
Appendixes

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NOTE: The original versions of the analysis of the growth and composition of the CEA/CBA literature, the bibliography, and many of the abstracts were prepared for OTA by Kenneth Warner and Rebecca Hutton.

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Appendix A.—Analysis of the Growth and Composition of the Health Care CEA/CBA Literature

As measured by contributions to the professional literature, interest in health care applications of CEA and CBA has grown dramatically over the past decade. This appendix analyzes the extent and nature of the growth in this literature and examines its substantive content. An assessment of the quality of contributions to the literature was presented in chapter 3.

The method of the analysis of the growth and composition of the health care CEA/CBA literature that appears in this appendix is described in the first section below. The second section offers an empirical characterization of the magnitude and nature of the literature, examining the diffusion over time of health care CEA/CBA interest in several dimensions: numbers of publications; the mix of medical and non-medical publication vehicles; relative preferences for CEA and CBA; medical functions emphasized; physical nature of subjects of study; and the decision orientation of analyses. Specific substantive topics and areas of interest which have dominated the attention of authors were analyzed in chapter 1. The material covered by that review accounts for roughly half of all the entries in the bibliography in appendix B. That section of chapter 1, therefore, should be regarded as part of this analysis.

Method

The empirical analysis in this appendix derives from counts and classifications of over 500 of the references in the bibliography of CEA and CBA in health care (app. B). With a few exceptions, the bibliography consists of references from the years 1966 through 1978, including CBAs and CEAs concerning personal health services, reviews and comments on such literature, and discussions of CEA/CBA methodology directed specifically to health care professionals. Appendix B includes a description of the bibliography's contents, rules for inclusion or exclusion of references, and the literature search process.

Each reference from the years 1966 through 1978 was classified according to the following dimensions:

1. year (1966 -78);
2. type of analysis (CBA, CEA, general or unknown);
3. publication vehicle (medical journal; journal intended primarily for nonphysician health professionals, administrators, or health services researchers; nonhealth);
4. medical function of the program or technology (prevention; diagnosis; treatment, divided into cure, rehabilitation, maintenance, or pallia-

tion; administration; some or all of the above or unknown);

5. physical nature of the program or technology (technique, drug, procedure, equipment, personnel, system, some or all of the above or unknown);
6. decision orientation (i. e., whose decision? individual, organization, society, unknown); and
7. subject matter (a specific program or technology, review article, methodology, combinations of these).

Classification involved numerous arbitrary judgments. Many of the assignments depended on the content of abstracts or even the wording of titles. Where available information suggested that each of two (and very occasionally three) categories was appropriate, half (or a third) credit was assigned to each. For example, in the "medical function" dimension, certain screening programs were recorded as half prevention and half diagnosis. (A comprehensive blood pressure control program was counted as one-third for each of prevention, diagnosis, and treatment.) For "type of analysis," a few studies presented both cost-benefit and cost-effectiveness estimates. Accordingly, these were scored as one-half CBA and one-half CEA. The "unknown" or "other" categories were used liberally when it was difficult or impossible to categorize references accurately.

Although the possibility remains that many of the assigning were not optimal, OTA is unaware of any significant sources of bias. Thus, at a minimum the quantitative analysis should provide an accurate qualitative characterization of the size, nature, and contents of the literature.

Growth and Character of the Literature

Diffusion

The magnitude and rate of growth of the health care CEA/CBA literature are indicated in table A-1 and figure A-1. Table A-1 records the annual numbers of CEAs, CBAs, and related publications for the years 1966 through 1978. The annual sum of identifiable CEAs and CBAs (column 3) is plotted in figure A-1, as is the total of all CEA/CBA-relevant references (column 5).

