Offshoring and Radiology

By Frank Levy and Ari Goelman[1]

[1] Professor and Post Doctoral Fellow, respectively, Department of Urban Studies and Planning, MIT. Contact author Levy: flevy@mit.edu. The authors wish to thank the Alfred P. Sloan Foundation and the MIT Industrial Performance Center for financial support, as well as Professor Howard P. Foreman of Yale University, Dr. Krishna Kandarpa of University of Massachusetts Memorial Hospital, Dr. Jonathan Sunshine of the American College of Radiology, Robert Hartman, and Professors Joseph Newhouse and Dani Rodrik of Harvard University, among numerous other people, for helpful comments. Any errors in the paper are ours alone. This paper will appear as a chapter in Lael Brainard and Susan Collns (eds.), *The Offshoring of White Collar Occupations*, The Brookings Institution, forthcoming 2005.

> "It turns out that even American radiologists, with their years of training and annual salaries of $250,000 or more, worry about their jobs moving to countries with lower wages, in much the same way that garment knitters, blast-furnace operators and data-entry clerks do. Radiology may just be the start of patient care performed overseas."
>
> The New York Times "Who ís Reading Your X-Ray?" (Pollack, November 16, 2003)

Offshoring and Radiology

by Frank Levy and Ari Goelman

Introduction

The observation quoted above appeared when offshoring was rapidly entering the public consciousness. The author chose a dramatic example. At the time, economists argued that while technology made the offshoring of some work inevitable, the United States could still prosper with a sufficiently educated workforce. But skilled software jobs were already being offshored (Thurm 2004), and if offshoring could threaten the work of radiologists, an occupation requiring eight to ten years of post-college education, the economists' logic appeared suspect.

We argue that the situation of U.S. radiologists remains quite different from that of U.S. software engineers and other professionals whose jobs are being offshored. Media stories notwithstanding, only a tiny number of radiological images now are read by the medical equivalent of cheap foreign labor. These stories, however, have a kernel of truth since it has become technically feasible to receive and interpret radiology images from a distance. The current lack of offshoring reflects economic, social, and regulatory conditions as much as immutable technical constraints. Although low-cost offshore radiology reads now occur only rarely, the horizon is less clear.

The differences between radiology and software programming begin with the cognitive structure of the radiologist's work, which makes it particularly time-consuming to monitor.

Because work quality is hard to monitor, a U.S. doctor who refers an image to an unfamiliar radiologist relies heavily on the radiologist's credentials, in particular his or her U.S. board certification. One could imagine international agreements that allowed radiologists credentialed in one country to practice in another. In fact, no such agreements exist for radiologists practicing in the United States, a reflection, in part, of U.S. doctors' group power.

U.S. radiologists' power to restrict foreign competition is reinforced by malpractice insurance, Medicare reimbursement regulations, and in all likelihood, consumer preference. Software professionals have few of these protections and so face strong foreign competition. Conversely, these same factors do little to protect radiologists against other U.S. medical specialties, and interspecialty competition to read images is sometimes quite intense.

We tell the story of offshore diagnostic radiology in five brief sections.[2] We begin by sketching a cognitive framework to describe the jobs (of any kind) that are most easily offshored. We then situate the radiologist's job in this framework. Next we describe the economic conditions and regulatory factors that define the current U.S. market for radiologists. In the fourth section, we describe the "nighthawk" radiology industry, the industry that handles most offshored U.S. radiology reads. We close by speculating how some parts of offshore radiology might come to resemble the offshoring described in the opening quote and the implications of such a shift for the cost of medical care.

1) Offshoring in Cognitive Terms

Frank Levy and Richard J. Murnane (2004) have argued that there are broad similarities between the work most vulnerable to offshoring and the work most vulnerable to computer

substitution. Their argument can be summarized as follows:

> All workplace tasks involve processing information: an engineer reading a report, a chef tasting a sauce, a farmer looking to the sky to check for rain, and so on. The tasks most vulnerable to computer substitution are those where the information processing can be described in rules. When a task can be fully described in rules, it can be programmed for a computer. When significant parts of a task can be described in rules, it is vulnerable to offshoring since it can be assigned to offshore producers with reduced risk of miscommunication and lower costs of monitoring. When a task's rules cannot be articulated—when the task involves extensive tacit knowledge—neither computerization nor offshoring is a readily available alternative.[3]

The rules to which the argument refers can be either deductive or inductive. Deductive rules arise from the logical structure of the process—for example, the rules that describe issuing an airline boarding pass in a self-service kiosk ("Does this credit card number match a number in the reservation database? Yes/No"). This kind of information processing is often described as rules-based logic.

