Kenneth Arrow Fifty Years Later:

What has changed and what has remained the same?

Richard Embrey

Chief Medical Officer and Vice President for Population Health

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Fishersville, VA

In Memoriam

Kenneth Joseph Arrow

August 23, 1921 – February 21, 2017

- Born New York City
- B.A., City College of New York, 1940
- Ph.D., Columbia University, 1951
- Professor of Economics, Stanford University
- John Clark Bates Medal, 1957
- Nobel Memorial Prize in Economics, 1972
- Von Neumann Theory Prize, 1986
- National Medal of Science, 2004

Professor Arrow's most significant works were his contributions to social choice theory, welfare economics and general equilibrium analysis. Arrow also provided foundational work in many other areas of economics, including endogenous growth theory and the economics of information.

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"The most important paper about healthcare that no one in healthcare has actually ever read."

THE AMERICAN ECONOMIC REVIEW

VOLUME LIII DECEMBER 1963 NUMBER 5

UNCERTAINTY AND THE WELFARE ECONOMICS OF MEDICAL CARE

By KENNETH J. ARROW*

I. *Introduction: Scope and Method*

This paper is an exploratory and tentative study of the specific differentia of medical care as the object of normative economics. It is contended here, on the basis of comparison of obvious characteristics of the medical-care industry with the norms of welfare economics, that the special economic problems of medical care can be explained as adaptations to the existence of uncertainty in the incidence of disease and in the efficacy of treatment.

It should be noted that the subject is the *medical-care industry*, not *health*. The causal factors in health are many, and the provision of medical care is only one. Particularly at low levels of income, other commodities such as nutrition, shelter, clothing, and sanitation may be much more significant. It is the complex of services that center about the physician, private and group practice, hospitals, and public health, which I propose to discuss.

The focus of discussion will be on the way the operation of the medical-care industry and the efficacy with which it satisfies the needs of society differ from a norm, if at all. The "norm" that the economist usually uses for the purposes of such comparisons is the operation of a competitive model, that is, the flows of services that would be

* The author is professor of economics at Stanford University. He wishes to express his thanks for useful comments to F. Bator, R. Dorfman, V. Fuchs, Dr. S. Gilson, R. Kessel, S. Mushkin, and C. R. Rorem. This paper was prepared under the sponsorship of the Ford Foundation as part of a series of papers on the economics of health, education, and welfare.

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Putting Arrow's "Uncertainty" paper in context

- In 1963, Arrow was already well established as a leading "neo-classical" economist, having published groundbreaking work on competitive equilibrium that provided the foundation for modern economic thinking about the extent to which markets can or cannot reach welfare-maximizing equilibria.
- Arrow was invited by the Ford Foundation to examine medical markets as part of a larger effort to address policy areas with substantial public-private overlap (health, education, welfare)
- Arrow had to educate himself about health care and health insurance services before he could apply himself to the question.
- In 1963, medicine still consisted largely of a single physician treating a single patient with relatively rudimentary remedies and medications.
- At the time Arrow penned "Uncertainty and the Welfare Economics of Medical Care," government involvement with medical care was limited; insurance covered less than half of all medical expenditures, compared with more than 85% today.

Savedoff WD. Kenneth Arrow and the birth of health economics. Bull World Health Org 82(2), Feb. 2004.

Putting Arrow's "Uncertainty" paper in context

- In the intervening half century, medicine has been revolutionized by technological advances in the understanding and treatment of illnesses, and has been transformed by Medicare and Medicaid, malpractice, and managed care.
- Stimulated in part by rising incomes, spending on health services has increased dramatically in all of the world's high- and middle-income countries, leading to increased concerns about cost-containment, quality and responsiveness. Many of these countries, even if they have predominantly public systems, have introduced more market elements to relieve pressure on public services or to encourage greater productivity and allocative efficiency.
- Many of the non-market institutions that Arrow described, such as trust that physicians would not be motivated by profit and beliefs that the medical profession could regulate itself, have eroded.

Savedoff WD. Kenneth Arrow and the birth of health economics. Bull World Health Org 82(2), Feb. 2004.

Despite changes in health care, the relevance of "Uncertainty" has increased rather than decreased

	Period of Publication				
	First Ten Years (1963-1972)		Most Recent Ten Years (1991-2000)		Ratio – Last Ten years to First Ten Years
	Number	%	Number	%	
Economics	26	51%	95	34%	3.65
Non-economics	25	49%	187	66%	7.48
Total	51	100%	282	100%	5.53
Breakdown of Non-economics Journals					
Insurance	3	6%	11	4%	3.67
Human resources/industrial relations	3	6%	3	1%	1.00
Law	6	12%	26	9%	4.33
Medicine	3	6%	48	17%	16.00
Health Policy	2	4%	52	18%	26.00
Political Science	1	2%	0	0%	-
Sociology	0	0%	6	2%	All
Other	7	14%	41	14%	5.85

Hammer PJ, Haas-Wilson D, Sage W: Kenneth Arrow and the Changing Economics of Health Care. Duke University Press, 2003.

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“Uncertainty” remains the 2nd most cited paper in health economics fifty years after it’s publication

Table 1 (*Continued*)

Topic	Year	Title	First author	Journal/edited volume	Citations	Rank
Demand for health and health care	1998	Understanding the Context of Healthcare Utilization: Assessing Environmental and Provider-Related Variables in the Behavioral Model of Utilization	Kathryn A. Phillips	Health Services Research	267	248
Demand for health and health care	1975	Nonmonetary Factors in the Demand for Medical Services: Some Empirical Evidence	Jan Paul Acton	Journal of Political Economy	255	261
Demand for health and health care	1997	Demand for Medical Care by the Elderly: A Finite Mixture Approach	Partha Deb	Journal of Applied Econometrics	241	292
Medical insurance	2001	Uncertainty and the Welfare Economics of Medical Care	Kenneth J. Arrow	Journal of Health Politics, Policy and Law	4082	2
Medical insurance	1987	Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment	Willard G. Manning	American Economic Review	1196	13
Medical insurance	1991	The Economics of Moral Hazard: Comment	Mark V. Pauly	The economics of health. Volume 1	1064	20
Medical insurance	1997	Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study	Robert B. Barsky	Quarterly Journal of Economics	1056	21

What questions was Arrow trying to answer?

- Is the market for medical care competitive?
- If not, why not?
- Why should we care?

"The focus of discussion will be on the way the operation of the medical-care industry and the efficacy with which it satisfies the needs of society differ from a norm, if at all. The 'norm' that the economist usually uses for the purposes of such comparisons is the operation of a competitive model" (p. 941)

Requirements for a competitive market

- All of the quality dimensions of the good or service are accurately understood by both buyer and seller
- Potential buyers have full transparency on the price of the good or service
- It is easy for potential sellers to enter and exit the market
- There are so many buyers and sellers that none individually can affect the market price

Adapted from Reinhardt, 2010.

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“Uncertainty” is divided into four main sections:

Section I:	Scope and Method
Section II:	A Survey of the Special Characteristics of the Medical Care Market
Section III:	Comparisons with the Competitive Model under Certainty
Section IV:	Comparison with the Ideal Competitive Model under Uncertainty

I. Scope and Method

- **First Optimality Theorem**

  "If a competitive equilibrium exists, and if all commodities relevant to costs or utilities are priced in the market, then the equilibrium is necessarily optimal in this sense: there is no other allocation of resources that will make all participants in the market better off."

- **Second Optimality Theorem**

  "If there are no increasing returns in production … then every optimal state is a competitive equilibrium corresponding to some initial distribution of purchasing power. Operationally … then social policy can confine itself to steps taken to alter the distribution of purchasing power."

