Decision Support for Radiologists at the Time of Reporting

Computer-Assisted Reporting to Increase Radiology’s Value

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**Features:** The elements of a described lesion will be used to determine the output of the algorithm. Includes synonyms of those features that might be used in reports.

**Decision Tree:** The logic which determines the output of the algorithm based on a lesion's features.

**End Points:** Templates of the generated text to be inserted into the body, impression, and recommendations of reports.

```xml
<algorithm>
  <features>
    <feature name="size" type="numeric"/>
    <enumeration_feature name="side">
      <choice name="left_side">left</choice>
      <choice name="right_side">right</choice>
    </enumeration_feature>
    <feature name="uniformly_cystic" type="present_absent" default="absent">
      <synonym>fluid density</synonym>
      <synonym>simple cyst</synonym>
    </feature>
    <feature name="density" type="numeric"/>
    <feature name="macroscopic_fat" type="present_absent" default="absent">
      <synonym>fat density</synonym>
    </feature>
  </features>

  <decision_tree>
    <if feature="uniformly_cystic" value="present">
      <end_point ref="cyst_no_recommendation"/>
    </if>
    <if feature="hypodense" value="present">
      <if feature="stable" value = "present">
        <end_point ref="hypodense_stable"/>
      </if>
      <else>
        <end_point ref="hypodense_no_priors"/>
      </else>
    </if>
    <if feature="macroscopic_fat" value="present">
      <end_point ref="macroscopic_fat"/>
    </if>
    <if feature="old_hemorrhage" value="present">
      <end_point ref="old_hemorrhage"/>
    </if>
  </decision_tree>

  <end_points>
    <end_point id="hypodense_stable">
      <body>In the {{side}} adrenal gland{{series_image}}, the previously seen {{size}} mm lesion is homogeneously low density (10 HU or less on non-contrast-enhanced images) and therefore most consistent with an adenoma.</body>
      <impression>{{size}} mm nodule in the {{side}} adrenal gland, similar to prior. Radiologic findings are most consistent with a benign adrenal adenoma.</impression>
    </end_point>
    <end_point id="hypodense_no_priors">
      <body>Additional information is needed to make a definite diagnosis. Further work-up is recommended.</body>
      <impression>Unusual for a simple cyst or lipid-rich lesion.</impression>
      <recommendation>Considering further evaluation including CT-guided biopsy or percutaneous aspiration.</recommendation>
    </end_point>
  </end_points>
</algorithm>
```
COMPARISON:

FINDINGS:

IMPRESSION:

CITATION:
COMPARISON: 

FINDINGS: 

IMPRESSION: 

CITATION: 

Clinical Guidance (10):

- **Adrenal Cyst US**: Asymptomatic cystic lesions seen in the adrena on ultrasound.
- **Adrenal Nodule**: Discrete lesion within either adrenal gland measuring at least 10 mm that has not been previously characterized.
- **Hepatic Trauma Grading**: Grading of blunt hepatic trauma according to RAST liver injury scale.
- **Liver Lesion**: Hepatic lesion seen incidentally on CT.
- **Lung Cancer Staging**: IASLC staging system for lung cancer.
- **Adrenal Mass**: Incidental cystic adrenal mass seen on CT.
- **Renal Lesion**: Incidental renal mass detected on CT.
- **Lung-RADS Cancer Screening**: Lung-RADS based cancer screening on CT.
- **Pulmonary Nodule**: Solitary pulmonary nodule seen incidentally on chest CT.
- **Thyroid Nodule**: Thyroid nodule incidentally on CT or MRI.
Report - UNKNOWN, - temp

COMPARISON:

FINDINGS:

IMPRESSION:

CITATION:

Guidance: Lung Cancer Staging

- Tumor Size (cm):
- Tumor Location:
- Tumor status: Unknown
- Separate nodule(s)/mass(es): No
- Atelectasis-obstructive pneumonitis: No
- Tumor contact/abuts:
- Local invasion:
- Endobronchial involvement: No
- Intrathoracic metastasis:
- Extra-thoracic metastasis: Unknown
- Lymph nodes:
- Report Stage: No
- T-stage: Specify tumor size
- M-stage: Mx
- N-stage: No
- Overall stage:

The Clinical Guidance tool represents a translation of general information from literature sources into a computerized system, which cannot always be accomplished precisely, nor kept up-to-date continuously. Its application to any specific case should inform, not replace, the knowledge and judgment of the radiologist, who should adjust the final text to the clinical scenario as needed.

Enter the following required fields in order to generate report text:
- Tumor Size (cm)
- Tumor Location
FINDINGS:
Pulmonary mass in the right upper lobe measures 3 cm. A separate nodule/mass is seen in the same lobe. No atelectasis/obstructive pneumonitis is seen. There is no imaging evidence of bronchial involvement or invasion of local structures. No enlarged lymph nodes are seen.

