

# MedTVT-R1: A Multimodal LLM Empowering Medical Reasoning and Diagnosis

## Supplementary Material

### 1. Details About the Prompts of MedTVT-QA's Construction

This section presents the detailed prompts used in constructing the MedTVT-QA dataset. The MedTVT-QA dataset is built upon multi-modal medical information, and each QA pair is generated through carefully designed instruction prompts to guide large language models in producing clinically coherent reasoning and answers. Specifically, four specialized prompt templates were developed, each corresponding to a different medical data modality or integration scenario:

- **ECG-QA:** targets electrocardiogram interpretation, instructing the model to synthesize the provided ECG labels, explain their clinical relevance, and form a concise summary.
- **CXR-QA:** designed for chest X-ray analysis, focusing on summarizing global findings, identifying abnormalities, and suggesting possible diagnoses based on radiology reports.
- **LAB-QA:** covers blood test analysis, guiding the model to categorize and interpret a comprehensive set of laboratory indicators across multiple physiological systems.
- **Disease-QA:** integrates ECG, CXR, and laboratory results to perform multi-modal diagnostic reasoning, ensuring all listed diseases are supported by explicit evidence from each modality.

These prompts encapsulate the role setting, task description, answer guidance, and, when necessary, a specified output format. By structuring the task in this manner, the generated QA pairs not only reflect realistic clinical workflows but also support reasoning transparency and reproducibility. The following subsections list the exact prompt texts used during dataset construction.

#### ECG-QA Prompt

**Role Setting:** You are a renowned cardiologist with expertise in interpreting electrocardiograms (ECGs).

**Task Description:** The ECG analysis has yielded the following labels: {labels}. Based on these labels, please address the question: {question}.

**Answer Guidance:** Your response should incorporate all relevant labels, excluding any unrelated ones. Provide a synthesis of the labels, focusing on clinical significance.

**Answer Format:** Begin with a brief introduction to your analysis. Provide detailed explanations for each specific ECG label. Offer a concise summary.

#### CXR-QA Prompt

**Role Setting:** You are a radiology expert with expertise in interpreting chest X-ray image.

**Task Description:** The chest X-ray report is given {report}. Base on the given chest X-ray report, answer the question {question}.

**Answer Guidance:** Describe the overall condition of the lungs, heart, and chest cavity in the image. Identify and explain any abnormal findings such as shadows, opacities, effusions, or masses. Provide possible diagnoses.

#### LAB-QA Prompt

**Role Setting:** Please analyze this set of blood test data as a medical professional.

**Task Description:** This is the question: {question}. The following are the lab data: "Hematocrit": {data[0]}; "Platelet Count": {data[1]}; "Creatinine": {data[2]}; "Potassium": {data[3]}; "Hemoglobin": {data[4]}; "White Blood Cells": {data[5]}; "MCHC": {data[6]}; "Red Blood Cells": {data[7]}; "MCV": {data[8]}; "MCH": {data[9]}; "RDW": {data[10]}; "Urea Nitrogen": {data[11]}; "Sodium": {data[12]}; "Chloride": {data[13]}; "Bicarbonate": {data[14]}; "Anion Gap": {data[15]}; "Glucose": {data[16]}; "Magnesium": {data[17]}; "Calcium, Total": {data[18]}; "Phosphate": {data[19]}; "INR(PT)": {data[20]}; "PT": {data[21]}; "PTT": {data[22]}; "B-sophils": {data[23]}; "Neutrophils": {data[24]}; "Monocytes": {data[25]}; "Eosinophils": {data[26]}; "Lymphocytes": {data[27]}; "RDW-SD": {data[28]}; "H+": {data[29]}; "L": {data[30]}; "T": {data[31]}; "Alanine Aminotransferase (ALT)": {data[32]}; "Aspartate Aminotransferase (AST)": {data[33]}; "Lactate": {data[34]}; "Alkaline Phosphatase": {data[35]}; "Bilirubin, Total": {data[36]}; "pH": {data[37]}; "Albumin": {data[38]}; "Base Excess": {data[39]}; "pO2": {data[40]}; "Calculated Total CO2": {data[41]}; "pCO2": {data[42]}; "Absolute Neutrophil Count": {data[43]}; "Absolute Eosinophil Count": {data[44]}; "Absolute Monocyte Count": {data[45]}; "Absolute Basophil Count": {data[46]}; "Absolute Lymphocyte Count": {data[47]}; "Creatine Kinase (CK)": {data[48]}; "Immature Granulocytes": {data[49]}.

