

A few basic economic facts about research in the medical and related life sciences

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As president of the Federation of American Societies for Experimental Biology, I have been asked to speak to councils of scientific societies, government officials, voluntary health organizations, lay audiences, and the press about matters of public policy, especially as they affect federal support for research in medicine and the related life sciences. One question I am asked frequently is whether I can provide references to source materials that summarize some of the economic data I cite in these talks. In response to these queries, Stephen Heinig and Howard Garrison of FASEB's Office of Policy Analysis and Research and I have prepared this article and the tables and bibliographic materials that accompany it.—SCS

THE U.S. GOVERNMENT IS THE SINGLE LARGEST supporter of biomedical research in the world. Since the end of the Second World War, this country has been extraordinarily committed to biomedical research and to the advancement of human health through basic research. As a consequence of this commitment and investment, the life span of the average American has increased from 65 to almost 76 years and the United States has become the undisputed world leader in pharmaceuticals and biotechnology.

In 1994 the United States spent about \$33 billion for biomedical and related health research and development. Approximately 56% of these funds were derived from the private sector (e.g., pharmaceutical, chemical, biotechnology companies, voluntary health agencies) and 44% from the public sector (1). A substantial fraction of the private sector's research investment is for the development and commercialization of new products. The federal government provides approximately 80% of the monies spent each year for fundamental biomedical research at universities, medical schools, and nonprofit research institutes. In 1995 this will be approximately \$13 billion. The remaining 20% of monies for basic biomedical research comes from university endowments, public contributions to universities, nonprofit research institutes, private foundations (e.g., the Howard Hughes Medical Institute), and voluntary health agencies (e.g., the American Cancer Society, the American Heart Association). The Howard Hughes Medical Institute, with assets of more than \$7 billion, is the single largest nongovernmental supporter of basic biomedical research. It spent more than \$300 million for biomedical research and educa-

tion in 1993. The American Cancer Society, the largest supporter of basic research among voluntary health agencies, spent approximately \$95 million for research in the same year.

Eighty-seven percent of all federal support for biomedical research is derived from monies allocated by Congress to the National Institutes of Health (NIH). The 1995 NIH budget is \$11.3 billion. About \$6.2 billion is allocated for grants to individual investigators at universities, medical schools, and nonprofit research institutes. This \$6.2 billion supports research on ideas proposed by individual scientists working outside the NIH. The typical Individual Investigator Initiated Research Project Grant, termed R01 in NIH parlance, provides about \$207,000 per year for both direct research costs incurred by the investigator (salaries, research supplies, small items of equipment, etc.) and indirect costs incurred by the investigator's university or institute in support of the research (e.g., light, heat, administrative services, safe disposal of chemical and radioactive wastes, assurance of ethical treatment of humans and animals in research, etc.). Investigator-initiated research grants support the most innovative ideas of the most creative American scientists. These grants are the engines of invention in the biomedical and behavioral sciences.

Historically, the fundamental discoveries made with the assistance of these investigator-initiated research grants have provided the intellectual seed capital for new methods to prevent, detect, and treat disease. Competition for these grants is intense. In 1993 NIH received 24,774 applications but was able to fund only 6,148 (about 25%) of them.

In 1995, NIH will spend about \$1.5 billion for specialized clinical research centers at academic institutions, clinical education programs, and other types of research infrastructure, and about \$0.4 billion to support pre- and postdoctoral training in biomedical sciences and to encourage the recruitment of under-represented minorities to research careers. In addition to the funds allocated for research and training outside the NIH, about \$1.3 billion will be spent in 1995 to support research at NIH itself,

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\$0.75 billion for R&D contracts, and about \$1.25 billion for research grants management, cancer control, the National Library of Medicine, and the Office of the Director.

