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An Ounce of Prevention Is Worth a Pound of Cur(i)e

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The following material is in this sense a “preventative” topic, in the spirit of early and anticipatory efforts rather than greater investments once situations arise. The axiom is from *The Philadelphia Gazette* in 1734 and under the pseudonym of A.A. but attributed to Benjamin Franklin [1]. Unlike the common current application of this saying to general medical care, Franklin was in fact addressing local fire safety. Although the juxtaposition of the words “fire” and “radiation” in generalizing this axiom is alarming (the only intended pun), the early investment and longer-term benefits are relevant to both. The “pound of cure” can be represented by many of the current efforts at radiation safety including technical improvements in equipment, protocol modifications, adherence to appropriateness, advances in measures and benchmarks for radiation dose estimates, and enhanced understanding through education and awareness. Examples of this last effort include the Image Gently® and Image Wisely® organizations as recognized promoters among many global professional societies and organizations. And although the success of such efforts is difficult to determine beyond attribution [2], the “ounce of prevention” of early exposure, namely early medical education, on the informed use of medical imaging, especially regarding radiation doses, risks, and associated risk dialogues, embraces the conviction

that the benefits down the line will be evident and amplified.

To this end, the model of Radiology-TEACHES (Technology-Enhanced Appropriateness Criteria Home for Education Simulation) provides an online tool for improvements in the understanding of medical imaging examination appropriateness [3]. In this, Choosing Wisely imaging scenarios are used and feedback given as one navigates through requesting an imaging examination using clinical decision support. Investigators and developers of the model highlight value including (1) pre- and postcourse assessment (with an implied need for such education), (2) common and familiar medical scenarios, (3) digital active learning, and (4) transferability. Application of such a model would also have benefit in the domain of medical radiation safety. First, knowledge of radiation dose estimates and radiation safety for medical students is limited, demonstrating a need for such education. The ability to discuss and factor in elements such as individual examination doses, the growing topic of cumulative doses, the potential risks (especially for the more vulnerable pediatric population), and the methods to fashion patient and caregiver centered communication are limited. Medical imaging is one of the more frequently performed procedures, and trends in use have outpaced other diagnostic evaluation

[4]. Moreover, the majority of medical imaging involves the use of ionizing radiation. Data on pediatric imaging from the Society of Chiefs of Radiology at Children’s Hospitals (with permission) for the year 2015 to 2016 represents reports from 48 centers of pediatric-focused institutions. There were 4,472,748 examinations, of which 78% were those that use ionizing radiation (CT, nuclear medicine, radiography, and fluoroscopy), and 22% were ultrasound or MRI. Of those ionizing radiation examinations, nearly 85% were accounted for by radiographs [5], certainly a familiar technology for patients and caregivers. This resonates with the value of the Radiology-TEACHES education model through use of common or familiar scenarios. Another element of the model was knowledge assessment. Implied with this is that the existing level of knowledge is in some way deficient or incorrect. Medical student radiology training and understanding is lacking, even globally [6-8]. When radiology courses do occur, these are usually electives [9]. In another relevant investigation of a broad cross section of resident specialties, only 53% correctly answered the radiation dose equivalent in chest x-rays of an abdominal CT examination [10]. Of note, investigators did not, among many recommendations, suggest educational initiatives for medical students.

When medical imaging education does occur, it is arguably “how to interpret” and “what does this mean,” with some appropriateness that I have seen, rarely dealing with imaging safety or other performance aspects. Indeed, in a commentary on the value of radiologists as part of radiology incorporation into medical student education, Gunderman et al developed a large number of compelling justifications but the value of education on radiation use is not one of these [11]. Returning to the Radiology-TEACHES model, especially in the current time of coronavirus disease 2019 and an emphasis on e-learning and virtual education, development of digital learning with emphasis on learning management systems for assessment is especially relevant. E-learning is both circumstantial and evolutionary. As Willis et al stated, “The current generation of learners seeks a more active learning environment, technology based, and interactive with immediate and continuous feedback” [3].

There are challenges for development and delivery of educational material on medical radiation use in medical school curricula. These include the responsibility for preparing and delivering the material, including on a local versus broader platform, which have implications when using learning management systems if e-learning. Should the material be required or elective, reside as part of clinical competency preparation or within whatever radiology elective or clerkship might exist or in some other core course? Will this information be enduring when part of course work and not embedded in perhaps a more favorable experiential domain such as during clinical rotations? What is salient and sustaining information appropriate for a medical student? For example, UpToDate® is a standard Google-competitive resource frequently used by medical students; medical

radiation information on UpToDate is factual and comprehensive with respect to radiation doses for examinations and radiation risk but is difficult to digest and distill for point-of-care use, especially for helping configure answers to questions arising from the health care team as well as patients or caregivers. Is medical radiation risk a frequent concern of those we care for? I have, over several years, had the opportunity for conversations with medical students during their 4-week core rotation in radiology during the clinic clerkships and understand that their perspective on prioritization, in decreasing frequency, for medical imaging is “When will this happen?” (for inpatients), “How long will the examination take?,” “Will there be any discomfort or pain?,” “What preparation is needed?,” “When will I (or we) get the results?”—followed by radiation risk concerns. Although anecdotal, the point is that in designing educational material for medical students, leaders must be mindful of the relative value of this prioritization in the context of all else medical students are exposed to and required to understand with respect to medical imaging and beyond. One approach would be to embed information about radiation use in more generic and relevant framework such as appropriateness and including decision support, evidence-based strategies and tools, motivational interviewing, and shared decision making. The value prioritization also argues for concise, targeted medical radiation material with an enduring familiarity of avenues for easy access to such information over ensuing years.

Despite these challenges, such radiology education should take place before residency (and later years) and address safety, including medical radiation use. These efforts can be embedded in educational pathways in medical school that are in addition to the more typical “how to interpret” and “what does this

mean” approaches to teaching radiology to these students. Such education may have more enduring value and broader relevance in a framework of educational essentials such as appropriateness, shared decision making, and evaluation of evidence-based strategies in medical care. This early and preventative approach to informed use of medical imaging radiation can then be more than worth the “pound of cure” efforts at putting out the fires of misunderstanding currently in place, and the medical imaging profession has a responsibility for designing, implementing, and auditing this earlier institution of medical radiation education. As Franklin stated in his 1734 letter, “As to our Conduct in the Affair of Extinguishing Fires, . . . we seem to want Order and Method, and . . . as I am well inform’d, a Club or Society of active Men [or women] belonging to each Fire Engine; whose Business is to attend all Fires with it whenever they happen; and to work it once a Quarter, and see it kept in order” [1].

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The author states he has no conflict of interest related to the material discussed in this article. The author is a non-partner/non-partnership track/employee.

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