**Answer Guidance:** These data comprise 50 different indicators, categorized into seven main classes: routine blood indicators, electrolyte and metabolic indicators, renal function indicators, liver function indicators, acid-base balance and gas exchange, coagulation function indicators, and other indicators.

**Answer Format:** Begin with a brief introduction to your analysis.

**routine blood indicators:** explanation

**electrolyte and metabolic indicators:** explanation

**renal function indicators:** explanation

**liver function indicators:** explanation

**acid-base balance and gas exchange:** explanation

**coagulation function indicators:** explanation

**other indicators:** explanation

Finally, offer a concise summary.

## Disease-QA Prompt

**Role Setting:** You are a renowned diagnostician with expertise in integrating ECG, CXR, and blood test results.

**Task Description:** The following diagnostics have been provided:

- ECG Analysis: {ecg\_report}
- CXR Analysis: {cxr\_report}
- Blood Test Analysis: {blood\_test\_report}
- Diseases: {result\_diseases}

You need to pretend that the ECG, CXR, and blood test analyses are based on your interpretation of the raw data, and the final diagnosis is your synthesis of these three diagnostic methods, please address the question: {question}

**Answer Guidance:** Please find definitive evidence from the ECG, CXR, and blood test results, leveraging the complementarity and mutual corroboration of these three modalities, to robustly prove the reasons why the patient has the diseases I provided. Your response must include every disease I provided, using the exact wording I provided, and you must not mention any diseases other than those I provided. Please make sure to provide evidence for these diagnoses! These are confirmed conditions.

**Answer Format:** <think>{Diagnostic evidence synthesized from the three modalities}</think>\n <answer>{disease1; disease2; ...}</answer>

## 2. Label Distribution of MedTVT-QA

When constructing the physiology-level ECG-QA dataset, we filtered out invalid ECG labels to ensure that the final labels align with morphology descriptions at the physiological level. Additionally, we conducted a detailed statistical analysis of the labels in the ECG-QA training data. As shown in Table 1, it presents ECG labels with occurrences greater than 100 along with their respective counts.

Label	Count
extensive st-t changes may be due to myocardial ischemia	143
possible left ventricular hypertrophy	150
abnormal r-wave progression, early transition	102
inferior infarct, old	123
ventricular premature complex	119
possible septal infarct - age undetermined	188
right axis deviation	141
lateral st-t changes may be due to myocardial ischemia	227
inferior/lateral st-t changes may be due to myocardial ischemia	167
iv conduction defect	376
generalized low qrs voltages	161
qrs changes v3/v4 may be due to lvh but cannot rule out anterior infarct	103
lateral t wave changes may be due to myocardial ischemia	106
rbbb with left anterior fascicular block	314
extensive st-t changes may be due to hypertrophy and/or ischemia	135
normal ecg	753
normal ecg except for rate	334
abnormal ecg	4761
borderline ecg	2074
inferior/lateral st-t changes may be due to hypertrophy and/or ischemia	116
lateral st-t changes may be due to hypertrophy and/or ischemia	112

Table 1. ECG labels and counts (>100) in ECG-QA dataset.