The investment of the American people in NIH has produced spectacular advances that have led to the development of new, cost-effective therapies, drugs, and diagnostic methods. Examples of these cost savings, from a list of cost savings studies identified by FASEB, are presented in **Table 1** and **Table 2**. Some of these estimates include days of productive work gained and morbidity avoided. Total savings resulting from the research advances listed are more than \$69 billion annually. The discounted present value of this \$69 billion is \$1.1 trillion, calculated from a treasury note interest rate of 7%. Moreover, the knowledge, technology, and trained personnel that have resulted from NIH-sponsored research have spawned an entirely new industry, the biotechnology industry. An additional \$92 billion in sales is generated annually by just 10 biomedical discoveries that have been adopted by industry for purposes other than health services (see **Table 3**).

THE RESEARCH FUNDING SITUATION FROM THE PERSPECTIVE OF THE INDIVIDUAL RESEARCH SCIENTIST

A sense of crisis currently pervades the basic biomedical research community. This sense of crisis is felt by everyone, from senior professors to graduate students. It reflects the imbalance between the number of excellent grant applications submitted and the ability of federal agencies to fund them.

At the same time, the opportunities for progress in biomedical and related life science research have never been greater. But this research also has become more technologically sophisticated and more expensive, and generous as they have been, federal appropriations for life science research and development have not kept pace with either the opportunities or the costs of performing this research.

The biomedical research community was pleased when the Clinton administration included NIH and the National Science Foundation in its investment agenda soon after taking office. However, it was shocked when the Clinton administration's recommended NIH budget for 1994 was \$10.7 billion, an increase of only 3.3% more than 1993. This was less than the 3.9% rate of inflation, as measured by the Biomedical Research and Development Price Index (BRDPI) for 1994.

The 1994 Clinton administration budget did recommend substantial increases in AIDS, tuberculosis, and vaccine research at the National Institute of Allergy and Infectious Diseases (NIAID) and breast cancer research at the National Cancer Institute (NCI). However, it provided less than a 1% increase for all ongoing research at NIAID. Consequently, in 1994 NIAID's ability to fund new and competing grants in areas of basic and applied immunology (e.g., autoimmune diseases), allergy (e.g., asthma), and infectious diseases (e.g., viral and bacterial infections) other than AIDS, tuberculosis, and vaccines was reduced below

the 1993 level. In 1993, NIAID was able to fund grant applications that were ranked in the top 14% of all applications received in these areas. By 1994, NIAID was able to fund only the top 10% of applications in these areas.

Federal appropriations for life science research and development have not kept pace with either the opportunities or the costs of performing biomedical and related life science research.

The Clinton administration's 1994 budget also recommended an absolute decrease in support for nine other NIH institutes including the National Heart, Lung, and Blood Institute and the National Institute for Child Health and Human Development. Fortunately, Congress did not accept these recommendations. Instead it appropriated \$10.9 billion for NIH and it eliminated most earmarks. This provided a 5.2% increase for each NIH Institute. By its actions, Congress prevented a further decrease in the number of new and competing investigator-initiated research project grants that were funded in 1994.

Donna Shalala, Secretary of Health and Human Services, was quoted as saying that the administration would recommend a larger increase for NIH in 1995, but that did not occur. The NIH received a 3.5% overall increase in 1995, bringing its present budget to \$11.3 billion. At this level NIH is able to support about 25% of all grant applications. However, close inspection shows that NIH funds only about 15% of new unsolicited proposals for traditional research project grants (ROIs) (2).

Congress's 1995 NIH appropriation of \$11.3 billion represents an investment of less than 1.1% of the national expenditure for health care. This is a serious underinvestment in the fundamental and applied research needed to deal with new diseases, with the reemergence of others, and with increasing numbers of Americans suffering from other chronic and/or degenerative diseases. Cost savings in health care are critically dependent on discovery of new ways to prevent and treat these diseases. The most advanced industrial nations (i.e., Germany and Japan) spend a larger proportion of their gross domestic product on research, than does the U.S.