IMPRESSION:
Pulmonary mass in the right upper lobe measuring 3 cm is concerning for neoplasm. Histologic confirmation or short-term follow-up chest CT is recommended. Separate nodule/mass in the same lobe, which could represent either metastasis or a metasynchronous primary. No bronchial involvement is seen. Mass is surrounded by lung or visceral pleura. No enlarged lymph nodes are seen, though this does not exclude nodal disease. No imaging evidence of intrathoracic metastasis is seen.
Supraclavicular Zone

1. Low cervical
2. Supraclavicular
3. Sternal
total notches sides

Superior Mediastinal Nodes
Upper Zone
- 2R. R. Upper paratracheal
- 2L. L. Upper paratracheal
- 3a. Prevascular
- 3p. Retrotracheal
- 4R. R. Lower paratracheal
- 4L. L. Lower paratracheal

Inferior Mediastinal Nodes
Subcarinal Zone
- 7. Subcarinal

Lower Zone
- 8. Paraesophageal (below carina): Right / Left
- 9. Pulmonary Ligament: Right / Left

Aortic Nodes
- 5. Subaortic
- 6. Para-aortic (ascending aorta or phrenic)

Hilar/Interlobar Zone
- 10. Hilar: Right / Left
- 11-14. Interlobar:
  - More distal stations Right / Left

NB: Lymph nodes measuring 1 cm or more in the short axis are considered significant in size and suspicious for metastasis.
Supraclavicular Zone
1. Low cervical
Supraclavicular
Sternal notch sides

Superior Mediastinal Nodes
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2R. R. Upper paratracheal
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Lower Zone
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9. Pulmonary Ligament: Right/Left

Aortic Nodes
5. Subaortic
6. Para-aortic (ascending aorta or phrenic)

N1 Nodes
Hilar/Interlobar Zone
10. Hilar: Right/Left
11-14. Interlobar/
More distal stations
Right/Left

NB: Lymph nodes measuring 1 cm or more in the short axis are considered significant in size and suspicious for metastasis.
Pulmonary mass in the right upper lobe measures 3 cm. A separate nodule/mass is seen in the same lobe. No atelectasis/obstructive pneumonitis is seen. There is no imaging evidence of bronchial involvement or invasion of local structures. Enlarged lymph nodes are seen in the right upper paratracheal (2R) and right lower paratracheal (4R) stations.

IMPRESSION:

Pulmonary mass in the right upper lobe measuring 3 cm is concerning for neoplasm. Histologic confirmation or short-term follow-up chest CT is recommended. Separate nodule/mass in the same lobe, which could represent either metastasis or a metasynchronous primary. No bronchial involvement is seen. Mass is surrounded by lung or visceral pleura. Enlarged lymph nodes are seen in ipsilateral mediastinal station(s). No imaging evidence of intrathoracic metastasis is seen.
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IMPRESSION:
Pulmonary mass in the right upper lobe measuring 3 cm is concerning for neoplasm. Histologic confirmation or short-term follow-up chest CT is recommended. Separate nodule/mass in the same lobe, which could represent either metastasis or a metasynchronous primary. No bronchial involvement is seen. Mass is surrounded by lung or visceral pleura. These features correspond to tumor staging descriptor of T3 by imaging features. Enlarged lymph nodes are seen in ipsilateral mediastinal station(s). This corresponds to node staging descriptor of N2 by imaging features. No imaging evidence of intrathoracic metastasis is seen. In this patient with unknown status of distant metastasis, this corresponds to a metastasis descriptor of Mx. Together, the imaging features would correspond with stage IIIA disease in absence of distant metastasis.
COMPARISON: []

FINDINGS: Pulmonary mass in the right upper lobe measures 3 cm. A separate nodule/mass is seen in the same lobe. No atelectasis/obstructive pneumonitis is seen. There is no imaging evidence of bronchial involvement or invasion of local structures. Enlarged lymph nodes are seen in the right upper paratracheal (2R) and right lower paratracheal (4R) stations.

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CITATION: []
The Data Divide

- Imaging Data
- Data-Enabled Radiology Report
- Clinical Data
  - Lab Values
  - Genetic Data
  - Diagnoses
  - Clinical Measurements (pulmonary, cardiology)
  - Imaging Data
Where Does the Data Come From?

- Raw Images
- Direct from Scanner
- Technologist Entered
- Radiologist Created
- Machine Extracted
- Data-Enabled Radiology Report
“Regarding ITEM, recommend ACTION in TIME for REASON with STRENGTH pending DEPENDENCY.”
Structured Recommendation

In low or average risk patients, the hepatic finding is most likely benign and no additional follow-up is warranted. In high risk patients, this finding remains indeterminate for a neoplastic process and follow-up CT or MRI in 6 months is recommended.
Benefits of Structured Recommendations

Ordering
One-click response to order recommended exam(s).

Tracking
Identify when recommended exam hasn’t been obtained.

Responding
Cue radiologist reading recommended exam to respond.

Monitoring
Track rates of recommendation, compliance, and outcomes.
1. **Image Acquisition:**
   Image protocols tailored to extract needed elements

2. **Data-oriented Interpretation:**
   Image analysis and reporting focused on including and structuring key data elements based on clinical scenario

3. **Clinical Decision Support:**
   Incorporate guidance based on imaging, other clinical data

- Lab Values
- Genetic Data
- Diagnoses
- Clinical Measurements (pulmonary, cardiology)
- Imaging Data
Acknowledgements

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