As the data vividly demonstrate, widespread interest in health care CEA/CBA is a phenomenon of the 1970's. Prior to 1970, the annual number of health care CEA/CBAs and related publications never exceeded 16; after 1970, the number was never less than

Table A-1.—Numbers of Health Care CEA/CBAs by Year (1966-78)

Year	CBAs ^a (1)	CEAs ^b (2)	CBAs + CEAs (3) = (1) + (2)	Other ^c (4)	Total (5) = (3) + (4)
1966	4.5	0.5	5	0	5
1967	4.0	1.0	5	0	5
1968	6.5	4.5	11	4	15
1969	2.5	1.5	4	2	6
1970	3.0	9.0	12	4	16
1971	9.5	10.5	20	5	25
1972	14.5	5.5	20	7	27
1973	25.5	16.5	42	2	44
1974 ^d	19.0	17.5	36.5	7	43.5
1975 ^d	17.0	21.5	38.5	13	51.5
1976	40.5	36.5	77	15	92
1977	31.5	47.5	79	23	102
1978	33.0	38.0	71	22	93
Total	211.0	210.0	421	104	525.0

^aAll All papers identified as CBAs in title or otherwise known. O 5 indicates half CEA and half CBA

^bAll papers identified as CEAs in title or otherwise known O 5 indicates half CEA and half CBA

^cAll other papers, including those the title of which does not state CEA or CBA, also general methodology Papers, etc

^dFractional entries for 1974 and 1975 reflect the inclusion of one article that appeared in a journal with publication date December 1974/January 1975

SOURCE Off Ice of Technology Assessment

25. The two curves in figure A-I exhibit the characteristics of the classic diffusion process (759), with “take-off” occurring around 1970 and diffusion proceeding at an almost exponential rate throughout the decade. The nature of the data is such that it is impossible to tell whether the curves have reached an “inflection point,” a point beyond which growth in the literature will proceed at a progressively slower rate.

The proliferation of professional journals might be expected to result in increased numbers of publications on many subjects, without representing a genuine increase in relative interest in the subject. To provide perspective, one can compare the growth in the health care CEA/CBA literature with that of the overall number of citations in *Index Medicus*. Over the entire period studied (through 1977, since 1978 was not yet completed when the data were acquired) *Index Medicus* citations increased from 157,000 to 260,000 articles, a growth of two-thirds (66 percent). By comparison, the CEA/CBA literature grew by a factor of from 14 to 20 (using column 3) and column 5 data from table A-1, respectively). Even in very recent years, growth in the latter considerably outpaces that of the overall medical literature. For example, from 1975 to 1977, the number of contributions to the CEA/CBA literature doubled, while *Index Medicus* citations rose less than 10 percent. Clearly, the

¹The count of papers revealed slightly fewer for 1978 than for 1977, and growth in the number of papers in 1977 was relatively little compared to that in 1976. An inflection point may have been reached. Barring any changes in the environment, continued diffusion may be gradual. As observed immediately below, however, the environment is changing in significant ways which may very well accelerate diffusion.

rate of growth of the health care CEA/CBA literature vastly exceeds that of the medical literature in general.

The usual “mechanics” of a diffusion process suggest continued growth in the number of publications, but this general tendency should be reinforced in the early 1980’s by several influences in the health care environment: Establishment of the National Center for Health Care Technology, with its authority to assess the safety, efficacy, and cost implications of medical technologies should foster analytical activity; publicity associated with other governmental efforts should increase awareness and interest; a similar effect can be anticipated to follow activities within the medical profession, such as the AMA’s Resident Physicians Section’s recent publication of its report on cost-effective care; growth in attention to health economics issues in medical school curricula should promote interest and understanding among young physicians; and most generally, but probably most importantly, continued concern about the high and growing costs of care should itself generate numerous attempts to assess the cost effectiveness of medical technologies (703).

Publication Vehicles

Table A-2 shows the distribution by year of the health care CEA/CBA literature by type of publication. The purpose is to examine what proportion of the literature has been intended primarily for a physician audience, as reflected in publication in medical journals, and how this proportion has changed over time.

