

Arrow and the Information Market Failure in Health Care: The Changing Content and Sources of Health Care Information

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Kenneth Arrow's "Uncertainty and the Welfare Economics of Medical Care," published in the *American Economic Review* in 1963, makes profound contributions in the areas of health economics and, more generally, in the economics of information.

At the time Arrow was writing this article, unlike today, there was almost no scholarship on the economics of information. The only article on this topic published at that time in the economics literature was "The Economics of Information" by George Stigler (1961), and its focus was on consumers' information about price rather than quality. In *Public Health Reports*, however, Selma Mushkin had published "Toward a Definition of Health Economics" in which she discussed how consumers' lack of information about quality could result in market failure in medical markets. She wrote, ". . . they [consumers] reveal considerable absence of accurate knowledge about the quantity and quality of health services required. The nature of the medical service itself and its intangible character reinforce the consumer's lack of knowledge about his purchases, and impede a rational choice that could guide the allocation of resources" (Mushkin 1958: 787).

This essay is organized into three parts. First is a description of Arrow's contributions with respect to information problems leading to market failures in medical care markets. Second, it is shown that theo-

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retical work by economists since 1963 is consistent with Mushkin's and Arrow's thinking—specifically, information imperfections result in market failure. Third, it includes a discussion of the changing nature of the informational asymmetry between physicians and patients since 1963.

Arrow's Understanding of the Nature of Information in Medical Markets

Arrow recognized that medical care markets are characterized by extremely high levels of uncertainty and, in particular, patients' uncertainty about the consequences of purchasing medical treatments. Patients' inherent uncertainty about the effectiveness of medical treatments—uncertainty about which treatments can best cure their illnesses or relieve their pain—makes it extremely difficult for patients to learn about and evaluate the quality of medical care services. *“Uncertainty as to the quality of the product is perhaps more intense here than in any other important commodity. Recovery from disease is as unpredictable as is its incidence. . . . Further, the amount of uncertainty, measured in terms of utility variability, is certainly much greater for medical care in severe cases than for, say, houses or automobiles, even though these are also expenditures sufficiently infrequent so that there may be considerable residual uncertainty”* (951).

Second, Arrow recognized that under conditions of uncertainty, accurate information becomes a very valuable commodity and that, in many ways, medical markets are really markets for information. *“When there is uncertainty, information or knowledge becomes a commodity. . . . but, information, in the form of skilled care, is precisely what is being bought from most physicians”* (946).

Third, Arrow recognized that information's “elusive character” limits its marketability on both the demand and supply sides of the market. In his analysis there are limits on consumers' abilities to acquire information and limits on consumers' abilities to process information. Specifically, for cases of severe illness the limits on acquiring information are *“the uncertainty due to inexperience”* (inadequate number of trials to learn from) and *“the intrinsic difficulty of prediction”* (951).

With respect to limits on consumers' abilities to process information, he described consumers as not knowing the value of the information being bought from physicians. *“. . . if, indeed, [the consumer] knew*

enough to measure the value of the information, he would know the information itself" (946). Further, Arrow understood illness and ". . . demand for medical services is associated, with a considerable probability, with an assault on personal integrity. There is some risk of death and a more considerable risk of impairment of full functioning" (949). Compared to periods of good health, in periods of poor health (especially those associated with an impairment of cognitive functioning, pain, and anxiety about death), consumers may not be able to fully process information. Further, individuals confronted with new illnesses often have limited time to collect information since the effectiveness of many medical treatments depends on minimizing the time between the onset of the illness and the start of the treatment.

Fourth, Arrow recognized that some market participants will be better informed than others. "*Like other commodities, it [information] has a cost of production and a cost of transmission, and so it is naturally not spread out over the entire population but concentrated among those who can profit most from it*" (946). The quantity of information acquired by each consumer depends on that individual's expected costs and benefits of acquiring information. Consumers will vary in these costs and benefits due to differences in income (or opportunity costs of time), analytical abilities, and other factors.

Fifth, Arrow recognized the special asymmetric nature of the information in medical markets. Arrow focused his attention on informational asymmetries between physicians and their patients (rather than informational asymmetries between insurers and their enrollees). "*Because medical knowledge is so complicated, the information possessed by the physician as to the consequences and possibilities of treatment is necessarily very much greater than that of the patient, or at least so it is believed by both parties. Further, both parties are aware of this informational inequality, and their relation is colored by this knowledge*" (951).

