

ED crowding associated with differences in CXR interpretations between emergency physicians and radiologists^{☆,☆☆}



To the Editor,

Emergency department (ED) crowding is a widespread challenge nationwide, with many EDs facing high ED patient volumes and increasing ambulance diversion, leading the Institute of Medicine to describe United States EDs as nearing the “breaking point” [1]. Emerging evidence has documented multiple negative outcomes associated with overcrowding, including increased walkout rates [2], delays in treatment during myocardial infarction [3], and increased mortality [4]. Other associated effects of overcrowding include poorer perceived clinician-patient communication [5,6], and increased risk of posttraumatic stress symptoms following evaluation [7]. Past studies have also pointed to the potential for errors in clinical decision under times of stress and overcrowded clinical environments [8,9] but little work has studied the association of crowding on clinical actions such as the interpretation of radiographic imaging in the ED.

CXRs are among the most common radiographic studies used by emergency physicians (EPs) to aid diagnosis and clinical decision making in the ED [10]. While frequently ordered and interpreted, CXRs have been found to be among the most challenging films to reliably read and interpret correctly for both radiologists and EPs [11]. Past work measuring differences in EP and radiologist interpretation of CXRs have reported difference rates ranging from 0.1% to 17% [12,13]. The potential increased psychological demands and stress of working in an overcrowded ED may negatively impact clinical care, yet little is known about its association with important clinical tasks such as the interpretation of radiographic imaging. The goal of our prospective observational study was to examine the association of ED overcrowding with the frequency of errors in CXR interpretations done by EPs compared to radiologists.

500 radiographs were interpreted by 52 emergency physicians (32 board certified attending EPs and 20 emergency medicine residents) at an urban academic ED from June 2015–June 2016. Physicians and rotating residents from services outside of emergency medicine were excluded. Demographic information included years of clinical practice and clinical severity of patient (e.g. ESI). Participants completed a self-report questionnaire immediately after the CXR was performed, asking for their clinical impression of the CXR. Participants were also asked to note the presence of clinically significant radiographic findings such as infiltrate or pneumothorax (see Table 1) Results of this questionnaire were compared to the final attending radiologist report for any possible discrepancies. Measure of ED crowding was calculated using the emergency department work index (EDWIN) [14]. The EDWIN score is a tool commonly used across EDs to quantitatively assess ED crowding, volume, and staffing [15]. The primary outcome measure was differences in CXR interpretation between EP and final radiologist interpretation.

On average each participant interpreted 8.2 CXRs during the study (min: 1 CXR interpreted, max: 17 CXRs interpreted). We found that among the 500 CXR reads, there were 32 instances (6.4%) of differing interpretations of the CXR by EPs versus radiologists. Among those 32 differences, the most common discrepancy was radiologist interpreting atelectasis/pneumonia (14 cases) and the EP noted none, followed by 11 cases where EP interpreted atelectasis/pneumonia and radiologist noted none.

We used multiple linear regression to evaluate if ED overcrowding predicted frequency of discrepancies between EP and radiologist. The model adjusted for years of experience of provider and patient severity

Table 1
Radiographic findings analyzed.

Atelectasis
Clear lungs
Fracture
Infiltrate or pneumonia (\pm lung lobe specification)
Multiple infiltrates or multifocal pneumonia
Normal heart or cardiomegaly
Interstitial edema
Normal or widened mediastinum
Pleural effusion
Pneumothorax/hemothorax
Foreign body

(by ESI). The model significantly predicted discrepancies of EP and radiology reads ($F = 3.496$, $p < 0.01$, $R^2 = 0.20$). Among the three variables in the model only EDWIN was significantly associated with increased discrepancies in radiology interpretations ($\beta = 0.14$, $p < 0.02$)

