**Clinical Condition:** Chronic Dyspnea — Suspected Pulmonary Origin

**Variant 1:** Any age.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-ray chest</td>
<td>9</td>
<td>A negative chest radiograph does not exclude diffuse disease.</td>
<td>☢</td>
</tr>
</tbody>
</table>

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

**Variant 2:** Any age, nonrevealing or nondiagnostic clinical, standard radiography, and laboratory studies.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT chest without IV contrast</td>
<td>9</td>
<td>In the setting of chronic dyspnea, the most appropriate imaging study is a thin-section high-resolution chest CT with prone imaging when appropriate. Patients with obstructive or mixed PFTs, the inclusion of expiratory imaging is important to evaluate air trapping and possible tracheobronchomalacia.</td>
<td>☢☢☢</td>
</tr>
<tr>
<td>CT chest with IV contrast</td>
<td>5</td>
<td>Usually not indicated unless suspect mediastinal or hilar adenopathy or fibrosing mediastinitis as cause for dyspnea. If a patient has dyspnea not clearly of pulmonary origin, other entities such as chronic or acute pulmonary embolism may need to be excluded. In that setting, a chest CTA is appropriate. See the ACR Appropriateness Criteria® topic on “Acute Chest Pain — Suspected Pulmonary Embolism.”</td>
<td>☢☢☢</td>
</tr>
<tr>
<td>MRI chest without IV contrast</td>
<td>2</td>
<td>May be useful in characterizing pleural and chest wall masses, but its use in diffuse lung disease is currently limited to research.</td>
<td>☢</td>
</tr>
<tr>
<td>MRI chest without and with IV contrast</td>
<td>2</td>
<td>May be useful in characterizing pleural and chest wall masses, but its use in diffuse lung disease is currently limited to research.</td>
<td>☢</td>
</tr>
<tr>
<td>CT chest without and with IV contrast</td>
<td>1</td>
<td>May be useful in characterizing pleural and chest wall masses, but its use in diffuse lung disease is currently limited to research.</td>
<td>☢☢☢</td>
</tr>
<tr>
<td>FDG-PET/CT chest</td>
<td>1</td>
<td>May be useful in characterizing pleural and chest wall masses, but its use in diffuse lung disease is currently limited to research.</td>
<td>☢☢☢☢</td>
</tr>
</tbody>
</table>

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level
CHRONIC DYSPNEA — SUSPECTED PULMONARY ORIGIN

Expert Panel on Thoracic Imaging: Debra Sue Dyer, MD1; Tan-Lucien H. Mohammed, MD2; Jacobo Kirsch, MD3; Judith K. Amorosa, MD4; Kathleen Brown, MD5; Jonathan H. Chung, MD6; Mark E. Ginsburg, MD7; Darel E. Heitkamp, MD8; Jeffrey P. Kanne, MD9; Ella A. Kazerooni, MD10; Loren H. Ketai, MD11; J. Anthony Parker, MD, PhD12; James G. Ravenel, MD13; Anthony G. Saleh, MD14; Rakesh D. Shah, MD15.

Summary of Literature Review

Introduction/Background

Dyspnea is generally defined as a subjective experience of breathing discomfort [1]. It is often described as breathlessness or shortness of breath. Functional brain imaging studies have shown that dyspnea is associated with activation of the limbic system, especially the insular area [2,3]. The cause for dyspnea is usually cardiopulmonary disease. Common cardiovascular causes are myocardial infarction and congestive heart failure. Common pulmonary causes include asthma, emphysema, pneumothorax, pulmonary embolism, upper airway obstruction, and interstitial lung disease. The clinical signs and symptoms often determine whether the cause is cardiac or pulmonary. The distinction between cardiac and pulmonary causes, however, is not always obvious. Furthermore, the etiology has been reported to be multifactorial in up to one-third of patients [4]. Certain laboratory and ancillary tests are helpful such as hemoglobin, brain natriuretic peptide (BNP) test, pro BNP, pulse oximetry, 6-minute walk test, and pulmonary function tests (PFTs). It is important to distinguish whether the dyspnea is acute (lasting a few minutes to a few hours) or chronic (duration >1 month).

Two important causes for acute dyspnea, pulmonary embolism and congestive heart failure, are not included in this section as they are reviewed in other ACR Appropriateness Criteria® topics. Another significant cause of dyspnea and disability in patients with chronic lung disease is pulmonary hypertension, which is addressed in another ACR Appropriateness Criteria® topic dedicated to the condition. This document addresses chronic dyspnea of pulmonary origin, particularly chronic obstructive pulmonary disease and interstitial lung disease.

Chest Radiography

It is recognized that the decision-making process in the individual patient is affected by factors other than just the presence or absence of dyspnea, including the severity of dyspnea and the presence or absence of other symptoms and other risk factors (cardiovascular, pulmonary, and neoplastic diseases). In clinical practice, chest radiography is usually performed as part of the initial evaluation of dyspnea. Two studies [5,6] suggest that the chest radiograph adds enough additional useful information to recommend its routine use in patients with chronic and acute dyspnea. A review by Morgan and Hodge [7] stated that the most useful methods for evaluating dyspnea are the electrocardiogram (ECG) and chest radiograph. In another study [8], chest radiographs were helpful in making a diagnosis in 66% of the hospitalized patients admitted for other reasons and referred to respiratory physicians for breathlessness. A retrospective review of the value of chest radiographs in chronic obstructive pulmonary disease (COPD) found that radiographs detected treatable disease in 14% of cases and changed management in 84% of cases [9]. In a review of evidence-based approaches, Soto and Varkey [10] recommended chest radiography in the initial assessment of patients with acute exacerbation of COPD.