Sixth, despite the lack of economic scholarship on information about quality, Arrow understood that the nature of information in medical markets—patients' uncertainty about the effectiveness of medical treatments, the "*informational inequality*" between patients and physicians, and the imperfect marketability of information provided by physicians—would result in market failure, specifically "*a failure to reach an optimal state in the sense of Pareto*" (947).

Economic Theory on Information Market Failure since Arrow

Economists have spent a great deal of time and energy in pursuit of a better understanding of the efficiency properties of markets for information and markets characterized by imperfectly informed consumers.¹ It is now recognized that markets for information are characterized by peculiarities that frequently lead to market failure and inefficiencies. One peculiarity is that sellers of information often have difficulty capturing the returns on the information they provide. This will be the case when sellers of information are unable to prevent buyers from reselling the information to others. The inability of information sellers to prevent resale of their information potentially leads to the market failure of too little information being traded. In markets for physician services, however, this market failure is averted through the tie-in between information and physician services and the patient-specific nature of the information traded. A second peculiarity (and one discussed by Arrow) is that buyers of information rarely know the value of the information until after it is purchased and sometimes never at all.

Another widely recognized market peculiarity is that buyers of a product often have less information about the product's value (price and/or quality) than do its sellers.² That the quality of the product is not apparent on inspection by prospective buyers is especially true in the market for physician services and was recognized by Arrow: "*the social obligation for best practice is part of the commodity the physician sells, even though it is a part that is not subject to thorough inspection by the buyer*" (1965).

When no information on quality is available prior to purchase, quality deteriorates to the lowest level in the market—a serious market failure since mutually advantageous trades involving higher quality products do not take place. George Akerlof (1970), in his classic article on lemons in the market for used cars, showed that when sellers of used cars know their quality, but potential buyers do not, only lemons will be traded. Since buyers cannot tell the difference between good used cars and

1. Due to space constraints this is a very brief review of the literature. For a more thorough review, see Stiglitz 1989.

2. Many economists, including Stigler (1961), Rothschild (1973), and Salop and Stiglitz (1977), examined the nature of market equilibrium when consumers are uncertain about sellers' prices. Since the problem of price uncertainty seems less important than the problem of uncertainty about quality in medical care markets, these articles will not be discussed in this brief review.

lemons, all used cars sell for the same price. In this situation owners of good used cars have no financial incentive to sell their cars, and thus only lemons will be traded. Similarly, Hayne E. Leland (1979) showed that quality deteriorates to the lowest level in markets where price can be observed costlessly, quality cannot be observed at all, and price is not a signal of quality. Richard Schmalensee (1978) and Dennis Smallwood and John Conlisk (1979) also showed equilibria exist in which the lowest quality brands have the largest shares in markets where consumers follow an adoptive strategy while searching among sellers and that buyers can learn price but not quality before purchase.

Clearly there is an asymmetry in information about quality in markets for physician services, yet this sort of lemons' equilibrium, with only low-quality physicians selling their services, does not occur. The difference can be explained by two assumptions of the Akerlof model. First, in the Akerlof model, quality is determined exogenously, and in the market for physician services, quality is at least partially determined by the physician. Unlike the sellers of used cars in the Akerlof model, physicians have some control over the quality of care they sell. Second, in the Akerlof model, buyers of used cars are totally ignorant about quality prior to purchase, while in markets for physician services, patients can obtain at least partial information on physician quality prior to purchase. Medical care consumers almost always have some indication of physician quality, either from past experience, discussions with friends, relatives, or co-workers about their past experiences, physician signaling, or other sources.

Arrow recognized that while a medical care consumer cannot directly observe whether "*the physician is using his knowledge to the best advantage,*" the medical care consumer can obtain partial information about physician quality prior to purchase. Arrow recognized that consumers may use a physician's avoidance of "*the obvious stigmata of profit-maximizing*" as "*a signal to the buyer of his intentions to act as thoroughly in the buyer's behalf as possible*" (1965).

Since Arrow, economists have studied markets characterized by signaling: when consumers use seller-specific attributes, screening devices, or signals (other than avoidance of profit-maximizing behavior) as substitutes for direct information about quality (see Akerlof 1976 and Spence 1973). For example, if consumers infer that physicians who work the longest hours provide the highest quality care (possibly because those physicians are the most competent and thus have the most patients), consumers may use hours of work as a signal of quality and select their physicians accordingly.