The results of our study found that overall, EPs did an excellent job of interpreting CXR at the bedside under conditions varying degrees of ED overcrowding, as evidenced by the overall low discrepancy rate between EP and radiologists with regards to CXR interpretation. However, we found that in the instances of discrepancies in CXR read, increasing levels of overcrowding was significantly associated with higher frequencies of differences with radiologist read. These differences in interpretation have the potential for changes in clinical management (e.g. administration of antibiotics, etc.). The findings of our study builds on existing literature of ED crowding by highlighting the negative impact that overcrowding may have on provider analysis of clinical data. Future work identifying interventions to support clinician decision making in the face of fluctuating patient volumes and crowding may improve patient outcomes and care. Our study was limited as a single site study at an academic urban medical center with 24 hour emergency radiology resident and attending staffing (though all comparison reads were indexed to the final attending radiology read). In summary, our study found ED overcrowding to be associated with increased frequency of discrepancy between EP and radiologist interpretation of CXR. Efforts to reduce crowding as well as target education programs aimed at increasing detection of such radiographic findings may help reduce such differences further and optimize patient management and outcomes in the ED.

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References

- [1] Institute of Medicine Committee on the Future of Emergency Care in the US Health System. Hospital Based Emergency Care: At the Breaking Point. Washington, D.C.: The National Academies Press; 2006
- [2] Weiss SJ, Ernst AA, Derlet R, King R, Bair A, Nick TG. Relationship between the National ED Overcrowding Scale and the number of patients who leave without being seen in an academic ED. *Am J Emerg Med* 2005;23(3):288–94.
- [3] Schull MJ, Vermeulen M, Slaughter G, Morrison L, Daly P. Emergency department crowding and thrombolysis delays in acute myocardial infarction. *Ann Emerg Med* 2004;44(6):577–85.

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- [4] Sprivilis PC, Da Silva J, Jacobs IG, Frazer AR, Jelinek GA. The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. *Med J Aust* 2006;184(5):208.
- [5] Chang BP, Carter E, Suh EH, Kronish IM, Edmondson D. Patient treatment in ED hallways and patient perception of clinician-patient communication. *Am J Emerg Med* 2016;34(6):1163–4.
- [6] Chang BP, Sumner JA, Haerizadeh M, Carter E, Edmondson D. Perceived clinician-patient communication in the emergency department and subsequent post-traumatic stress symptoms in patients evaluated for acute coronary syndrome. *Emerg Med J* 2016;33(9):626–31.
- [7] Homma K, Chang BP, Edmondson D. Association of social support during emergency department evaluation of acute coronary syndrome with subsequent posttraumatic stress symptoms. *J Health Psychol* 2016;39(5):823–31.
- [8] Croskerry P. ED cognition: any decision by anyone at any time. *CJEM* 2014;16(01):13–9.
- [9] Laxmisan A, Hakimzada F, Sayan O, Green RA, Zhang J, Patel V. The multitasking clinician: decision-making and cognitive demand during and after team handoffs in emergency care. *Int J Med Inform* 2007;76(11):801–11.
- [10] Gatt ME, Spectre G, Paltiel O, Hiller N, Stalnikowicz R. Chest radiographs in the emergency department: is the radiologist really necessary? *Postgrad Med J* 2003;79(930):214–7.
- [11] Mayhue FE, Rust DD, Aldag JC, Jenkins AM, Ruthman JC. Accuracy of interpretations of emergency department radiographs: effect of confidence levels. *Ann Emerg Med* 1989;18(8):826–30.
- [12] Urrutia A, Bechini J, Tor J, Olazábal A, Rey-Joly C. Assessment of thoracic X-ray readings by emergency room physicians at a university hospital. *Med Clin (Barc)* 2001;117(9):332–3.
- [13] Klein EJ, Koenig M, Diekema DS, Winters W. Discordant radiograph interpretation between emergency physicians and radiologists in a pediatric emergency department. *Pediatr Emerg Care* 1999;15(4):245–8.
- [14] McCarthy ML, Aronsky D, Jones ID, Miner JR, Band RA, Baren JM, et al. The emergency department occupancy rate: a simple measure of emergency department crowding? *Ann Emerg Med* 2008;51(1):15–24.
- [15] Jones SS, Allen TL, Flottemesch TJ, Welch SJ. An independent evaluation of four quantitative emergency department crowding scales. *Acad Emerg Med* 2006;13(11):1204–11.

