

## Other Findings on Screening CTs and Recommendations

### A. Cardiovascular Findings

#### 1. Ordinal coronary artery calcification

Each coronary artery is identified (left main, left anterior descending, circumflex, and right coronary artery). Evidence of calcification in each artery is documented as none, minimal, moderate, or severe, scored as 0, 1, 2, and 3, respectively. Minimal calcification was defined if less than 1/3 of the length of the entire artery, moderate as 1/3-2/3, and severe as more than 2/3 shows calcification. With 4 arteries thus scored, each person receives an Ordinal coronary artery calcium (CAC) Score in the range from 0 to 12 (104-108). With additional effort, the Agatston, volume or mass calcium scores on LDCTs can also be obtained. New rapid scanning techniques minimize cardiac motion and allow for improved Agatston scoring on non-gated examinations.

Ordinal CAC Score	Agatston Score	<b>RECOMMEND</b>
0	0	Probability of cardiovascular heart disease (CHD) is low. Reassure and keep healthy lifestyle
1-3	1-100	Probability of CHD is mild to moderately increased; Recommend healthy lifestyle, moderate statin, ASA
4-12	> 100	Probability of CHD is moderate to high. Healthy lifestyle; very intensive statin + second drug as needed; ASA; Consider function testing to r/o obstruction; Aggressive BP lowering; Referral to internist or preventive cardiologist

#### 2. Aortic valve calcification

Using standard mediastinal window setting (width and level of 350 HU and 50 HU with 2.5 mm or 3.0 mm slice thickness) and if needed, multiplanar reconstruction to determine the location of calcifications (109-114). The extent of AVC was classified as:

- Mild: single or multiple isolated aortic valve calcifications;
- Moderate: multiple larger aortic valve calcifications, but not involving all three aortic leaflets
- Severe: multiple larger aortic valve calcifications of all three aortic leaflets.

For moderate and severe AVC, **RECOMMEND** referral to a cardiologist is recommended and possible echocardiography, as there is a high probability of aortic stenosis (AS).

#### 3. Pulmonary artery hypertension

The diameters of the main pulmonary artery (MPA) and ascending aorta (AA) are measured on an axial CT image at the level of the MPA bifurcation at the widest diameter vertical to its long axis and of the adjacent AA diameter (115).

If  $MPA \geq 34$  mm or  $MPA:AA \geq 1.0$ , **RECOMMEND** a pulmonary consult to determine its etiology and possible echo sonography.

**Table B. Pulmonary Findings other than lung cancer****1. Emphysema**

The extent of emphysema is identified and classified as none, mild, moderate, or severe. Each subject receives an emphysema score in the range from 0 to 3 (116, 117) .

Mild emphysema (Score 1): no discrete areas of decreased CT attenuation but splaying of blood vessels suggesting parenchymal expansion or having occasional discrete areas of decreased attenuation;

Moderate emphysema (Score 2): discrete areas of decreased attenuation can be identified involving less than half of the lung parenchyma; and,

Severe emphysema (Score 3): discrete areas of decreased attenuation can be identified involving more than half of the lung parenchyma.

If emphysema is present and previously unrecognized, **RECOMMEND** consultation with a pulmonologist.

**2. Interstitial findings**

Early findings of usual interstitial pneumonitis (UIP) include pre-honeycomb and honeycomb (HC) findings. Other interstitial diseases can also be identified and may differ in location and findings. Pre-honeycomb findings may start with traction bronchiectasis alone and then progress to ground-glass opacification and reticulations, typically at the periphery of the lungs and at the lung bases. The likelihood of disease progression is associated with honeycombing. Early identification is important and consultation with a pulmonologist is recommended (118-121).

If any of these findings are identified, **RECOMMEND** consultation with a pulmonologist.

**3. Bronchiectasis**

Bronchiectasis is present if: 1) the external diameter of a bronchus is greater than the diameter of its adjacent pulmonary artery, 2) lack of tapering of the bronchial lumen toward the periphery for a length of more than 2.0 cm, or 3) peripheral bronchi can be identified abutting medial pleura or within 1.0 cm of the costal pleura (122-125).

