

Disclosure forms provided by the author are available with the full text of this article at NEJM.org.

From the Departments of Radiology and Biomedical Imaging, Epidemiology and Biostatistics, and Obstetrics, Gynecology, and Reproductive Sciences, University of California at San Francisco, San Francisco.

This article (10.1056/NEJMp1002530) was published on June 23, 2010, at NEJM.org.

1. Eisenberg RL, Bankier AA, Boiselle PM. Compliance with Fleischner Society guidelines for management of small lung nodules: a survey of 834 radiologists. *Radiology* 2010; 255:218-24.
2. Board of Radiation Effects Research Division on Earth and Life Sciences. Health risks from exposure to low levels of ionizing radiation: BEIR VII phase 2. Washington, DC: National Academy Press, 2006.
3. Smith-Bindman R, Lipson J, Marcus R, et al. Radiation dose associated with common computed tomography examinations and

the associated lifetime attributable risk of cancer. *Arch Intern Med* 2009;169:2078-86.

4. Catalano C, Francone M, Ascarelli A, Mangia M, Iacucci I, Passariello R. Optimizing radiation dose and image quality. *Eur Radiol* 2007;17:Suppl 6:F26-F32.
5. Medicare Payment Advisory Commission. Healthcare spending and the Medicare program: a data book. June 2009. (Accessed June 10, 2010, at <http://www.medpac.gov/documents/Jun09DataBookEntireReport.pdf>.)

Copyright © 2010 Massachusetts Medical Society.

The Uncritical Use of High-Tech Medical Imaging

Bruce J. Hillman, M.D., and Jeff C. Goldsmith, Ph.D.

The use of advanced imaging methods such as computed tomography (CT), magnetic resonance imaging (MRI), and positron-emission tomography (PET) has made diagnosis more accurate and less invasive for nearly all organ systems. Unfortunately, as the use of imaging has rapidly increased, imaging costs have grown as well. Indeed, until recently, these costs were the fastest-growing physician-directed expenditures in the Medicare program, far outstripping general medical inflation.^{1,2}

Such dramatic growth has placed imaging in the policy spotlight. There is broad agreement that an unknown but substantial fraction of imaging examinations are unnecessary and do not positively contribute to patient care. Unnecessary use has indiscriminately tarred technologies that provide great value to patients and the health care system when used appropriately. Failure to reduce unnecessary use risks inviting policies that could stifle important future innovation.

Several interrelated factors have promoted the nonbeneficial use of imaging. For one, the evidence basis for using imaging is incom-

plete; much imaging practice is driven by habit or anecdote. Although new imaging technologies are exhaustively evaluated for regulatory purposes, they enter clinical practice with limited testing of their contribution to improving health.³ Nonetheless, information on the Web, in the lay press, and in direct-to-consumer advertising has promoted the benefits of diagnostic imaging while underplaying the risks and costs. As a result, despite well-publicized concern over the possible long-term effects of accumulated diagnostic radiation, patients pressure their physicians to refer them for imaging studies even when imaging is unlikely to provide any value.

Patients' desire for more imaging aligns with compelling financial interests of physicians who have acquired imaging equipment and, thanks to a loophole in Medicare antiabuse legislation, can "self-refer" their patients for imaging studies in their offices. There is an extensive literature validating the relationship between self-referral and significantly higher imaging utilization.⁴

Physicians often request imaging exams out of concern over liability risk. Legal actions over

failure to diagnose serious abnormalities are common, whereas lawsuits arising from the overuse of testing are exceedingly rare. Like most people, physicians tend to overweight small risks, especially when the consequences may be severe. A recent survey of Massachusetts physicians showed that 28% of diagnostic imaging referrals represent defensive practices.⁵ The cost may be compounded by similar fears on the part of physicians interpreting the exams, who may recommend additional imaging studies to reduce their uncertainty.

Ultimately, though, the root cause of unnecessary use of imaging may be the style and content of clinical education and their impact on medical practice. All new physicians are educated, and the majority trained, in academic medical centers, where the acuteness and complexity of illness tend to be high. Faculty members, trainees, and students are stressed by having to address both clinical care and scholarly activities, which puts a premium on efficiency and influences both how faculty physicians oversee patient care and how they teach their trainees to use diagnostic testing.