Label	Count
sinus rhythm with 1st degree a-v block	140
sinus rhythm	4033
atrial fibrillation	761
sinus tachycardia	1565
consider acute st elevation mi	161
atrial fibrillation with rapid ventricular response	224
age not entered, assumed to be 50 years old for purpose of ecg interpretation	328
sinus bradycardia	402
sinus rhythm with pac(s)	132
sinus rhythm with borderline 1st degree a-v block	121
pacemaker rhythm - no further analysis	160
leftward axis	435
possible left anterior fascicular block	138
rightward axis	164
probable left atrial enlargement	224
low qrs voltages in precordial leads	540
st junctional depression is nonspecific	149
possible inferior infarct - age undetermined	425
lateral t wave changes are nonspecific	328
short pr interval	167
inferior t wave changes are nonspecific	312
left ventricular hypertrophy	428
lvh with secondary repolarization abnormality	285
left axis deviation	1067
poor r wave progression - probable normal variant	538
indeterminate axis	108
possible anterior infarct - age undetermined	511
anterior t wave changes are nonspecific	182
possible left atrial abnormality	271
inferior/lateral st-t changes are nonspecific	240
prolonged qt interval	618
possible anteroseptal infarct - age undetermined	254
septal t wave changes are nonspecific	134
right bundle branch block	517
lateral st-t changes are nonspecific	289
anteroseptal infarct - age undetermined	129
left anterior fascicular block	202
extensive st-t changes are nonspecific	111
inferior infarct - age undetermined	550
rsr'(v1) - probable normal variant	199
left bundle branch block	354
low qrs voltages in limb leads	395

Figure 1 presents an example report from the MIMIC-IV-CXR dataset, used in constructing CXR-QA. The report contains some unclear and unrelated content to the CXR image description. By applying the previously described CXR prompts, we transformed the report into a more organized and focused description centered on CXR.

Figure 1. An CXR report example from MIMIX-IV-CXR-report dataset.

#### FINAL REPORT

**EXAMINATION:** CHEST (PA AND LAT)

**INDICATION:** ...F with new onset ascites // eval for infection

**TECHNIQUE:** Chest PA and lateral

**COMPARISON:** None.

**FINDINGS:** There is no focal consolidation, pleural effusion or pneumothorax. Bilateral nodular opacities that most likely represent nipple shadows. The cardiomeastinal silhouette is normal. Clips project over the left lung, potentially within the breast. The imaged upper abdomen is unremarkable. Chronic deformity of the posterior left sixth and seventh ribs are noted.

**IMPRESSION:** No acute cardiopulmonary process.

Disease-level labels are derived from the MIMIC-IV-ECG-EXT-ICD [1] dataset, with these labels stored as ICD-10 codes. Each sample may correspond to multiple disease categories. We filtered out diseases for which evidence could not be found in ECG, CXR, or LAB data. Ultimately, we identified seven main categories: Coronary Artery Disease, Acute Renal Failure, Hypertension, Atrial Fibrillation, Pneumonia, Diabetes Mellitus, and Sepsis, along with some subclasses within these categories. Details are provided in Table 2.

### 3. Examples of QA Pairs Corresponding to Each Modality

This section provides examples of question-answer pairs corresponding to each modality (e.g., ECG, CXR, LAB) in the MedTVT-QA dataset.

#### ECG-QA Example

**Question:** What information can be derived from the ECG <ecg>?

**Answer:** ECG Analysis: Upon evaluating the electrocardiogram (ECG), the following observations can be made:

1. Sinus Rhythm: The heart is under the control of the sinoatrial (SA) node, which is the natural pacemaker. This finding suggests that the electrical activity of the heart is originating from the SA node and progressing through the normal conduction pathway, leading to a regular rhythm. This is a foundational indicator of organized cardiac activity.

2. Left Bundle Branch Block (LBBB): There is evidence of delayed or disrupted conduction through the left bundle of the heart's electrical conduction system. This results in a characteristic pattern on the ECG, with a widened QRS complex ( $\geq 120$  ms) and specific morphologies in leads, such as a broad, notched appearance in V5-V6 and an absence of normal septal depolarization. LBBB may occur in conditions like ischemic heart disease, cardiomyopathy, or hypertension-induced structural changes, though it can also occasionally be found in asymptomatic individuals.

**Summary:** The heart demonstrates a sinus rhythm, indicating normal initiation of electrical activity. However, the presence of a left bundle branch block signifies an abnormality in electrical conduction, often associated with underlying cardiac pathology. As a whole, this ECG is classified as abnormal due to the conduction disturbance, warranting further investigation to assess structural or functional cardiac issues.

