# American College of Radiology
# ACR Appropriateness Criteria®

**Clinical Condition:** **Routine Chest Radiograph**

**Variant 1:** **Monitoring stable patient.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable routine admission | 9 | Not for coronary artery bypass graft. Not for acute upper gastrointestinal bleeding. | Min |
| X-ray chest portable clinical indications only | 8 | Clinical worsening only. | Min |
| X-ray chest portable routine monitoring | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Variant 2:** **Respiratory failure. Patient receiving mechanical ventilation.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable daily | 9 | | Min |
| X-ray chest portable clinical indications only | 9 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Variant 3:** **Compromised respiratory function. Patient with endotracheal tubes.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable after catheter/tube insertion | 9 | | Min |
| X-ray chest portable clinical indications only | 9 | | Min |
| X-ray chest portable follow-up catheter/tube | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Clinical Condition:** **Routine Chest Radiograph**

**Variant 4:** **Central venous pressure catheter (CVP) insertion.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable after catheter/tube insertion | 9 | | Min |
| X-ray chest portable clinical indications only | 8 | | Min |
| X-ray chest portable follow-up catheter/tube | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Variant 5:** **Cardiopulmonary compromise. Swan-Ganz catheter insertion.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable after catheter/tube insertion | 9 | | Min |
| X-ray chest portable clinical indications only | 8 | | Min |
| X-ray chest portable follow-up catheter/tube | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Variant 6:** **Potential cardiopulmonary compromise. Nasogastric (NG) tube insertion.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable after catheter/tube insertion | 9 | Feeding NG tube. | Min |
| X-ray chest portable after catheter/tube insertion | 6 | Nonfeeding NG tube. | Min |
| X-ray chest portable follow-up catheter/tube | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

**Clinical Condition:** **Routine Chest Radiograph**

**Variant 7:** **Respiratory compromise. Chest tube insertion.**

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| X-ray chest portable after catheter/tube insertion | 8 | | Min |
| X-ray chest portable clinical indications only | 8 | | Min |
| X-ray chest portable follow-up catheter/tube | 2 | | Min |
| **Rating Scale:** 1=Least appropriate, 9=Most appropriate | | | *Relative Radiation Level |

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## Summary of Literature Review

**Portable Radiographs in the ICU Setting**

Portable radiographs can be categorized as: 1) daily or routine radiographs for patient monitoring; 2) radiographs obtained after specific procedures; and 3) radiographs documenting the presence or course of disease.

This narrative concerns the daily routine radiograph only and does not include postprocedural or postsurgical radiographs. Studies that included large volumes of chest radiographs (CXR) (>200) were included in this discussion. The most recent two studies evaluated the clinically relevant use of daily routine versus non-routine clinically indicated chest radiographs. A large study by Graat et al [1] prospectively evaluated the clinical value of 2,457 routine CXRs in a combined surgical/medical intensive care unit (SICU/MICU). In their study, 5.8% of routine CXRs showed new or unexpected findings; but only 2.2% warranted a change in therapy. No difference was found between the medical and surgical patients. A randomized control study of MICU patients by Krivopal et al [2], prospectively divided MICU patients into those who received routine CXRs and those who only received non-routine (clinically indicated) CXRs. They found a greater percentage of radiographs with significant findings (requiring intervention) in the non-routine group (26.5%) than in the routine group (13.3%). Significant interventions included diuresis, antibiotic administration, or an invasive procedure. The non-routine group also received significantly less radiographs per person than the routine group (4.4 vs 6.8). There was no significant difference in outcome between the groups in length of intubation, ICU stay, hospital stay or mortality.

Older studies reviewed only daily radiographs in ICU patients without comparison to the outcome of those without routine films. The yield in routine radiographs was overall higher, especially in MICU patients and especially those who were intubated. If one looks at a broader definition of radiographic value such as "important or unexpected findings," the range in results was large, from 3% to 60%. Studies by Brainsky et al [3] and Marik et al [4] reported 20% and 37% changes in management, respectively from routine portable CXRs obtained in the MICU. Patients who were intubated were the most affected. Hall et al [5] reported the lowest rate of significant abnormal CXR findings at 3% of all films in 18% of the MICU patients. They still recommended routine studies on all critically ill patients. In a study by Strain et al [6] although a high yield was found in MICU patients who had acute cardiopulmonary disease, the yield was very low in patients with stable cardiac disease (usually myocardial infarction) and in patients in the ICU who had extrathoracic disease only.