Imaging tests are most valuable when the probability of disease is neither very high nor very low but in the moderate range. Ideally, in determining whether a patient will undergo imaging, physicians should carefully weigh both the likelihood of disease and the test's accuracy in detecting and diagnosing abnormalities. Yet the stresses of academic medical centers discourage such contemplation. A "shotgun" approach to patient evaluation both reduces the intellectual demands on busy trainees and meshes nicely with faculty physicians' often remote oversight of patient care. Medical students and trainees are encouraged to leave no stone unturned in identifying the most likely diagnosis and confirming it with the greatest possible certainty.

These high-intensity practice patterns become ingrained and are carried uncritically into settings with much lower disease frequency and severity, where they increase costs unnecessarily and risk causing avoidable harm to patients. The exquisite depictions of anatomy and function generated by modern imaging technologies have blinded many physicians to the limitations and potential harms of radiologic diagnosis. The greatest risk that patients face with unnecessary imaging is needless exposure to nonbeneficial downstream testing and inappropriate treatment related to misdiagnosis and the overdiagnosis of common but unimportant findings.

Much could be done through the exercise of political will to reduce the nonbeneficial use of imaging. Correcting the abuses of our tort system would go a long way toward changing physicians' perception of their own

risks and reducing defensive referrals. Ideally, this would mean addressing the way in which lawyers are paid for tort claims. Some alternatives include implementing a fee schedule like the one used for physician payment, capping the percentage that lawyers could receive as contingency fees, and instituting a "loser pays" rule for attorneys' fees.

The same goes for financially motivated self-referred imaging. In-office self-referral for high-technology imaging procedures creates conflicts of interest that undermine the public's trust in physicians. Abolishing or sharply limiting Medicare's in-office ancillary services exception would reduce unnecessary imaging and restore faith that physicians are primarily acting in the best interests of their patients. The argument that limiting self-referral "safe harbors" would reduce patients' access to imaging is self-serving and ignores the fact that stresses on imaging capacity would be reduced if there were fewer financially motivated exams.

Ultimately, though, minimizing unnecessary imaging requires a change in mindset among physicians. One place to start would be the medical school curriculum. According to 2009 data from the Association of American Medical Colleges, less than a fifth of medical schools have a mandatory radiology clerkship, despite the near-ubiquitous use of CT, MRI, and PET scanning among medical specialties. In addition, the radiology curriculum needs updating. Rather than teaching the rudiments of interpretation, radiologists should emphasize topics such as when to consider requesting imaging, what imaging might be appropriate, and how to consult with a radiolo-

gist. The goal should be to redirect nascent physicians from a shotgun approach toward the critical use of imaging in thoughtful and elegant diagnosis.

Society would benefit if radiologists were also more assertive as consultants. The "orders" that radiologists receive are actually requests for consultation. Properly addressed and managed, such requests afford opportunities to encourage more rational use of imaging. Unfortunately, the volume and complexity of imaging work, in combination with referring physicians' enhanced access to electronic images and imaging reports, have driven many radiologists underground. Too many radiologists refrain from entering the diagnostic fray for fear of alienating referring physicians — and perhaps because they are paid as much for unnecessary exams as for appropriate ones. However, making consultation inaccessible and failing to question ill-advised imaging use are ultimately self-defeating for the specialty.

Innovation in imaging is poised to accelerate as medicine enters the era of personalized care. If allowed to flourish, molecular imaging could someday reveal abnormalities earlier, permit physicians to more accurately diagnose and quantify disease, and guide targeted, less invasive treatments. These innovations will better differentiate important threats to health from nonharmful findings, lessening the costly cascade of nonbeneficial follow-on testing and treatment.