#### CXR-QA Example

**Question:** Would you mind explaining the findings on my chest X-ray <cxr>?

**Answer:** Based on the evaluation of your chest X-ray image, the lungs appear overall unchanged from prior assessments, indicating no new substantial developments. There is no evidence of acute cardiopulmonary disease, which means there are no significant new concerns regarding your heart or lungs. Specifically, there are no signs of pneumonia, which would typically appear as clouded or consolidated areas in the lung fields. Similarly, there is no vascular congestion; this would generally be associated with heart-related problems affecting the lung's blood vessels and is absent in this image. Additionally, there is no pleural effusion, which would be fluid accumulation in the space between the lungs and chest wall.

However, there is a notable finding of a dense streak of atelectasis at the left base of the lung, which is a condition where a part of the lung collapses or does not inflate properly, resulting in that portion not being fully functional. This streak appears denser than usual tissue, indicating that a segment of the lung at the left base may not be fully expanded or aerated. Atelectasis can result from various causes, such as mucus blocking an airway, external pressure on the lung, or post-surgical changes.

Despite this abnormality, the absence of acute cardiopulmonary disease indicators is reassuring. The streak of atelectasis should be monitored, and clinical correlation with your symptoms is important. Continuous observation or additional imaging might be recommended to ensure there are no underlying issues contributing to this finding. Always consult with your healthcare provider to discuss the implications of these findings based on your clinical history and symptoms.

#### LAB-QA Example

**Question:** Would you be able to undertake a comprehensive examination of this patient's blood panel <lab>, including the reference ranges and clinical implications associated with all abnormal values?

**Answer:** Comprehensive Blood Panel Analysis: This blood test reflects multiple systemic functions. I will analyze the provided values across seven categories, indicating normal findings and clinical implications for abnormal or missing data.

**Routine Blood Indicators:** Hematocrit, hemoglobin, red blood cells, MCV, and MCHC fall within normal ranges, suggesting typical oxygen-carrying capacity and erythrocyte health. RDW is borderline high, which could indicate subtle variability in red cell size, potentially pointing toward early nutritional deficiencies or mild anemia. Platelet count and white blood cells are normal, showing adequate clotting potential and immune activity. All differential leukocyte percentages are within normal ranges, reflecting balanced immunity.

**Electrolyte and Metabolic Indicators:** Potassium, sodium, magnesium, bicarbonate, and phosphate are within normal ranges, indicating balanced electrolytes and acid-base homeostasis. However, chloride is mildly low (97.0), potentially reflecting minor electrolyte imbalance or compensatory metabolic alkalosis. Glucose is significantly elevated (185.0), possibly suggesting poorly controlled diabetes mellitus or acute hyperglycemia. Lactate is elevated (4.6), which could suggest tissue hypoxia or metabolic distress. Calcium is borderline low (8.5), potentially indicating subtle hypocalcemia warranting further evaluation.

**Renal Function Indicators:** Creatinine is within the high-normal range, which might raise concerns for early renal insufficiency depending on age/gender. Urea nitrogen is elevated, possibly indicating dehydration, increased protein metabolism, or mild renal dysfunction.

**Liver Function Indicators:** ALT, AST, bilirubin, and alkaline phosphatase values are missing and assumed normal, precluding further analysis.

**Acid-Base Balance and Gas Exchange:** With missing pH and gas exchange values, bicarbonate is normal but anion gap is elevated (22.0), potentially indicating metabolic acidosis from lactate accumulation or unmeasured ions.

**Coagulation Function Indicators:** INR, PT, and PTT are missing and presumed normal, suggesting no overt coagulation abnormalities.

**Other Indicators:** Data gaps in albumin, base excess, and other parameters limit full metabolic insight.

**Summary:** Elevated glucose and lactate suggest metabolic dysregulation. Elevated urea nitrogen and borderline creatinine warrant renal assessment. Mild hypocalcemia and low chloride need further exploration. Elevated anion gap hints at underlying acidosis. Follow-up tests are recommended for confirmation and diagnosis refinement.