If present, **RECOMMEND** pulmonary consultation for further workup.

**4. Discrete cystic airspaces**

The walls of discrete cystic airspaces should be assessed for progressive wall thickening, both in terms of increasing thickness and increasing circumferential wall involvement, as these may be due to lung cancer (56).

If a nodule emerges, **RECOMMEND** further evaluation or 3-month follow-up CT.

## Table C. Breast Findings

### 1. Breast density

Using mediastinal settings, the CT images of the breast are reviewed and classified according to the Breast Imaging Reporting and Data System (BI-RADS) developed by the American College of Radiology (Sickles EQ, D'Orsi CJ, Bassett LW et al. ACR 2013, 4<sup>th</sup> edition). The BI-RADS classification identifies 4 grades according to the breast density. Calcifications seen in the breast also provide information about coronary artery disease and should be reported (126-129).

The key differentiation is between Grades 1-2 and 3-4 (126, 127).

Grade 1: almost entirely fatty

Grade 2: there are scattered fibroglandular densities

Grade 3: breasts are heterogeneously dense, which may obscure small masses

Grade 4: breasts are extremely dense, which lowers the sensitivity of mammography

For Grade 3 or 4, **RECOMMEND** including this information in the report as it suggests an increased risk for breast cancer and if clinically indicated ultrasound (Mendelson EB, Bohm-Velez M, Berg WA, et al. ACR 2013) or MRI (Morris EA, Cornstock CE, Lee CH, et al. ACR, 2013) of the breast is suggested instead of a mammogram as it might obscure an early cancer or precursor lesion.

### 2. Breast masses

While a chest CT is never ordered to screening for breast cancer, some breast mass can be seen on chest CT as the images always include breast tissue (130). Breast can be viewed in axial, sagittal, and coronal planes and on MIP images which are routinely obtained for screening. Therefore, detection of breast masses can be done without additional radiation and at no direct cost to the healthcare system.

Multiple studies have reported incidental detection of breast cancers on chest CT but have not reported which projection was optimal for detection of masses (130). In our review by 10 radiologists, we found that MIP images were preferred over axial, coronal, or sagittal images, while sagittal and coronal images were equally preferable to axial images.

When a breast mass is identified, **RECOMMEND** further evaluation by mammography.

**Table D. Mediastinal Findings**

Mediastinal masses can occur anywhere in the mediastinum, including in the thymus, heart, and esophagus; and masses in the neck, such as the thyroid, may extend into the mediastinum. Such mediastinal and soft tissues masses are documented as to location and size.

Thymic mass (131):

- a.  $\leq 30$  mm in diameter on baseline CT without invasive features (e.g., irregular borders or loss of fat planes), **recommend** follow-up CT in one year;
- b.  $> 30$  mm, **RECOMMEND** further workup according to standard practice is recommended.

Thyroid nodule (132):

- a.  $< 15$ mm on baseline or annual repeat LDCT with low HU attenuation, **RECOMMEND** annual follow-up;
- b.  $< 15$  mm with heterogeneous enlarged appearance, **RECOMMEND** dedicated thyroid ultrasound examination
- c.  $\geq 15$  mm, **RECOMMEND** dedicated thyroid ultrasound examination

**Table E. Abdominal Findings****1. Adrenal glands**

Adrenal glands are measured on axial CT images (133). If the largest transverse diameter is:

- $\geq 40$ mm, **RECOMMEND** further evaluation according to standard of care;
- $< 40$  mm and low attenuation (less than 10 HU), **RECOMMEND** annual low-dose CT scans to assess growth, but if the borders are irregular, heterogeneous, hemorrhagic, central necrosis or calcifications, **RECOMMEND** further evaluation.

**2. Liver steatosis**

The hepatic portal level is selected to measure liver attenuation (HU) and the liver is divided into four sectors (left lateral, left medial, right anterior, right posterior). In each sector, a standard  $1.0 \text{ cm}^2$  region of interest (ROI) is selected, avoiding other lesions and large blood vessel (134-136). HU measurements are made using standard mediastinal window settings (width 350 HU; level 25 HU) and the average attenuation and its standard deviation (SD) are calculated.

