



Single intervention for a reduction in portable chest radiography (pCXR) in cardiovascular and surgical/trauma ICUs and associated outcomes☆



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ABSTRACT

Purpose: Studies suggest that “on-demand” radiography is equivalent to daily routine with regard to adverse events. In these studies, provider behavior is controlled. Pragmatic implementation has not been studied.

Materials and methods: This was a quasi-experimental, pre-post intervention study. Medical directors of two intervention ICUs requested pCXRs be ordered on an on-demand basis at one time point, without controlling or monitoring behavior or providing follow-up.

Results: A total of 11,994 patient days over 18 months were included. Combined characteristics: Age: 56.7, 66% male, 96% survival, APACHE II 14 (IQR: 11–19), mechanical ventilation (MV) (occurrences)/patient admission: mean 0.7 (SD: 0.6; range: 0–5), duration (hours) of MV: 21.7 (IQR: 9.8–81.4) and ICU LOS (days): 2.8 (IQR: 1.8–5.6). Average pCXR rate/patient/day before was 0.93 (95% CI: 0.89–0.96), and 0.73 (95% CI: 0.69–0.77) after. Controlling for severity, daily pCXR rate decreased by 21.7% ($p < 0.001$), then increased by about 3%/month ($p = 0.044$). There was no change in APACHE II, mortality, and occurrences or duration of MV, unplanned re-intubations, ICU LOS.

Conclusions: In critically ill adults, pCXR reduction can be achieved in cardiothoracic and trauma/surgical patients with a pragmatic intervention, without adversely affecting patient care, outside a controlled study.

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Abbreviations: CXR, chest radiograph; pCXR, portable chest radiograph; ICU, intensive care unit; CVICU, cardiovascular intensive care unit; SICU, surgical intensive care unit; NCCU, neurocritical care unit; MICU, medical intensive care unit; IMCU, intermediate care unit; LTAC, long term acute care; SNF, skilled nursing facility; APACHE II, Acute Physiology and Chronic Health Evaluation II; ECMO, extracorporeal membrane oxygenation; VAD, ventricular assist device; MODS, multiple organ dysfunction syndrome; PE, pulmonary embolism; VAP, ventilator associated pneumonia; MV, mechanical ventilation; IQR, inter-quartile range; CI, confidence interval.

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1. Introduction

Portable chest radiography (pCXR) is used frequently in intensive care units (ICUs), especially for postoperative cardiothoracic surgery and trauma patients. Extensive data demonstrates a low yield of clinical information when routine daily chest radiography is done for diverse ICU patient populations, including in postoperative surgical and cardiothoracic patients [1–7]. Studies have suggested that use of “on demand” chest radiography in the surgical ICU setting may increase the rate of positive findings found compared to “routine” chest radiography methodology [8,9]. Additionally, there are controlled clinical trials that demonstrate that moving from “routine” to “on-demand” chest radiography has no detrimental impact on patient outcome, though these trials have excluded cardiothoracic patients [10,11]. A recent meta-analysis found no difference among trials using restrictive ordering practices, but it was noted that studies did not rigorously assess for harm [12]. Smaller pre-post interventional studies have demonstrated no adverse effect on patient outcomes in the postoperative cardiothoracic and surgical

populations when changing from “routine” to “on-demand” [13,14]. It is unknown if these same results can be achieved in routine clinical practice among any ICU population without at the same time mandating provider ordering behavior through the terms of a clinical trial or changes in order structure.

All previously observed studies of pCXR reduction in the ICU have managed provider behavior, through clinical trials, deliberate changes to ordering structure, and often by requiring a clinical indication for obtaining a radiograph [5,13–15]. To date, there are no studies that have evaluated the efficacy, durability or adverse events after a single time point intervention. Prior to undertaking this study, placement of a routine order for daily pCXR was standard culture in the cardiothoracic (CVICU) and surgical/trauma (SICU) ICUs at our institution. We chose to evaluate the impact of a pragmatic single time point intervention requesting on-demand testing as opposed to routine testing in our CVICU and SICU and to observe the efficacy and durability of the intervention and monitored patient outcomes for adverse events associated with this change.