## 4. Further Analysis

**Disease Co-occurrence Structure and Error Patterns.** As shown in Figure 2, the predicted co-occurrence matrix largely preserves the topology of the ground truth, recovering clinically plausible comorbidity clusters (e.g., hypertension–diabetes–coronary artery disease and hypertension–atrial fibrillation). Pairwise counts are modestly inflated in prediction, suggesting that the model leverages co-occurrence priors and tends to overproduce multi-label sets. The error profile in Figure 2 indicates systematic difficulty on lab-driven conditions. Diabetes mellitus and acute renal failure exhibit both high false positives and false negatives, pointing to unstable evidence due to missing labs, or heterogeneous diagnostic criteria. Sepsis also shows elevated false negatives, consistent with episodic onset and sparse specific biomarkers. In contrast, atrial fibrillation skews toward false negatives more than false positives, hinting at a conservative decision boundary or sensitivity to ECG noise/quality. Overall, the model learns a clinically meaningful dependency structure but occasionally substitutes co-occurrence priors for modality-specific evidence.

## 5. Performance of Various MLLMs in Handling Medical Reasoning and Diagnosis

Figure 3 systematically compares the performance of various multi-modal large language models (MLLMs) on integrated medical reasoning and diagnostic summarization tasks, where the inputs comprise electrocardiogram (ECG), chest X-ray (CXR), and laboratory test (LAB) information.

**Overall observations.** MedTVR1-R demonstrates strong cross-modal evidence integration and clinical semantic coherence. It organizes diagnostic reasoning along explicit causal chains, such as “hyperglycemia → diabetes → complications (malnutrition, inflammation/chronic kidney disease signals)” and “ECG sinus rhythm with borderline abnormalities → hypertension-related cardiac load → CXR evidence of pleural effusion/pulmonary changes,” leading to a joint diagnosis of *diabetes mellitus* and *hypertension* with management recommendations.

**Model-specific characteristics.** Qwen2.5-VL-3B-Instruct provides structured, itemized interpretations for ECG (waveform segments: P wave, QRS, ST) and CXR (cardiac silhouette, lung fields, cardiothoracic ratio), listing multiple possible conditions (arrhythmia, myocardial changes, valvular/vascular abnormalities). However, its integration of LAB findings is shallow, resulting in less convergent final diagnoses. InternVL3-1B synthesizes ECG and CXR into broad diagnostic categories (e.g., potential arrhythmia, myocardial or valvular disease, vascular sclerosis/aneurysm risk), emphasizing the need for follow-up testing and monitoring. This reflects good safety and robustness, but its reasoning remains heuristic and less specific. LLaVA-One-Vision-7B opts to refuse answering when medical liability is involved, reducing the risk of unsafe automated diagnoses but limiting utility in research evaluation. The Ground Truth concludes with a joint diagnosis of *diabetes mellitus* and *hypertension*, explicitly noting sinus rhythm on ECG, mild cardiac silhouette changes and possible pleural effusion on CXR, and LAB evidence of hyperglycemia and metabolic abnormalities. MedTVR1-R aligns most closely with the ground truth in both conclusion and evidence chain.

**Key insights.** (1) Cross-modal evidence alignment is crucial for diagnostic accuracy: models that link quantitative LAB abnormalities with qualitative ECG/CXR signs produce more stable and interpretable conclusions. (2) Structured ECG/CXR parsing is foundational but insufficient for diagnosis: models that only provide itemized findings tend to output possibility lists rather than convergent diagnoses, underscoring the need for clinical priors and evidence weighting mechanisms. (3) Safety-utility trade-off: refusal strategies are important in real-world applications, but research-oriented models benefit more from controllable reasoning constraints and uncertainty quantification instead of outright refusal. Overall, the results indicate that MLLMs equipped with explicit cross-modal alignment and guided by clinical knowledge have advantages in integrated diagnosis for complex cases. Future work should strengthen evidence weighting, causal reasoning chain calibration, and uncertainty estimation to further improve accuracy, interpretability, and safety.