Inductive rules, which are more complicated, typically refer to the equations of probits, neural nets, and other statistical models whose parameters are estimated on "training samples" of data before the model is put into use. Examples include models estimated on credit card purchase histories to flag the possibility of fraud and speech recognition software for a personal computer that must be trained by the user before it is used. This kind of information processing is usually described as pattern recognition.

We will use the term "pure pattern recognition" to describe information processing that is too complex—at least for the moment—to express even in inductive rules. Tasks based on pure pattern recognition arise at both the high and low ends of the skill distribution. It is hard to infer the rules involved in writing a convincing legal brief. It is equally hard to infer the rules a janitor

---

2. Radiology has several subspecialties. Diagnostic radiologists read images and typically do not deal directly with patients. Interventional radiologists both read images and perform procedures on patients—for example, the image-guided insertion of a stent—and so their work is not at issue here.

uses to convert a two-dimensional array of photons on his retina into a three dimensional understanding of an unfamiliar room. From a cognitive perspective, pure pattern recognition also rests on rules, but the rules are too deeply embedded to articulate. Figure 1 illustrates this typology.

FIGURE 1

VARITIES OF INFORMATION PROCESSING

Increasingly Hard to Program or Offshore

Conscious Application Of Deductive Rules (Rules-Based Logic)	Application of Deductive Rules (Pattern Recognition)	Rules Cannot be Articulated (Pure Pattern Recognition)
Examples		
Issuing an Airline Boarding Pass	Speech Recognition, Cancerous Cell Cluster Recognition in Mammograms	Writing a Legal Brief, Making Visual Sense of an Unfamiliar Room

Within this framework, the same structure that makes a task easier to computerize often makes the task easier to send offshore. A computer executes rules: a task cannot be computerized without instructions for every contingency (including, in the case of the boarding pass kiosk, "Unable to Process Your Request – See Desk Agent"). Similarly, when a firm assigns a task to an offshore contractor, the transaction is much simpler when the firm can specify, step by step,

3. See also Autor, Levy, and Murnane (2003). A second characteristic required for computerization is that

how the task is to be done. The absence of such instructions risks quality problems and complicates the assignment of responsibility in the case of errors. Alternatively, the absence of instructions requires a higher level of contractor skill.

Multiple examples illustrate this overlap between computerization and offshoring. Call center work is subsumed by speech recognition software, and call center work is sent offshore using operator-read scripts (a kind of rule). Doctors' dictated case notes are sent offshore for transcription, but speech recognition software is subsuming that work too. Production of Boeing aircraft modules is sent offshore using digitized machine tool instructions;[4] other production jobs are lost in this country to assembly line robots. Basic tax preparation is sent to offshore accountants (who use the tax code's rules) while other tax preparation work is done by TurboTax and TaxCut software.

As other countries gain in expertise (that is, tacit knowledge), the need for fully specified rules will decline. Offshored software work is an example of this transition, an occupation that involves tacit knowledge but rests on the rules of programming languages. In the near term, however, the rules-based nature of both computerized and offshore work is a reasonable characterization.

2) Where Radiology Reads Fit In

In contrast to these examples, reading most radiological images is pure pattern recognition, work that so far defies characterization in rules. Several U.S. centers work on computer-assisted diagnostic (CAD) software to scan radiological images for abnormal patterns.[5]

---

the information being processed can be digitized. For simplicity, we do not discuss that characteristic here.

4. The machine tool instructions come from the computer-assisted software used to design the aircraft. See Levy and Murnane (2004, chap. 3) for further discussion.

5. The Kurt Rossmann Laboratory at the University of Chicago Medical School is one such center. Note that the radiologist must both recognize an abnormal pattern (which is what the software does) and identify the abnormality, a potentially harder job.

To date, however, only two applications have received approval from the Food and Drug Administration: software to scan mammograms for potentially cancerous cell clusters and software to scan lung images for cancerous nodules.[6] A third application—to scan virtual colonoscopies for polyps—is on the horizon. Most other images are currently too complex to infer the underlying rules. This is not surprising. An abdominal CT scan can reveal many different abnormalities, and even normal abdominal scans vary significantly among individuals. MRIs are particularly complicated. Where most of a telemarketer's calls are similar, each radiological image is essentially a special case.

