



# ROUTINE ADMISSION AND PREOPERATIVE CHEST RADIOGRAPHY

Expert Panel on Thoracic Imaging: Theresa C. McLoud, MD<sup>1</sup>; Sheila D. Davis, MD<sup>2</sup>; Suzanne L. Aquino, MD<sup>3</sup>; Poonam V. Batra MD<sup>4</sup>; Philip C. Goodman, MD<sup>5</sup>; Linda B. Haramati, MD<sup>6</sup>; Arfa Khan, MD<sup>7</sup>; Ann N. Leung, MD<sup>8</sup>; Melissa L. Rosado de Christenson, MD<sup>9</sup>; Anna Rozenshtein, MD<sup>10</sup>; Charles S. White, MD<sup>11</sup>; Larry R. Kaiser, MD<sup>12</sup>; Suhail Raof, MBBS.<sup>13</sup>

## **Summary of Literature Review**

Routine chest radiography obtained at the time of admission to hospital and in the preoperative setting has been a common practice. This paper will address the use and efficacy of this practice in both settings. Most routine chest radiography is done in the preoperative setting rather than as part of a routine admission for medical reasons. However, several studies have addressed the use of routine chest radiography prior to nonsurgical procedures, at the time of admission for various medical conditions, and for all elderly patients admitted to the hospital. Several studies have also addressed the use of routine chest radiography prior to interventional but nonsurgical procedures. A study by Malone et al [1] regarding the routine utilization of chest radiography prior to biliary lithotripsy reviewed a group of 75 patients referred for this procedure. All patients underwent PA and lateral chest radiographs. No significant pulmonary or pleural disease was noted in any of the patients. A similar study by Grier et al [2] documented that routine chest radiography prior to angiography was not necessary in the absence of any specific clinical indications. In their series of 240 patients, no angiogram was postponed or canceled because of abnormalities detected on the routine chest radiograph.

## **Routine Admission Chest Radiography**

Several studies have addressed the utility of routine chest radiographs in patients admitted for various clinical conditions, including acute gastrointestinal hemorrhage [3], acute stroke [4], and in the elderly [5]. None of these studies supported the use of routine radiography in these patient groups unless there were clinical indications of cardiac or pulmonary disease. Gupta et al [5] prospectively studied 1,000 consecutive admissions to an acute geriatric ward and demonstrated that 35%-50% of

these patients had little or no clinical indication for routine chest radiograph examination and that omitting this study in these patients would not have resulted in any significant chest conditions. The remainder of the population had signs and symptoms, other evidence of pulmonary or cardiovascular disease, or other clinical features that indicated the need for chest radiography. Of the 35% with no indication for chest radiography, 5.5% did have some abnormality, but in only 3 (less than 1%) was this considered to be significant. Of the 65% who had some indication for a chest radiograph, 17% of the total had known chronic cardiac or pulmonary disease and in these, radiologic findings did not contribute to further management.

A more recent study by Gomez-Gil et al [6] recorded the chest radiographic findings in 200 patients who were admitted to an acute psychiatric ward. The chest radiograph was normal in 82% of these patients. Relevant abnormalities were noted in 5%, but all of them were already known. In all cases, the screening test was of no practical value [6]. Hubbell et al [7] studied the impact of routine admission chest radiography on the treatment of patients on internal medicine wards at a Veterans Administration hospital in California. In a population of 294 patients, 36% had abnormalities noted on the routine admission chest radiograph. However, the findings were previously known to be chronic and stable in 86 patients and were new in only 20. Treatment was changed because of the chest radiographic results in only 4% of the patients, and in only one of these patients would appropriate treatment probably have been omitted had the chest radiograph not been obtained. The recommendation from this study was that routine chest radiographs should not be ordered solely because of admission. It is of particular interest to note that this patient population had a very high prevalence of both chronic cardiac and pulmonary disease [7].

## **Preoperative Chest Radiography**

In the United States, more than \$30 billion is spent on preoperative testing annually [8]. Chest radiography is included in many centers for routine preoperative evaluation. As is evident, the study is a relatively low-cost, low-risk procedure to screen or evaluate for occult or known cardiopulmonary disease. However, in the past two decades, the efficacy of its use, along with other routine preoperative laboratory studies, has been the issue of multiple studies [9-20].