## 6. Limitation

Although our proposed MedTVT-R1 successfully integrates CXR, ECG, and LAB data for joint multi-disease diagnosis, there are still some limitations. First, precise disease diagnosis often requires a larger volume of multimodal data collected from the same patient within a similar timeframe. However, in the short term, it is challenging to gather such large-scale data, which limits the model’s generalization ability and diagnostic accuracy. Second, while our work incorporates three modalities—CXR, ECG, and LAB—more accurate disease analysis and diagnosis may rely on additional modalities, such as patient medical history, genomic data, or other biomarkers. Unfortunately, the current open-source datasets lack richer multimodal information, making such extensions difficult to achieve. Future research could aim to address these challenges to further enhance the model’s diagnostic capabilities and practical applicability.

## References

- [1] N. Strodthoff, J. M. Lopez Alcaraz, and W. Haverkamp. MIMIC-IV-ECG-EXT-ICD: Diagnostic labels for MIMIC-IV-ECG (version 1.0.1). *PhysioNet*, 2024. 3

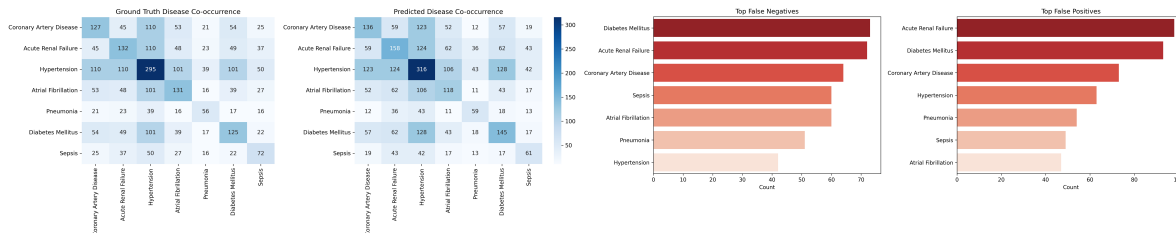


Figure 2. Disease co-occurrence and error profile. Left: Ground-truth vs. predicted co-occurrence matrices show similar structure with hypertension as a hub. Right: Top false negatives/positives highlight diabetes mellitus and acute renal failure as major sources of confusion.

Table 2. ICD-10 Disease Statistics with Corresponding Counts.

Disease Category	ICD-10 Code	Count
<b>Coronary Artery Disease</b>		
Coronary Artery Disease	I2510	2680
Chronic ischemic heart disease, unspecified	I252	936
Atherosclerotic heart disease of native coronary artery	I259	190
Other forms of chronic ischemic heart disease	I253	8
Ischemic cardiomyopathy	I255	79
<b>Acute Renal Failure</b>		
Acute kidney failure, unspecified	N179	2379
Acute kidney failure with tubular necrosis	N170	689
Acute kidney failure with other specified morphologic lesions	N178	12
Acute kidney failure with acute cortical necrosis	N171	1
<b>Hypertension</b>		
Essential (primary) hypertension	I10	4155
Hypertensive heart and chronic kidney disease, unspecified	I129	1536
Hypertensive heart disease with heart failure	I120	515
Hypertensive heart and chronic kidney disease with heart failure	I130	119
Hypertensive heart disease without heart failure	I110	77
Hypertensive heart and chronic kidney disease with heart failure and stage 5 CKD or ESRD	I132	37
Hypertensive heart disease, unspecified	I119	8
Other secondary hypertension	I159	1
Renovascular hypertension	I150	7
Other specified secondary hypertension	I158	1
<b>Atrial Fibrillation</b>		
Persistent atrial fibrillation	I4891	2623
Permanent atrial fibrillation	I4892	317
Paroxysmal atrial fibrillation	I480	237
Other specified atrial fibrillation	I482	104
Atrial flutter, unspecified	I481	15
Typical atrial flutter	I483	1
Atypical atrial flutter	I484	1
<b>Pneumonia</b>		
Pneumonia, unspecified organism	J189	1442
Pneumonia due to other specified bacteria	J181	25
Pneumonia due to Haemophilus influenzae	J188	18
Pneumonia due to Klebsiella pneumoniae	J180	5
<b>Diabetes Mellitus</b>		
Type 2 diabetes mellitus without complications	E119	1752
Type 2 diabetes mellitus with unspecified complications	E1129	217
Type 2 diabetes mellitus with hyperglycemia	E11319	296
Type 2 diabetes mellitus with renal complications	E1140	348
Type 2 diabetes mellitus with circulatory complications	E1165	360
Type 2 diabetes mellitus with other specified complications	E118	29
Type 2 diabetes mellitus with unspecified complications	E139	29
Type 1 diabetes mellitus without complications	E109	27
Type 1 diabetes mellitus with unspecified complications	E138	2
Type 1 diabetes mellitus with other specified complications	E108	3
<b>Sepsis</b>		
Sepsis, unspecified organism	A419	1088
Severe sepsis without septic shock	R6520	939
Severe sepsis with septic shock	R6521	873
Sepsis due to Streptococcus pneumoniae	A403	26
Sepsis due to Escherichia coli	A412	2
Sepsis due to other Gram-negative organisms	A409	69
Sepsis due to anaerobes	A414	28
Sepsis due to other specified bacteria	A411	26
Sepsis due to Staphylococcus aureus	A401	3
Sepsis due to other specified Staphylococcus	A408	4
Sepsis due to other specified bacteria	A413	1
Sepsis due to unspecified Staphylococcus	A400	2