In organizational terms, the radiologist is usually the agent of the referring doctor who ordered the scan. For the sake of the patient and to minimize malpractice issues, the referring doctor has to be confident that a radiologist reads images correctly, but the absence of articulated rules makes this hard to determine. The problem is not limited to radiologists many miles away. As a surgeon in a large Boston area hospital told us: "When I get night call from 'Bob' or 'Jim' [the attending radiologists in the emergency room] and they say I have to come in to operate, I come right in. When I get a night call from a radiology resident and they say I have to come in, I want much more information. I've been burned too many times by residents misreading a film" (personal communication, April 2005).

Not all doctors face a surgeon's decisions, but learning to trust a radiologist 9,000 miles away—a relationship with no face-to-face contact—is a potentially significant problem. Since the task is not defined by rules, the problem's current solution is to rely heavily on the radiologist's qualifications. The radiologist must be U.S. board-certified, which in turn requires the completion of a residency in an approved U.S. program.[7] The radiologist must also be

6. One developer of such software is R2 Technologies in Santa Clara, California; see www.r2tech.com.
7. But residency does not require having attended a U.S. medical school, a point we return to below.

licensed in the state and accredited in the hospital in which the images were generated. As with most professional standards, these standards simultaneously address quality and limit competition.

3) The U.S. Radiologist Market

U.S.-trained radiologists face a very tight market for their services. The website Salary.com reports a median cash compensation for diagnostic radiologists of $277,000 and 75th percentile compensation of $331,000. The *RSNA News*, a publication of the Radiological Society of North America, reports that median 2003 compensation for a diagnostic radiologist in a group practice was $346,000.[8] Radiologists' income has also increased faster than the income of many other doctors: between 1998 and 2000, for example, radiologists reported real annual increases of 9.1 percent in their income, while general internal medicine physicians saw a real annual decrease of 1.3 percent (Kane and Loeblich 2003).

This tight market reflects both supply and demand factors. In classic cobweb fashion, today's limited supply of radiologists has its roots in the mid-1990s. The Balanced Budget Act of 1997 capped the total number of a hospital's residency slots that could receive federal support. At that time, relatively few residency slots were devoted to radiology because medical students perceived a weak job market for radiologists and federal policy was being designed around the primacy of the family practitioner (Grumbach 2002).

Although it was unclear then, multiple factors were beginning to expand demand for radiologists' services. Continued improvements in scanning equipment increased both the regions of the body that could be scanned and the number of images produced in a given case. One doctor notes that fifteen years ago, a CT scan could produce twenty "slices" (cross-sectional body images) in ten or fifteen minutes. Today a CT scan can turn out several hundred slices of

similar resolution in less than a minute, producing "a flood of data to analyze" (personal communication, July 2004). As Goelman (2005) describes, imaging also became more important to diagnosis, in part due to concerns about malpractice liability. A final factor in increased demand for radiologists' services was the rapidly expanding supply of scanning equipment. After brief governmental attempts to ration equipment purchases—through the "certificate of need" programs—many community hospitals now have the kinds of advanced equipment that used to be found only in regional medical centers. Several doctors have suggested to us that this increased access and convenience tilt the referring doctor's decision toward ordering a scan. Taken together these factors improved radiologists' job prospects and increased demand for radiology residencies. But under the federal funding cap, more radiology residencies required reallocation of slots from other specialties, an arduous process.

In the 1990s the software industry responded to a skill shortage by using H1B visas to import foreign labor.[9] The U.S. health care system pursues a limited version of the same strategy. Each year, U.S. hospitals hire more residents than the number of students who graduate from U.S. medical schools. The system makes up the difference by hiring foreign-educated medical students who have passed a series of U.S. certification exams. Once through residency, these students are eligible to take U.S. board certification exams, with the result that one quarter of the physicians currently practicing in the United States received their medical training elsewhere in the world. While the cap on funded residency slots means that the increment of foreign students is more limited than previously, Mullan estimates that every year one-quarter of roughly 100,000 first-year residents are foreign medical school graduates (Mullan 2002, 2003). From the

8. *RSNA News*, October 2004 (www.rsna.org/publications/rsnanews/oct04/salary-1.html).

9. The H1B visa is the primary USA work visa (permit) for foreign professionals who want to live and work in the United States. It is typically valid for up to six years.

perspective of offshore radiology, interviews conducted in India by our colleague Kyoung-Hee Yu indicate that the market for U.S. board-certified radiologists in India is tight largely because many Indian students who have received U.S. board certification choose to remain in the United States.[10]

Board certification itself points to the overriding difference between doctors and software professionals: U.S. doctors have a professional dominance in which doctors themselves are allowed to determine who qualifies as a doctor (Freidson 1970)—a power that software professionals, call center operators, and production workers do not have.