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II. A Survey of the Special Characteristics of the Medical-Care Market

A. The Nature of Demand

- Irregular and unpredictable
- Associated with an "assault on personal integrity"

B. Expected Behavior of the Physician

- Is different from businessmen (who are expected to act in their own self-interest)
- The product and the activity of production are identical
- Consumer cannot test the product before consuming, and there is a significant element of trust required

"the ethically understood restrictions on the activities of a physician are much more severe than on those of, say, a barber. His behavior is supposed to be governed by a concern for the customer's welfare which would not be expected of a salesman." (p. 949)

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II. A Survey of the Special Characteristics of the Medical-Care Market

C. Product Uncertainty

- Impossible for patients to learn from experience (severe illness)
- Intrinsic difficulty with prediction (of outcomes)
- Information asymmetry between provider and patient

"Uncertainty as to the quality of the product is perhaps more intense here than in any other commodity. Recovery from disease is as unpredictable as is its incidence." (p. 951)

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II. A Survey of the Special Characteristics of the Medical-Care Market

D. Supply Conditions

- Restricted by licensing, high cost of medical education
- Subsidized AND rationed by educational institutions

E. Pricing Practices

- Extensive price discrimination by income (zero prices for sufficiently indigent patients)
- Opposition to prepayment (i.e., health plans or HMOs)

"Both the licensing laws and the standards of medical school training have limited the possibilities of alternative qualities of medical care." (p. 953)

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III. Comparisons with the Competitive Model under Certainty

A. Nonmarketable Commodities

- The concern of individuals for the health of others

B. Increasing Returns

- Problems associated with increasing returns play some role in allocation of resources, particularly in areas of low density or low income
- In some cases it may be socially desirable to subsidize medical care

"In interdependencies generated by concern for the welfare of others there is always the theoretical case for collective action if each participant derives satisfaction from the contribution of all." (p. 954)

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III. Comparisons with the Competitive Model under Certainty

C. Entry

- Restriction to entry is the most striking departure from competitive behavior (admission to medical school and licensing)
- To achieve genuinely competitive conditions requires removal of restrictions on entry and removal of subsidies for medical education
- Barriers exist to exclude "imperfect substitutes" for physicians, generating inefficiencies

"If entry were governed by ideal competitive conditions, it may be that the quantity on balance would be increased, but that is not obvious. The average quality would probably fall… The decline in quality is not an over-all social loss, since it is accompanied by an increase in quality in other fields…indeed, if demands accurately reflected utilities, there would be a net social gain through a switch to competitive entry." (p. 956)

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III. Comparisons with the Competitive Model under Certainty

D. Pricing

- Price discrimination is incompatible with the competitive model (such as in charity care and prepayment plans)
- Preservation of price discrimination in the presence of ample supply is equivalent to a collective monopoly
- Elasticity of demand for all income levels is < 1

IV. Comparison with the Ideal Competitive Model under Uncertainty

A. Introduction

- This section compares the operation of the actual medical-care market with those of an ideal system in which the usual commodities and services are available, as well as insurance policies against all conceivable risks
- There are two types of risk: the risk of becoming ill and the risk of incomplete recovery from the illness.
- The loss due to illness is only partially the cost of medical care.
- If available, individuals would like to insure against both risks

IV. Comparison with the Ideal Competitive Model under Uncertainty

B. The theory of Ideal Insurance

- The expected-utility hypothesis best explains behavior under uncertainty
- Individuals are risk-adverse (certainty is preferred over uncertainty with the same expected return)
- Individuals will buy insurance against uncertainty even if the cost of the uncertain event (i.e., medical care) over time is the same as the insurance premium
- The pooling of risk produces social gain.
- The presumption is that the value of recovery from illness is greater than the cost of medical-care.

"A suitable insurance policy would, however, mean that [the patient] paid nothing if he doesn't benefit." (p. 961)

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IV. Comparison with the Ideal Competitive Model under Uncertainty

C. Problems of Insurance

- Moral Hazard
- Alternative methods of insurance payment
- Third-party control over payments
- Administrative costs
- Predictability and insurance
- Pooling of unequal risks
- Gaps and coverage

IV. Comparison with the Ideal Competitive Model under Uncertainty

D. Uncertainty of Effects of Treatment

- There are two major aspects to the uncertainty for an individual already suffering from illness: uncertainty about the effectiveness of treatment, and the uncertainty due to information asymmetry between the individual and their physician
- In the absence of ideal insurance, institutions of trust and delegation can offer some element of a guarantee
- The patient must delegate some freedom of choice to the physician
- Educational and licensing standards are important guarantees in the face of uncertainty and information asymmetry

"Ideal insurance … necessarily involves insurance against failure to benefit from medical care… One form would be a system in which payment to the physician is made in accordance with the degree of benefit." (p. 964)

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“It is contended here, on the basis of comparison of obvious characteristics of the medical-care industry with the norms of welfare economics, that the special economic problems of medical care can be explained as adaptations to the existence of uncertainty in the incidence of disease and in the efficacy of treatment.” (p. 941)

Areas where the market for medical care deviates from the competitive model

- Uncertainty as to the incidence of disease and efficacy of treatment
- Information asymmetry between provider and patient
- Lack of ideal insurance
- Nonmarketable commodities
  - Concern of individuals for the health of others
  - Societal benefits
  - Regulations and barriers to entry

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Requirements for a competitive market

- All of the quality dimensions of the good or service are accurately understood by both buyer and seller
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Adapted from Reinhardt, 2010.

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In the past 50 years…

- There has been dramatic improvement in the outcomes of medical care (cardiac disease, cancer, infant mortality)
- Genotyping and genetic risk analysis are among the techniques that have become available to predict an individual's specific risk of disease
- Information regarding "best practices" and optimal treatment has become much more prevalent and is accessible to consumers
- Health insurance continues to shield consumers from the true cost of care

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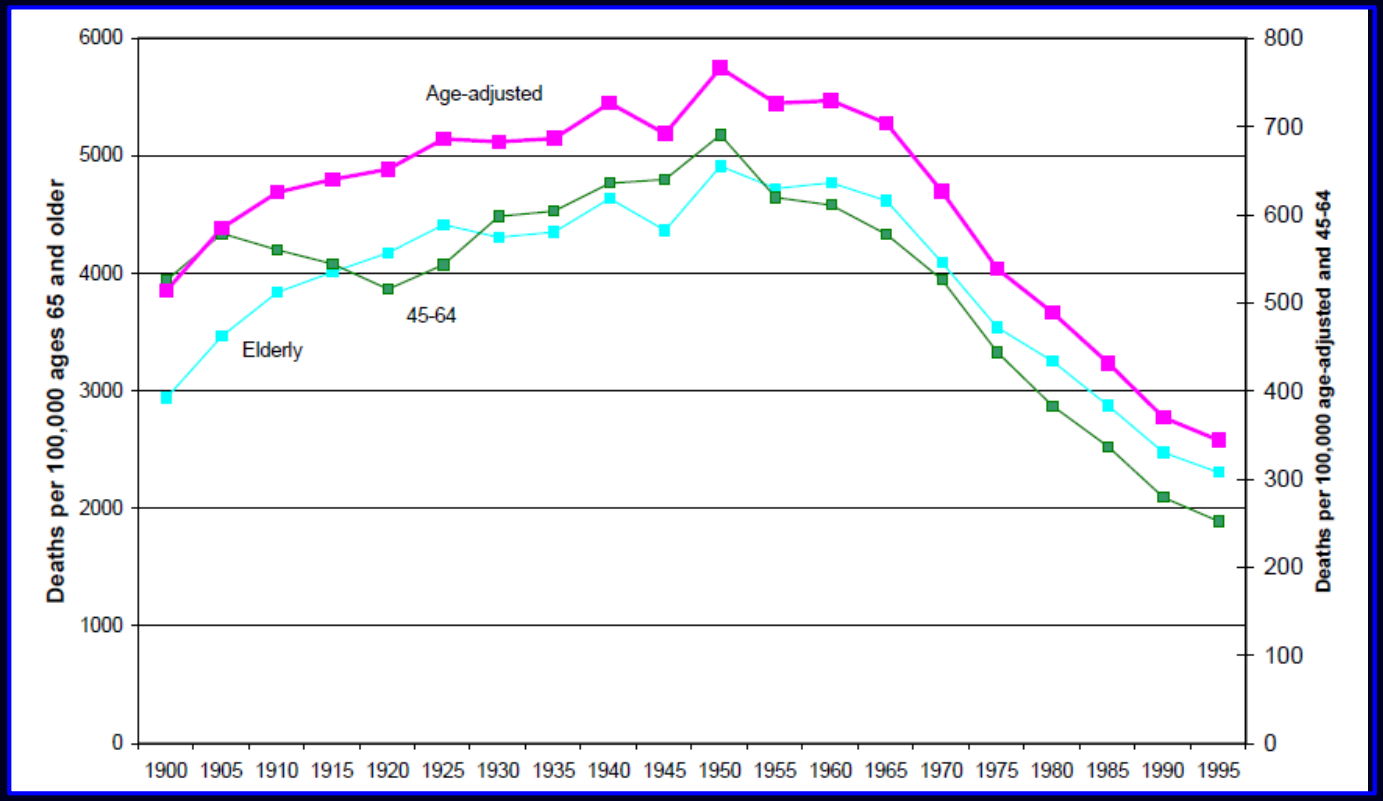
Deaths due to cardiovascular disease



Cutler DM, Meara E: Changes in the age distribution of mortality over the 20th century. NBER working paper 8556, 2001.

