What Are the Greatest Opportunities and Challenges for Radiology During the Coming Twenty-five Years?

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INTRODUCTION TO THE FUTURE

Niels Bohr once said, “It’s difficult to make predictions, especially about the future.”a The line has been repeated so often it has become a cliché, but that makes it no less true. Given the rapid rate of discovery in medical imaging and the changing health care environment, accurately forecasting the next five years would be a challenge. The next twenty-five years are a tabula rasa. Almost anything could happen. So let me start with the only thing I am sure of—the future success of radiology will depend in large part on whether there is continuing important innovation in imaging that makes its way into practice. You can write it down. Future success depends upon more of the same extraordinary development of new technologies that has underpinned radiology’s current “Golden Age.”

According to Elias Zerhouni, b radiologist and former director of the National Institutes of Health, the future practice paradigm will be P4 medicine:

Predictive—New tests will probe for genetic and environmental influences affecting our predispositions to disease, allowing more targeted, less costly surveillance than current methods.

Personalized—Treatment will target specific disease and patient characteristics unique to the individual and will be more effective and have fewer side effects.

Preemptive—It is an axiom of medical care that finding disease earlier in its course is better than discovering disease after it has become established or widespread.

Participatory—Patients have increasing access to health-related information. Patient expectations of participating in medical decision-making will only increase in the future.

The direction of imaging research is both being dragged along by the transition to molecular-based P4 medicine and, in some cases, leading the way. What is now developing in the realm of molecular imaging portends an acceleration of innovation that might one day overshadow imaging’s remarkable past. Consider the following metaphor for how molecular imaging discovery could ideally satisfy the demands of P4 medicine.

The year is 2036. An outwardly healthy-appearing young woman lies fully conscious in a sophisticated advanced imaging device called the Omniscient, awaiting her first annual whole-body screening examination. The Omniscient employs a completely safe radiant energy, discovered during testing of experimental weaponry.

A technologist administers a safe, odorless gas—a molecular contrast agent—then conducts a scan that broadly assesses genomic risk for a number of serious diseases. In this case, the agent attaches to specific cellular receptors, identifying a genetic lesion that predisposes Lucinda to the highly aggressive lung cancer #236R (by this time, there are 335 known genetic variants of cancers arising from the lungs). A second gaseous agent specifically seeks out any evidence of active #236R, detecting a sub-millimeter lesion in the left upper lobe. A software program highlights the abnormality and sets off a beeping sound as reinforcement. The scan finds no other hot spots, showing with exceedingly high reliability that there are no metastases.

Finally, the technologist directs the Omniscient to transmit a new and unique set of energy pulses precisely focused on the abnormality. The pulses cleave the contrast agent’s molecules attached to the cancer cells, transforming the agent into a highly effective therapeutic molecule. The molecule triggers tumor cell apoptosis but leaves the surrounding normal lung tissue unharmed.

Lucinda is cured of a condition that formerly was nearly uniformly fatal. She drives herself home immediately following the procedure. Insurers happily pay for annual

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a This quip is most often attributed to Yogi Berra, probably because it sounds so much more like Yogi than it does a Danish Nobelist. b P4 medicine was originally described by biologist Leroy Scott. Scott’s formula was predictive, preventive, personalized, and participatory [http://www.systemsbiology.org].

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Omniscient screening exams for all individuals older than twenty-five years because comparative effectiveness research has shown both improved outcomes and large cost savings relative to previously used diagnostic algorithms.\(^4\)

**OPPORTUNITIES FOR RADIOLOGY**

There probably will never be an Omniscient, but the ways in which the Omniscient is most successful point to opportunities to improve imaging into the future. Specifically, future imaging methods should be less invasive, less painful, more convenient for patients, and more cost-effective. No waiting for results! No repeat visits to run down “suspicious foci!” The ideal is for patients to comfortably experience the continuum of detection-diagnosis-treatment-recovery in a single session. Fundamental to addressing this goal are both knowing better who needs imaging and reducing the uncertainty radiologists currently experience in interpreting medical images. Future imaging modalities must more accurately differentiate important disease from non-threatening findings. Better characterization of detected foci on the initial exam would diminish the expensive and often harmful cascade of non-beneficial testing and erroneous treatment that follows misdiagnosis and the identification of incidentalomas. Imaging would become a better “value,” providing more benefit to patients’ health at the same or lower cost.

