defined border, or it could be fuzzy and unclear.<br>• Fluid: absence or presence of fluid can indicate different types of lesions.<br>• Location: can appear anywhere in the lung.<br>• Opacity: more opaque and less transparent, appearing whiter or darker compared to the surrounding lung tissue.<br>• Other: size can vary, calcification may be present in some lesions, and if the lesion is growing, it can cause a shift in surrounding structures.<br>• Patterns: solitary or multiple depending on the type of lesion.<br>• Shape: could be a round, oval, or irregular spot, often with a clear, sharp edge.<br>• Texture: solid or hollow, depending on the type of lesion. |
| Finding | • Border: borders that are blurred, irregular, or abnormally sharp could indicate a disease or condition.<br>• Fluid: fluid accumulation or effusion with a cloudy appearance could indicate an issue.<br>• Location: note if the finding is in an unusual location or if there is asymmetric appearance between two sides of the chest.<br>• Opacity: this will depend on the finding, but generally, anything that appears unusually dark or light could be significant.<br>• Other: any other findings that seem out of the ordinary, such as unexplained shadows, lines, or spots, could be significant. increased or decreased lung volume could also be indicative of a condition or disease.<br>• Patterns: unusual patterns, such as spots, streaks, or clusters, could be significant.<br>• Shape: look for any structures that appear misshapen, distorted, or out of place.<br>• Texture: any areas that appear grainy, mottled, patchy, or have a different texture from the surrounding tissue could indicate a problem. |
| Borderline | • Border: clear and distinct from the surrounding lung tissue.<br>• Fluid: no fluid accumulation or effusion is usually visible in this condition.<br>• Location: centered in the chest, between the lungs.<br>• Opacity: the heart area appears white and opaque compared to surrounding tissue.<br>• Other: the heart occupies more than half of the chest's width, but not significantly larger; the lung fields will appear normal, without opacity or fluid accumulation; there may be displacement of the surrounding structures due to the increased heart size.<br>• Patterns: consistent and symmetrical on both sides.<br>• Shape: the heart silhouette is round or oval, but larger than normal.<br>• Texture: smooth, consistent, and homogeneous texture. |

| Findings | Aspect Descriptions |
|---|---|
| Hardware | • Border: very clear, sharp edges, unlike the blurry or fuzzy edges of lung or other soft tissue.<br>• Fluid: not typically associated with fluid accumulation, but could be surrounded by fluid if there's a complication.<br>• Location: can be anywhere, depending on the type of hardware, but most commonly seen in the chest wall, spine, surrounding the heart, or within the lungs.<br>• Opacity: very opaque, appearing as bright white objects.<br>• Other: casting of shadows, presence of surgical clips, wires, or sutures.<br>• Patterns: often geometrical, may resemble known objects, such as the shape of screws, plates, valves, wires, tubes, or pacemakers.<br>• Shape: the shape of the hardware can be very different, but it is often linear or geometric.<br>• Texture: smooth and well-defined, unlike the softer textures in lung tissue. |
| Dilation | • Border: the borders of the dilated structures are well-defined and may appear thicker or more prominent.<br>• Fluid: no fluid or effusion accumulation typically associated with dilation.<br>• Location: the location of dilation can vary, but it is usually visible in the area of the bronchial tubes.<br>• Opacity: the area of dilation may be more transparent or darker due to the increased air content.<br>• Other: increased lung volume, visible air-filled spaces, and distortion of nearby structures.<br>• Patterns: no specific patterns, but the affected structure may show a tubular or cylindrical pattern due to dilation.<br>• Shape: an enlarged and distorted shape of the bronchial tubes or other structures.<br>• Texture: the texture inside the dilated area might appear smooth due to increased air content. |
| Congestive heart failure | • Border: the outline of the heart may appear fuzzy or blurred.<br>• Fluid: fluid accumulation or effusion in the lung fields and around the heart.<br>• Location: the heart, located in the center of the chest, is the main organ affected.<br>• Opacity: more opaque, appearing as white or cloudy around the heart region.<br>• Other: widening of the vascular markings, particularly in the upper lung fields; presence of pleural effusion (fluid in the space between the lungs and chest wall); increased lung volume.<br>• Patterns: fluid accumulation may appear in a butterfly or bat-wing pattern in the lungs.<br>• Shape: heart appears enlarged and rounder than normal.<br>• Texture: grainy texture in the lung fields due to fluid accumulation. |
| Redistribution | • Border: no specific border, normal lung fields.<br>• Fluid: no fluid or effusion accumulation unless there's a concurrent condition.<br>• Location: vessels in the upper part of the lungs appear larger and more numerous than usual.<br>• Opacity: normal or slightly more opaque, depending on the underlying cause.<br>• Other: heart size may appear larger, especially if the redistribution is due to heart failure.<br>• Patterns: appearance of more blood vessels in the upper part of the lungs and fewer in the lower part.<br>• Shape: no specific shape, it's more about the redistribution of blood vessels.<br>• Texture: no specific texture, normal lung fields. |