The political situation with respect to funding of basic research changed dramatically in 1995. The newly elected Republican congressional leadership, although highly supportive of fundamental research in the medical and related life sciences, has made a balanced federal budget by the year 2002 the cornerstone of its agenda. To achieve this goal, the Budget Committees in the House and Senate propose to freeze and/or reduce spending for all federal programs except Social Security. For example, in May the House Budget Committee recommended reducing the 1996 NIH budget by 5% below 1995 and maintaining this level until 2002. The Senate Budget Committee proposed a 10%

TABLE 1. *Estimated annual costs saved by medical research in billions of dollars*

Type of research	Savings ^a	Source ^b
Vaccines and infectious diseases		
Polio	\$ 2.0	12
Influenza	\$ 1.66	14
Hemophilus influenza b	\$ 0.46	21
Chicken pox	\$ 0.008	49
Measles	\$ 0.18	29
Hepatitis B	\$ 0.154	32, 33
Hepatitis C screening	\$ 0.685	17
Tuberculosis	\$ 4.97	8
Subtotal	\$10.117	
Diseases of infancy and childhood		
Screen neonates for hypothyroidism	\$0.436	25
Rh disease of newborn	\$0.275	26
Neonatal herpes treatment	\$0.183	30
Respiratory distress syndrome	\$0.498	39, 48
Decrease tonsillectomies	\$0.4	23
Febrile seizure treatment	\$0.098	38
Chlamydia screening	\$1.900	13
Subtotal	\$3.790	
Nervous and mental diseases		
Manic depressive illness	\$ 8.953	1
Schizophrenia	\$25.0	3
Subtotal	\$33.953	
Cardiovascular diseases		
Hypertension	\$ 0.048	45
Stroke	\$ 1.881	4
Evaluations of cardiac surgery	\$ 0.826	19, 35
Arrhythmia suppression treatment	\$ 0.104	36
Heart attacks	\$ 9.135	2
Subtotal	\$11.994	
Surgical, metabolic, and immunological diseases		
Prevent recurrence of renal stones	\$0.872	18
Ulcers	\$0.816	16
Diabetic retinopathy	\$1.58	15
Renal transplantation and autoimmune renal diseases	\$0.640	20, 34, 46
Psoriasis	\$0.077	41
Desensitization to bee stings	\$0.102	37
Subtotal	\$4.087	
Cancer		
Breast cancer	\$0.53	22
Testicular cancer	\$0.179	24
Melanoma	\$0.171	31
Colon cancer	\$0.215	28
Subtotal	\$1.095	
AIDS/HIV		
Screen blood supply for HIV	\$0.267	11
Improved diagnosis/treatment for complications of AIDS	\$0.056	42
Subtotal	\$0.323	
Dental disease		
Fluoridation of drinking water prevents tooth decay	\$3.84	9
Miscellaneous, orthopedic, blood	\$0.112	44, 47, 50, 51, 52
Subtotal	\$3.952	
Total	\$69.311	

^aCost savings estimates represent maximum value when original studies reported ranges. In some cases, multiyear estimates were annualized and dollar amounts were converted to current dollars. ^bNumbers in this column refer to line numbers in Table 2.

reduction in 1996 for NIH while keeping funding for AIDS research at its current level. If this measure were enacted, and the NIH budget were frozen at this level, by 2002 the purchasing power of the majority of NIH research programs would decrease by nearly 33%. A reduction of this magnitude would have a devastating effect on research progress and a lasting negative effect on this nation's prospects for improved health and economic productivity.

NEW SOURCES OF WEALTH, NEW JOBS, AND IMPROVEMENTS IN THE HEALTH OF HUMANKIND

According to Ernst and Young, the private sector had invested \$41 billion in 1,311 U.S. biotechnology companies by 1994 (3). In 1994 these companies spent \$7 billion on research and development, employed 103,000 people, and generated \$11.2 billion in revenues—increases of 23%, 6%, and 12%, respectively, from 1993. For the last 9 years, the U.S. biotechnology industry has experienced continued growth in the number of companies, jobs, and revenues.

The success of the biotechnology industry is dwarfed by that of the U.S. pharmaceutical industry, which enjoys economic dominance in world markets. In 1994, the top 15 U.S. pharmaceutical companies employed more than 353,800 people, recorded sales of \$84.8 billion, invested \$13.8 billion in research and development, and earned profits of \$13.3 billion. Although concerns with the effects of managed care on profitability of pharmaceutical companies produced contraction in employment and investment in these companies, many of them have indicated the importance they place on research by reducing personnel primarily in categories other than discovery research.