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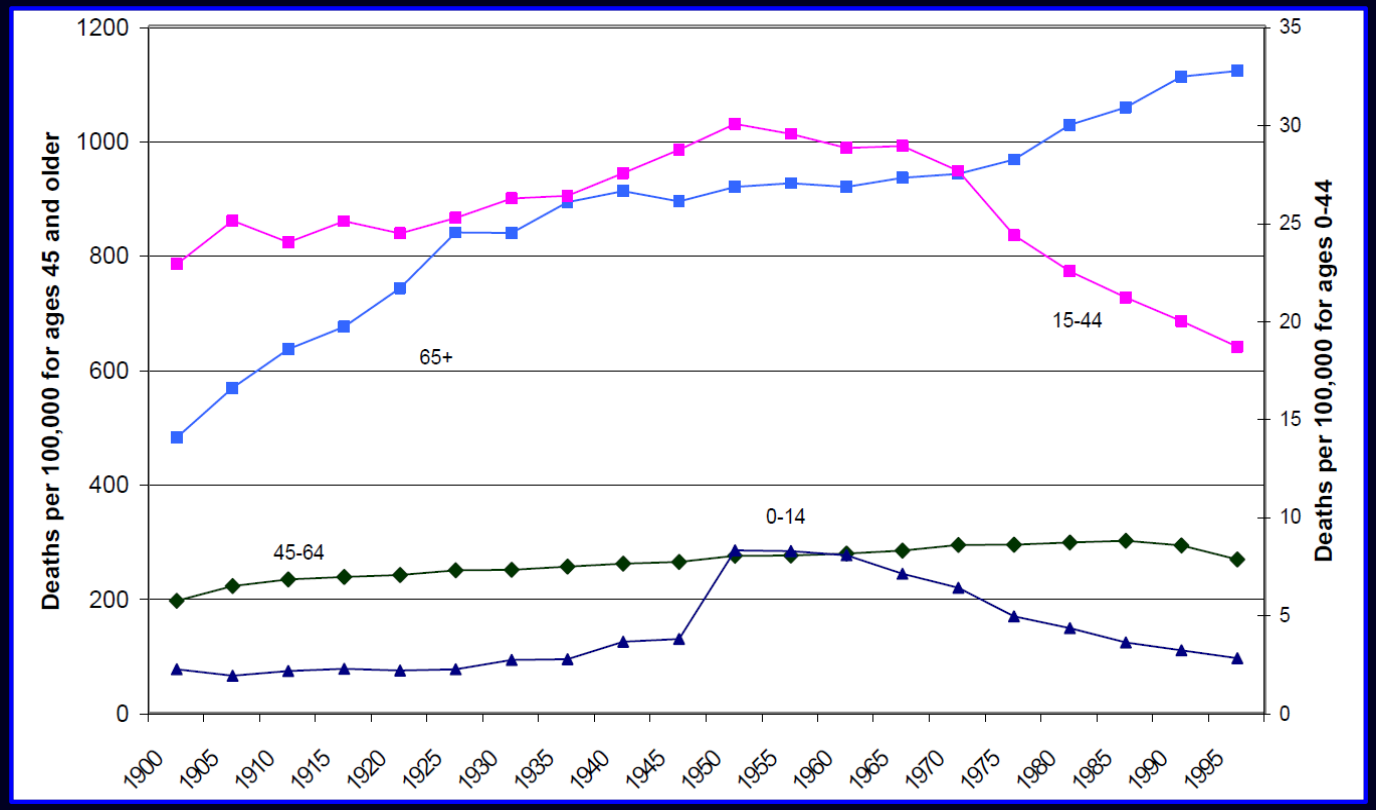
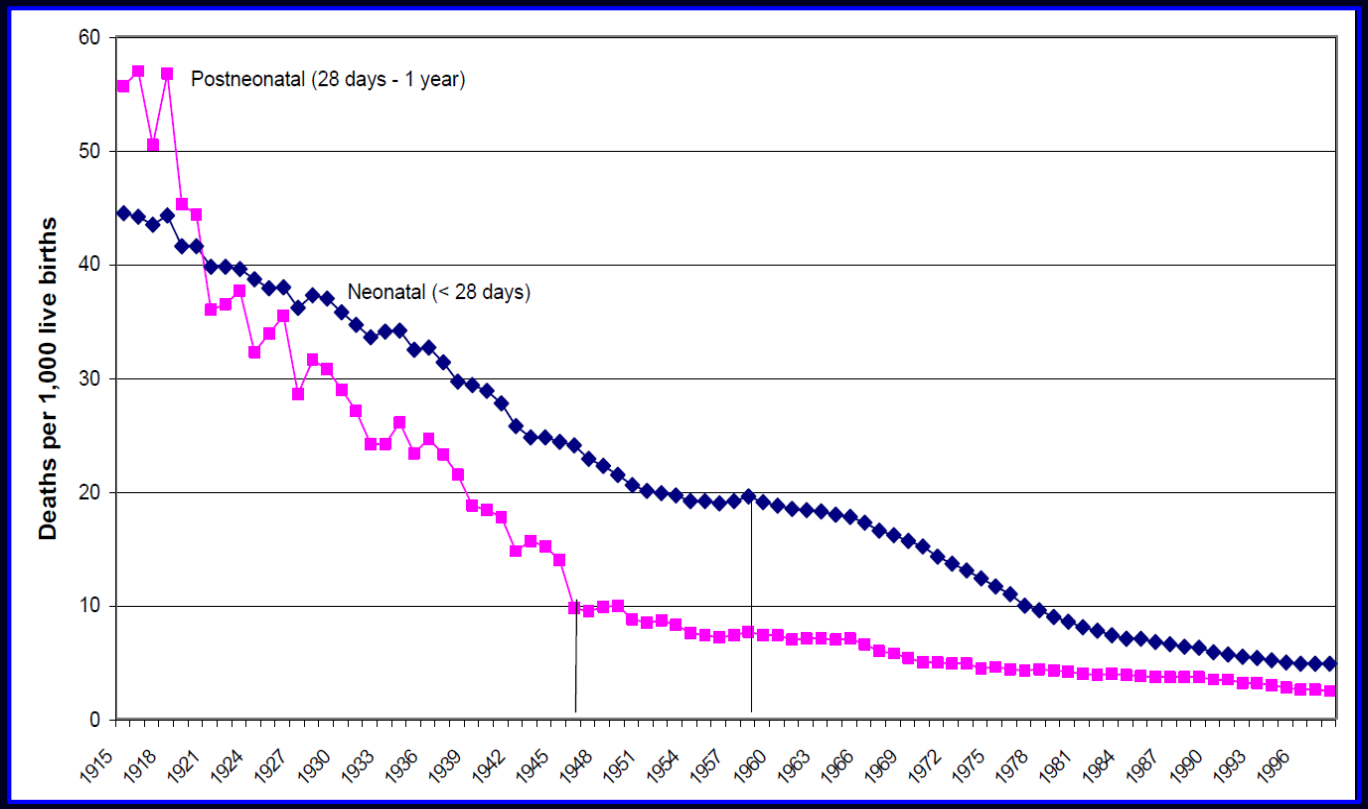
Deaths due to neoplasm, by age



