



Low Value of Routine Chest Radiographs in a Mixed Medical-Surgical ICU*

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Objective: To determine the diagnostic efficacy (DE) and therapeutic efficacy (TE) of daily routine chest radiographs (CXRs), and to establish the impact of abandoning this CXR from daily practice on total CXR volume, ICU length of stay (LOS), readmission rate, and ICU mortality.

Design: Prospective controlled study in two parts. The first part comprised a 1-year period during which attending physicians were blinded for findings on daily routine CXRs and were only informed if something deemed important was seen by the radiologist (predefined major abnormalities) who reviewed all CXRs as usual. The second part comprised a half-year period during which daily routine CXRs were replaced by clinically indicated CXR.

Setting: Mixed medical-surgical ICU of a teaching hospital.

Results: Data on 1,780 daily routine CXRs in 559 hospital admissions were collected. DE of daily routine CXRs was 4.4%. The most frequent unexpected major abnormalities were new or progressive infiltrates (1.8%) and oropharyngeal tube malposition (0.7%). TE of daily routine CXRs was 1.9%. The most frequent intervention was oropharyngeal tube adjustment (0.6%). No relation was found for DE or TE and hospital admission type or intubation and mechanical ventilation. In the second study part, 433 CXRs were obtained in 274 admissions. Abandoning daily routine CXRs did not affect clinically indicated CXRs orders, or ICU LOS, readmission rate, and mortality. A total CXR volume reduction of 35% (which equaled \$9,900 per bed per year [US dollars]) was observed after abandoning daily routine CXRs.

Conclusion: Diagnostic and therapeutic value of the daily routine CXR is low. Daily routine CXRs can be safely abandoned in the ICU. (CHEST 2007; 132:823–828)

Key words: critical care; daily-routine chest radiograph; ICU

Abbreviations: CXR = chest radiograph; DE = diagnostic efficacy; IQR = interquartile range; LOS = length of stay; PACS = picture archiving and communication system; TE = therapeutic efficacy

In ICUs, chest radiographs (CXRs) are frequently obtained on a daily basis.¹ These so-called “daily routine” CXRs are made irrespective of the patient’s clinical status, which is in line with recommendations by the American College of Radiology for ICU patients.² However, obtaining daily routine CXRs is a labor-intensive strategy, while diagnostic and therapeutic yields of daily routine CXRs are low.^{3–8}

One could therefore argue that CXRs should only be obtained when clinically indicated, which was substantiated by three previous studies.^{9–12} However, these studies were either small,^{9,10} performed in children,⁹ or performed in academic and tertiary

referral ICUs with a relatively high number of physicians and nurses per bed.⁹ This setting makes the results difficult to generalize to a general ICU population. In addition, the attending physicians were not blinded for findings on daily routine CXRs. Thus, no information was obtained about the presence of pathology on the routine CXR that was clinically unsuspected. In order to judge whether abolishing a daily routine CXR strategy is indeed warranted, knowledge of the presence of clinically significant pathology that otherwise would have gone undetected is essential.

We evaluated the diagnostic and therapeutic effi-

cacy of daily routine and clinically indicated CXRs in a prospective controlled blinded study in a nonacademic, mixed medical-surgical ICU. In addition, effects of abandoning the daily routine CXRs strategy on CXR volume, ICU length of stay (LOS), readmission rate, and mortality were evaluated during a 6-month implementation phase.

MATERIALS AND METHODS

We performed a prospective observational study evaluating the diagnostic and therapeutic value of all CXRs of patients admitted to the ICU during a period of 1 year. During this study period, we compared daily routine and clinically indicated CXRs in the same patient group. Thereafter, the daily routine regimen was abolished, all CXRs required a clinical indication, and data were collected for an additional half-year period (implementation phase).

The study was approved by the local ethical board. The requirement to obtain informed consent was waived because this study evaluated a routine approach, and all daily routine CXRs were evaluated by trained radiologists.

Study Location

The study was performed in the ICU of the Gelre Hospitals, Lukas site, a 985-bed university-affiliated teaching hospital in Apeldoorn, the Netherlands. The ICU is a 10-bed "closed format" department with medical and surgical patients. Cardiothoracic surgery and neurosurgery are not performed in our hospital. The ICU team comprises two full-time ICU physicians, five physicians who participate in evening and night shifts, and one resident.

CXR Protocol, Study Phase

A daily routine CXR was obtained every day in all patients at 8:00 AM during the 1-year study phase. These daily routine CXRs were not accessible in the picture archiving and communication system (PACS) to attending physicians responsible for daily clinical care during the ICU stay, and could only be retrieved when radiologists involved in scoring of daily routine CXRs logged-on to the PACS.

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In addition to the daily routine CXR, the attending physicians ordered additional CXRs if deemed clinically necessary. These clinically indicated CXRs were, in contrast to the daily routine CXRs, available for review by attending physicians. If a clinically indicated CXR was obtained between 4:00 AM and 8:00 AM, a daily routine CXR was not obtained. The attending physician could always order a new CXR even if a daily routine CXR was obtained shortly before. It was left to the discretion of the attending physician whether the daily routine CXR would suffice. If it did, that CXR became available for review (and was scored as "clinically indicated" for the purpose of the study analysis); if it did not, a new clinically indicated CXR was performed.

All CXRs were evaluated by trained radiologists before 8:30 AM. The radiologist interpreted all CXRs for the presence of predefined radiologic findings, categorized them as minor or major, and recorded whether they were new or old. In case of a life-threatening finding on a daily routine CXR, such as tension pneumothorax, the physician was notified immediately and that specific CXR was released for view in the PACS. Every morning, at the interdisciplinary meeting in the radiologic department, all clinically indicated CXRs of the previous 24 h were discussed. In addition, daily routine CXRs with unexpected, major predefined radiographic findings were shown by the radiologist, discussed with the physician, and released for view in PACS. A change in patient management that had been started based on CXR findings was recorded.

Data Collection

To evaluate the CXRs, two different request forms were designed. The form for the daily routine CXRs was divided into three parts. The first part contained the patient data and was filled in by the ICU nursing staff before the daily routine CXR was performed. It contained the date and time and the patient's name, age, and hospital number. Also, the clinical diagnosis and respiratory management of the patient (eg, intubation and mechanical ventilation) was recorded. The second part was the radiologic section of the form, and it contained a number of predefined possible radiographic findings, as defined in Table 1. Each finding was subdivided into three categories of severity: (1) new or progressive major findings, (2) new or progressive minor findings, or (3) unchanged, improved, or normal CXR findings. In particular, pulmonary edema was not included on the list of major predefined abnormalities because its presence was judged to be inferred from clinical data, such as physical examination, vital signs, fluid balance, and oxygen saturation. If the radiographic finding noticed by the radiologist was a new or progressive major finding and unsuspected by the physician, a specific box was ticked. The third part contained a list of predefined possible patient-management decisions including changes in medication or ventilator settings, repositioning of the endotracheal tube, IV catheters or chest tubes, bronchoscopy, insertion of a chest tube, surgical intervention, request for additional imaging studies, or no intervention or unchanged continuation of patient management. To assess actual changes in patient management, these changes in management were discussed and scored during the next interdisciplinary meeting with radiologists.

Diagnostic and Therapeutic Efficacy

To determine the value of the daily-routine CXRs, we used the two categories of efficacy defined by the American College of Radiology committee on efficacy.¹³ Diagnostic efficacy (DE) [the number of CXRs with a new or progressive major finding divided by the total number of CXRs] is an indicator of the value of the CXR in assisting in a diagnosis. Therapeutic efficacy (TE) [the

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