Biotechnology companies are located close to major research universities in every major urban center in the U.S.: the San Francisco Bay area, the New York-New Jersey-Connecticut tristate area, North Carolina's research triangle, and in Boston, San Diego, and Seattle. Biotechnology companies have chosen to locate in these areas because of the nearby presence of research universities. Federal investment in these universities has been cited by California and Massachusetts as stimulating the growth of biotechnology companies.

A 1991 New York Academy of Medicine study indicates that the \$1.5 billion federal investment in university-based research in New York City generates another \$1.3 billion in indirect economic activity and 13,000 jobs, in addition to the 20,000 jobs that are a direct result of the government's investment in research there (4). Assuming continued investment in fundamental research, the biotechnology industry is expected to generate sales of \$50 billion by the year 2000 according to analysts at Ernst and Young, thereby creating an additional 250,000 to 500,000 new jobs.

A Bank of Boston (5) study reports that "for each \$1 million of biotechnology activity in Massachusetts 25.5 jobs are created." Moreover, "for each \$1 of biotechnology activities... \$0.70 of wages and salaries are generated." These funds are used to pay personnel at all levels, from dish-

washers to postdoctoral researchers, from administrators to senior scientists.

According to a 1990 assessment of the biotechnology industry in Massachusetts (6), "salaries at biotechnology companies are relatively high, averaging \$31,700 per employee, so that the average employee makes a larger-than-average contribution to the local economy both in the form of taxes and personal expenditures."

Federally funded biomedical and behavioral research creates new sources of wealth, produces secure new jobs, and contributes markedly to improvements in the overall health of humankind.

Reports from California and Maryland indicate similar social and economic benefits. The Maryland Department of Economic and Employment Development calculates that NIH, both intra- and extramural programs, contributes \$3.6 billion in gross sales, \$1.9 billion in employee income, and about 63,000 jobs to the Maryland economy (7). The California Health Care Institute reports that biotechnology and pharmaceutical companies and medical device companies had revenues of more than \$12 billion and directly employed 111,000 workers in California in 1992 (8). Universities and federal facilities employ an additional 33,000 Californians in health care research.

A Coopers and Lybrand study points out that most large U.S. industries (Fortune 500 companies) are consolidating and reducing personnel, and are projected to continue in this mode throughout the 1990s (9). Consequently, most economists project that new jobs and economic growth will result from the development of small businesses and start up companies. The same Coopers and Lybrand study documents that 75% of these start-up companies are technology related, and 56% focus on biomedical research. It predicts that technology-related industries will grow at an annual rate of 6.4%, two and one-half times faster than the output of the whole manufacturing sector. Moreover, it points out that these companies "generate the skilled jobs that will keep the U.S. dominant. The percentage of skilled positions for scientists, engineers, and managers created by these start-up companies is more than four times greater than the percentage of skilled jobs created in the economy as a whole." Thus commercialization of advances in the life sciences has proved to be a powerful source of economic growth. In so doing it creates a high technology industry that has an extremely low environmental impact.

Research universities train the people who provide the brainpower that makes biotechnology one of this country's fastest growing industrial sectors. Federally funded university-based fundamental research is the seed capital of this industry in terms of trained personnel, new processes and products, and revolutionary ideas. By investing in life sciences research we invest in ourselves and in a productive and healthy future for all.