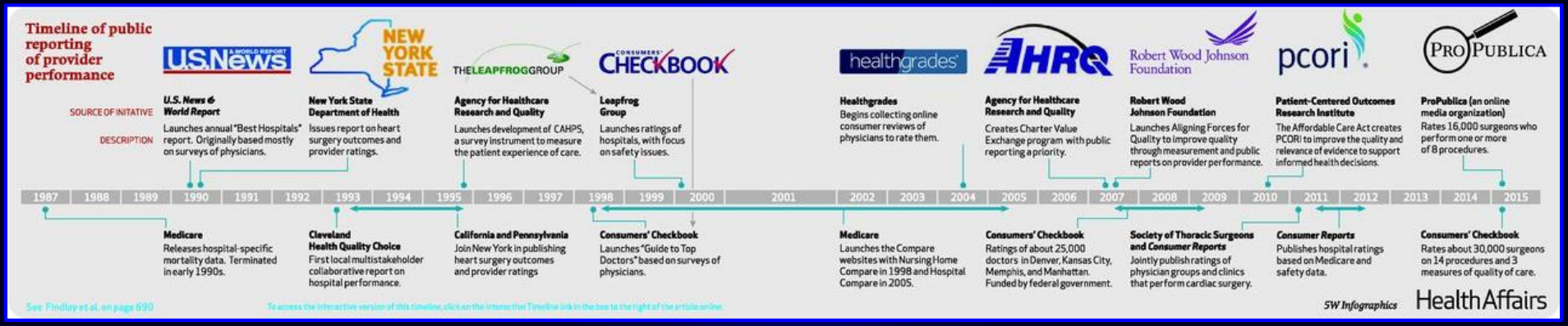
Cutler DM, Meara E: Changes in the age distribution of mortality over the 20th century. NBER working paper 8556, 2001.

Neonatal and postneonatal mortality



Cutler DM, Meara E: Changes in the age distribution of mortality over the 20th century. NBER working paper 8556, 2001.

Timeline of public reporting of provider performance



Patients' And Consumers' Use Of Evidence. *Health Affairs* 35, no.4 (2016):564-565. doi: 10.1377/hlthaff.2016.0171

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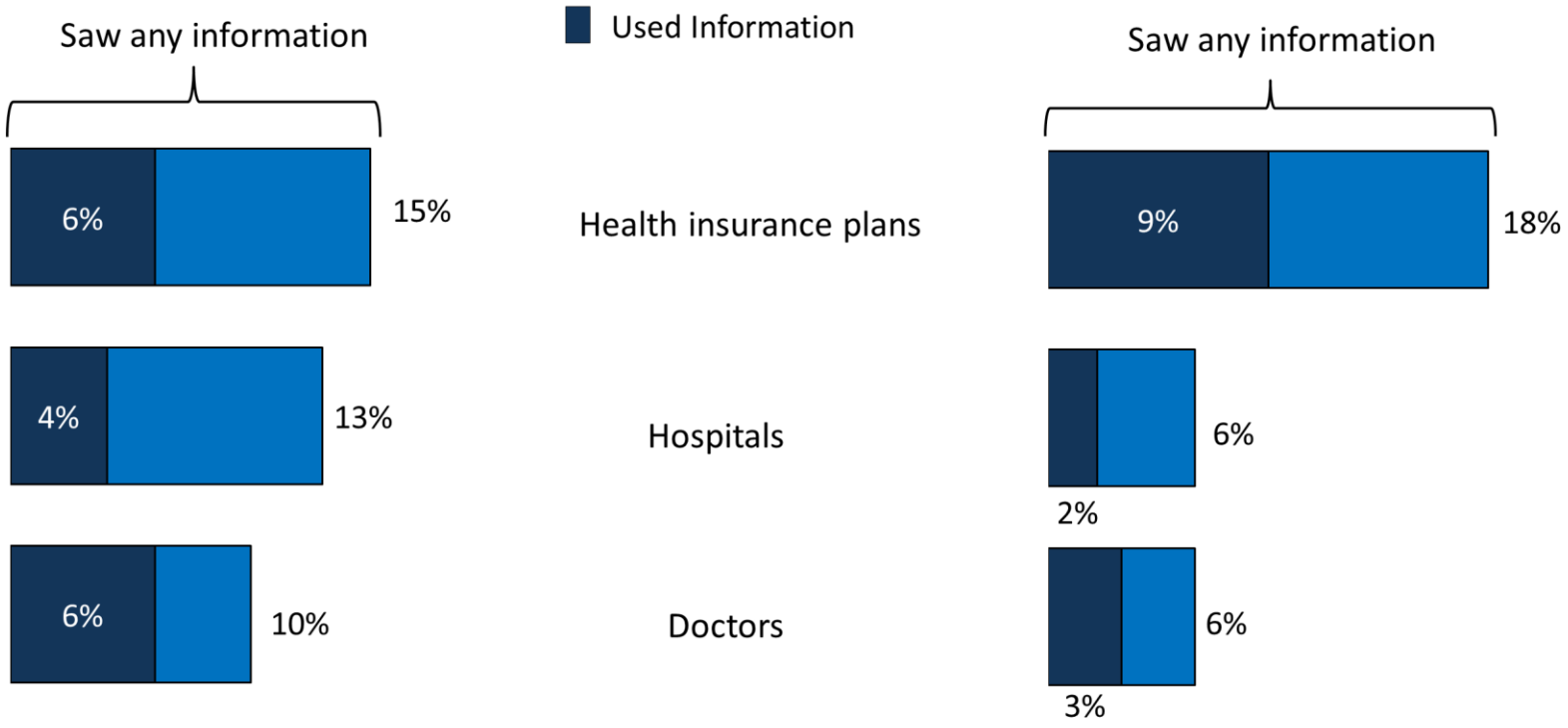
Few Say They Have Seen Or Used Information Comparing Quality Or Prices

Percent who say they saw or used ANY information comparing the…

…**QUALITY** among different doctors, hospitals and health insurance plans in the past 12 months.

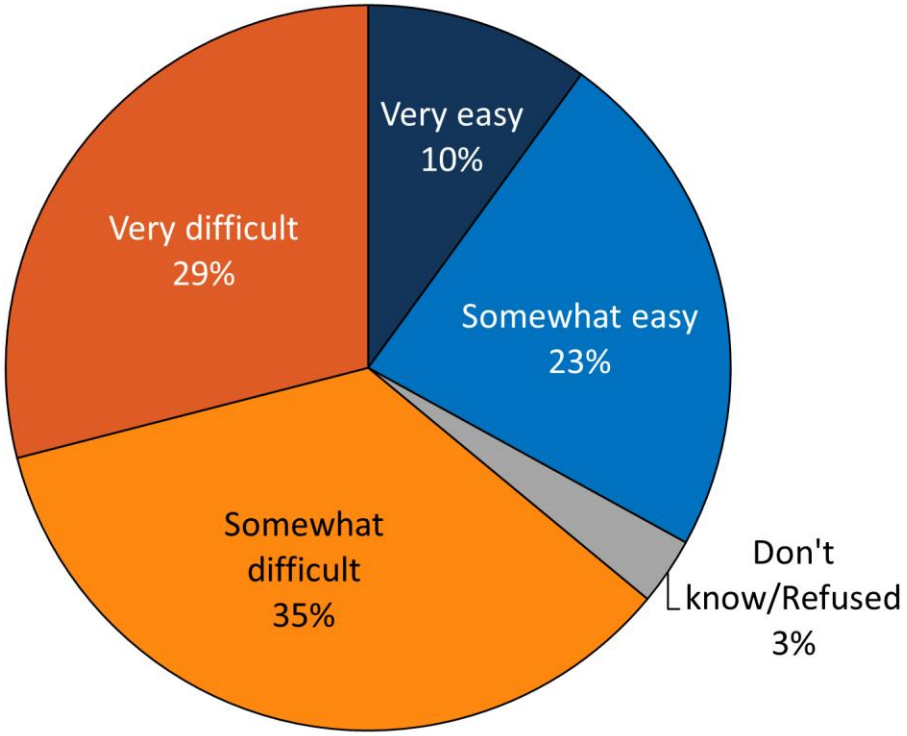
…**PRICES** among different doctors, hospitals and health insurance plans in the past 12 months.