Unfortunately, over time both competent and less competent physicians will start to work longer hours to exploit consumers' screening device—a dynamic called the *rat race*. It is unclear whether hours worked will continue to convey information about quality. If all physicians increase their hours proportionally, then there will be no change in relative hours, and the signal continues to convey information about quality. If, on the other hand, the less competent physicians increase their hours, then the positive correlation between quality and hours disappears and the signal conveys no information about quality.

Economists have shown that even when consumers obtain partial information on quality, quality deterioration is still a possible market outcome. When uninformed consumers use high price as a signal of high quality, as shown by Russell Cooper and Thomas W. Ross (1984), “dishonest firms” may sell low-quality goods at high-quality prices. Charles Stuart (1981) showed that equilibria exist with only low-quality goods in markets where consumers maximize expected utility and can purchase partial information on product quality. Likewise, Yuk-Shee Chen and Hayne Leland (1982) showed that in the presence of asymmetric information, even when consumers can obtain price and quality information about individual sellers, consumers may still pay high-quality prices for low-quality products.

Thankfully for individuals in need of health care services, when consumers can obtain information on physicians' reputations for high- or low-quality care, the problem of quality deterioration may be ameliorated. When firms' reputations become public information, Benjamin Klein and Keith B. Leffler 1981 showed wealth-maximizing firms would not cheat on promises to sell high-quality products, if prices are sufficiently above costs. In other words, firms will sell high-quality products at high prices rather than try to sell low-quality products at high prices. Likewise, assuming all consumers prefer higher to lower quality, but differ in their willingness to pay for quality, and some provider-specific information about quality reaches potential consumers, Asher Wolinsky (1983) showed that higher quality products will sell at higher prices and lower quality products will sell at lower prices.

The hope is that more informed health care consumers will be able to select the physicians (or health plans) offering the lowest quality-adjusted prices. In turn, more informed health care consumers may result in physicians (or health plans) decreasing their quality-adjusted prices by decreasing price and or increasing quality.

This is easier said than done in health care markets because consumers

may be better able to learn about some aspects of quality than others. Health care quality is a multidimensional construct with at least two components: technical quality (including how well medical knowledge is applied to the diagnosis and treatment of the medical problem) and interpersonal quality (including the responsiveness, friendliness, and attentiveness of the physician or health plan).³

Consistent with this, empirical evidence suggests that patient satisfaction is positively related to interpersonal quality but independent of technical quality (Haas-Wilson 1994; Chernew and Scanlon 1998). Further, consistent with economic theory, empirical evidence suggests that market-determined prices are positively correlated with the easier to learn aspects of quality, such as interpersonal quality, but not related to the more difficult to learn aspects of quality, such as technical quality (Haas-Wilson 1994).

Our Understanding about Information in Medical Markets since Arrow

To address the nature of informational asymmetries between physicians and patients now, relative to 1963, one must examine at least two related questions.

First, has there been a change in physicians' abilities to learn about the relative effectiveness of alternative treatments, and thus their abilities, to recommend the most effective treatments for their patients? Second, has there been a change in medical care consumers' abilities to learn about and evaluate, independent from the physician, the quality of the diagnostic and treatment information and medical treatments provided by their physicians?

To really answer these questions one needs to be able to measure information in the hands of both medical care consumers and physicians. Unfortunately, we cannot because information is an extremely difficult concept to quantify. However, there have been attempts to develop "proxies" that are at least correlated with the extent of health care information.

Economists have used at least two proxies to show the extent of information on physician-specific quality—one, a marketwide measure, is the number of physicians in an area (Satterthwaite 1979; Pauly and Satterth-

3. Donabedian 1980. Another aspect of health care quality is the amenities of care (including the appeal and comfort of the health care facilities).

waite 1981); and the other, a physician-specific measure, is the prevalence of a physician's referrals from informed sources (such as other physicians) rather than less-informed sources (such as self-referrals) (Haas-Wilson 1990). The argument behind the first proxy is that since physician services are a reputation plus, and since individuals learn about physician-specific quality by talking to their friends, relatives, and co-workers about their experiences with their physicians, as the number of physicians in an area increases, the probability that one's friends, relatives, and co-workers will have experience with any particular physician decreases. Thus, as the number of physicians increases, the availability of information about any individual physician decreases. The argument behind the second proxy is that physicians make referral recommendations based on their perceptions of other physicians' expertise and professional competence. Accordingly, referral patterns among physicians may reflect perceptions (information) of physician-specific quality of care.