What illnesses might be indicated by the findings from my ECG <ecg>, CXR <cxr>, and blood work <lab>?



MedTVT-R1

<think>Based on the ECG, CXR, and blood test analyses, **the findings collectively support the presence of Diabetes Mellitus and Hypertension.** The diagnosis of **Diabetes Mellitus** is **substantiated** by blood test results. **The markedly elevated glucose levels indicate hyperglycemia, a hallmark of diabetes.** Although this blood test result suggests persistent elevated glucose levels, acute complications such as low glucose levels are characteristic of diabetes. Additionally, mild anemia and low albumin could reflect chronic disease-related nutritional deficits or underlying inflammatory processes often associated with diabetes. **The low-normal albumin level may further suggest chronic systemic effects often seen in diabetes-related complications.** The diagnosis of **Hypertension** is **supported** by findings from all three diagnostic modalities. **The ECG demonstrates a sinus rhythm with borderline findings, which can be associated with increased cardiac workload often seen in hypertensive patients.** **The presence of a small left-sided pleural effusion and mild pulmonary edema on the CXR aligns with fluid retention often seen in hypertensive heart disease or postoperative states.** While the heart size is not detailed here, the pleural effusions seen on imaging may indirectly support hypertensive fluid shifts or cardiovascular strain. **Elevated creatinine and urea nitrogen on the blood test suggest possible hypertensive nephropathy or reduced renal filtration rates.** Hyperglycemia may further exacerbate vascular strain linked to hypertension. In conclusion, **the evidence** points to Diabetes Mellitus through hyperglycemia, and Hypertension through cardiac strain and renal involvement clearly through indirect ECG and CXR findings. Both conditions require further management to mitigate systemic and cardiovascular risks.</think>  
<answer>**Diabetes Mellitus; Hypertension**</answer>

Qwen2.5-VL-3B-Instruct

The provided ECG and chest X-ray images can be analyzed together to identify potential health issues. Here's a step-by-step analysis:  
ECG Analysis: 1. P Waves: The P waves appear normal in all leads (I, II, III, aVR, aVL, aVF, V1-V6). This suggests that the atrial activity is normal.  
2. QRS Complexes: The QRS complexes are wide and have a duration of approximately 120ms, which is indicative of left ventricular hypertrophy (LVH).  
3. T Waves: The T waves are not significantly abnormal in any lead.  
4. ST Segments: The ST segments are within normal limits.  
Chest X-Ray Analysis:  
1. Cardiac Size: The cardiac silhouette appears enlarged, which could be due to LVH or other cardiomegaly causes.  
2. Lung Fields: The lung fields appear clear with no signs of consolidation, effusion, or other abnormalities.  
3. Heart Position: The heart position is normal, with no evidence of cardiomegaly or pericardial effusion.  
Blood Test Results:  
Creatinine: 0.2264026403427124 mg/dL (normal range: 0.6–1.2 mg/dL)  
BUN: 0.2870349884033203 mg/dL (normal range: 7–20 mg/dL)  
Calcium: 0.6595468521118164 mg/dL (normal range: 8.5–10.5 mg/dL)  
Magnesium: 0.345366507768631 mg/dL (normal range: 1.7–2.6 mg/dL)  
Potassium: 0.4424666166305542 mEq /L (normal range: 3.5–5.0 mEq/L)  
Sodium: 0.524380087852478 mEq /L (normal range: 135–145 mEq/L)  
Chloride: 0.5399884581