In 1979, the Royal College of Radiologists published a multicenter study that retrospectively examined 10,619 preoperative chest radiographs in patients undergoing elective noncardiopulmonary surgery. The conclusion was that the preoperative chest radiograph did not influence

<sup>1</sup>Review, Author, Massachusetts General Hospital, Boston, Mass; <sup>2</sup>Panel Chair, Westchester Medical Imaging Services, Hawthorne, NY; <sup>3</sup>Massachusetts General Hospital, Boston, Mass; <sup>4</sup>David Geffen School of Medicine, Los Angeles, Calif; <sup>5</sup>Duke University Medical Center, Durham, NC; <sup>6</sup>Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, NY; <sup>7</sup>Long Island Jewish Medical Center, New Hyde Park, NY; <sup>8</sup>Stanford University Medical Center, Stanford, Calif; <sup>9</sup>Ohio State University Medical Center, Columbus, Ohio; <sup>10</sup>Columbia Presbyterian Medical Center, New York, NY; <sup>11</sup>University of Maryland Hospital, Baltimore, Md; <sup>12</sup>University of Pennsylvania Medical Center, Philadelphia, Pa, The Society of Thoracic Surgeons; <sup>13</sup>New York Methodist Hospital, Brooklyn, NY, The American College of Chest Physicians.

Reprint requests to: Department of Quality & Safety, American College of Radiology, 1891 Preston White Drive, Reston, VA 20191-4397.

An 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 exams 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.

the decision to operate or the choice of anesthetic [21]. Rucker evaluated the usefulness of preoperative chest radiographs in 905 patients based on risk factors including history of malignancy, recent history of smoking, exposure to toxic chemicals or signs and symptoms of recent infection. He concluded that a group of patients does exist for whom preoperative chest radiographs will predictably demonstrate no serious abnormalities and that this low-risk population constitutes the majority of the surgical population [22]. Charpak et al [23] evaluated the utility of preoperative chest radiographs in 3,883 patients. They found that routine preoperative chest radiographs could be eliminated without undesirable effects on patient care or outcome. In a study of 1,000 patients by Gagner [24], the recommendation was that preoperative chest radiographs should only be ordered when there is a cardiopulmonary abnormality suspected on the basis of the history and physical examination. He emphasized that preoperative chest radiographs should not be routine in any age group.

Archer et al [25] performed a meta-analysis on 21 studies written between 1966 and 1992. They reported that abnormalities were found in approximately 10% of routine preoperative chest radiographs. Only 1.3% of the abnormalities were unexpected on the basis of the history and physical examination. The test results were of sufficient importance to cause modification of management in only 0.1% of these cases. In 1997, Munro et al [26] published a review of 46 empirical studies that included preoperative chest radiographs. They concluded that the available evidence does not support the practice of routine chest radiographs for all patients.

A recent study in 2004 by Ramaswamy et al [27] investigated the use of preoperative testing in morbidly obese patients undergoing gastric bypass. These patients are generally considered at high risk for perioperative and postoperative complications. Preoperative chest radiographs revealed abnormalities in only 4%, none of which required preoperative intervention. The authors concluded that preoperative chest radiography was not mandatory for such patients as a routine preoperative evaluation, but could be used selectively on the basis of medical history.

Despite the lack of support in the literature, there remains wide variation in the use of preoperative chest radiographs. Some proponents believe that the study is an extension of a general physical examination and, as such, should be routinely included in a preoperative evaluation. However, it has been shown that there is insufficient diagnostic yield to warrant the use of nonindicated chest radiography as part of a routine physical examination [28]. Especially in a healthy population, screening chest radiographs have a high cost-benefit ratio [22]. Scheduling a patient for surgery does not improve the

benefit. An operation, per se, does not constitute a risk factor requiring chest radiographs.

Others have cited medico-legal reasons as a justification for including chest radiographs in the preoperative evaluation. However, data are available to mitigate this contention [29]. Routine preoperative chest radiography is not supported in the medical literature and, therefore, cannot be considered the standard of care. Also, several authors have shown that many abnormalities detected in laboratory screening tests should not be pursued [23,30]. It can be argued that the risk of failure to follow up an abnormal test result presents a greater exposure to a lawsuit than not ordering a routine study.