The clinical practice in two ICUs at our institution (CVICU and SICU) was to routinely obtain daily portable chest radiographs (pCXR) for patients with clinical conditions of the thorax (such as, pneumonia, chest trauma, respiratory failure), cardiothoracic post-operative patients and patients with thoracostomy tubes. Resident physicians and advanced practice clinicians (APCs) placed the order for a morning pCXR each prior evening in anticipation of morning rounds, despite a general recognition among the involved providers that this practice rarely resulted in meaningful patient changes. A clinical indication was required in placing the order. On-demand pCXRs were also routinely obtained after invasive procedures of the thorax (central venous catheters,

thoracostomy tubes or postoperatively upon arrival to the ICU) or intubations. Subsequent on-demand pCXRs were obtained as clinically indicated rather than routinely ordered each day. The practice of obtaining routine daily pCXR was perpetuated by the practice culture in our ICUs where attending providers did not articulate that such ordering practice was not necessary and the perception by the ordering residents and APC providers that such daily pCXRs were expected by the attending staff and primary surgical teams.

2. Materials and methods

This was a prospective, pragmatic clinical practice intervention at a large tertiary academic medical center. Data collection was observational and approved by the Institutional Review Board as #IRB_00084463 AM_00023786. The study design was a pre/post pragmatic clinical intervention in two intensive care units (ICUs): the cardiovascular ICU (CVICU) and the surgical ICU (SICU). The CVICU has an annual admission of approximately 700 patients who primarily comprise post-cardiac surgery patients, including heart and lung transplantation, as well as patients with durable and temporary mechanical circulatory support devices. A smaller percentage of CVICU patients included cardiology patients; these patients were not part of the intervention group and were excluded from data analysis. The SICU has an annual census of approximately 1000 to 1200 patients who comprise trauma, general and emergency surgery, abdominal organ transplantation, orthopedic, gynecologic and obstetric, vascular, otolaryngology and polytrauma patients. The control group was composed of two ICUs which did not receive the intervention [a medical ICU (MICU) and a neurocritical care ICU (NCCU)].

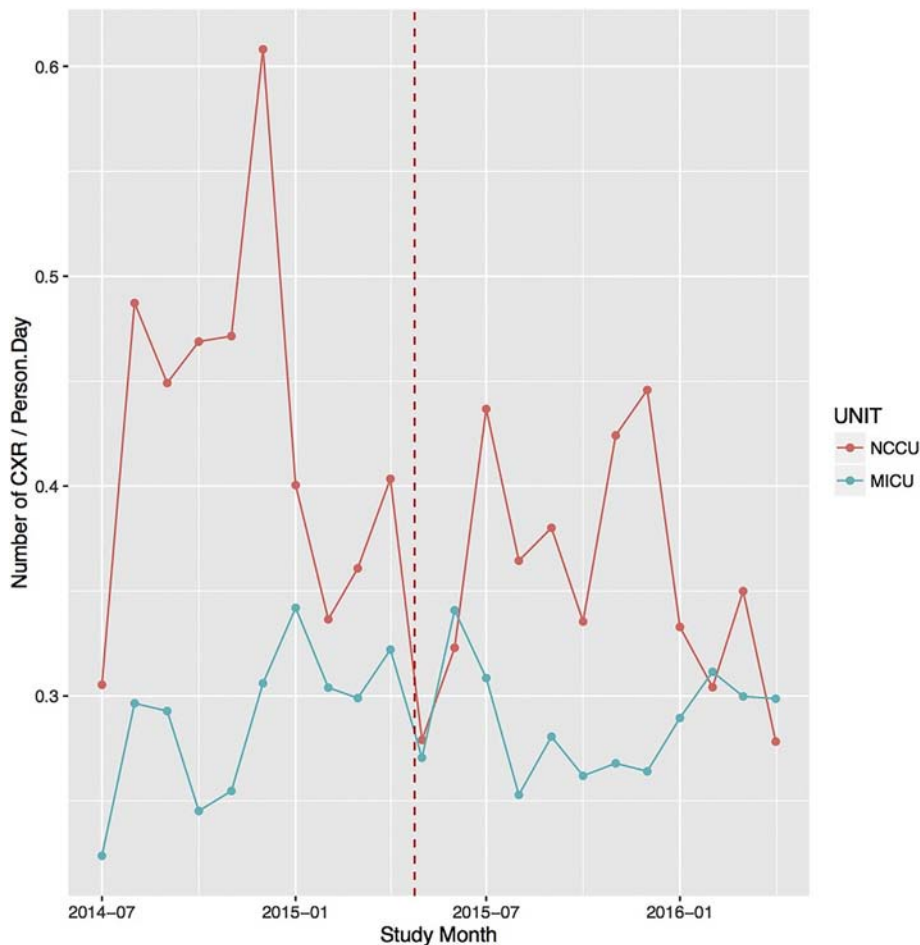


Fig. 1. Control ICU rate of pCXR/patient/day. Control ICU rate of pCXR/patient/day was stable before and after the intervention. (Figure displays monthly data for clarity).

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