The fallacy of the LNTH also partly, if not significantly, fuels the impetus of the ongoing PET/MR imaging initiative, based in part on avoiding the toxicity of the CT radiation dose attendant to the PET/CT scan (*2*). This is a misguided cost-ineffective effort of the nuclear medicine industry, in my opinion, attempting to displace more practical and well-established PET/CT imaging protocols costing one-fifth or less as much as the combined equipment and site preparation costs and affording shorter imaging protocols, and with no incremental diagnostic benefit from the use of PET/MR imaging in most cases.

Similarly, an arbitrary guideline from the American Society of Nuclear Cardiology was proposed to limit nuclear cardiology study doses to 9 mSv (*3*), without any scientific basis behind this recommendation. Such a low patient dose can be achieved only with current technology in the community setting, for the most part, using PET in lieu of SPECT imaging, at increased cost and more limited availability, despite the fact that SPECT affords near-comparable sensitivity and specificity for most patients (*4*). This is yet another misguided cost-ineffective radiation phobia–driven initiative.

As the authors pointed out in their article, abandonment of the LNTH would likely result in the elimination of many government jobs and significantly reduce the budget of the federal and state regulatory agencies, because the need to oversee and regulate such nonharmful, if not outright beneficial, low-level exposure would evaporate. Unfortunately, it is easy for such regulatory agencies to foment irrational radiophobia concerns on the part of the lay public, contributing to outrage at the suggestion of relaxing such standards.

I sincerely hope that this article will provoke a greater level of engagement by the nuclear medicine community at large, and hopefully by the Society of Nuclear Medicine and Molecular Imaging as well, to abandon the LNTH for guiding our radiation safety and imaging practices, in concert with the consensus of evidence from the literature.

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**TO THE EDITOR:** The recent article by Jeffry A. Siegel, Charles W. Pennington, and Bill Sacks (*1*) credibly demonstrates the fallacy of the linear no-threshold hypothesis (LNTH) and its illegitimate ALARA (as low as reasonably achievable) progeny as applied to medical imaging. The authors note that credible evidence of imaging-related carcinogenic risk at low absorbed dose (<100 mGy) is nonexistent. Any perceived risk is a hypothetical consequence of the presumed validity of the scientifically unjustified LNTH, and low-dose radiation does not cause, but more likely helps prevent, cancer. Siegel et al. (*1*) observe that the LNTH and associated ALARA concepts are fatally flawed and focus only on molecular damage while ignoring protective, organismal biologic responses. The article clearly illustrates the societal harm caused by the LNTH and ALARA.

The LNTH also affects acceptance of the use of radiation and radioactive materials and causes the ALARA concept to create harm rather than the presumed benefit. These concepts create a world in which ALARA becomes "A Law Against Radiation Applications." The negative societal impact of the LNTH and ALARA concept is significant (*1–5*).

Negative ramifications of the LNTH and associated ALARA concept include a limitation of research using radiation and radioactive materials, adverse impact on medical diagnoses, limitation of nuclear energy expansion in the United States and Europe, deterrence of the achievement of lower costs for radiation-related services, slowed recovery from the Fukushima Daiichi accident, and contribution to the unwarranted public fear of radiation and radioactive materials.

Radiophobia has inhibited research using low-dose radiation in the detection, prevention, and treatment of cancer and other diseases. Unwarranted fears caused by belief in the LNTH have also effectively inhibited research involving unique applications of radiation and radioactive materials. These applications include the use of low-dose radiation as a treatment protocol.

Patients have refused to undergo CT scans, and physicians are not prescribing these procedures because the LNTH has created concern about the subsequent radiation detriment. This fear could result in missed diagnoses because imaging doses are too low to produce adequate tissue resolution (*5*).

The expansion of nuclear energy in the United States and Europe has been limited because the radioactive releases resulting from Three Mile Island, Chernobyl, and Fukushima Daiichi reinforced unjustified fears regarding the effects of radiation (*4,6*). These effects include incorrect assumptions regarding the connection between cancer and hereditary effects and low doses of ionizing radiation. The associated radiophobia promotes the use of higher-cost and polluting energy-generating sources that negatively affect economic growth.