As noted above, radiologists who read images generated in the United States must be board-certified, licensed in the state where they are working, and credentialed at the hospital in which they practice. While radiologists, like other doctors, detest malpractice litigation, fear of that litigation helps to enforce these requirements. A doctor who must defend his treatment in court does not want to explain why he referred an image to an uncertified or unlicensed radiologist.

4) Outsourcing and Offshoring Radiology Reads

Given these strict limits on who can read images, the economics of outsourced radiology involves not cheap labor, but economies of scale. Outsourced reads are sent to "nighthawk" radiology services (so named because their services are in the greatest demand at night), usually provided by a large hospital or a private firm. The typical client for nighthawk services is a small private radiology practice at a hospital with an emergency room that generates several images a night requiring immediate reads. A small private practice cannot afford a full-time night radiologist to read half a dozen images. Putting a daytime radiologist on night call—potentially waking him or her up at 3:00 in the morning—risks errors, reduces the number of the more

10. Interviews conducted by Kyoung-Hee Yu, a Ph.D. candidate in MIT's Sloan School of Management.

remunerative day shifts the radiologist can work, and makes the practice a less desirable place to work at a time when the radiology market is very tight. In this situation, sending images to a nighthawk service is an attractive alternative. The nighthawk service, in turn, keeps its rates competitive by serving multiple hospitals in order to keep its radiologists busy for the duration of their shifts.

All of the large hospitals that provide nighthawk services are located in the United States, The non-hospital nighthawk firms are all headquartered in the United States but many locate their radiologists at offshore sites, including Sydney, Bangalore, Tel Aviv, and Barcelona. These remote locations allow radiologists to work daytime schedules as they read U.S. images generated at night. As one provider's website says, "When it's the middle of the night in Boston, it's daytime down under."[11]

To our knowledge, all nighthawk firms (and all hospitals) employ U.S. board-certified and licensed radiologists. This is partially in order to reassure potential clients concerned about quality, but once again, malpractice insurance plays a role. A referring practice risks its own malpractice insurance if it uses a nighthawk firm that does not carry malpractice insurance. A nighthawk firm, in turn, cannot purchase malpractice insurance unless it can prove it uses board-certified and licensed radiologists. In her interviews, Kyoung-Hee Yu heard occasional stories of "ghost reads," where individual U.S. doctors send films to uncertified radiologists abroad and then sign the reads themselves. This practice appears to be rare, in part because of the significant financial risk it entails.

The first radiology firms that focused solely on remote nighttime readings opened in 2001. Since then they have grown rapidly, with the leading firms currently reading images from

11. www.nighthawkrad.net

roughly 1,000 hospitals, almost 20 percent of the 5,764 hospitals registered with the American Hospital Association in 2003 (Goelman 2005). Given the recent inception of the market, it is unsurprising that the number of firms continues to fluctuate; but three firms now divide the majority of the market.

Despite using board-certified radiologists, nighthawk services chiefly perform what are called "wet" or preliminary reads. These wet reads inform the treatment the emergency room patient is given that night. Then, the following morning, the referred images are given a second read—a "dry" read—by a staff radiologist at the referring practice who signs off on the report. The two-read system reflects both quality control and regulatory considerations including the fact that Medicare will not reimburse medical procedures done outside the United States (another reason why U.S. doctors put their own names on "ghost reads").[12] In addition, it assuages any fear among physicians in the referring practice that they might lose control over their practice (Goelman 2005).

Regulatory barriers aside, the supply of qualified Indian radiologists is uncertain. Kyoung-Hee Yu has collected indirect evidence on this point by assessing to what extent Indian radiologists are supplying radiology services to countries other than the United States. She reports that as of 2005, Indian firms are starting to negotiate entry into the British market and have been invited to begin discussions with Singapore. It is unclear how fast these activities can expand before running into supply constraints.

Given this situation, U.S. radiologists are wary of foreign radiologists but, contrary to the opening *New York Times* quote, they currently do not see offshoring as their main competitive

12. This restriction was adopted a number of years ago to guard against, for example, people going to Mexico or Canada for treatment.

threat.[13] That honor goes to members of other U.S. medical specialties: cardiologists who want to read heart images, obstetricians/gynecologists who want to read ultrasound images, and other specialists. Since this competition comes from certified and licensed U.S. physicians, neither existing professional requirements nor malpractice fears offer radiologists much protection.