NOTE: Question wording abbreviated. See topline for full question wording.
SOURCE: Kaiser Family Foundation Health Tracking Poll (conducted April 8-14, 2015)

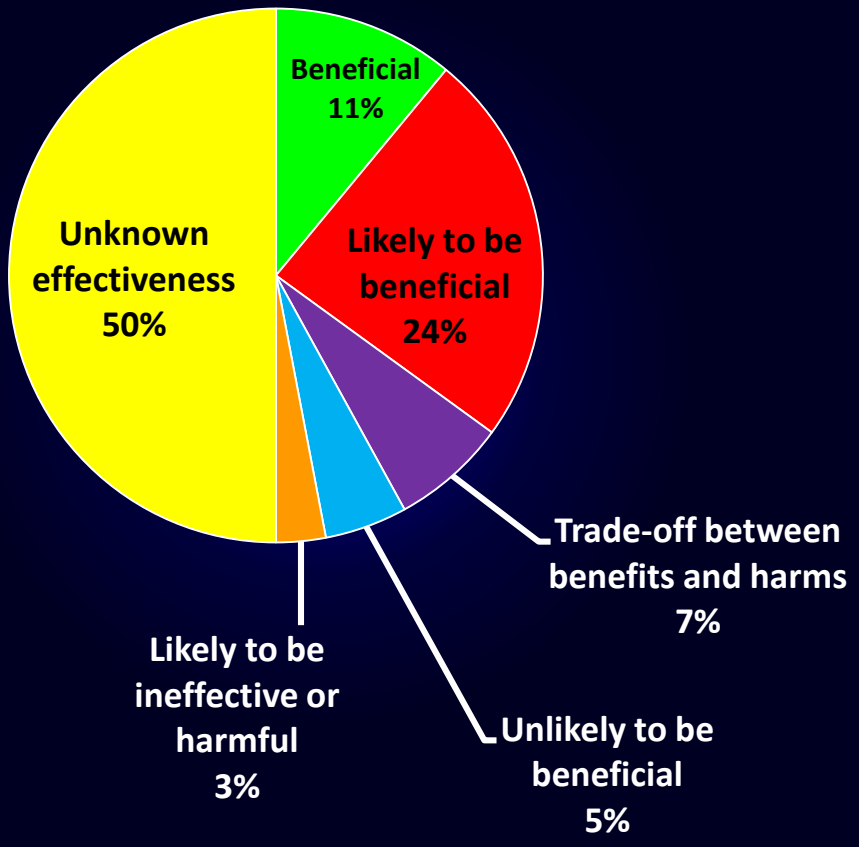
Nearly Two-Thirds Say It Is Difficult To Find Out What Medical Care Will Cost

In general, how easy or difficult would you say it is to find out how much medical treatments and procedures provided by different doctors or hospitals would cost you?



SOURCE: Kaiser Family Foundation Health Tracking Poll (conducted April 8-14, 2015)

Effectiveness of 3000 Treatments Reported in Randomized Clinical Trials



Source: *Clinical Evidence, BMJ*

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Information asymmetry leading to "dead-weight loss"

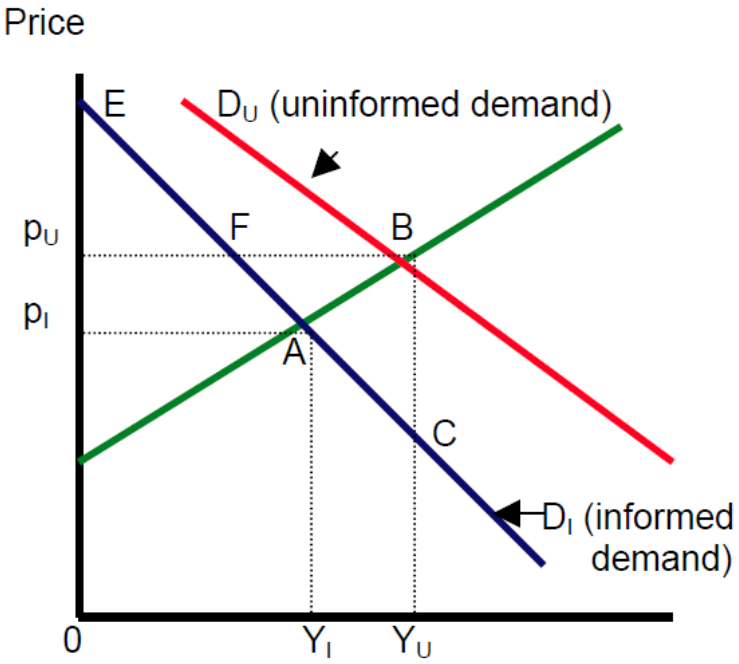

Figure 10:
Market Failure From Information Asymmetry

Source: Weimer and Vining (1999), p. 108

IOM Estimates of Wasteful Spending in Health Care (2009)

- Unnecessary services - $210 billion
- Excess administrative cost - $190 billion
- Inefficiently delivered services - $130 billion
- Prices that are too high - $105 billion
- Fraud - $75 billion
- Missed prevention opportunities - $55 billion

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Unnecessary services and prices that are too high

High Prices
$105 B

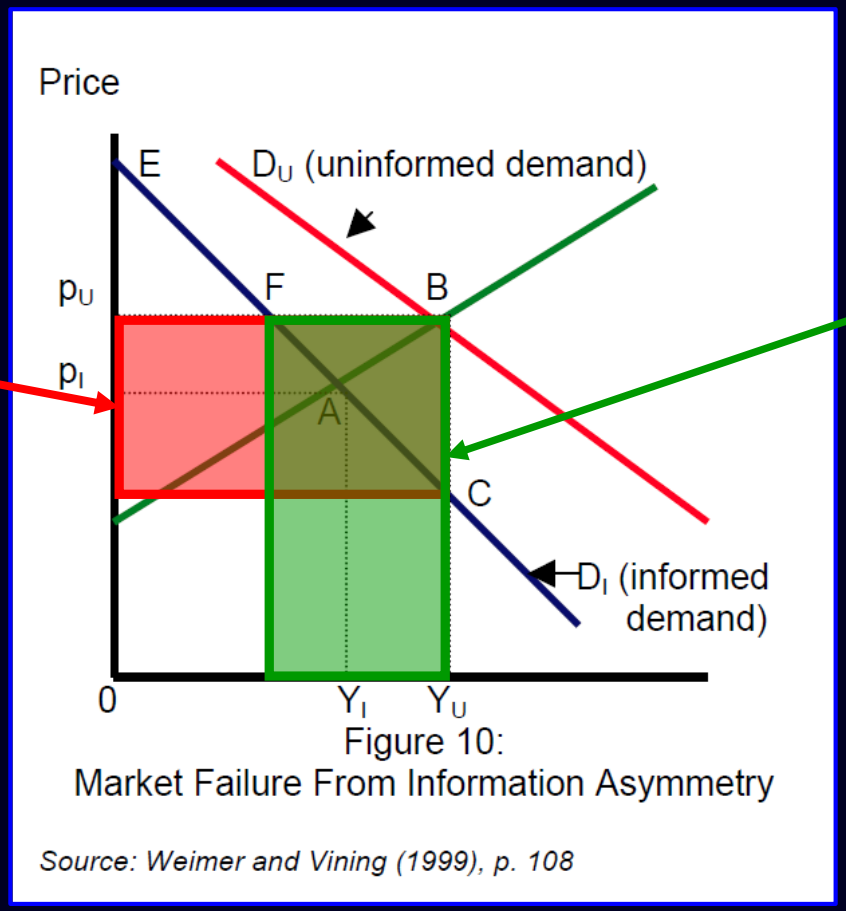
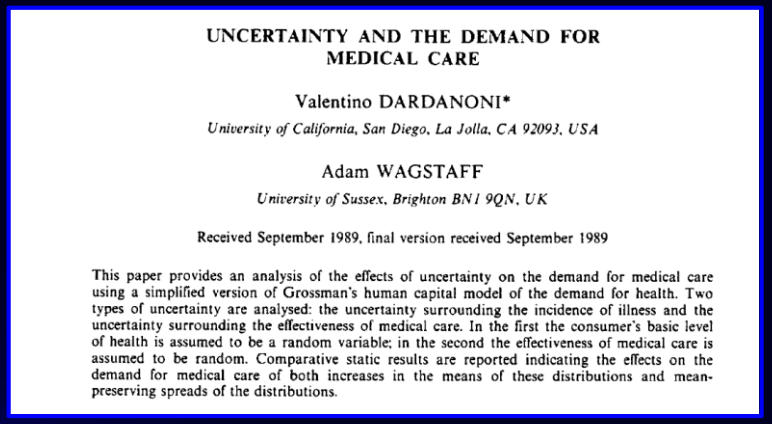


Figure 10:
Market Failure From Information Asymmetry

Source: Weimer and Vining (1999), p. 108

Unnecessary Services
$210 B

What happens to the demand for medical care when the amount of uncertainty changes?