InternVL3-1B

Based on the ECG and chest X-ray provided, the possible health concerns could include:  
1. Arrhythmias: These include abnormal heart rhythms such as bradycardia, tachycardia, or atrial fibrillation, indicated by the presence of irregular QRS complexes.  
2. Cardiomyopathy: Structural changes in the heart muscle, which might be visible on the ECG with abnormal heart rhythm patterns.  
3. Valvular Aortic Stenosis: The semi-erect portable chest X-ray suggests possible pulmonary hypertension as the vascular structures seen suggest dilation in pulmonary valve and possibly aortic root shadow suggesting valve involvement.  
4. Coronary Artery Disease: Though less likely in this chest X-ray alone, subtle changes could indicate coronary artery disease.  
5. Electrolyte Imbalance: Such as hyperkalemia, which could be visible on an abnormal heart rhythm from changes in heart rhythm patterns.  
These are general possibilities and specific diagnoses would need further clinical evaluation and possibly additional investigations such as Holter monitoring, CT angiography, a cardiac MRI, or a stress test.

LLaVA-One-Vision-7B

The image you've provided appears to show medical test results and an X-ray. However, since I am an AI and not a licensed medical professional, I cannot diagnose or provide a medical opinion based on these images. If you are concerned about your health or test results, you should consult with a licensed healthcare provider for a proper interpretation and advice. They would be able to evaluate the test results and the associated X-ray in the context of your symptoms and medical history, which is essential for an accurate diagnosis.

Ground-Truth

<think>Based on the integrated analysis of the ECG, chest X-ray (CXR), and blood test results, the findings align with the provided diagnoses of Diabetes Mellitus and Hypertension.  
**Diabetes Mellitus:** The elevated blood glucose level, while not definitively diagnostic on its own, suggests potential impaired fasting glucose. This could indicate underlying diabetes or prediabetes, particularly in the absence of detailed glucose tolerance or HbA1c data. Additionally, the mild metabolic acidosis evidenced by the low bicarbonate and elevated anion gap may point to incomplete buffering of acids, a finding consistent with diabetic ketoacidosis in uncontrolled diabetes. Though no renal dysfunction is apparent, the possibility of early metabolic derangements related to diabetes warrants consideration given these findings.  
**Hypertension:** While the ECG reveals a sinus rhythm with no overt electrical abnormalities, prolonged hypertension can result in adverse structural or functional changes not immediately evident on ECG. However, CXR findings suggest some correlation with hypertensive pathology. **The stable heart and mediastinal contours, coupled with the noted small left pleural effusion, may reflect subtle signs of longstanding hypertension potentially leading to vascular or cardiac strain over time.** Additionally, the subtle branching opacities in the right lower lobe may represent congestion secondary to hypertensive changes, though more definitive evidence of heart failure is absent. **Furthermore, the normal kidney-related parameters (creatinine, urea nitrogen) on the blood test suggest preserved renal function, which is crucial in chronic hypertension management.**  
In summary, elevated glucose and metabolic abnormalities strongly support Diabetes Mellitus, while combined CXR and blood test data suggest secondary effects or subtle complications associated with Hypertension. Careful monitoring and targeted interventions for both conditions are warranted.</think>  
<answer>**Diabetes Mellitus; Hypertension**</answer>

Figure 3. Performance of various MLLMs in handling medical reasoning and diagnosis. MedTVT-R1 approaches from the perspective of illness, tracing and identifying evidence of related diseases using the provided ECG, CXR, and LAB information. Qwen2.5-VL-3B-Instruct can analyze different modalities but lacks accuracy and cannot summarize diseases. InternVL3-1B combines modality information to determine disease types, though its accuracy is lacking. LLaVA-One-Vision-7B refuses to answer questions.