Mendelson reviewed the records of 369 surgical patients and determined that in 9% of cases the preoperative radiograph was helpful for comparison in the management of postoperative chest radiographic findings [31]. However, the actual effect of the baseline preoperative radiograph on patient care could not be determined in his retrospective analysis. Thomsen et al [32] studied 1,262 patients who had a preoperative chest radiograph. Sixteen percent went on to have postoperative radiographs. Their conclusion was that the comparisons had no “therapeutic consequences in any case.” In the paper by the Royal College of Radiologists [21], 70% of postoperative complications developed in patients without serious cardiopulmonary disease. On this basis, and assuming there is at least some value in having preoperative radiographs for comparison, the authors argued that it would be necessary to radiograph up to 90% of all surgical patients to be reasonably sure of having a baseline available for all those in whom a postoperative pulmonary complication develops.

Several authors have argued that there are adverse effects that result from routine preoperative chest radiographs [8,30,33,34]. First is the unnecessary radiation exposure. Additional expense is another concern. Also, surgery may be delayed due to incidental findings or improper communication. As with routine nonsurgical chest radiographs, there is the additional cost and morbidity in the further evaluation of incidental findings such as solitary pulmonary nodules.

In 1984, the Royal College of Radiologists published a set of guidelines for the ordering of preoperative chest radiographs. Their parameters included scheduled cardiopulmonary surgery age, suspected metastatic disease, acute respiratory symptoms, and recent immigration from a country where TB is endemic. Since then, multiple authors have proposed their recommendations and guidelines for the use of preoperative chest radiographs [8,23,24,34-38]. Other parameters presented include smoking, emergency cases, immunosuppressed patients, and American Society of Anesthesiologists (ASA) grades. Unfortunately, most of

An 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 exams 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.

these publications base their conclusions on statistical evaluation of the diagnostic yield of the chest radiograph interpretation. Some of the “positive” reports have included such findings as rib fractures, linear scarring, sub segmental atelectasis, pleural scarring, and mild increased cardiothoracic ratio that would likely have little to no effect on perioperative management. The real measure of the efficacy of routine chest radiographs in the preoperative setting is the impact on patient management and outcome analysis. It is in this context that a prospective study would greatly contribute to determining the appropriateness criteria for deciding which patients would truly benefit from preoperative chest radiographs.

This review of the literature supports the summary of Munro et al [26], who carried out an exhaustive review of the literature for all types of preoperative testing, including routine preoperative and admission chest radiographs. They concluded that:

- No randomized controlled trials of the effectiveness of routine preadmission or preoperative chest radiographs have been published. All available evidence reports the results of case series.
- Few studies allow the outcomes of routine chest radiographs to be distinguished from those of indicated chest radiographs, and fewer have gone beyond abnormalities to examine the impact on clinical management.
- Findings from routine preoperative chest radiographs are reported as abnormal in 2.5%–37% of cases and lead to a change in clinical management in 0%–2.1% of cases. The effect on patient outcome is unknown.
- Both abnormality yield and impact on patient management rise with age and poorer anesthesiology status.
- Limited evidence on the value of chest radiography as a baseline measure suggests that it will be of value in less than 5% of patients.

In 2005, Joo et al [39] published a meta-analysis of manuscripts published between 1966 and 2004 that addressed the value of screening preoperative chest radiographs. All eligible studies were reviewed, and data were extracted individually by two authors. Of the reported studies, the diagnostic yield of the preoperative chest radiograph was found to increase with age. However, most of the abnormalities consisted of chronic disorders such as cardiomegaly and chronic obstructive pulmonary disease which were already identified clinically. When further investigations were performed, the proportion of patients who had a change in management was low (10% of investigated patients). Postoperative pulmonary complications were similar between patients with preoperative chest radiographs (12.8%) and patients who did not have preoperative chest radiographs (16%). The authors concluded that an

association between preoperative screening chest radiographs and a decrease in morbidity and mortality could not be established. The conclusion appears warranted that chest radiographs should not be performed on patients younger than age 70 and without risk factors. For patients older than age 70, there is insufficient evidence against performance of routine chest radiographs.

