

## Lessons for Nuclear Cardiology from the DCRI/ACCF/AHA radiation think tank

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This issue of the *Journal* contains a summary<sup>1</sup> of proceedings of a think tank on patient radiation safety in adult cardiology, held in Tyson's Corner, Virginia in February 2011. The summit was convened by the Duke Clinical Research Institute together with the American College of Cardiology and American Heart Association, and included participation by numerous professional societies sharing this concern, including ASNC. The think tank included a plenary session with talks on various aspects of the problem of patient radiation safety by luminaries in cardiac imaging as well as by industry and regulatory experts, a friendly debate on the benefits and risks of ionizing radiation for cardiovascular care, and breakout groups which developed goals—and strategies for accomplishing these goals—related to four critical issues: risk estimation, measuring and reporting radiation dose, dose-reduction strategies, and education and communication about radiation.

An emphasis of the think tank and its proceedings, and reflected by its range of participants, is the need to engage the panoply of stakeholders with interests in patient radiation safety (Table 1). These range from basic and applied research scientists, who provide us with the data on radiation's biological effects and the data and models used to quantify and compare radiation dose and risk, all of which inform our positions as clinicians towards the role and scope of radiation

protection efforts<sup>2</sup>; to practitioners including various stripes of cardiologists, our staffs, and safety specialists such as medical physicists; to organizations which accredit and pay us; to the national and international organizations dedicated to radiation safety. Of course, all these efforts begin and end with the patient, and reflecting this, one of the most popular talks at the think tank was that delivered by the patient advocate. Sustained efforts to ensure continuous quality improvement in the realm of radiation safety will require greater collaboration and communication between these stakeholders, as the base of expertise needed to ensure best practices will always be divided among these groups, and the responsibility to patients will always remain a shared effort.

Indeed, ASNC is currently participating in numerous partnerships with other stakeholders to improve radiation safety for patients. These include (1) the Image Wisely™ campaign,<sup>3</sup> a multi-societal program spearheaded by radiology and medical physics societies aimed at lowering the amount of radiation used in medically necessary imaging studies as well as eliminating unneeded procedures; (2) the similarly named but distinct Choosing Wisely™ program<sup>4</sup> of the ABIM Foundation together with Consumer Reports and nine medical specialty organizations, aimed at sparking discussion between physicians and patients about the need for common medical tests and treatments that provide little benefit yet may harm (Table 2); (3) research and educational efforts together with the International Atomic Energy Agency and European Council of Nuclear Cardiology; and (4) a forthcoming conference, organized jointly with the Society for Cardiovascular Computed Tomography and funded by the National Heart, Lung, and Blood Institute, dedicated to improving laboratory practices for patient radiation safety.

Illustrating the importance of such cooperation, this clinically driven think tank identified as a priority the intensification of basic and translational research into mechanisms of low-dose radiation effects. Such mechanisms include the *bystander effect*, a phenomenon through which irradiated cells can induce mutagenesis in neighboring unirradiated cells,<sup>5</sup> the *adaptive response*, through which previous exposure to a low “priming” dose of radiation may be cytoprotective against a subsequent larger dose,<sup>6</sup> and *genomic instability*, by which

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**Table 1.** Stakeholders in the radiological protection of patients

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Basic and applied science
Research scientists
Radiation biologists
Physicists
Epidemiologists
Dosimetrists
Scientific organizations
Funding agencies
Healthcare delivery
Healthcare professionals
Physicians
Mid-level practitioners
Technologists
Medical physicists
Health physicists
Professional organizations
Professional specialties
Licensing
Provider certification
Facility accreditation
Patients
Healthcare education
Medical schools
Academic medical centers
Postgraduate and continuing medical education
Government
Regulators
Legislators
Government payers
Non-governmental organizations
Business
Industry
Imaging devices
Pharmaceutical
Nuclear
Trade organizations
Payers
Media
The public

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Compiled and expanded from Douglas et al.<sup>1</sup>

radiation exposure induces cellular instability that is transmitted to progeny cells, persistently increasing their rates of genetic changes.<sup>7</sup> These phenomena and their convergence may result in cancer risks from low-dose radiation that are lower or higher than would be expected from the linear-no-threshold (LNT) hypothesis,<sup>8</sup> and thus their elucidation have potentially important clinical implications. The think tank

proceedings communicate the need, as perceived by practicing physicians, for support of research into basic radiobiology. In fact, the primary mechanism for funding such research, the Low Dose Radiation Research Program of the Department of Energy's Office of Science, has been threatened by recent budget cuts.<sup>9</sup> Ultimately the interests of patients would be best served here by cooperation between stakeholders as varied as nuclear cardiologists, geneticists, and legislators.