TABLE 2. *Cost savings from biomedical research and development*

Condition/intervention	Units, detail	Source ^a	Notes
1. Manic depressive illness, lithium treatment for	\$145 billion saved over past 25 years from hospitalizations foregone	7	\$8.953 billion, annualized for 1990
2. Hypertension, pharmaceutical intervention reducing mortality from ischemic heart disease	\$83.8 billion lost wages saved, 1968–1986 (671,000 deaths averted)	3	\$9.135 billion, annualized for 1990
3. Schizophrenia, pharmaceutical treatment, e.g., clozapine	\$25 billion per year in savings from hospitalizations avoided	1	
4. Stroke, pharmaceutical intervention	\$16.3 billion in aggregate lost wages saved, 1970–1986 (456,000 stroke deaths averted)	3	\$1.881 billion, annualized for 1990
5. Tooth decay, savings from fluoridation and other advances	\$10 billion saved per year in 1980s from reduction in dental bills	7	Citing 19
6. Tuberculosis, pharmaceutical intervention	\$7.4–\$11.1 billion, indirect cost saving (productivity losses) from deaths averted (1947–1986)	3	Does not disaggregate environmental, nonpharmacological factors
7. Polio vaccine	\$6.06 billion saved, net of costs, includes medical care costs and income losses	6	
8. Tuberculosis treatment	\$4.97 billion per year in hospitalization and productivity savings	9	Citing 6
9. Improved oral health through multiple preventive approaches	\$2,881–3,841 million/yr in reduced treatment costs	12	
10. Proliferative diabetic retinopathy, argon laser therapy	\$2.816 billion saved over a 22 year period, includes \$231 million for direct costs	4	
11. HIV screening of blood supply	\$2.4 billion savings in direct costs from treatment averted (1985–1993)	16	Citing 3
12. Polio vaccine	\$2 billion per year	9	See also #7 above
13. Chlamydia screening and prevention	\$1.9 billion annual savings from avoidance of ectopic pregnancy, PID, and infertility	16	
14. Influenza immunization	\$1.66 billion saved in 1994, from reduced hospitalization of persons 65 years and older	5, 13	Projected from regional avg. cost savings rates, immunization rates, and efficacy rates reported, and population figures (14) See also #10 above
15. Diabetic retinopathy, laser treatment of	\$1.118–1.579 billion/yr in reduced risk and cost of vision loss	12	
16. Peptic ulcer therapy, including antibiotics	\$612.2–816.2 million/yr in reduced treatment costs	12	
17. Hepatitis C, screening of blood supply	\$685,000,000 in savings on direct costs from treatment averted (1986–1993)	16	Citing 3
18. Kidney stones, potassium citrate and other preventive measures against recurrence	\$436.2–872.4 million/yr in reduced treatment costs	12	
19. Heart disease, medical management vs. bypass heart surgery	\$402–804 million/yr estimated potential savings in 1983 if medical management approaches were used in lieu of surgery	12	
20. Kidney transplantation, improved efficacy and safety	\$359.3–479.1 million/yr in reduced treatment costs and lost earnings	12	
21. Hemophilus influenza type b intervention	\$346.6–462.1 million/yr in reduced custodial care costs and indirect costs of mortality and morbidity	10, 12	
22. Breast cancer, two-stage diagnosis and treatment	\$263.2–526.5 million/yr in reduced treatment costs	12	
23. Tonsillectomies, study determining lack of value for	\$305.1–401.0 million/yr in reduced cost of ineffectual treatment	12	
24. Testicular cancer, treatment for advanced form of	\$134.0–178.7 million/yr from improved survival and reduced premature mortality	12	
25. Neonatal hypothyroidism, mass screening for	\$193.0–436.2 million/yr in reduced treatment and related costs and lost earnings	12	
26. Rh disease	\$275 million saved per year	9	Citing 6
27. Ulcers, H2 antagonists drug therapy	\$224,000,000 savings, 80% estimated annual reduction in number of ulcer surgeries (1977–1987)	1	
28. Dukes' C colon cancer, adjuvant therapy for	\$161.4–215.2 million/yr in reduced loss of work days due to premature mortality	12	

^aNumbers in boldface refer to List of Sources, which follows Table 2.