| Findings | Aspect Descriptions |
|---|---|
| Aspiration | • Border: unclear or fuzzy, blending into the surrounding lung tissue.<br>• Fluid: possible fluid accumulation, appearing as a dense, cloudy area.<br>• Location: usually in the right lower lobe of the lung, but can be in any part depending on the position of the patient when aspiration occurred.<br>• Opacity: more opaque, appearing denser or whiter than the surrounding lung tissue.<br>• Other: presence of a foreign body or object; collapsed lung tissue around the aspirated material; and possible widened mediastinum if the aspirated material is in the central airways.<br>• Patterns: dense patch or cloud that is not uniformly spread out.<br>• Shape: irregular, with no specific shape, appearing as a patch or cloud in the lung.<br>• Texture: appears grainy or fluffy, similar to a hazy cloud. |
| Abnormal observation | • Border: borders might be fuzzy, blurred, or sharp depending on the nature of the disease.<br>• Fluid: fluid accumulation or effusion may or may not be present.<br>• Location: can occur anywhere within the chest, including in the lungs, heart, or bones of the chest wall.<br>• Opacity: may vary widely depending on the specific disease, but often includes abnormal white or dark spots.<br>• Others: abnormalities in the size or shape of the heart, unusual bone structures, or any other unusual features not typically seen in a healthy chest x-ray.<br>• Patterns: patterns can vary widely, but any unusual or asymmetric pattern might be indicative of a rare disease.<br>• Shape: irregular shapes, nodules, or masses that do not normally appear in the lungs.<br>• Texture: could be grainy, mottled, or dense depending on the disease. |
| Covid19 | • Border: fuzzy or unclear, blending into the surrounding lung tissue.<br>• Fluid: no specific fluid accumulation or effusion.<br>• Location: typically affects both lungs and often located at the lung's edges or periphery.<br>• Opacity: bilateral and peripheral ground-glass opacities, appearing as hazy, gray areas in the lungs.<br>• Other: "crazy-paving" pattern, which resembles irregularly placed paving stones. it's seen as a combination of ground-glass opacity and interlobular septal thickening. asymmetry between the two lungs is often observed.<br>• Patterns: multifocal patchy consolidation, appearing as several cloudy areas that are not evenly spread.<br>• Shape: irregular, round, patchy areas in the lung.<br>• Texture: fluffy, grainy or frosted glass appearance within the lung area. |

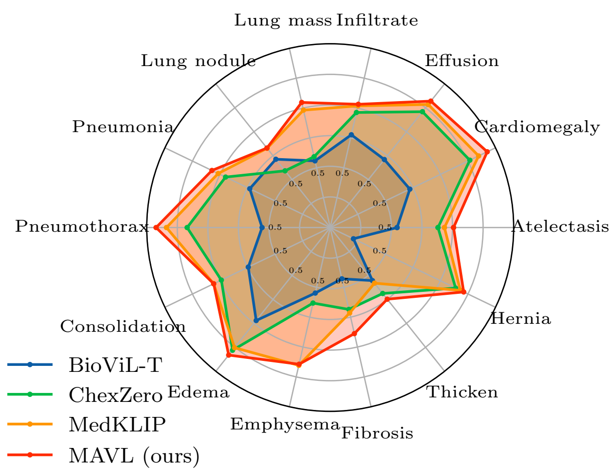


Figure 4. Per-class AUC scores on the 14 fine-grained disease categories in the ChestXray-14 dataset.