Figure A-1.— Diffusion of Health Care CEA/CBAs by Year (1966-77)

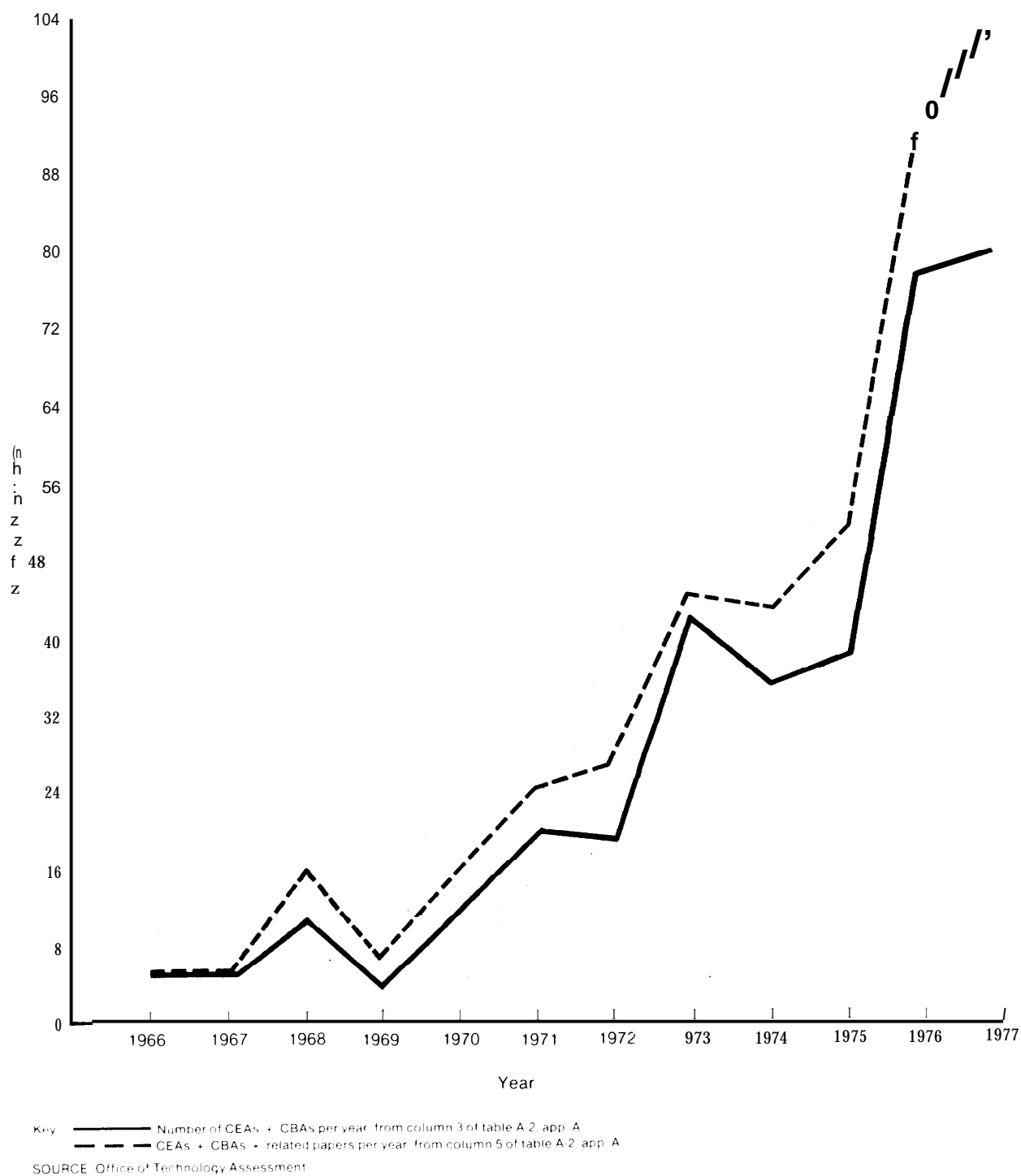


Table A-2.—Numbers of Health Care CEA/CBAs by Type of Journal and Year (1966-78)

Year	Number of CEA/CBAs by type of journal				Total (5) = (1) + (3) + (4)
	Medical journals ^a	NEJM ^b	Nonmedical journals ^c	Other ^d	
	(1)	(2)	(3)	(4)	
1966	0	0	1	4	5
1967	0	0	1	4	5
1968	4	2	6	5	15
1969	2	1	2	2	6
1970	4	1	6	6	16
1971	10	0	7	8	25
1972	6	0	15	6	27
1973	11	1	19	14	44
1974 ^e	23	1	7.5	13	43.5
1975 ^e	20	7	15.5	16	51.5
1976	44	5	30	18	92
1977	44	5	27	31	102
1978	42	8	25	26	93
Total	211.0	31	162.0	153	525.0

^aJournals read primarily by Physicians. Excludes nursing, dental, public health, hospital Journals, etc. Includes psychiatric journals.