The available evidence does not support a policy for performing routine admission or preoperative chest radiographs for all patients. Although there is no evidence showing that such a policy would lead to worse outcomes for patients, the finding that only 2% of chest radiographs lead to a change in management of patients suggests a high level of cost and inconvenience with potentially limited benefits.

Because of the lack of adequate prospective studies, particularly studies dealing with the effect of admission and preoperative chest radiographs on patient outcome, a recommendation from the American College of Radiology that these studies not be obtained may be premature. However, given the current evidence, routine preoperative and admission chest radiographs are not recommended except when the following conditions exist:

- Acute cardiopulmonary disease is suspected on the basis of history and physical examination.
- There is a history of stable chronic cardiopulmonary disease in an elderly (older than age 65) patient without a recent chest radiograph within the past six months.

#### 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. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations	
Relative Radiation Level	Effective Dose Estimate Range
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

An 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 exams 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.

## References

1. Malone DE, Becker CD, Muller NL, Burhenne HJ. Is routine chest radiography required with biliary lithotripsy? *AJR* 1989; 152(5):987-989.
2. Grier DJ, Watson LJ, Hartnell GG, Wilde P. Are routine chest radiographs prior to angiography of any value? *Clin Radiol* 1993; 48(2):131-133.
3. Tobin K, Klein J, Barbieri C, Heffner JE. Utility of routine admission chest radiographs in patients with acute gastrointestinal hemorrhage admitted to an intensive care unit. *Am J Med* 1996; 101(4):349-356.
4. Sagar G, Riley P, Vohrah A. Is admission chest radiography of any clinical value in acute stroke patients? *Clin Radiol* 1996; 51(7):499-502.
5. Gupta SD, Gibbins FJ, Sen I. Routine chest radiography in the elderly. *Age Ageing* 1985; 14(1):11-14.
6. Gomez-Gil E, Trilla A, Corbella B, et al. Lack of clinical relevance of routine chest radiography in acute psychiatric admissions. *Gen Hosp Psychiatry* 2002; 24(2):110-113.
7. Hubbell FA, Greenfield S, Tyler JL, Chetty K, Wyle FA. The impact of routine admission chest x-ray films on patient care. *N Engl J Med* 1985; 312(4):209-213.
8. Marcello PW, Roberts PL. "Routine" preoperative studies. Which studies in which patients? *Surg Clin North Am* 1996; 76(1):11-23.
9. Asimakopoulos G, Harrison R, Magnussen PA. Pre-admission clinic in an orthopaedic department: evaluation over a 6-month period. *J R Coll Surg Edinb* 1998; 43(3):178-181.
10. Brorsson B, Arvidsson S. The effect of dissemination of recommendations on use. Preoperative routines in Sweden, 1989-91. *Int J Technol Assess Health Care* 1997; 13(4):547-552.
11. Clelland C, Worland RL, Jessup DE, East D. Preoperative medical evaluation in patients having joint replacement surgery: added benefits. *South Med J* 1996; 89(10):958-960.
12. Fowkes FG. The value of routine preoperative chest X-rays. *Br J Hosp Med* 1986; 35(2):120-123.
13. France FH, Lefebvre C. Cost-effectiveness of preoperative examinations. *Acta Clin Belg* 1997; 52(5):275-286.
14. Ishaq M, Kamal RS, Aqil M. Value of routine pre-operative chest X-ray in patients over the age of 40 years. *J Pak Med Assoc* 1997; 47(11):279-281.
15. Narr BJ, Warner ME, Schroeder DR, Warner MA. Outcomes of patients with no laboratory assessment before anesthesia and a surgical procedure. *Mayo Clin Proc* 1997; 72(6):505-509.
16. Rao PS, Abid Q, Khan KJ, et al. Evaluation of routine postoperative chest X-rays in the management of the cardiac surgical patient. *Eur J Cardiothorac Surg* 1997; 12(5):724-729.