Both of these information proxies are of limited value for measuring the availability of information in markets today because both were developed prior to the growth of managed care. Under managed care the total number of physicians is less relevant because individuals in managed care plans have insured access to only those physicians included in their plan's provider network. Likewise under managed care, referral patterns are increasingly influenced by financial considerations and network membership.

Accordingly, there are no particularly good measures of the availability of information about quality, and quantitative answers to the two questions just mentioned are not possible. Rather, what follows are broad-brush observations.

At least three types of information are of value to patients—information about what is causing patients' illnesses and symptoms (diagnostic information), and, given their diagnoses, information about the effectiveness of alternative treatments to restore their health (treatment information), and information about which physicians provide the most accurate, useful information or the highest quality care (physician-specific quality)—were the focus of Arrow's analysis. Diagnostic and treatment information are extremely valuable to patients faced with decisions about what health care services to consume. Patients experiencing chest pains first need to know whether they are suffering from a heart attack or indigestion, and second, if it is a heart attack, what is the best (most effective) treatment option—cardiac catheterization followed by an

angioplasty (a procedure that involves a balloon at the end of a catheter to eliminate blockages), cardiac catheterization followed by bypass surgery (an open-heart surgical procedure to bypass the blockages), drug treatments using aspirin, thrombolytics (which inhibit clotting), beta-blockers, or ACE inhibitors, or some combination of these treatments.

Diagnostic and treatment information are at least as relevant to health care consumers today. In fact, the number of available treatments has expanded greatly, making this sort of information even more valuable. Further, there is little reason to argue that today's patients are better able to diagnose their own health problems.

What has changed since 1963 is patients' abilities to identify possible treatments, given their diagnoses, and patients' abilities to learn about the likely consequences of those treatments. Patients have access to new sources of information on alternative treatments and their consequences, independent from their physicians.

In 1989 the federal government, through its Agency for Healthcare Research and Quality,⁴ started to fund research on the effectiveness of alternative clinical interventions—the linkages between clinical practices and clinical outcomes. The goal of this research is to provide evidence for or against the effectiveness of alternative clinical interventions. Research of this sort can demonstrate whether, on average, a treatment is effective for a given illness.⁵ Funded projects have included treatment effectiveness for acute myocardial infarction (heart attack), prostate disease, cataracts, arthritis of the knee, coronary artery disease, diabetes, gallbladder disease, pneumonia, hip fracture and osteoarthritis of the hip, and other clinical conditions.

Simultaneously, there has been explosive growth in the amount of health care information available online. As of March 2001 there were approximately 26,000 health-related Web sites (Firstman 2001). The National Guideline Clearinghouse (www.guideline.gov) publishes evidence-based clinical practice guidelines on multiple topics, including acute pain management, urinary incontinence, cataracts, sickle cell disease, unstable angina, heart failure, and smoking cessation. Similarly, CBSHealth Watch (www.cbshealthwatch.com), WebMD (www.webmd.com), and the National Library of Medicine (www.nlm.nih.gov) have become popular sources of information on treatment effectiveness, ongoing clinical trials, and new drugs. Patients can also use the Internet to

4. Formerly the Agency for Health Care Policy and Research.

5. However, clinical research cannot demonstrate whether a treatment will be effective for a particular patient with that illness.

communicate with and learn from others with similar diagnoses. Jeff Goldsmith (2000: 152), a health care forecaster, wrote, "The patient who types 'lupus' into the search box of an Internet portal is within minutes of discovering an online community of fellow lupus sufferers, which brings a framework for collective learning about how to cope with the disease independent of one's physician."

Another change since 1963 is that we now have a better understanding of the importance of information about *where* to obtain health care services (as opposed to information about *what* health care services to buy, such as diagnostic and treatment information). We now have a better understanding of the importance of patients' uncertainty about which physicians (or hospitals) provide the highest quality care. Patients' uncertainty concerning where to buy is at least as important as patients' uncertainty about what to buy. For example, since 1991 the New York State Department of Health has published a report⁶ showing significant variation in surgeon-specific coronary artery bypass graft surgery outcomes (Hannan et al. 1997).