TABLE 2. (continued)

Condition/intervention	Units, detail	Source ^a	Notes
29. Measles prevention	\$180 million savings per year	9	Citing 6
30. Congenital and neonatal herpes, demonstrate efficacy of drug, acyclovir, to treat neonatal herpes	\$137.5 to \$183.3 million per year in total direct and indirect costs, 1992 dollars	10, 12	
31. Cutaneous malignant melanoma, early diagnosis of	\$128.6–171.4 million/yr in reduced cost of treatment and premature mortality	12	
32. Hepatitis B, screening of blood supply	\$145 million savings on direct costs from treatment averted (1971–1993)	16	
33. Hepatitis B vaccine	\$73.7–147.6 million/yr savings approx. estimated incidence in 1983; prevents acute chronic illness, reduces health care utilization	12	
34. Lupus-induced kidney disease, combination treatment of	\$89.8–119.7 million/yr in reduced treatment costs and lost earnings	12	
35. Extra- and intracranial arterial bypass surgery, negative valuation	\$16.1–21.5 million/yr in reduced treatment costs	12	
36. Cardiac arrhythmia suppression treatment	\$78.1–104.2 million/yr in reduced cost of unnecessary diagnosis and medications	12	
37. Bee sting desensitization	\$76.3–101.7 million/yr in reduced cost of ineffectual treatment	12	
38. Febrile seizures, establishing the need for chronic anticonvulsant therapy for	\$73.4–97.9 million/yr in reduced cost of ineffectual treatment	12	
39. Neonatal respiratory distress syndrome and related conditions, steroid therapy to prevent	\$127–\$477 million/yr in reduced treatment costs (hospitalizations)	11	Citing 17
40. HIV, testing of blood supply for contamination	\$59.1–78.7 million/yr in reduced treatment costs and premature mortality	12	See #11 above
41. Severe psoriasis, alternative treatment for	\$58.1–77.5 million/yr in reduced treatment costs and lost earnings	12	
42. <i>Pneumocystis carinii</i> pneumonia, improved diagnostic process for	\$41.9–55.9 million/yr in reduced cost of diagnosis	12	
43. HIV, avoidance of unnecessary testing of blood for	\$37.0–49.4 million/yr. Avoids cost of unnecessary screening of blood	12	
44. Guillain-Barré syndrome, therapy to accelerate recovery from	\$28.2–56.4 million/yr in reduced treatment costs	12	
45. Isolated systolic hypertension treatment	\$29.1–48.5 million/yr in reduced treatment cost	12	
46. Organ transplantation, support testing of drug, T10B9, to reverse kidney graft rejection	\$31.2–\$41.5 million/yr in hospital and other medical costs, 1992 dollars	10, 12	
47. Joint dysfunction, nonsurgical operation (orthosis) for	\$20.9–41.6 million/yr reduction in treatment costs	12	
48. Septic shock, elimination of ineffective methylprednisolone treatment for adult respiratory distress syndrome	\$15.5–20.7 million/yr reduction in ineffectual treatment	12	
49. Chickenpox vaccine in immunocompromised children	\$6.3 to \$8.4 million per year in reduced treatment costs in children with leukemia and lymphoma; 1992 dollars	10, 12	
50. Biotin metabolism disorder, protocol for screening and treating children	\$5.4–7.2 million/yr in reduced treatment costs, caretaking, special education, and lost earnings	12	
51. Cooley's anemia, improved blood preparation for transfusing patients	\$2.8–4.1. million/yr in reduced treatment costs	12	
52. Blood transfusion, salvage of previously unusable blood	\$1.6–3.1 million/yr in reduced treatment cost	12	
53. Hyaline membrane disease, spray	Saves \$71,500 average hospital costs per baby	7	Citing 15
Other benefits reported, not monetized			
54. Influenza and pneumonia vaccines	1920–1990, decline from 200 deaths per 100,000 pop. to 75 deaths per 100,000	1	
55. Tuberculosis treatment	1920–1990, decline from 120 deaths per 100,000 pop. to <1 death per 100,000	1	
56. Syphilis treatment	1920–1990, decline from 16 deaths per 100,000 pop. to <1 death per 100,000	1	

TABLE 2. (continued)