What is the best chest compression technique for infant cardiopulmonary resuscitation?



Dear Editor,

I read the article by Smereka et al., “Evaluation of new two-thumb chest compression technique for infant cardiopulmonary resuscitation performed by novice physicians. A randomized, crossover, manikin trial” with great interest [1]. I agree with the authors' conclusion. However, I would like to discuss several important issues about this interesting article.

The key mechanism of the new two-thumb chest compression technique (nTTT) is the direction of the two thumbs vertically against the chest wall. The authors suggested that this posture might allow upper body strength to be directed downward to the sternum [1]. The concept of a vertical two-thumb technique (vTTT) is not new. Na et al. reported that vTTT could generate more pressure than the conventional two-thumb technique (cTTT) [2]. Although finger placements other than for the two thumbs were slightly different between the two studies, the key concepts remain the same [1,2]. Na et al. also described vertical compression as the reason for improved efficacy. vTTT utilizes the upper body strength by positioning both shoulders vertically, with the elbows extended [2]. Therefore, deeper chest compression is expected with this posture modification. I agree that vTTT (or nTTT) can generate a higher chest compression force (or greater chest compression depth) than cTTT. However, I raise four issues about the study methodology and compression mechanism.

First, the researchers compared nTTT with cTTT and the two-finger technique (TFT). It was recently confirmed that the quality of TFT could vary significantly according to the fingers used [3]. Average chest compression depth was significantly greater when TFT was conducted with the index and middle fingers of the right hand [3]. However, Smereka et al. did not describe details regarding TFT (e.g., which

fingers were used during TFT). If the TFT protocol was not standardized, the average chest compression depth of TFT might be underestimated.

Second, one of the advantages of TFT is a short hands-off time compared to cTTT [4]. However, the hands-off time shown in the study results did not differ for TFT and nTTT even though the hands-off time was significantly longer in cTTT as expected [1]. It is intriguing why the hands-off times for TFT and nTTT were not different. The hands-off time could be affected by rescuer position and hand posture. The rescuer might stand at the foot of the infant to maintain a vertical angle during nTTT. If the rescuer is positioned beside the infant as in TFT, the hands-off time might be decreased. However, the vertical angle could not be maintained in this case. Knowledge is required regarding the positional relationship between the participants and infant manikin in each trial to understand the reason for shortening the hands-off time (TFT, cTTT, and nTTT).

Third, another advantage of TFT is airway maintenance during chest compression. The rescuer can maintain a head-tilt position with one hand while compressing the infant chest wall with two fingers of the other hand. Similar results are expected with cTTT. The rescuer can induce neck extension by supporting the infant's back with encircling hands while compressing the chest wall with both thumbs. However, this advantage cannot be availed with nTTT (or vTTT). With two or more rescuers, airway maintenance needs to be achieved by another rescuer. Considering that most pediatric arrest cases are caused by airway obstruction, this difference should be considered in selecting an adequate chest compression technique.

Fourth, the mechanisms of force generation and transmission during chest compression are different between a two-hand chest compression technique for adults and chest compression techniques for infants (TFT, cTTT). In adult patients, a force of 50 kg is needed to achieve adequate chest compression depth [5]. Therefore, chest compression in the vertical angle should be maintained to use the rescuer's upper body mass. However, the force of chest compression during TFT or cTTT is generated by the rescuer's hand or forearm muscles, and is transmitted through the thumb or finger including the interphalangeal joints to the infant's chest wall. The force is transmitted using two interphalangeal joints during TFT and via one interphalangeal joint during cTTT. This might be one reason for the difference in force generation. In addition, I have observed that thumb power is significantly greater than that of any other fingers in both hands, and two-thumb power is significantly greater than that of any other two-finger combinations (unpublished). Therefore, nTTT (or vTTT) can achieve greater chest compression depth in comparison with TFT regardless of upper body strength. This aspect should have been considered.

Although there are several concerns, the article by Smereka et al. is very interesting, and provides an alternative method to enhance the quality of cardiopulmonary resuscitation (CPR). However, further studies are needed to confirm the exact mechanism and best method for infant CPR.

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