

How many strikes does it take till we are out?

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Digital radiography has a superb ability to make almost any image look good by post-processing. This has caused a disconnect between the dose utilized to make the image and the final product. This is one of the major reasons that the CT dose in the past was so high and the radiologist never knew it [1]. We were more like deer in the headlights of an oncoming car. We didn't have a clue that we didn't know the dose and didn't worry about it. Absolutely clueless! STRIKE ONE!

We partially managed this shortcoming over the years by adjusting techniques based on the size or age of the children, by demanding a dose estimate with each CT examination and by trying to screen each request for a CT so any potentially inappropriate orders led to a discussion with the ordering health care provider to avoid exposing the patient to greater risk than necessary.

Unfortunately, up until now $CTDI_{vol}$ has been the only easily available CT dose metric. This metric was defined and developed to allow comparison of the amount of radiation generated by two different CT phantoms. It does not and was never intended to reliably indicate the radiation dose to the pediatric patient [2]. Soon, thanks to the efforts of the SPR, the Alliance for Radiation Safety, and a group

of medical physicists concerned about the radiation dose delivered to our children (AAPM Task Group 204 co-chaired by John Boone and Keith Strauss), we will have a published method to make a much more reasonable estimate of the radiation dose that will be delivered to a pediatric patient, prior to the CT scan [3]. This will allow the technologist or radiologist to adjust scan techniques to avoid radiation doses that exceed acceptable levels.

Fifty to 60% of imaging remains non-CT digital radiography—both CR (computed radiography) and DR (direct digital radiography). Once again, we cannot tell the dose by looking at the examination. We continue to have higher doses than necessary because no one can tell what the dose is and the radiologist will only complain about photon-starved radiographs. At the 2010 Society of Chairs of Radiology in Children's Hospitals (SCORCH) meeting, only two of approximately 50 departments present indicated they had the dose metric of direct digital radiographs on their PAC images—two of approximately 50 departments of the most conscientious, dose-sparing, ALARA-pursuing departments in the country!

Why is this? It cannot be for lack of education, because the five ALARA conferences produced by the SPR, the Alliance for Radiation Safety and the Image Gently campaign, and numerous articles, emphasized appropriate imaging with knowledge of the lowest achievable radiation dose with diagnostic images [4–9].

Is it because we don't consider digital radiography an important source of radiation? With 50–60% of all examinations done by digital radiography, how can anyone reach that conclusion? Maybe we don't know a ballpark figure for the radiation dose for the most common examinations. The fact, though, is these numbers are published and, for example, the chest radiograph (skin exposure) in a neonate should be less than 5 mrad (50 μ Gy), and a teenager's single-view chest (skin

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exposure) less than 15 mrad (150 μ Gy) [10, 11]. Why, then, do I occasionally find (since the dose is on our films) a chest film having 90 mrad (900 μ Gy)? This is, at best, six times greater than needed. Steve Don emphasized exposure creep in extremity films with CR radiography [12]. The variation from the appropriate dose on some abdominal radiographs can be even *greater* than a six-fold difference. But we, as a pediatric community, don't know this because, as a group, we've *chosen not* to demand that the dose metric is on the PACS. Sure, this is not at the level of the radiation doses delivered in CT, but many children get multiple digital radiographs.

In this issue is a minisymposium that includes dose metrics of CR [13]. Here, we have a new exposure index (EI), which as of 2011 is the same from all the manufacturers of CR [14]. While it is not the radiation dose received to the individual patient, it allows the operator to determine whether the patient's dose is greater or less than the standard radiation dose adopted within the department.

The bottom line is that we *need* to know the dose metric or equivalent on all PACS images. We must be both accountable and responsible for this. If we don't demand this information, maybe it will be legislated, as in California law on reporting of CT dose. We need to have this information to follow the ALARA principle in pediatrics and to help us control the quality of our work. Without it, technologists have no feedback, though they may be grossly overexposing the patient. It is too easy for the technologist to choose the wrong body type (e.g., medium peds vs. large peds) and to cause a significant error in the actual dose delivered. Without this feedback, we cannot improve what our technologists are doing, and we cannot improve the quality of our work or advocate the ALARA principle for our patients in the field of digital radiography. STRIKE TWO!

In pursuing the ALARA concept, two strikes and we are out!

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