An example of these turf battles is the controversy surrounding a recent policy statement by Mark Miller, executive director of the Medicare Payment Advisory Commission (MedPAC), before the House Ways and Means Committee (Miller 2005). Medicare currently reimburses any physician for taking and interpreting images even if he or she has no training in image interpretation. Miller argued that some interpretation training should be required before a specialist – e.g. an orthopedic surgeon – could receive imaging reimbursement. Miller based his recommendation on cost and quality grounds but the recommendation was seen as favoring radiologists over other specialists. Michael Wolk, president of the American College of Cardiology, quickly challenged Miller's statement telling his membership: "Radiology leadership is directly challenging our ability to use the best and latest technology to care for our patients in our offices and in the hospitals in which we work."[14]

Radiologists argue that these turf battles reflect a basic asymmetry. As they see it, radiologists' patients are referred to them by other doctors. Other specialists who install scanning equipment in their offices can self-refer. Total imaging expenditures are now on a par with pharmaceuticals as drivers of rising medical expenditures (Stein 2003), and many radiologists

13. For example, a principal website for radiologists, www.AuntMinnie.com, holds an annual poll to choose "The Minnies," the leading people and most significant developments and events in the field. In 2004, competition from foreign doctors was neither the first- nor second-ranked "biggest threat to radiology." (It had been ranked second in the semifinal voting.) The Minnie for biggest threat went to "increased use of medical imaging by physicians in other specialties (turf battles)," discussed later in this section. See www.auntminnie.com/index.asp?Sec=nws&Sub=rad&pag=dis&ItemId=63476.

14. As reported in Tracie L. Thompson, "Cardiology Leader Slams ACR Imaging Initiatives" (www.auntminnie.com/index.asp?Sec=sup&Sub=imc&Pag=dis&ItemId=65661) [March 10, 2005]). See also Tracie

believe, perhaps incorrectly, that much of the growth reflects self-referrals done by other doctors to increase income (see, for example, Thorpe and others 2004). The MedPAC statement coincided with radiologists' desire to avoid restrictions that are triggered by rising imaging costs. But recent evidence suggests that some radiologists have discovered how to self-refer by offering "discounts" (that is, kickbacks) to doctors who refer patients to them.[15]

5) The Future of Offshore Radiology

How will offshore radiology evolve? A speculative answer begins by first reviewing how radiologists are paid. The insurance reimbursement for a scan typically involves two pieces. The professional fee covers the radiologist's interpretation. The technical fee covers the cost of the scanning equipment, the technologist who operates the equipment, and so on. For example, at this writing in 2005, the Medicare schedule for the Boston metropolitan area reimburses a chest X-ray (frontal and lateral) for $43.78, of which the professional fee is $12.36 (28 percent). A CT scan of the spine, including a contrast agent, receives reimbursement of $424.49, of which the professional fee is $68.92 (16 percent). An MRI of the spinal canal with contrast agent is reimbursed at $785.16, of which the professional fee is $103.33 (14 percent).[16] Although the reimbursement per read is modest, a private practice radiologist (one who does not teach or do research) can read in excess of 11,000 images per year, and thus his or her potential income is quite large.

From an insurer's perspective, the cost of interpretation is a relatively small share of the scan's total cost, particularly for the more expensive CT or MRI. Correspondingly, an insurer

---

Thompson, "U.S. Congress Hears Debate over Federal Imaging Standards" (www.auntminnie.com/index.asp?Sec=sup&Sub=imc&Pag=dis&ItemId=65757 [March 17, 2005]).

15. See David Armstrong, "MRI and CT Centers Offer Doctors Way to Profit on Scans." *Wall Street Journal*, May 2, 2005.

16. Information available from the Center for Medicare and Medicaid Services (www.cms.hhs.gov/regulations/pfs/2005/1429fc.asp).

seeking to control aggregate imaging costs would likely focus on limiting the number of scans through benefits management before they would consider mechanisms for hiring cheaper radiologists. Ironically, it is doctors themselves—both nonradiologists and radiologists—who may have the greater incentives to explore offshore radiology. Because doctors often own their own scanning equipment, they can collect technical fees regardless of who interprets the image.