Society should welcome these advances, but their introduction into clinical practice is not ensured. The concerns of employers and payers over unnecessary imaging are promoting policies

that could inhibit technological development. An imaging industry that is confronting payment reductions and utilization controls is likely to pull back from critical investments in research and development. Changing the culture of medical practice to encourage more thoughtful use of imaging today will help to ensure that future patients will benefit from continued imaging innovation.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

From the Departments of Radiology (B.J.H.) and Public Health Sciences (B.J.H., J.C.G.),

University of Virginia; and Health Futures (J.C.G.) — both in Charlottesville.

This article (10.1056/NEJMp1003173) was published on June 23, 2010, at NEJM.org.

1. Government Accountability Office. Medicare: trends in fees, utilization, and expenditures for imaging services before and after implementation of the Deficit Reduction Act of 2005. (GAO-08-1102R.) Washington, DC: GAO, 2008. (Accessed June 10, 2010, at <http://www.gao.gov/new.items/d081102r.pdf>.)
2. *Idem*. Medicare Part B imaging services: rapid spending growth and shift to physician offices indicate need for CMS to consider additional management practices. (GAO-08-452.) Washington, DC: GAO, 2008. (Accessed June 10, 2010, at <http://www.gao.gov/new.items/d08452.pdf>.)
3. Baker LC, Atlas SW, Afendulis CC. Expanded use of imaging technology and the

challenge of measuring value. *Health Aff (Millwood)* 2008;27:1467-78.

4. Impact of physician self-referral on use of imaging services within an episode. In: Report to the Congress — improving incentives in the Medicare program. Washington, DC: Medicare Payment Advisory Commission, June 2009:81-96. (Accessed June 10, 2010, at http://www.medpac.gov/documents/Jun09_EntireReport.pdf.)
5. Investigation of defensive medicine in Massachusetts. Informational report I-08. Waltham: Massachusetts Medical Society, November 2008. (Accessed June 10, 2010, at http://www.ncrponline.org/PDFs/Mass_Med_Soc.pdf.)

Copyright © 2010 Massachusetts Medical Society.

Hunger and Socioeconomic Disparities in Chronic Disease

Hilary K. Seligman, M.D., and Dean Schillinger, M.D.

Each year just before Thanksgiving, the U.S. Department of Agriculture (USDA) reports the number of U.S. households that are at risk for going hungry because of an inability to afford food — a condition termed “food insecurity.” After a stable prevalence for the past decade, the rate of food insecurity rose by 32% in 2008, to 14.6% of U.S. households — the highest level since the first food-security survey was conducted in 1995. About 21% of U.S. households with children are affected, as are more than a quarter of black and Hispanic households, and 42% of households with incomes below the federal poverty level (see graph).¹

According to the Life Sciences Research Office, food insecurity exists “whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways [e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies] is limited

or uncertain.” The concept of food insecurity thus encompasses both the physical sensation of hunger and compensatory behaviors used to avoid hunger. These compensatory behaviors have enormous implications for the prevention and management of chronic disease. To maintain caloric intake, adults who worry that they will not have adequate money for food reduce the variety in their diet and concentrate their intake on a few low-cost, energy-dense, and (unfortunately) nutritionally poor foods. These are generally refined carbohydrates and foods with added sugars, fats, and sodium. Calorie for calorie, these foods cost less than nutritionally rich fruits, vegetables, and dairy products. For example, \$1 can purchase either 1200 kcal of cookies or potato chips or 250 kcal of carrots.² This differential in the supermarket prices of unhealthy and healthy foods has widened over the past two decades. The USDA reports that between 1985 and

2000, the retail price of carbonated soft drinks rose by 20%, the prices of fats and oils by 35%, and those of sugars and sweets by 46%, as compared with a 118% increase in the retail price of fresh fruits and vegetables.

This widening cost differential, in combination with the global economic crisis, has profound implications in terms of increasing socioeconomic disparities in the incidence and management of obesity, hypertension, diabetes, and other diet-sensitive chronic diseases. The U.S. experience also offers a window into the emerging epidemics of obesity and diet-sensitive chronic disease in developing and newly industrialized countries.

Diabetes provides an illustrative example of the way in which food insecurity affects the incidence and management of chronic disease. Among U.S. adults 50 to 64 years of age in California, for instance, the prevalence of diabetes is 8% among whites, 16% among blacks, and 22%