For cardiothoracic ICU patients, two prospective nonrandomized studies showed a low incidence of significant findings on routine daily radiographs (4.5% in both studies) resulting in minimal impact on patient management. The results support the recommendation to obtain CXRs in cardiothoracic ICU for clinical findings and not for routine follow-up [7,8].

*Recommendation*

Routine daily portable radiographs are indicated for patients with acute cardiopulmonary problems. In stable patients admitted for cardiac monitoring, or in stable patients admitted for extrathoracic disease only, an initial admission radiograph is recommended, with follow-up radiographs obtained only for specific clinical indications.

**Endotracheal Tubes**

There are nine studies described in the literature since 1980 [4,6,7,9-14] that evaluate the significance of the chest radiograph in assessing endotracheal tube placement following insertion. In five of them, between 12% and 15% of patients had malpositioned endotracheal tubes, many of which required repositioning. Two studies found 28% and 46% of tubes malpositioned upon insertion, and the single dissenting paper found 2% malpositioned. Two studies compared x-ray with physical exam [9,15]. In both studies, physical exam predicted malpositioned tubes in 3% of patients, whereas the x-rays showed malpositioning in 14% of patients in one study and 28% in the other. Kollef et al [16] found that the vast majority of malpositioned tubes were discovered in the first three days.

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*Recommendation*
Very few malpositioned tubes are detected by physical examination. Routine radiographs immediately postintubation are indicated to insure proper positioning.

**CVP Catheters**
Eight studies were reviewed regarding central venous pressure (CVP) catheters [6,9-14,16]. The vast majority came to the same conclusion. Approximately 10% of the CXRs demonstrated malpositioned catheters. Pneumothoraces were present in only a small percentage of patients. Gray et al [9] separated jugular and subclavian catheters. Complications were twice as common with subclavian catheters (17% vs 8%), although unsuspected complications were infrequent.

*Recommendation*
A CXR after insertion of a CVP catheter is recommended to demonstrate proper placement and detect any complications. Beyond the initial insertion, follow-up radiographs have a low yield for revealing complications. Follow-up radiographs are suggested only when complications are suspected clinically.

**Swanz-Ganz Catheters**
Previously mentioned studies incorporated the position and potential complications of Swan-Ganz catheter placements on CXRs obtained immediately post-procedure. The majority of complications, which occur in approximately 10% of catheter insertions, are minor and require catheter repositioning [9,10,12,17]. Pneumothorax rate was approximately 2% [10,17].

*Recommendation*
Portable radiography is suggested after catheter insertion. Once pneumothorax has been excluded and proper positioning has been assured, follow-up radiographs are not required except for specific clinical indications.

**Nasogastric Tubes**
There are no large prospective studies that consider the utility of obtaining CXR immediately after the insertion of a nasogastric suction tube or a small-bore feeding tube. Routine radiographs revealed important tube malpositioning in 1% of cases [6,10,12]. Other complications have also been reported [18-21]. Clearly, a patient with a functioning nasogastric tube that has already been documented to be in satisfactory position needs no imaging unless a clinical problem arises.

*Recommendation*
Based on limited evidence, small-bore feeding tubes may, in a small but significant number of patients, be inadvertently placed in the lungs. This error is not always detected clinically and may lead to injection of feeding material into the lung, or tube penetration of the pleura, with subsequent pneumothorax. A CXR is warranted after initial nasogastric tube insertion and before the first feeding. Beyond the initial radiograph, follow-up radiographs are not required for management of stable tubes.

**Chest Tubes**
Few studies have been performed to evaluate the efficacy of the initial CXR after the insertion of a chest tube. The three available studies show that approximately 10% of tubes are malpositioned [6,11,14]. Many of the x-ray abnormalities detected are minor and do not result in changes of tube positions.

*Recommendation*
After insertion of a chest tube, a CXR is recommended to show the position of the tube, any success in drainage, and possible complications from insertion. Beyond this point, evaluation of tube position and function is warranted based on management of the pleural space and clinical indications.

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