^b*New England Journal of Medicine*

^cAll other journals. Includes non-physician-oriented health journals, economics journals, policy analysis journals, etc.

^dBooks, chapters in books, unpublished papers, etc.

^eFractional entries for 1974 and 1975 reflect the inclusion of one article that appeared in a journal with publication date December 1974/January 1975.

SOURCE: Office of Technology Assessment.

Figure A-2 plots columns 1 and 3 of table A-2 to illustrate the diffusion paths of medical and nonmedical journal articles. Although the paths follow each other closely, the graph shows a shift from a rough parity prior to 1973 to a clear majority of medical journal articles after 1973. In other words, the rate of growth of the medical literature has exceeded that of the nonmedical journal literature, particularly in recent years. This shift is clearly suggestive of a growing economic consciousness in the medical profession.

Column 2 in table A-2 records the annual number of CEA/CBA articles in the *New England journal of Medicine (NEJM)*. Several of the best, most influential health care CEA/CBAs have been published in *NEJM* (see ch. 3), hence its isolation here. It is interesting to observe that prior to 1975, the number of CEA/CBA-relevant contributions in *NEJM* exceeded one only once (in 1968). *NEJM* has published several relevant articles each year since 1975. Some observers believe that medical interest in CEA/CBA received its biggest boost from publication of the controversial July 31, 1975, issue of *NEJM* which was devoted to CEA/CBA studies and discussions of their methodology and usefulness. (See the methodology review article section of ch. 3.)