**CHALLENGES TO CONTINUING INNOVATION**

Achieving better value would ameliorate to a great extent the principal challenges imaging innovations will face in the foreseeable future. The developmental pipeline of potentially beneficial imaging technologies is robust. However, whether these innovations eventually are implemented into clinical practice will depend on both the extent to which they improve on current imaging and the tenacity of the economic, regulatory, and reimbursement environment.

Make no mistake about it. The environment is becoming more draconian, less receptive to imaging technologies. Despite the proven benefits of modern high technology imaging modalities, the attitudes towards imaging of those who make the laws and pay for care are souring. As just a few evidences of this assertion, consider the Deficit Reduction Act of 2005; further reductions in technical fees mandated by 2010 health care reform; and recent regulatory and reimbursement efforts to raise the bar for what constitutes sufficient proof of safety and effectiveness to market and receive payment for new imaging methods. Continued worsening of the receptivity for imaging innovations threatens to reduce benefits to patients from undergoing imaging exams.

CALL TO ACTION

There are three main concerns underlying policymakers’ negative attitudes toward imaging. First, Medicare outlays for imaging have outpaced all other physician-directed services over the past decade.\(^2,3\) Second, an unknown but sizable fraction of imaging does not positively contribute to improving health. Finally, there is too little rigorous, generalizable research that demonstrates real benefits to patients from undergoing imaging exams.

By addressing these concerns, radiologists can pave the way to a more receptive future environment for important imaging innovations. To address the cost and unnecessary use issues, radiologists must reassert their role as consultants. The missives we receive from referring physicians aren’t “orders,” they’re requests for consultation and should be treated as such. Marginal and inappropriate exams need to be turned back. Yes, this means added cost to the practice, risks alienating referring clinicians, and injures the bottom line, but if radiologists don’t do it, someone else will (or already has). Radiologists’ failure to address unnecessary utilization may provide short-term benefits but is inconsistent with the notion of “professionalism” and jeopardizes the future of the specialty.

I can hear in my mind the outcries about what I’ve just written. I can hear readers slapping shut their journals. It’s not radiologists who are at fault! It’s the rapacious self-referring non-radiologists and their financially motivated overutilization. It’s the too timid legislators and their failure to enact meaningful tort reform that continues to motivate defensive imaging.\(^4\) It’s the pointy-heads in government who make it so hard to do the high quality, practically oriented clinical research the specialty needs. Yes it is. But it’s us as well. And because we have the most to lose (the self-referrers will dump imaging and move on to something else when the price goes too low), we need to step up now and reverse the growing anti-imaging bias.

Clinical research in radiology is improving dramatically, but more needs to be done to reliably assert the circumstances in which imaging is of the greatest value to patients. I admit I have a bias here,\(^4\) but the clinical trials of the American College of Radiology Imaging Network (ACRIN) are a model for defensible, generalizable, multicenter research that has led to the acceptance of and payment for new technologies and new applications of existing technologies related to cancer. Funding from sources other than NCI is beginning to allow ACRIN to branch out into trials of imaging for diseases of the cardiovascular, neurological, and other organ systems.

It’s not just the future of radiology we’re talking about here. Really, who could say what our specialty might look like in twenty-five years? Nonetheless, acting now to maximize the future benefit of imaging to patients over the next quarter century, is our best bet. As Mark Twain once said, “Always do the right thing. It will gratify some and astound the rest.”

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\(^1\) Adapted from the book, *The Sorcerer’s Apprentice: How Medical Imaging is Changing Health Care* by Bruce J. Hillman and Jeff C. Goldsmith, to be published in the fall of 2010 by Oxford University Press.

\(^2\) I was the founding principal investigator for the National Cancer Institute grants that support ACRIN activities and was for nine years the ACRIN Chair.

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**REFERENCES**