Increased regulation of radiation and radioactive materials and the associated costs to implement compliance further dampen the expansion and use of radiation and radioactive materials. Regulations affect consumer, medical, industrial, health care, and research applications and result in significantly increased costs with limited benefit.

These concerns are illustrated by a simple example of resource allocation. Nuclear facilities (e.g., power reactors and fuel cycle facilities) devote significantly more personnel and attention to radiation safety driven by LNTH/ALARA than to industrial safety. The imagined benefit of saving 10 μSv (1 mrem) leads to a larger resource allocation for radiation safety. Commonplace signs and slogans promoting the fact that "Every Millirem Counts" further reinforce LNTH/ALARA and its misguided basis. The resources devoted to saving trivial doses come at the expense of worker health and safety and prioritize radiation safety based on the LNTH/ALARA myth over industrial safety. These issues go beyond trip-and-fall hazards. The imagined radiation risk is deemed

to be more important than actual risks. For example, steam and chemical burns and heavy load drops are real events that have occurred and caused serious injuries. These are real issues rather than the imagined benefits derived from LNTH/ALARA.

Jeffry A. Siegel, Charles W. Pennington, and Bill Sacks should be applauded for illustrating the LNTH fallacy. Hopefully, their work will cause professionals to challenge poor science and use radiation and radioactive materials to their full potential.

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**TO THE EDITOR:** Thank you for publishing the Special Contribution entitled "Subjecting Radiologic Imaging to the Linear No-Threshold Hypothesis: A Non Sequitur of Non-Trivial Proportions," which appeared in your January issue (*1*). Siegel, Pennington, and Sacks have produced a comprehensively researched, timely review of evidence that deserves wide dissemination. I hope it is read and understood by all members of regulatory bodies.

As a diagnostic radiologist I have been frustrated for many years by the incomplete, overly simplistic approach of the linear no-threshold (LNT) hypothesis. Administratively convenient and currently politically acceptable it may be, scientifically accurate it is not. Attempts to discuss with colleagues the LNT hypothesis, and the "as low as reasonably achievable" (ALARA) strategy that follows from it, have invariably produced a resigned shrug of the shoulders and a "we can't change the regulations so you might as well accept it" type of comment.

Well, let's review and hopefully change the regulations. And while we're at it, can we persuade our regulators to become a little more positive in their outlook? The "it's-all-nasty-stuff" atmosphere promulgated by LNT is depressing, ignoring as it does the incalculable benefits of radiation, particularly in the low-dose diagnostic range. Can I suggest that the International Commission on Radiological Protection (ICRP) be rebranded? Perhaps ICRE—the International Commission on Radiologic Education? Just a thought.

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**TO THE EDITOR:** Allow me to refer to the article by Jeffry A. Siegel, Charles W. Pennington, and Bill Sacks entitled "Subjecting Radiologic Imaging to the Linear No-Threshold Hypothesis: A Non Sequitur of Non-Trivial Proportion," which was published in *The Journal of Nuclear Medicine* this January (*1*). I would like to congratulate your journal for its courage to present a platform for engagement in the controversy regarding low-dose–associated health risks and benefits from radiologic imaging. The medical community at large, not only the nuclear medical physicians and radiologists, should be delighted to read this superb review and conclusion. The widespread fear of low-dose radiation has brought on serious negative impacts on public health and socioeconomic development. The fear creates huge expenditures to avoid radiation exposure even at low doses at which detrimental health effects are not observed. The article by Siegel at al. should serve for teaching students. One should hope that the current discourse with the wealth of new data will lead to further research to fully unravel the mechanisms that underlie the facts of low-dose–induced protection against damage, be it radiogenic or nonradiogenic. A ratio of 1 between the amounts of radiation-induced damage and of radiation-induced damage prevention in the exposed system signals zero system response; a hormetic system response is the result of this ratio being below 1. National and international protection advisers and officers hesitate to accept the new biologic data but will eventually follow the best of science.

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