

X-ray Flip

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The Case

A 19-year-old man presented to the emergency department with respiratory distress after blunt chest trauma. A digital chest radiograph was labeled backwards; a "left" marker was mistakenly placed over the right chest. There was a moderate pneumothorax seen on the film on the anatomic left side (the side of the aortic arch). On the radiograph, however, the pneumothorax appeared to be on the patient's right ([Figure](#)).

The resident assigned to the patient performed a brief physician examination, but based his localization of the pneumothorax largely on the reading of the chest radiograph. He thus placed a right chest tube. A correctly labeled follow-up chest x-ray showed persistent pneumothorax on the patient's left and the right-sided chest tube. A second chest tube was then placed, this time in the patient's left chest. The patient remained stable. The right chest tube was removed after the physicians confirmed that there was no air leak. There were no further sequelae.

The Commentary

While sidedness errors often make dramatic headlines, their incidence is difficult to determine based on available epidemiologic studies.⁽¹⁻³⁾ Wrong site surgery, one type of sidedness error, provides some insight into the frequency of these adverse events. In December 2001, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) issued a Sentinel Event Alert reporting 150 cases of wrong site, wrong person, and wrong procedure surgery. In the year 2002 alone, more than 60 errors were reported—a four-fold higher number of wrong site surgeries than reported in 1998.⁽⁴⁾ The "root causes" of these events are available online.

In a recent study looking at the incidence of wrong site surgery among hand surgeons, 21% (217/1050) of physicians reported having performed wrong site surgery at least once in their career.⁽⁵⁾ Of an estimated 6,700,000 surgical procedures, 242 were performed at the wrong site, making this a "rare occurrence."⁽⁵⁾ Risk management databases might provide an alternative source of information, but access to national data on claims is difficult to obtain. In our large (approximately 600 beds), urban teaching hospital, we have seen two wrong side invasive procedures in the past three years. The actual incidence of wrong side

procedures is likely higher than published data as a result of incomplete reporting of minor events without adverse consequences.

It would certainly be helpful to know the magnitude of x-ray mislabeling and how digital radiography might affect this error rate, but there are no reliable data on this topic. While digital radiography could decrease the frequency of labeling errors, this case illustrates that technology will not be a panacea and may, in fact, create new error patterns. For example, recent implementation of bar code medication administration at Veterans hospitals was designed to reduce medication errors. While it may be doing so, it has also had some negative consequences that may ultimately lead to new types of adverse events.[\(6\)](#)

Case Investigation

Although it is easy to retrospectively identify the two obvious human errors in this case—mislabeling and incorrect interpretation of the x-ray—making real strides in reducing medical errors requires that our community accept the precept that active errors in human performance are inevitable in complex systems.[\(7\)](#) Similar to aviation, anesthesia research has stated that between 70%-80% of errors result from human factors.[\(8,9\)](#) Human factors, however, represent only the most visible end result of a more complicated series of occurrences leading to an adverse event. It is often less fruitful to focus on assigning causality or "root cause" than to better define all the contributing factors. The Adapted Organizational Accident Causation Model [\(10\)](#) is a good framework for incident investigation and provides a more comprehensive understanding of why an adverse event occurred. By identifying latent errors related to organizational processes and other contributing factors, it becomes more apparent where systematic change is required.

Cognitive Errors

Trying to perform a cognitive autopsy to understand why the resident committed the error is difficult without a more detailed investigation into this incident. Did the resident rely more heavily on the x-ray for localization and not trust the physical examination or attempt to confirm the x-ray finding with auscultation or another diagnostic modality? Perhaps there was an error of overconfidence, a failure to recognize his/her limitation in radiograph interpretation, or a reluctance to ask for help due to an expectation of competency in what appeared to be a straightforward diagnosis. We must improve training of physicians to help them gain a better understanding of their thought processes (metacognition) and potential cognitive biases which affect clinical decision making. Armed with this understanding, they can apply cognitive forcing strategies to reduce the occurrence of diagnostic error.[\(11,12\)](#)

Possible Solutions

This case illustrates a need for specific solutions. Hospitals must standardize the process for acquisition and labeling of radiographs. In doing so, hospitals should strive to implement a universal cognitive forcing strategy to always verify that a radiograph belongs to the patient and is properly oriented. Analogous to the solution for wrong site surgeries, a required checklist and pre-procedure pause could serve as a defense barrier in all but the most emergent cases. For example, independent confirmation of location by two clinicians for all blind procedures or those involving laterality should be standard operating procedure. Additionally, with chest tube or thoracentesis, there should be a confirmation by a minimum of two methodologies, such as auscultation, radiograph, or ultrasound.

This case serves as a caution for health care leaders that technology systems alone will not eliminate errors in health care institutions. The movement away from the 'person' model of error—'blame and train'—to a focus on systems is necessary, but we must balance our safety programs to ensure human factors training exists for front-line clinical personnel. To create a grass roots cultural change, we must translate the general tenets of a "high reliability" organization—(i) preoccupation with failure avoidance, (ii) reluctance to simplify interpretations, (iii) sensitivity to operations, (iv) commitment to resilience, and (v) deference to expertise (13)—into meaningful curricula in areas such as cognitive decision making and teamwork.(14) Training in team dynamics, communication skills, and interpersonal behaviors should concentrate on encouraging all team members to cross-monitor each other, exert situational leadership, and assert corrective actions to reduce error.

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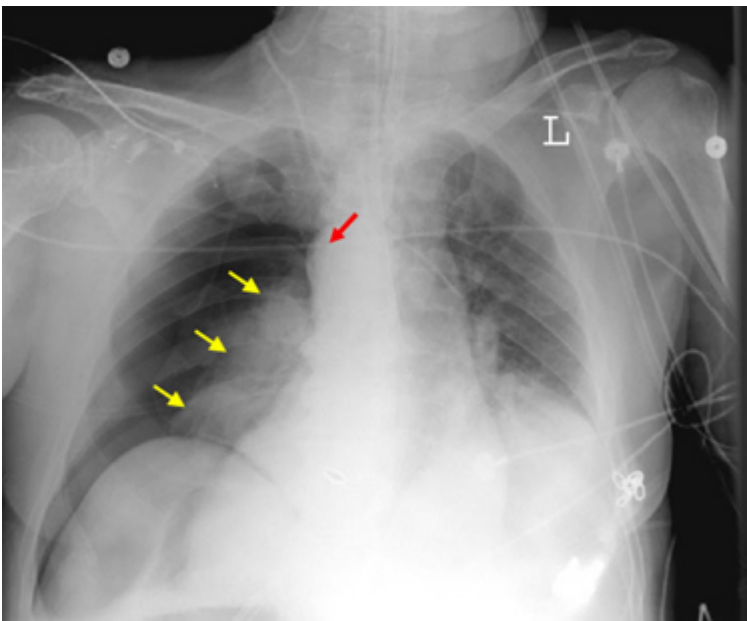
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Figure

Figure. Representative Chest X-ray*



***Not the actual radiograph. The red arrow indicates the aortic arch. The yellow arrows indicate the outline of the pneumothorax.**

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