At one extreme, some self-referring specialists (nonradiologists) may recognize they are billing for images that they cannot accurately interpret and may turn to non-board-certified foreign radiologists for assistance. At the other extreme, some radiology practices may openly work to certify offshore radiologists to handle low-profit work. Today, for example, Medicare reimburses $101.65 for a screening mammogram, including a professional fee of $39.61. For many private practices, this fee makes the screening mammogram a loss leader: a frequently requested scan that can displace more profitable work but must be offered as part of a full array of services. More precisely, the large volume of *normal* screening mammograms is a loss leader: abnormal screening mammograms can lead to additional scans that can generate a profit. In this situation, many U.S. radiologists might welcome a mechanism that would triage the normal scans, allowing the radiologist to focus on the abnormalities.

Such triage may be plausible. A mammogram is scanned for only a limited number of abnormalities (though these abnormalities, such as microcalcifications, are very small and often hard to detect). This helps explain why mammograms are one of the two kinds of images receiving FDA approval for computer assisted diagnosis.[17] As one radiologist suggested, it is possible to imagine a private offshore firm that offers to screen mammograms twice—once by an offshore radiologist and again by computerized scanning—flagging those mammograms that

[17] As noted earlier, the scan functions as a second read, complementing the radiologist's work.

show any sign of abnormality. The arrangement might build on previous, unsuccessful attempts to redefine offshore foreign radiologists as “virtual residents” – a reference to the way that radiology residents in U.S. hospitals (who are not yet board certified) do supervised reads as part of their training. The redefinition would require a significant institutional shift including coordination with U.S. malpractice insurance. Given the status of radiologists however, this scenario is one of the easier offshoring scenarios to imagine.

6) Conclusion

In the first news reports about the offshoring of high-skilled jobs, radiologists were often paired with software engineers. We have argued in this paper that these occupations, while both high skilled, are distinguished by several key differences. Unlike the work of software engineers, the quality of a radiologist’s work is very difficult to gauge. This has contributed to the radiology profession’s continuing ability to exercise power over decisions about who is permitted to interpret U.S. radiological images. The radiologists’ control of their profession is reinforced by malpractice concerns that in part reflect U.S. consumer preferences. U.S. consumers may not care who wrote the code in their PC, but they do not favor having medical treatments influenced by an anonymous benefits manager or an anonymous foreign doctor. In most markets, consumer behavior is determined by price as well as preferences, but U.S. health insurance offers little price incentive for consumers to reconsider their view.

For all these reasons, pairing the threats faced by radiologists and software engineers makes for a terrific headline but not much else.

References

Autor, David, Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technical Change: An Empirical Investigation." *Quarterly Journal of Economics* 118 (November): 1279–1334.

Freidson, Eliot. 1970. *Professional Dominance: The Social Structure of Medical Care*. New York: Atherton.

Goelman, Ari. 2005. "What's Space Got to Do with It?" Ph.D. dissertation, Department of Urban Studies and Planning, Massachusetts Institute of Technology.

Grumbach, Kevin. 2002. "Fighting Hand to Hand over Physician Workforce Policy; The Invisible Hand of the Market Meets the Heavy Hand of Government Planning." *Health Affairs* 21 (5): 13–27.

Kane, Carol, and Horst Loeblich. 2003. "Physician Income: The Decade in Review." In *Physician Socioeconomic Statistics*, edited by John Wassenaar and Sara Thran, pp. 5–11. Chicago: American Medical Association.

Levy, Frank, and Richard J. Murnane. 2004. *The New Division of Labor*. Princeton University Press and the Russell Sage Foundation.

Mullan, Fitzhugh. 2002. "Some Thoughts on the White-Follows-Green Law." *Health Affairs* 21 (1): 158–59.

_____. 2003. "The Future of Medical Education: A Call for Action." *Health Affairs* 22 (4): 88–90.

Miller, Mark E. 2005. "MedPAC Recommendations on Imaging Services." Statement prepared for the Ways and Means Committee, U.S. House of Representatives, March 17 (http://www.medpac.gov/publications/congressional_testimony/031705_TestimonyImaging-Hou.pdf).

Stein, Charles. 2003. "Partners Program Aims to Rein in Skyrocketing Costs of Diagnostic Imaging." *Boston Globe*, June 27, 2003

Thorpe, Kenneth, E., S. Curtis and Florence and Peter Joski. 2004. "Which Medical Conditions Account for the Rise in Health Care Spending? *Health Affairs, Web Exclusive*, August 25.

Thurm, Scott. 2004. "Lesson in India: Not Every Job Translates Overseas." *Wall Street Journal*, March 3.