Computed Tomography

High-resolution computed tomography CT (HRCT) is considered the best imaging tool for assessing diffuse lung disease [11-13]. It is particularly appropriate in patients when the results of the clinical, radiographic, and laboratory studies are either nonrevealing or nondiagnostic [14,15]. Many diseases — including bronchiectasis, sarcoidosis, emphysema, pneumoconiosis, idiopathic pulmonary fibrosis, Langerhans cell histiocytosis,
hypersensitivity pneumonitis, bronchiolitis obliterans, lipoid pneumonia, drug toxicity, and lymphangitic cancer — have features characteristic enough to enable experienced radiologists to make a confident, probable, or limited differential diagnosis in most cases [12,16-34]. Biopsy and additional diagnostic testing are often unnecessary [35,36]. HRCT may reveal an abnormality even when the chest radiograph is normal [13]. There is a good correlation between the extent of disease on HRCT and the level of dyspnea in patients [37-41]. HRCT is also a sensitive indicator of disease progression [41,42] and can be used as an outcome measure in therapeutic trials [43].

HRCT is the most sensitive modality for diagnosing early emphysema in smokers with dyspnea [44]. The severity of dyspnea and air trapping on CT correlates with PFTs [45]. Srinakarin et al [44] found HRCT to be more sensitive than PFTs for diagnosing emphysema. HRCT provides unique phenotypic information in COPD and can predict health status [46,47].

Expiratory HRCT is a powerful adjunct to inspiratory HRCT in the diagnosis of diffuse lung disease [48,49]. In certain interstitial lung diseases, such as chronic hypersensitivity pneumonitis, expiratory imaging can show characteristic lobular air trapping [22]. Expiratory scans are useful in the differentiation of causes of inhomogeneous lung attenuation [48]. In COPD, expiratory CT reflects airflow limitation and correlates well with levels of dyspnea [49]. Dynamic contiguous expiratory CT improves the recognition and diagnosis of tracheobronchomalacia [50,51].

Inspiratory high-resolution CT images are typically 1-2 mm in thickness, done in the supine and, if necessary, prone positions. Contiguous or noncontiguous thin-section expiratory imaging is added in patients with known or suspected airflow limitation. CT scans with a slice thickness of >5 mm are NOT adequate to demonstrate fine detail in the lungs.

Intravenous contrast is rarely needed in the evaluation of chronic dyspnea. It is useful, however, in diagnosing fibrosing mediastinitis in which the obstruction of vital structures is elegantly demonstrated [52].

It is important to recognize that radiology and pathology have complementary roles in the evaluation of diffuse lung disease. CT can help guide surgeons to optimal biopsy sites. Chest radiography and CT capture the entire lung as an “in vivo gross specimen” and convey architectural details, multifocal abnormalities, and overall distribution of findings. It is crucial for the pathologist to interpret lung histology in diffuse lung disease with an appreciation of information provided by radiologic studies [53].

Magnetic Resonance Imaging and Positron Emission Tomography

Magnetic resonance imaging (MRI) has been investigated as an alternative imaging tool to CT due to its lack of ionizing radiation [54-57]. Yi et al [57] found 3T MRI to be useful in differentiating inflammatory and fibrous lesions in 26 patients with usual interstitial pneumonia and nonspecific interstitial pneumonia. Hyperpolarized helium 3 MRI appears to be a safe and sensitive tool in the quantitative evaluation of COPD [58-60]. It also seems to be useful in the diagnosis of pneumonia and bronchial abnormalities in immunocompromised patients [61,62]. Fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET) has been shown to demonstrate disease activity in diffuse lung disease, sarcoidosis, and drug toxicity [63-66]. Groves et al [63] found differences in metabolic activity depending on morphology, with higher FDG metabolism in areas of reticulation and honeycombing than in areas of ground glass.

Both MRI and PET have been shown to be useful in evaluation of chest wall masses and pleural disease [67,68]. Otherwise, the use of MRI and PET still seems to be limited to research, and investigators acknowledge the superiority of CT in diffuse lung disease.

Summary

• Chest radiography is indicated when dyspnea is chronic or severe. It has been shown to change management in up to 84% of cases.
• HRCT is the best imaging tool for assessing diffuse lung disease. It is recommended when the initial evaluation of the dyspneic patient is nonrevealing or when it reveals abnormality but no definitive diagnosis. Expiratory HRCT is indicated in patients with obstructive physiology and suspected tracheobronchomalacia. Expiratory CT series can also be useful in the evaluation of interstitial lung disease.
• Contrast-enhanced CT is rarely indicated in the evaluation of chronic dyspnea.
• MRI and PET have a role in the evaluation of chest wall masses and pleural disease, but their roles in diffuse lung disease are still investigational.

**Relative Radiation Level Information**

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

<table>
<thead>
<tr>
<th>Relative Radiation Level*</th>
<th>Adult Effective Dose Estimate Range</th>
<th>Pediatric Effective Dose Estimate Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>&lt;0.1 mSv</td>
<td>&lt;0.03 mSv</td>
</tr>
<tr>
<td>☢</td>
<td>0.1-1 mSv</td>
<td>0.03-0.3 mSv</td>
</tr>
<tr>
<td>☢☢</td>
<td>1-10 mSv</td>
<td>0.3-3 mSv</td>
</tr>
<tr>
<td>☢☢☢</td>
<td>10-30 mSv</td>
<td>3-10 mSv</td>
</tr>
<tr>
<td>☢☢☢☢</td>
<td>30-100 mSv</td>
<td>10-30 mSv</td>
</tr>
</tbody>
</table>

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

**Supporting Documents**

For additional information on the Appropriateness Criteria methodology and other supporting documents go to [www.acr.org/ac](http://www.acr.org/ac).

**References**


The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient’s clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient’s condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.