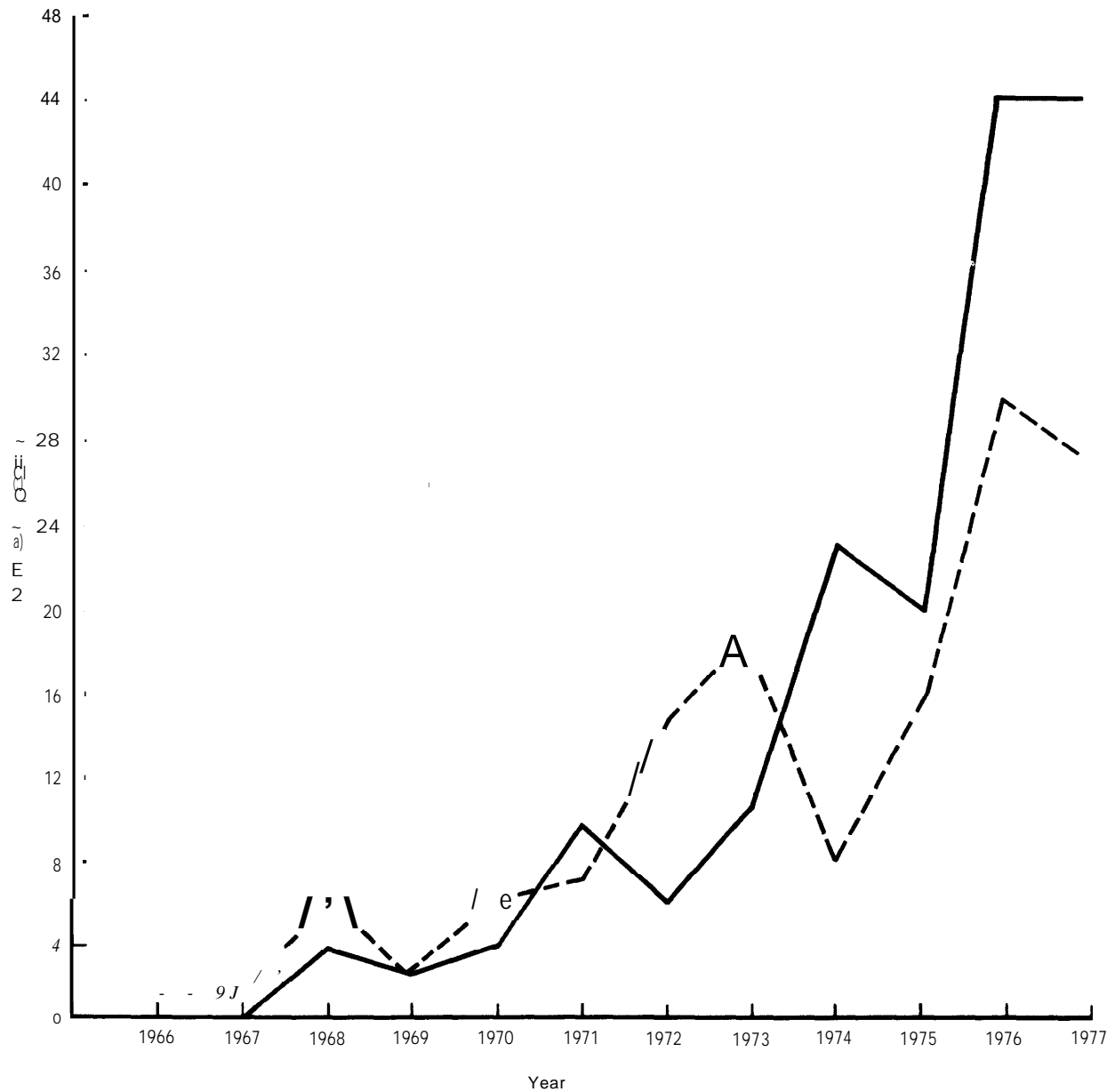
Mix of CEAs and CBAs

Columns 1 and 2 of table A-1 distinguish analyses identified as CBAs from those identified as CEAs.

Prior to the most recent years, the annual number of CBAs generally exceeded the number of CEAs. Since 1975, the reverse has been true, supporting the statement in a recent review by Weinstein that CEA "has been gaining in acceptance relative to benefit-cost" (569). The reason is not obvious. Weinstein attributes the shift to "the conceptual limitations of the (human capital) approach and the empirical barriers to the willingness-to-pay approach." Complementary or alternative explanations relate to the apparent relative conceptual simplicity of CEA: Analysts use CEA because it is easier for the economic layperson—e.g., the physician—to understand; also, the recent relative growth in the literature in medical journals appears to include relatively more contributions by physicians, who, as economic laypersons, may find CEA easier to perform than CBA.² Economists' traditional preference (at least in nonhealth care areas) for CBA may reflect a general conceptual bent toward valuing and directly comparing the positive and negative consequences of activities. It also probably reflects the successful use of CBA in early applications in which benefits were reasonably amenable to monetary valuation (e.g., water resource management).

²The observation that physicians are making relatively more contributions to the literature in recent years is based on an impression. No attempt was made to formally categorize authors by degree or profession.

Figure A-2.—Diffusion of CEA/CBAs in Medical and Nonmedical Health Care Journals by Year (1966-77)



Key: — CEAs and CBAs in medical journals per year (from column 1 table A-3 app A)
 - - - CEAs and CBAs in nonmedical health care journals per year (from column 3 table A-3 app A)

SOURCE: Office of Technology Assessment

Medical Functions

Tables A-3 and A-4 present categorizations of literature contributions by the general medical function which is the substantive focus of each paper. Table A-3 includes three broad categories (prevention, diagnosis, and treatment, plus a fourth miscellaneous category). Table A-4 breaks down treatment functions by their purpose: cure, rehabilitation, maintenance, or palliation.

Among the three broad categories, prevention and diagnosis each account for more than a quarter of the studies over the entire period, while the various types

of treatment total just under half.³ If one divides the years covered into the period preceding 1974 and the period from 1974 through 1978, however, there is a significant shift in the relative mix, away from prevention and toward diagnosis and treatment. During the most recent 5 years, the numbers of both diagnosis- and treatment-oriented papers have exceeded the pre-1974 totals by a factor of four or five. By con-

³In this recent review, Weinstein (569) observed: "Diagnostic procedures, apart from screening tests, have received little attention. This OTA analysis' attribution of nearly a quarter of the codable literature to diagnosis is not necessarily at variance with this observation, since it includes many screening programs in the diagnosis category."