UNCERTAINTY AND THE DEMAND FOR MEDICAL CARE

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Adam WAGSTAFF
University of Sussex, Brighton BN1 9QN, UK

Received September 1989, final version received September 1989

This paper provides an analysis of the effects of uncertainty on the demand for medical care using a simplified version of Grossman's human capital model of the demand for health. Two types of uncertainty are analysed: the uncertainty surrounding the incidence of illness and the uncertainty surrounding the effectiveness of medical care. In the first the consumer's basic level of health is assumed to be a random variable; in the second the effectiveness of medical care is assumed to be random. Comparative static results are reported indicating the effects on the demand for medical care of both increases in the means of these distributions and mean-preserving spreads of the distributions.

- An increase in the uncertainty of disease results in an increase in the demand for medical care.
- An increase in the expected effectiveness of care is found to reduce the demand for care.

Dardanoni V, Wagstaff A: Uncertainty and the demand for medical care. Journal of Health Economics (9) pp. 23-28, 1990.

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Health care is not Velveeta®

Health care cannot be modeled as a single, homogeneous good or service. Healthcare is an interrelated, complex system made up of markets for many different types of goods and services.

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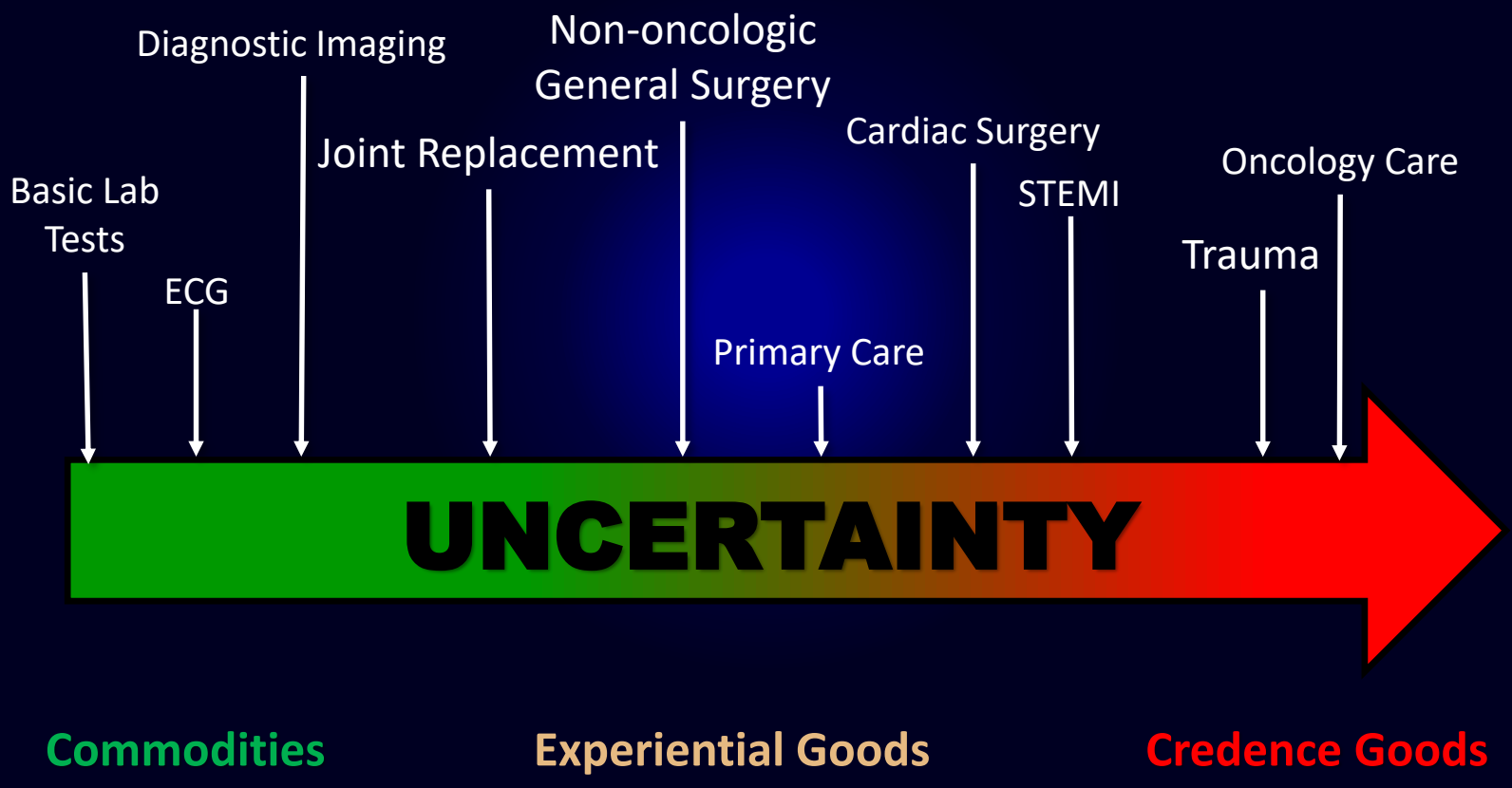
Four types of goods and services

- **Commodity** – an undifferentiated good or service where all dimensions of quality are completely understood by both buyer and seller, and discrimination is on the basis of *price alone*
- **Search Good** – a good or service whose quality is easily observable to the buyer prior to purchase
- **Experiential Good** – a good or service whose value can only be determined by use
- **Credence Good** - a good with qualities that cannot be observed by the consumer after purchase, making it difficult to assess its utility.

Factors contributing to the uncertainty of treatment

- Risk of outcome (mortality, significant morbidity, permanent disability)
- Effectiveness of treatment
- Urgency for treatment
- Presence of alternative treatments
- Time interval between treatment and outcome