If the liver attenuation measurement  $< 40$  HU or liver-spleen ratio  $< 0.8$ , **RECOMMEND** follow-up with a primary care physician or liver specialist for further evaluation.

**Table E. Bone Findings**

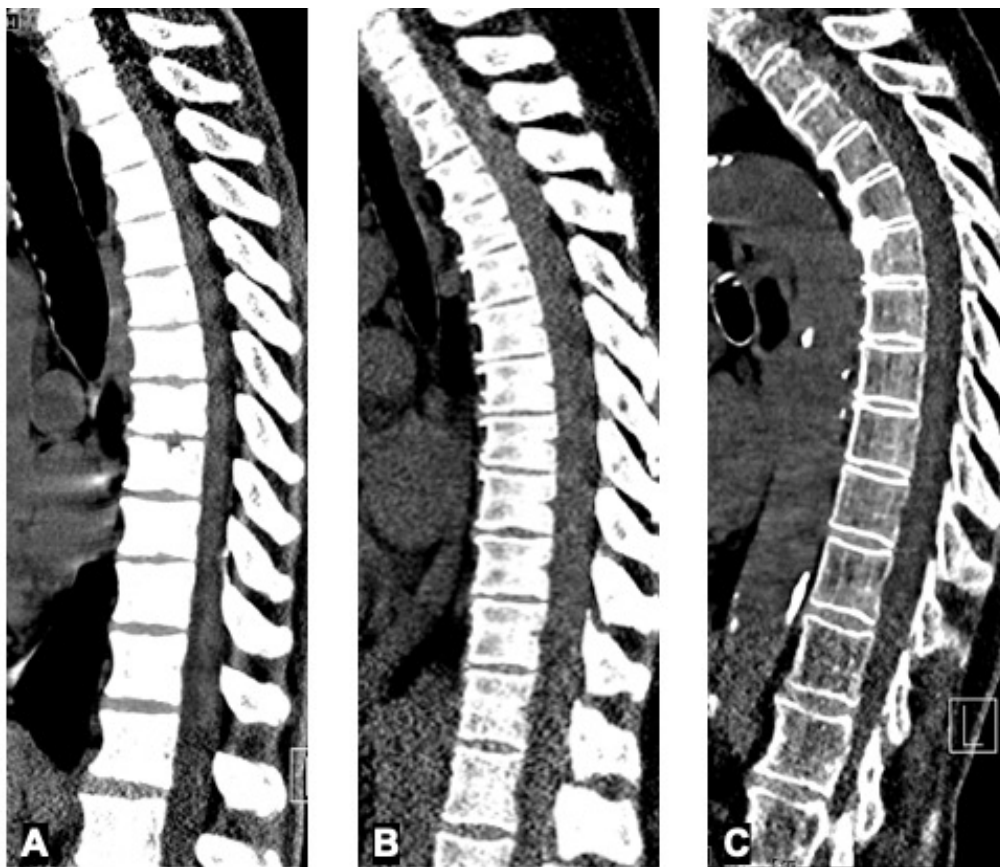
**Osteoporosis**

Osteoporosis can be identified on low-dose CT by the a) CT attenuation values or by b) comparison to a reference standard. Both are given below (137), (138). (139).

a) The CT attenuation values are measured on the sagittal images of the T12/L1 vertebrae while avoiding the vertebral vein plexus and abnormalities.

If the T12/L1 attenuation < 110 HU, recommend follow-up with a primary care physician or bone specialist for further evaluation (139).

b) Compare the sagittal image of the spine using osteoporosis window settings (width 30 HU; level 80 HU) (137). Visually identify which the most appropriate category (A-C) shown below (138). If visual scoring identifies osteoporosis, recommend follow-up with a primary care physician or bone specialist for further evaluation,



Reference images of each osteoporosis category (window width 350 HU, level 24 HU).

A: normal bone density; B: indeterminate; C; osteoporosis.