Table A-3.—Numbers of Health Care CEA/CBAs by Medical Function and Year (1966-78)

Year	Number of CEA/CBAs by medical function			
	Prevention (1)	Diagnosis (2)	Treatment (3)	Other ^a (4)
1966	0.0	0.0	0.0	5
1967	0.0	0.3	1.7	3
1968	2.5	3.0	3.5	6
1969	1.5	0.5	2.0	2
1970	3.0	2.0	3.0	8
1971	6.5	3.5	4.0	11
1972	7.0	2.0	4.0	14
1973	14.5	4.0	10.5	15
1974	2.5	5.0	14.0	22
1975	5.0	10.0	14.5	22
1976	15.0	16.0	28.0	33
1977	12.5	17.0	37.5	35
1978	18.0	25.5	18.5	31
Total	88.0	88.8	141.2	207

^aIncludes mixes of all three functions (prevention, diagnosis, and treatment), administration, general, and unknown

SOURCE: Office of Technology Assessment

Table A-4.—Numbers of Health Care CEA/CBAs by Treatment Function and Year (1966-78)

Year	Number of CEA/CBAs by treatment function				Total (5) = (1) + (2) + (3) + (4)
	Cure (1)	Rehabilitation (2)	Maintenance (3)	Palliation (4)	
1966	0.0	0.0	0.0	0	0.0
1967	1.3	0.3	0.0	0	1.7
1968	1.0	1.0	1.5	0	3.5
1969	1.5	0.0	0.5	0	2.0
1970	0.5	1.0	1.5	0	3.0
1971	2.0	1.0	1.0	0	4.0
1972	2.5		0.0	0	4.0
1973	4.5	3.5	2.5	0	10.5
1974	5.0	7.5	1.5	0	14.0
1975	6.5	3.0	5.0	0	14.5
1976	10.5	6.5	11.0	0	28.0
1977	25.0	4.5	8.0	0	37.5
1978	8.5	4.0	6.0	0	18.5
Total	68.8	33.8	38.5	0	141.2

SOURCE: Office of Technology Assessment

trast, the number of prevention-oriented contributions is only 50 percent greater than that of the earlier period (see table A-3).

This shift seems consistent with the relative growth in the medical journal share of the literature, assuming that physicians are relatively more interested in diagnosis and treatment, as opposed to prevention, than are nonphysician health professionals (including both providers and health services researchers). Also, consistent with the principal early nonhealth care applications of CEA/CBA, early health care CEA/CBAs concentrated relatively more on health care “public goods,” including especially communicable disease control, than on individual patient care, a growing concern today. Several excellent communicable disease prevention studies are found in the recent medical literature, but this is one of the few substantive areas in which the number of pre-1974 papers actually exceeded the number of 1974 through 1978. (See ch. 1.)

The shift away from prevention may not be permanent. The widespread perception that “technology” is a major villain in medical cost inflation, combined with the general medical orientation toward diagnosis and treatment, has contributed to growing interest in diagnostic and treatment technology, both in the CEA/CBA literature and in individual physician decisionmaking concerning the use of such technology. These interests will likely be sustained in the near future. However, the Federal Government’s recent emphasis on prevention (743), increasing public acceptance of the ideas of disease prevention and health promotion, and the conscious linking of prevention to cost containment (e. g., 564) may promote renewed interest in prevention-oriented CEA/CBA.

Table A-4 shows that half of all treatment-oriented papers are concerned with curative treatments, and the remaining half are divided roughly equally between medical rehabilitation and maintenance. Reflecting the inherent subjectivity and difficulty of quantifying “pain relief,” “comfort,” etc., the literature included not a single contribution that could be identified as dealing with palliation. The relative mix of treatment functions has not changed significantly in recent years. Of note is the unusually large number of cure-oriented papers in 1977.

Physical Nature of Subjects of Study

Is there a growing emphasis in health care CEA/CBA on individual technologies? OTA’s examination of the literature permits only an impressionistic answer. In attempting to categorize subjects by their physical nature, OTA was incapable of definitively assessing the vast majority as either technique, drug,

procedure, equipment, personnel, or system. Most seemed to represent a mix of two or more categories; consequently, they were included in the “miscellaneous” category.⁴ Even some which could be categorized were categorized with a feeling of discomfort. A study of the cost effectiveness of CT scanning appears on the surface to belong under “equipment” (where it was categorized), yet that same study emphasizes the important role of the new technicians needed to operate the scanner.