Condition/intervention	Units, detail	Source ^a	Notes
57. Diphtheria treatment	1920–present, decline from 16 deaths per 100,000 pop. to <1 death per 100,000	1	Citing National Immunization Program
58. Whooping cough treatment	1920–present, decline from 12 deaths per 100,000 pop. to <1 death per 100,000	1	
59. Measles treatment	1920–1990; decline from 9 deaths per 100,000 pop. to <1 death per 100,000	1	Citing National Immunization Program
60. Tagamet and zantac for peptic ulcers	59% reduction in ulcer surgery over 15 years	7	Citing 2, 8
61. Pulmozone for cystic fibrosis	25% net treatment cost reduction	7	
62. Betaseron for multiple sclerosis	52% reduction hospitalization rates	7	
63. Rh antibody testing	96% survival rate for fetuses with maternal Rh incompatibility	7	Citing 18

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TABLE 3. Estimated retail dollar value of selected biomedical discoveries adopted by industry for purposes other than health service^a

Biomedical discovery	Industrial application	1995 Estimated annual \$ value (millions)
Freeze-drying	Food preservation	\$ 1,056
Immobilized enzymes	High-fructose corn syrup, sugar beet, molasses	\$ 2,900
Keratin biochemistry	Home hair permanents	\$ 6
Laboratory instrument computer (LINC)	Minicomputer	\$ 22,200
Virology/oncology	Vaccine for Marek's disease	\$ 80
Chlorotetracycline	Animal feed	\$ 5,680
Warfarin	Rodenticide	\$ 124
Fiber optics	Telecommunications	\$ 3,700
Steroid hormones	Animal feed	\$ 2,515
Enzyme biochemistry	Chillproofing of beer, leather bating, enzyme detergents	\$53,660
Total for 10 biomedical discoveries		\$91,921

^aData from *Washington FAX*, May 2, 1995, based on report prepared for NIH Office of Medical Applications of Research by Battelle Columbus Laboratories and CDP Associates.

ECONOMIC DIFFERENCES BETWEEN PUBLIC AND PRIVATE INVESTMENTS

The search for fundamental knowledge differs from efforts to develop a drug or device. Knowledge is not directly tied to a specific product. Thus, no single company can capture the full value of its investment in fundamental research. Even though society reaps a very great return from investments in fundamental research, each company can capture only a portion of this benefit. For this reason, fundamental research requires public investment. Edwin Mansfield, professor of economics at the University of Pennsylvania, estimated that the social rate of return on academic research was 28% and concluded that in industries such as drugs and information processing, the contribution of academic research was crucial to industrial innovation (10).

Despite the demonstrated inability of private investors to capture the full value of their investments in fundamental research, there are those who still believe that the private sector can and will assume responsibility for fundamental research in medicine and the related life sciences if called upon to do so. A brief review of the magnitude of public vs. private sector investments in fundamental research indicates that the private sector has insufficient resources to accomplish this task. In 1994, U.S. pharmaceutical and biotechnology industries together invested about \$22 billion in research and development. Ninety percent of this \$22 billion was invested in development. Thus, the two most research-intensive industries in the U.S. invested a total of \$2.2 billion in discovery research in 1994. Even if the entire \$2.2 billion supported fundamental research, and 25% of this \$2.2 billion were donated to universities and non-profit research institutions, the private sector could provide only \$550 million per year for fundamental research at non-profit research institutions. This is less than 5% of the current annual federal investment in the NIH.

RECOMMENDATIONS FOR THE 1996 NIH BUDGET

FASEB has recommended a \$1.1 billion increase in the FY 1996 NIH appropriation to \$12.4 billion (2). This \$12.4 billion would allow NIH to fund a significantly larger

number of research project grants in 1996 than it did in 1995. It would allow NIH to maintain research training at the present level and facilitate renewal and replacement of aging and outdated equipment. This level of investment would maintain the rate of advance in fundamental knowledge needed to retain American leadership in biotechnology and assure continued growth in jobs and revenues. Even at this funding level, NIH would be able to support only 30% of all research applications. This level of funding will allow the NIH to support the very best scientists and research initiatives. Support for the NIH at less than the present level, as threatened by the 5% budget cut and 5-year freeze recommended by the House Budget Committee, will result in further erosion of the research base and in the interruption or discontinuation of many promising research initiatives. FJ

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