According to the Book of Exodus, a man who assaults another must pay a physician to heal the wounds. A careful examination of the Hebrew text reveals that the word “heal” appears twice; the literal reading is “and heal he shall be healed.” The 13th-century medieval physician and philosopher Nachmanides interprets this redundant phrase to mean that physicians require permission to heal, for “without the warrant to treat, physicians might hesitate to treat patients . . . in that there is an element of danger in every medical procedure; that which heals one may kill another.” This 800-year-old warning seems self-evident, yet one might think otherwise when one sees the way modern physicians make use of outpatient imaging.

Consider Jim, a 58-year-old man with newly diagnosed angina pectoris, hypertension, and hypercholesterolemia. His physician treats Jim’s conditions with appropriate lifestyle advice and medications. Jim and his physician believe he is receiving high-quality, evidence-based medical care that is supported by numerous large-scale, randomized trials. So far, so good.

Jim’s physician then follows common practice and refers him for an exercise myocardial perfusion scan. The scan is mildly abnormal — mild enough that Jim’s physician is not ready to rush him to coronary angiography but abnormal enough that he feels uncomfortable ignoring it. He refers Jim for computed tomographic (CT) coronary angiography, an increasingly common test. The CT scan also shows abnormalities, leading to an invasive angiographic procedure that reveals mild disease. Jim is happy to hear that he need not undergo any further testing.

This story may not seem all that interesting, yet by referring Jim for three common outpatient imaging tests, his physician inflicted at least two harms. First, Jim incurred costs for procedures of uncertain value, since no large-scale, randomized trials have shown that imaging in these circumstances prolongs life, improves quality of life, prevents major clinical events, or reduces long-term medical costs. Second, Jim was exposed to radiation. As described in the report by Fazel...
et al. in this issue of the Journal (pages 849–857), Jim underwent two of the five outpatient imaging tests that result in the greatest degree of medical radiation exposure among typical nonelderly American adults. This exposure causes a small but real increase in the risk of cancer.

Jim’s story reflects outpatient practice that has become increasingly common in the United States, which has the world’s highest per capita imaging rate.\(^1\) Between 1993 and 2001, the number of myocardial perfusion scans increased by more than 6% per year, with no justification for their use based on disease rates, health care disparities, or newly published, definitive randomized trials.\(^2\) Since 1992, the number of CT scans obtained has quadrupled.\(^3\) Physicians are referring their patients for so many imaging tests that as many as 2% of cancers may be attributable to radiation exposure during CT scanning.\(^3\) Despite these harms, our medical system sees nothing wrong with Jim’s care. Most physicians who order imaging tests experience no consequences for incurring costs for procedures of unproven value. On the contrary, they or their colleagues are paid for their services, and their patients don’t complain because the costs are covered by third parties. Patients are pleased to receive thorough evaluations that involve the best cutting-edge technologies. Physicians can easily defend their practices because their specialty societies argue that the procedures are “appropriate.” The issue of radiation exposure is unlikely to come up because each procedure is considered in isolation, the risks posed by each procedure are low and seemingly unmeasurable, and any radiation-induced cancer won’t appear for years and cannot easily be linked to past imaging procedures.

When skeptics complain about excessive costs for unnecessary imaging procedures, it is easy to dismiss them for advocating restriction (even “rationing”) of services that logical constructs argue should help. In the case of myocardial perfusion imaging — the procedure responsible for more radiation exposure than any other, according to the report by Fazel et al. — proponents (my colleagues and I among them)\(^4\) have argued that abnormalities detected on such scans are powerful predictors of future clinical events. It is logical, the argument goes, that imaging tests may identify patients for whom aggressive therapies should improve the outcome. But this logic represents only a hypothesis, not a proof. One recent trial of myocardial perfusion imaging in patients with diabetes showed no improvement in the outcome despite an accurate prediction of events.\(^5\) Prediction does not necessarily lead to prevention.

Radiation exposure presents a different kind of risk. Rather than a problem of cost-effectiveness or of levels of evidence, irradiation represents a direct danger imposed by a physician’s decision to refer a patient for imaging. Though the danger may be small, it is cumulative and hence of particular relevance to the small but substantial minority of people who, like Jim, undergo clusters of tests. Exposure to even moderate degrees of medical radiation presents an important yet potentially avoidable public health threat.\(^6\) Oncogenesis associated with sublethal doses of radiation goes unrecognized because it is neither accurately measurable in nor predictable for individual pa-
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tients, and because clinically significant consequences will not become evident for many years.

Overall, we must conclude that with a few exceptions — such as mammography — most radiologic imaging tests offer net negative results. There is little high-level evidence of benefit, whereas cumulative radiation exposure can produce real harm, even if it may not be possible to trace adverse outcomes to individual patients who have been exposed. If we approached this component of medical practice with the humility of Nachmanides, we would have to wonder not only why so much imaging is being carried out but also why its use is increasing so rapidly (see graph).

Because the use of ionizing radiation carries “an element of danger in every . . . procedure,” we need to adopt a new paradigm for our approach to imaging. Instead of investing so many resources in performing so many procedures, we should take a step back and design and execute desperately needed large-scale, randomized trials to figure out which procedures yield net benefits. This approach would require leadership and courage on the part of our profession, our opinion leaders, and the research enterprise, but were we to insist that all, or nearly all, procedures be studied in well-designed trials, we could answer many critical clinical questions within a short time. Because we will continue to be uncertain of the magnitude of harm, an accurate understanding of the magnitude of benefit is a moral imperative.

To adopt this paradigm, we will have to take two critical steps. First, we must approach imaging with the same humility with which others in our profession approached experimental methods for treating acute coronary syndromes and other conditions that today have a strong evidence base. We have come a long way since the time when the primary management of acute myocardial infarction was prophylactic lidocaine. Many of the interventions that we now consider standard do come with their own elements of danger, but we can feel comfortable recommending them because a large body of data from well-powered randomized trials has clearly shown a net benefit.

Second, we must assume a “public health” mind-set when considering our roles with regard to medical imaging. We have to think and talk explicitly about the elements of danger in exposing our patients to radiation. This means taking a careful history to determine the cumulative dose of radiation a patient has already received and providing proper, personalized information to each patient about the risk of iatrogenic cancer. If we began a national conversation about the dangers of ionizing radiation, it might cause enough discomfort to stimulate demand for the high-quality evidence our patients deserve.

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From the National Heart, Lung, and Blood Institute, Bethesda, MD.


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H1N1 Influenza, Public Health Preparedness, and Health Care Reform
Nicole Lurie, M.D., M.S.P.H.

In December 2009, the Department of Health and Human Services will present to Congress its first-ever national health security strategy, outlining high-priority activities and areas of investment for strengthening the capability of the United States to prepare for, respond to, and recover from large-scale public health emergencies. Fortunately, the strategy is being developed...