A principal impression is that the literature covers a broad spectrum of types of programs and technologies, with procedures being the best represented category. In recent years, there appears to have been distinct growth in the attention devoted to equipment-embodied technologies, with CT scanning leading the way with some 18 references since 1975. (See ch. 1.)

Decision Orientation

The original intent of CEA/CBA was to assist in social decisionmaking, i.e., to identify and value program costs and benefits from a societal perspective. Businesses and individuals have long employed the ideas behind CEA/CBA to grapple with decision problems, but the CEA/CBA label seems to be applied with increasing frequency to analyses whose decision-assisting perspective is narrower than that of “society.”

Table A-5 permits an exploration of the distribution of “decision orientation” in the health care CEA/CBA literature and of changes in the distribution over time. The table suggests that the social perspective has dominated the literature over the entire period studied, accounting for roughly 70 percent of all publications in both the early and most recent years; if anything, its dominance has grown slightly over time. Nevertheless, it is also true that articles oriented toward individual (e. g., practitioner) decisionmaking have increased most rapidly in recent years. Comparing the pre-1974 period with the years 1974 through 1978, one observes a near doubling of the share of papers oriented toward the individual perspective. This growth has come at the expense of papers with an organizational orientation. While the latter two categories together account for fewer than 30 percent of the literature contributions, the shift may be significant.

⁴In no year did OTA manage to categorize more than 40 percent of the references as other than miscellaneous, and about 20 percent was typical. A table of the counts is not presented, because the mix in the specific categories, based on so few observations, is not necessarily representative.

Table A-5.—Numbers of Health Care CEA/CBAs by Decision Orientation and Year (1966-78)

Year	Number of CEA/CBAs by decision orientation			
	Individual (1)	Organization (2)	Society (3)	Unknown (4)
1966.....	0	0	3	2
1967	0	0	5	0
1968.....	0	4	9	2
1969.....	0	2	2	2
1970.....	1	3	7	5
1971.....	4	2	14	5
1972.....	2	5	12	8
1973.....	2	7	27	8
1974a.....	5.5	2	21	15
1975a.....	2.5	11	24	14
1976.....	12	4	49	27
1977.....	13	4	50	35
1978.....	8	7	50	28
Total	50	51	273	151

^aFractional **entries** for 1974 and 1975 reflect the inclusion of one article that appeared in a journal with publication date December 1974/January 1975

SOURCE: Office of Technology Assessment

Summary

Table A-6 summarizes highlights of this empirical description of the literature, Breaking the period into the “early” years (those prior to 1974) and “recent”

Table A-6.—Overview of Trends in Health Care CEA/CBA Literature (1966-73 and 1974-78)^a

	1966-73	1974-78
Average annual number of publications.	18	76
Publications in medical journals as percent of total journal publications.	39%	62%
CEAs as percent of CEAs + CBAs	41	53
Percent of articles on:		
Prevention	44	22
Diagnosis	19	31
Treatment	36	47
Percent of articles with orientation of:		
Individual	8	16
Organization	21	11
Society	71	74

^aAll differences significant at $p < 0.05$

SOURCE: Office of Technology Assessment

years (1974-78) represents an arbitrary decision based on observation of trends. Nevertheless, it is interesting to note that this dividing line (or one a year earlier) seemed appropriate for all of the phenomena of interest. No explanation is offered as to why this was the case.

As the table indicates, recent years have witnessed dramatic growth in the number of contributions to the health care CEA/CBA literature (item 1). More of this growth has occurred in medical than in nonmedical journals (item 2), and CEA is gaining favor relative to CBA (item 3). The early prominence of studies with a substantive prevention theme has diminished, while studies related to diagnosis and treatment have become more popular (item 4). Health care CEA/CBAs retain as their principal orientation a societal perspective on problems, though studies with an individual practitioner orientation are becoming increasingly common (item 5).