Continuum of Medical Services



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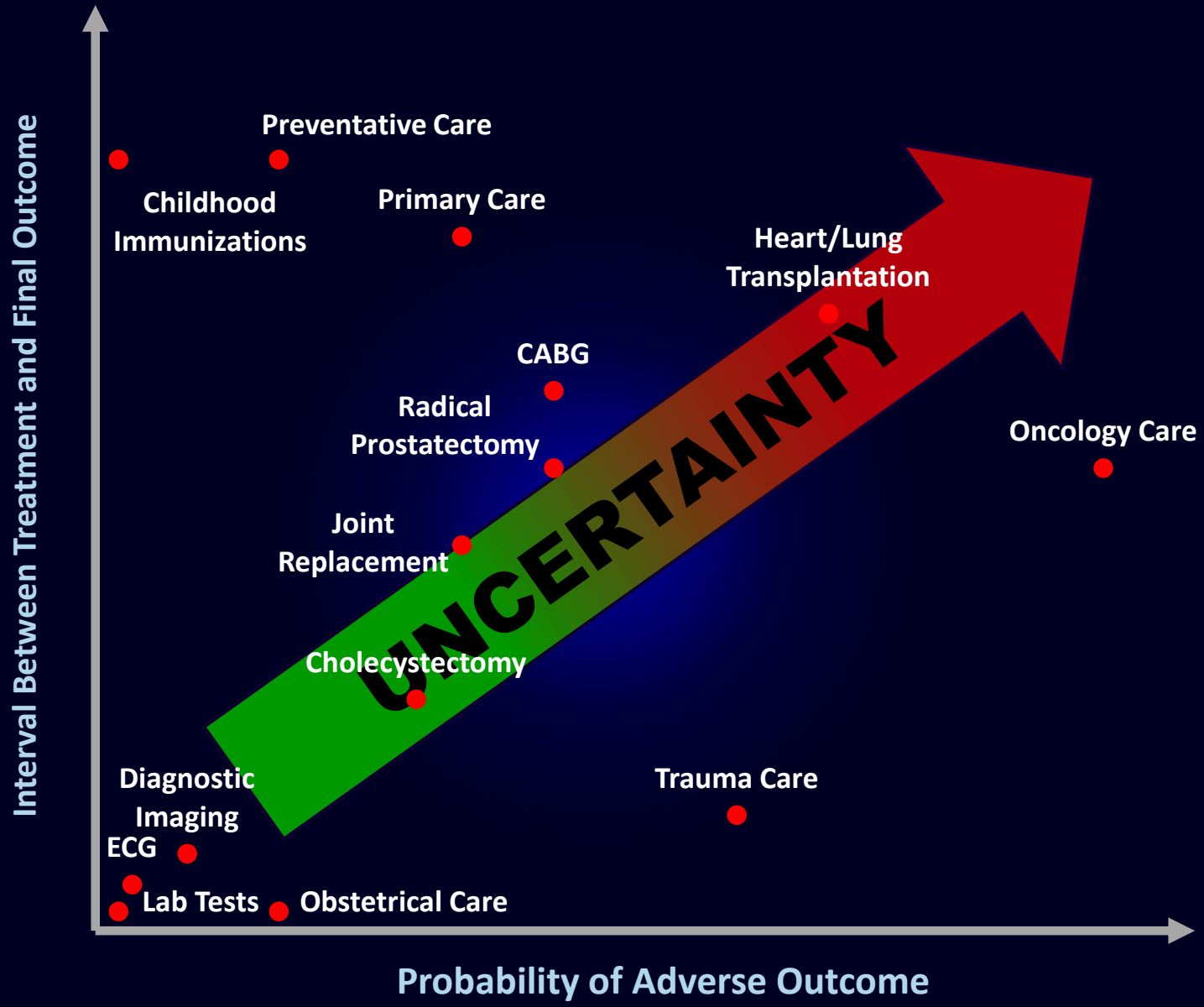

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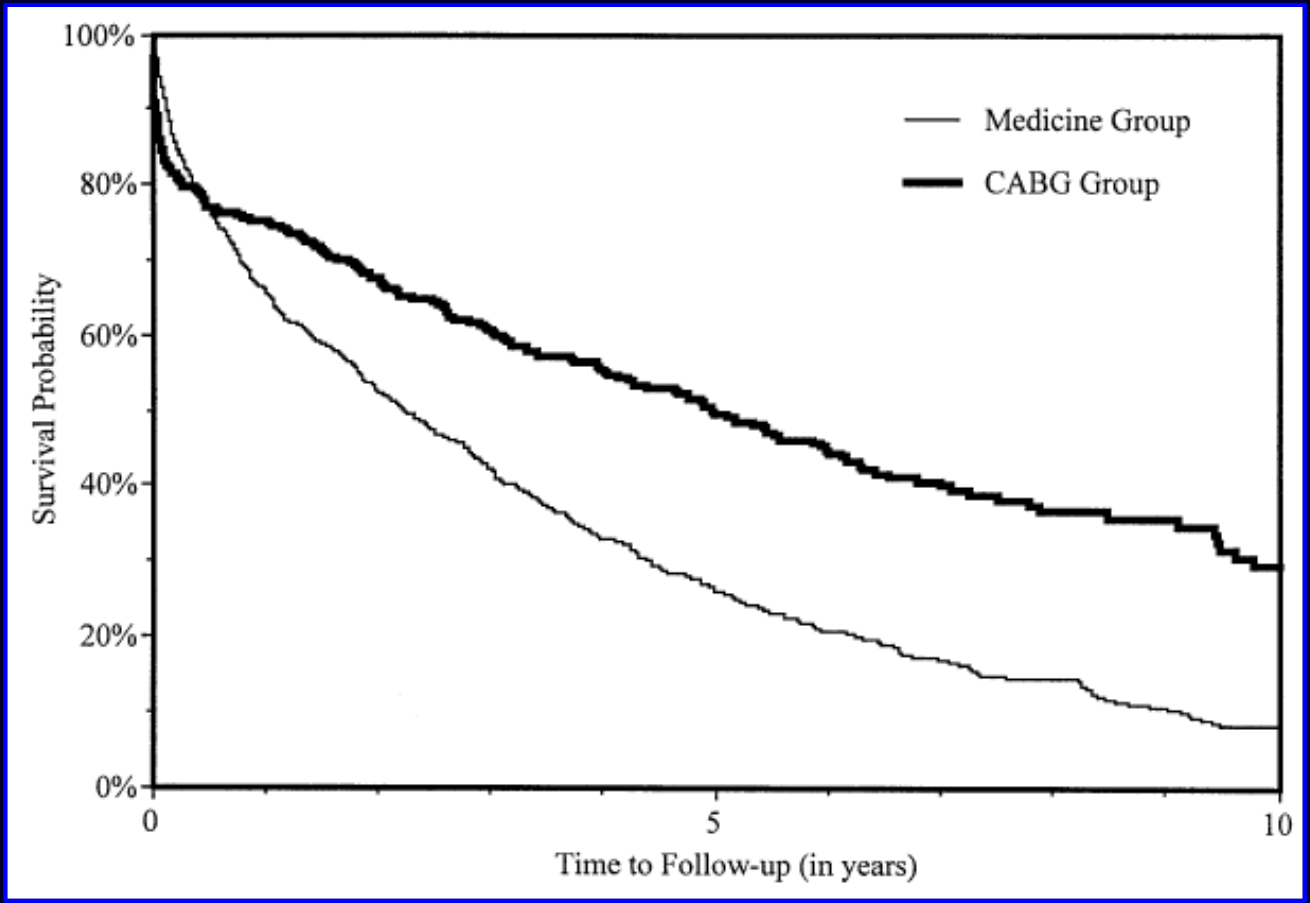
Event-free survival
CABG vs. medical therapy



O'Connor CM, Velazquez EJ et al: Ischemic Cardiomyopathy (A 25-year experience from the Duke cardiovascular disease databank). Am J Cardiol 2002;90:101–107.

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Outcomes-based provider payments

- Similar to the concept of bonds; provider treats the patient and receives a series of payments over time proportional to the health of the patient that has been restored.

Outcomes-based provider payments

- Treatment of illness results in restoration of health to or near to the expected state
- At any point in time, the state of health can be objectively assessed (observed state) and compared to the state had the illness never occurred (normal state) and had it never been treated (untreated state). These can be conceived of as “health flows” that result from the treatment, analogous to cash flows.