In general, there is tremendous variation across physicians in terms of the quality of care (the treatments recommended and the health outcomes realized). Physicians' styles of practice or their propensity to use medical resources vary greatly even within a geographic region. This implies that some patients are getting too much treatment and some too little treatment—a situation that can only exist in markets characterized by imperfect consumer information about physician quality (Phelps 2000). In fact, it is well documented that many Americans do not receive care that is based on the best scientific knowledge (Institute of Medicine 2001).

Accordingly, the most important decision a patient makes is from whom to get treatment recommendations and treatment. Patients would like to select the physicians or hospitals with the best record for improving health outcomes among patients with their particular medical problems. Unfortunately, at this point in time, information technologies provide patients with new, but very limited, opportunities to learn about the health outcomes achieved by particular physicians and hospitals.⁷ Cur-

6. The New York reports contain information on the number of cases, the number of deaths, observed mortality rates, expected mortality rates, and risk-adjusted mortality rates.

7. The development of high-speed computer systems and standardized, computerized medical records has made the collection and analysis of clinical and administrative data feasible. This, in turn, has made measurement and comparison of some aspects of quality within and across physician organizations feasible.

rently available measures of physician-specific quality are more apt to measure other dimensions of quality. For example, the Association of State Medical Board Executive Directors publishes information on physicians' education, malpractice judgments, and disciplinary histories.⁸ The Pacific Business Group on Health, a group of thirty-three employers, publishes a study of patient satisfaction with medical groups and physician networks in California and the Pacific Northwest.⁹ This report ranks groups and networks on patient satisfaction, ease of getting referrals, and their records of keeping blood pressure and cholesterol under control and counseling patients on preventive care.

Another change since 1963 is that it has become increasingly clear that physicians' uncertainty in health care markets is more profound than Arrow's analysis suggested. While Arrow never claimed that physicians are all-knowing, he also did not address the limitations in physicians' abilities to collect, process, and use all relevant information. Since 1963, however, we have gained a better understanding of physicians' incomplete knowledge about treatment effectiveness. Despite many years in medical school and residency training programs, physicians, like their patients, have incomplete information about the relationships between the thousands of possible diseases and the effectiveness of all alternative treatments and are forced to make medical decisions under conditions of uncertainty.¹⁰

Further, we have a better understanding of the two-sided nature of the asymmetry in medical information. In some aspects the physician knows more, and in other aspects the patient knows more. Patients may know more about their own medical histories (including health care services received in other settings and medications prescribed by other clinicians), their willingness to comply with medical treatments, and their individual preferences between the consequences of their illnesses and the side effects of the treatment than their physicians. Accordingly, physicians (like their patients) are forced to make treatment decisions without the benefit of complete information.

8. Web site visited on 11 December 2000. The on-line address is www.docboard.org.

9. *American Medical News* 1 December 1997, 5; and *Wall Street Journal* 17 September 1997, B6.

10. Physicians' uncertainty is due, at least in part, to the increasing availability of more and increasingly complex treatment options.

Concluding Thoughts

New sources of information provide the potential for a metamorphosis of physician-dependent patients (patients dependent on their physicians for information on treatment effectiveness) into better-informed consumers (patients with multiple sources of information on treatment effectiveness).

This is not to say, however, that the Internet will replace physicians as patients' primary source of information on the effectiveness of various medical treatments. Even if patients have access to all the relevant medical information, there are limits to patients' abilities to process it and to make choices between treatments independently from their physicians. Patients tend to rely on guidance from their physicians to understand medical factors in the context of their particular medical problems and to give these medical factors their proper weight in treatment decisions.

Even well-informed patients will most likely continue to follow their physicians' recommendations concerning choice of treatment. All the technological innovations in the world cannot make the informational asymmetry between physicians and patients go away. "No Internet site will ever replace the intangibles of the doctor-patient relationship. Data crunching will never eliminate the vast gray areas where technology, medical judgment, and patient preference intersect" (Millenson 2000: 273).

Accordingly, for potential patients no choice is more important than their choice of physician. Hopefully, patients in the future will have access to reliable and precise physician-specific information about quality, such as measures of physician-specific health outcomes. There are reasons to be hopeful. Advances in information technology and research methods make this a possibility (McClellan and Staiger 1999).

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