17. Ricciardi G, Angelillo IF, Del Prete U, et al. Routine preoperative investigation. Results of a multicenter survey in Italy. Collaborator Group. *Int J Technol Assess Health Care* 1998; 14(3):526-534.
18. Tiret L, Hatton F, Desmonts JM, Vouc'h G. Prediction of outcome of anaesthesia in patients over 40 years: a multifactorial risk index. *Stat Med* 1988; 7(9):947-954.
19. Walters G, McKibbin M. The value of pre-operative investigations in local anaesthetic ophthalmic surgery. *Eye* 1997; 11 (Pt 6):847-849.
20. Wiencek RG, Weaver DW, Bouwman DL, Sachs RJ. Usefulness of selective preoperative chest x-ray films. A prospective study. *Am Surg* 1987; 53(7):396-398.
21. Preoperative chest radiology. National study by the Royal College of Radiologists. *Lancet* 1979; 2(8133):83-86.
22. Rucker L, Frye EB, Staten MA. Usefulness of screening chest roentgenograms in preoperative patients. *JAMA* 1983; 250(23):3209-3211.
23. Charpak Y, Blery C, Chastang C, Szatan M, Fourgeaux B. Prospective assessment of a protocol for selective ordering of preoperative chest x-rays. *Can J Anaesth* 1988; 35(3 (Pt 1)):259-264.
24. Gagner M, Chiasson A. Preoperative chest x-ray films in elective surgery: a valid screening tool. *Can J Surg* 1990; 33(4):271-274.
25. Archer C, Levy AR, McGregor M. Value of routine preoperative chest x-rays: a meta-analysis. *Can J Anaesth* 1993; 40(11):1022-1027.
26. Munro J, Booth A, Nicholl J. Routine preoperative testing: a systematic review of the evidence. *Health Technol Assess* 1997; 1(12):i-iv; 1-62.
27. Ramaswamy A, Gonzalez R, Smith CD. Extensive preoperative testing is not necessary in morbidly obese patients undergoing gastric bypass. *J Gastrointest Surg* 2004; 8(2):159-164; discussion 164-155.
28. Evens RG. Appropriateness of routine chest radiography. *JAMA* 1996; 275(4):326.
29. Macario A, Roizen MF, Thisted RA, Kim S, Orkin FK, Phelps C. Reassessment of preoperative laboratory testing has changed the test-ordering patterns of physicians. *Surg Gynecol Obstet* 1992; 175(6):539-547.
30. Roizen MF. Preoperative evaluation of patients: a review. *Ann Acad Med Singapore* 1994; 23(6 Suppl):49-55.
31. Mendelson DS, Khilnani N, Wagner LD, Rabinowitz JG. Preoperative chest radiography: value as a baseline examination for comparison. *Radiology* 1987; 165(2):341-343.
32. Thomsen HS, Gottlieb J, Madsen JK, et al. [Routine x-ray examination of the thorax prior to surgical intervention under general anesthesia]. *Ugeskr Laeger* 1978; 140(14):765-768.
33. Tape TG, Mushlin AI. How useful are routine chest x-rays of preoperative patients at risk for postoperative chest disease? *J Gen Intern Med* 1988; 3(1):15-20.
34. Vogt AW, Henson LC. Unindicated preoperative testing: ASA physical status and financial implications. *J Clin Anesth* 1997; 9(6):437-441.
35. Bouillot JL, Fingerhut A, Paquet JC, Hay JM, Coggia M. Are routine preoperative chest radiographs useful in general surgery? A prospective, multicentre study in 3959 patients. Association des Chirurgiens de l'Assistance Publique pour les Evaluations medicales. *Eur J Surg* 1996; 162(8):597-604.
36. Haug RH, Reifeis RL. A prospective evaluation of the value of preoperative laboratory testing for office anesthesia and sedation. *J Oral Maxillofac Surg* 1999; 57(1):16-20; discussion 21-12.
37. McClean GJ. Routine preoperative chest X-rays. *Ir J Med Sci* 1989; 158(3):67-68.
38. Wagner JD, Moore DL. Preoperative laboratory testing for the oral and maxillofacial surgery patient. *J Oral Maxillofac Surg* 1991; 49(2):177-182.
39. Joo HS, Wong J, Naik VN, Savoldelli GL. The value of screening preoperative chest x-rays: a systematic review. *Can J Anaesth* 2005; 52(6):568-574.

An 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 exams 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.