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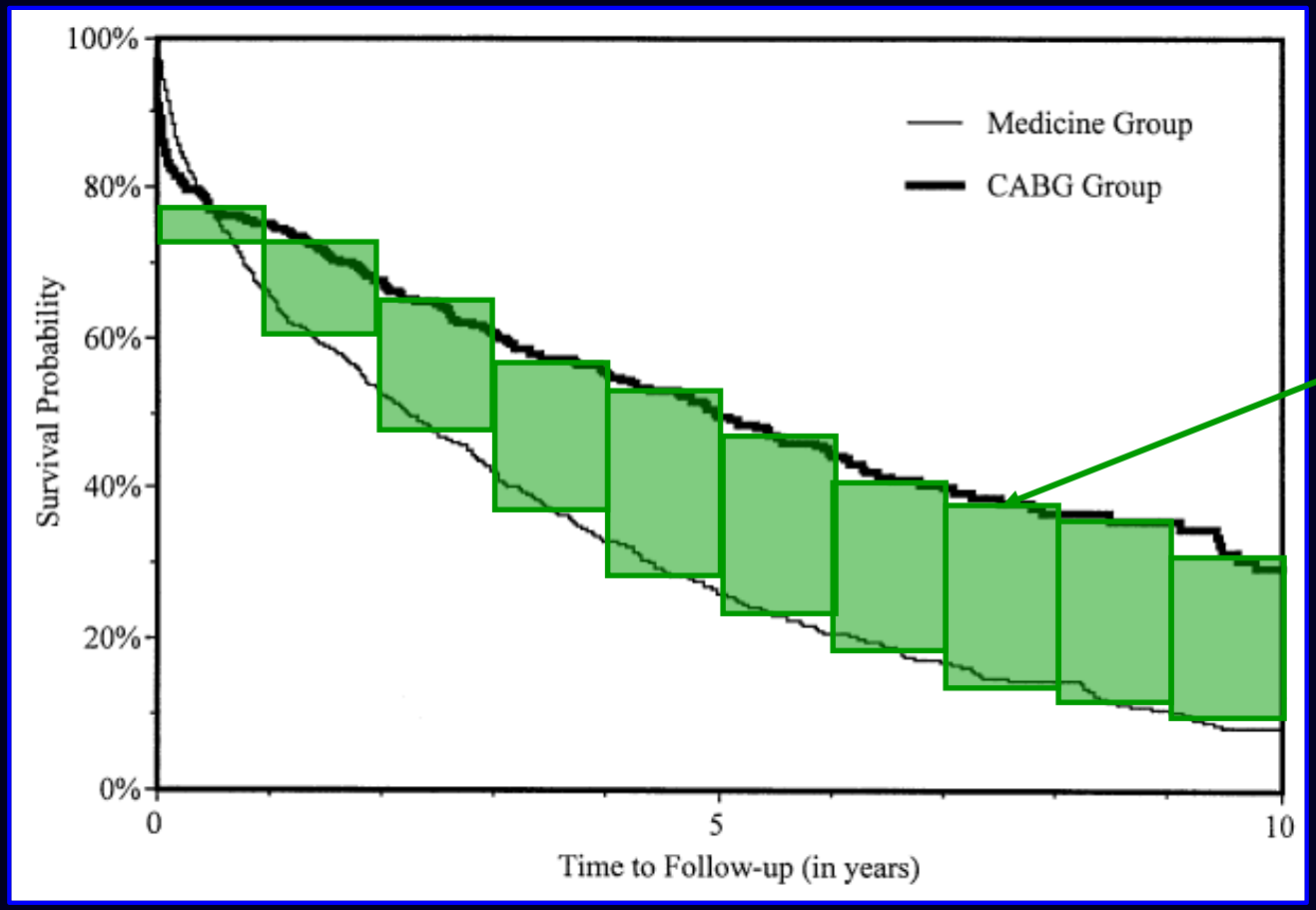
Event-free survival
CABG vs. medical therapy



O'Connor CM, Velazquez EJ et al: Ischemic Cardiomyopathy (A 25-year experience from the Duke cardiovascular disease databank). Am J Cardiol 2002;90:101–107.

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Outcomes-based provider payments

- At regular intervals, if the observed state of health exceeds the untreated state, the provider receives a payment proportional to the amount of the normal state of health the patient achieves.
- If the patient's health falls below the untreated state, payments stop.
- By definition, payments for sicker patients are higher (the difference between the normal state and the untreated state is greater).

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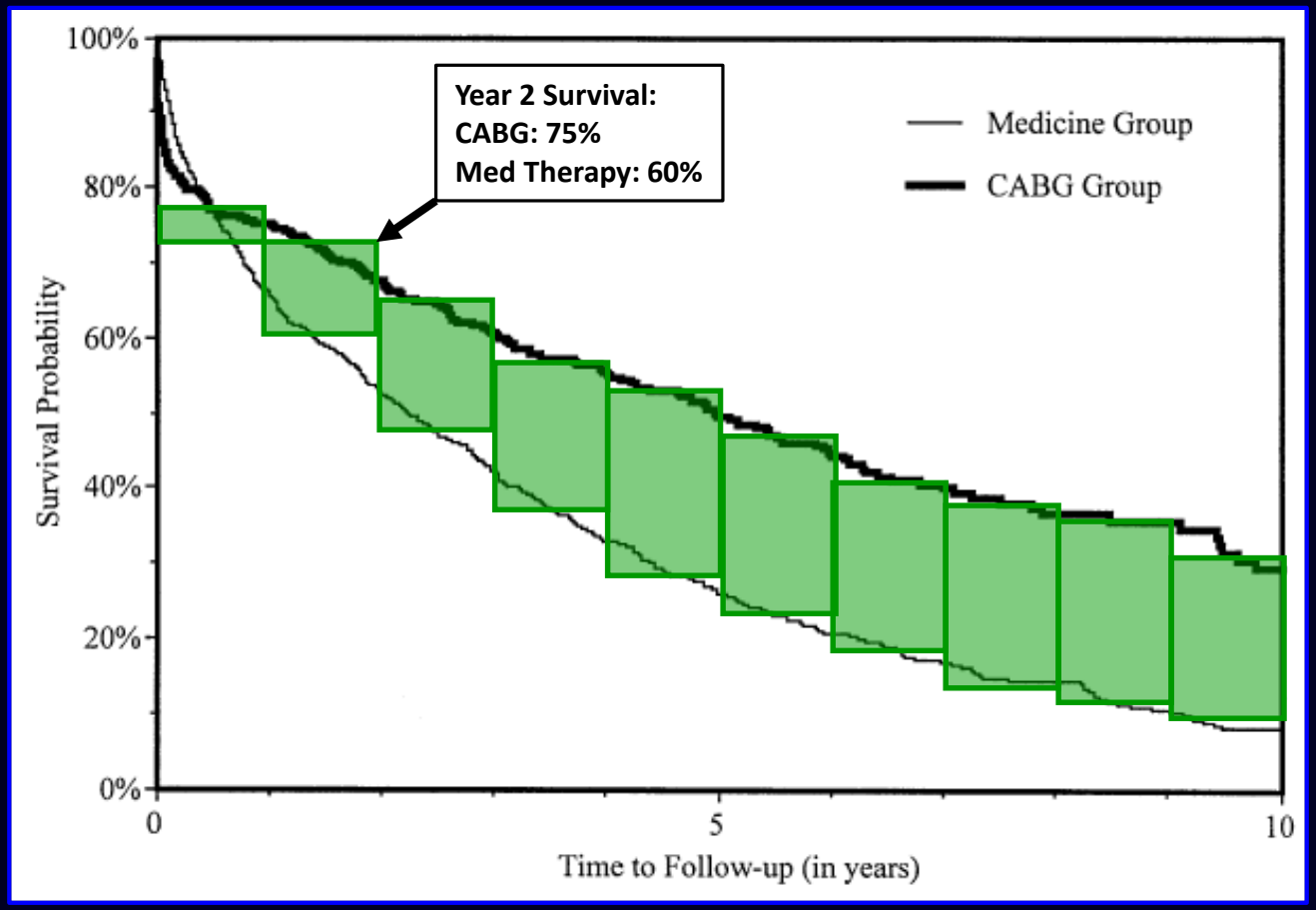
Event-free survival
CABG vs. medical therapy



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Calculating outcomes-based provider payments

Value of QUALY	$50,000
Incremental benefit of CABG in Year 2	15%
Discount Factor	5%
Payment in Year 2	$7875

Outcomes-based provider payments

- The rights to future payments can be sold to third parties by the provider and resold by those parties.
- This secondary market allows providers with better results and reputation to receive higher compensation for their services.
- Investors and insurance carriers could be purchasers of these provider revenue streams.
- ***A Secondary market can create efficiencies that a primary market for medical care cannot.***

Summary

- In the fifty years since Arrow wrote “Uncertainty,” the uncertainty he described, related to the incidence of disease and efficacy of treatment, has not been reduced enough to move the market for medical care towards a competitive or efficient state.
- Information asymmetry continues to drive prices and consumption to levels higher than would result from an ideal competitive market.
- The constraints imposed by the current structure of health insurance prevent consumers from responding to the true price of medical care.

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