Appropriately, the think tank proceedings provide recommendations aimed at all stakeholders, not just cardiologists. What are some take-home messages that this document delivers specifically for the practitioner? The breakout group on reporting dose recommended ensuring consistent and complete recording in reports of radiation exposure and parameters required to estimate dose. For nuclear cardiology studies, this means we need to document in our reports the radiopharmaceutical(s) used and their administered activities (mCi). The breakout group on dose reduction strategies emphasized education to create a more uniform understanding and approach to dose minimization techniques. For nuclear cardiologists, ASNC has published several documents addressing dose reduction approaches and strategies,<sup>10-12</sup> which are worthy of study and implementation in our practices, and numerous talks at the annual meeting in Baltimore will focus on radiological protection, including an entire session on the theme of "Radiation Safety in Nuclear Cardiology and Cardiac CT." The breakout group on education and communication identified the need to disseminate best practices, including use of appropriateness guidelines and laboratory accreditation. Such appropriate use criteria exist and are regularly updated for radionuclide imaging<sup>13</sup>; these also merit careful study and implementation. Three organizations—the Intersocietal Accreditation Commission, the American College of Radiology, and the Joint Commission—offer the opportunity to have our laboratories accredited.

Thus, by taking concrete efforts to improve radiation safety in our own practices, and by working together with a wide range of stakeholders to create a culture of safety, we can move towards the twin goals of keeping radiation doses *as low as reasonably achievable* (ALARA), and keeping the benefits-to-risks balance of cardiac imaging *as high as reasonably achievable* (AHARA).<sup>1</sup> As pointed out in the think tank proceedings, this is an ongoing process. While the Tyson's Corner think tank represented neither a beginning nor an end of this journey, it served as an important meeting point to share ideas and set goals with a broad spectrum of experts, and a milestone along the road of progress for radiation protection in cardiovascular medicine.

**Table 2.** ASNC/Choosing Wisely's list of five commonly used nuclear cardiology procedures whose necessity should be questioned or discussed

1. Do not perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms, unless high-risk markers are present
2. Do not perform cardiac imaging for patients who are at low risk including younger individuals
3. Do not perform radionuclide imaging as part of routine follow-up in asymptomatic patients
4. Do not perform cardiac imaging as a pre-operative assessment in patients scheduled to undergo low or intermediate risk non-cardiac surgery
5. Use methods to reduce radiation exposure in cardiac imaging, whenever possible, including not performing such tests when limited benefits are likely

Each partner organization in the Choosing Wisely program has identified five procedures or tests that are commonly used in their field, yet whose necessity should be questioned or discussed.<sup>4</sup> This list summarizes the five items highlighted by ASNC. The first four items support the radiation protection principle of justification, whereas the fifth enhances the principle of optimization.

### Conflict of interest

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### References

1. Douglas PS, Carr JJ, Cerqueira MD, et al. Developing an action plan for patient radiation safety in adult cardiovascular medicine: proceedings from the Duke University Clinical Research Institute/American College of Cardiology Foundation/American Heart Association think tank held on February 28, 2011. *J Nucl Cardiol* 2012. doi:10.1007/s12350-012-9545-6.
2. Einstein AJ. Effects of radiation exposure from cardiac imaging how good are the data? *J Am Coll Cardiol* 2012;59:553-65.
3. <http://www.imagewisely.org/>. Accessed March 20, 2012.
4. <http://choosingwisely.org/>. Accessed March 20, 2012.
5. Zhou H, Randers-Pehrson G, Waldren CA, Vannais D, Hall EJ, Hei TK. Induction of a bystander mutagenic effect of alpha particles in mammalian cells. *Proc Natl Acad Sci USA* 2000;97:2099-104.
6. Olivieri G, Bodycote J, Wolff S. Adaptive response of human lymphocytes to low concentrations of radioactive thymidine. *Science* 1984;223:594-7.
7. Kennedy AR, Cairns J, Little JB. Timing of the steps in transformation of C3H 10T 1/2 cells by X-irradiation. *Nature* 1984; 307:85-6.
8. ICRP. Low-dose extrapolation of radiation-related cancer risk ICRP Publication 99. *Ann ICRP* 2005;35:1-140.
9. Barcellos-Hoff MH, Brenner DJ, Brooks AL, et al. Low-dose radiation knowledge worth the cost. *Science* 2011;332:305-6.
10. Cerqueira MD, Allman KC, Ficaro EP, et al. Recommendations for reducing radiation exposure in myocardial perfusion imaging. *J Nucl Cardiol* 2010;17:709-18.
11. Fazel R, Dilsizian V, Einstein AJ, Ficaro EP, Henzlova M, Shaw LJ. Strategies for defining an optimal risk-benefit ratio for stress myocardial perfusion SPECT. *J Nucl Cardiol* 2011;18:385-92.
12. Depuey EG, Mahmarian JJ, Miller TD, et al. Patient-centered imaging. *J Nucl Cardiol* 2012;19:185-215.
13. Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging: A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine. *J Am Coll Cardiol* 2009;53:2201-29.