Funding Impact of the National Cancer Act and Beyond

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Abstract

During the seven years following passage of the National Cancer Act of 1971, the appropriation for the National Cancer Institute (NCI) was increased by nearly $700 million. A major effect of the Act has been increased funding for grants-in-aid, which rose from $93 million in fiscal year (FY) 1970 to over $416 million in FY 1978.

Grants programs account for over 60% of the total NCI extramural research budget and are divided into four broad categories: research; training (including fellowships); cancer control; and construction. For the first 4 years following passage of the Act, funding for all grants programs increased dramatically. However, growth began to slow in 1976, and the deceleration is continuing. Total NCI obligations for FY 1978 increased at a rate of 7% (as opposed to an increase of 20.3% in FY 1975), which merely managed to keep pace with the estimated Biomedical Inflation Factor of 6.8%. Traditional grants have more than doubled in average cost over the past 10 years, a growth attributable to inflation, more sophisticated and expensive equipment and supplies, and, in some cases, more ambitious projects.

The principal types of research grants include: traditional, investigator-initiated research; program projects, a team approach directed toward a common goal; and “core” support used to fund administrative and shared equipment costs of cancer centers. In FY 1977, the actual number of traditional grants awarded declined for the first time in 7 years, while the number of applications for both new and renewal grants increased at an unprecedented rate. Coincidentally, the number of traditional grants awarded this fiscal year increased by 4%, enabling the figure to exactly match that in 1978.

While support for traditional grants has remained in the forefront of NCI funding, money for program projects and core support has increased at a greater rate in recent years. However, unlike the years immediately following the Act, emphasis is now being placed on core support (which increased by 9.4% in FY 1978) and program project grants (up 5.1%), as opposed to the exploratory grants necessary to initiate cancer centers. Funds allocated for construction in the wake of the Act are now being reduced, as the pace of development of new centers begins to slow.

Although the number of grant awards has decreased, young investigators (35 years old or younger) continued to receive a significant share of NCI funds, and, in fact, are faring better than older investigators in terms of recommendation, previously referred to as “approval,” and award rates. Awards to foreign scientists increased steadily after the Act, achieving their greatest dollar increase ever in FY 1977; in FY 1978, however, they declined by more than 6%.

As part of the NCI reorganization plan instituted by NCI Director Arthur C. Upton upon his arrival in July 1977, all existing grants and grant-awarding authority have been transferred from the Division of Cancer Research Resources and Centers to the other four operating divisions in NCI, giving the latter administrative responsibility for grants, as well as contracts, in their respective areas. The Division of Cancer Research Resources and Center, whose portion of the NCI budget dropped from 43 to 8%, is now responsible for the review and business management of all grant and contract activities, the purpose of the reorganization being to separate program from review.

Until this fiscal year, the NCI’s award rate had been decreasing rapidly, from 59 to 35% in just 2 years. In 1978, however, in keeping with Dr. Upton’s commitment to strengthen the grant support mechanism, award rates rose by over 4% for new applications and over 10% for renewals. Because of its broader mandate, NCI continues to award more total dollars for research grant programs alone than each of the other institutes (with the exception of the National Heart, Lung, and Blood Institute) allocates for its total budget. A significant portion of the NCI extramural budget goes for basic research, of which NCI is supporting more than it has at any time in its history.

Introduction

The National Cancer Act of 1971 (6), with its concomitant increase in funding for the NCI,1 has had a significant impact on NCI’s grant-supported programs. Prior to the Act, it had become increasingly difficult for NCI to support some of the most worthy cancer research projects. The Act reversed this trend.

Members of the scientific community have expressed concern that the additional moneys appropriated to cancer research might divert support from biomedical research in other fields and have raised the following questions. In relation to other institutes of the NIH, how much greater is NCI funding? What portion of the total NCI grants program is used to fund traditional grants, awarded for investigator-initiated research? What portion is used to fund large grants such as program project and center support (core) grants? What has been the trend in recommendation (approval) rates and award rates? Have young investigators received a fair share of the additional moneys? This review will answer these and other questions and will focus on NCI grant-supported programs rather than on budget formulation (10).

History

The NCI, the oldest component of the NIH, was established in 1937 when President Franklin D. Roosevelt signed the National Cancer Institute Act to create "... in the Public Heath

1 The abbreviations used are: NCI, National Cancer Institute; FY, fiscal year; NHLBI, National Heart, Lung, and Blood Institute; DCCRRC, Division of Cancer Research Resources and Centers.
Service a division..." to conduct "...studies relating to the cause, diagnosis, and treatment of cancer."

This institute, the progenitor of many federally funded biomedical research programs, was authorized with an appropriation of $700,000 per fiscal year. In 1938, the National Advisory Cancer Council recommended approval of the first awards of fellowships in cancer research.

The Public Health Service Act of 1944 (9) incorporated NCI as a division of NIH, removed the $700,000 annual appropriations limit, and revised and consolidated existing laws relating to the USPHS.

A large share of the funding increases granted to the NIH by Congress in the late 1950's and early 1960's went to NCI. By 1967, however, these annual appropriations began to reach a plateau which did not offset the cost of inflation. As a result, NCI supported less research (both in terms of numbers of projects and total dollars) from 1967 to 1970 than it had in previous years, and, in order to continue funding new research projects, it reduced support of existing programs by 10 to 15%.

Passage of the National Cancer Act of 1971 led to increased levels of funding which alleviated these constraints by permitting a dramatic upward surge in the number of traditional grants awarded (4). In FY 1970, the year prior to the passage of the Act, 818 grants totalling $42 million were awarded (a decline of 23% in number and 15% in dollars from 1968). By FY 1972, however, when the Act first began to take effect, the figures surpassed the FY 1968 levels, reaching peak figures of 1953 traditional grants funded and $128 million awarded in FY 1976. In FY 1977, the number of traditional grants awarded declined, for the first time since 1970, and, in FY 1978, the NCI awarded 1978 grants totalling $154 million. This 18% increase in dollars awarded was 3 times that of the previous year.

Obviously, the rapidly increasing average cost per grant (doubling over the past decade and 40% more than 5 years ago), coupled with a traditional grant budget struggling merely to keep pace with inflation (7.0% growth in total obligations versus 6.8% Biomedical Inflation Factor2), means that fewer and fewer deserving researchers (as judged by the number of projects assigned high priority scores that remain unfunded) can be supported. Nonetheless, the modest upswing in FY 1978 is encouraging.

For the first 3 to 5 years following the Act, NCI had more funds with which to support applicants than did the other NIH Institutes, with the exception of NHLBI, whose own act provides significant increases. Consequently, in an effort to make certain that as much worthy basic research as possible received funding, the NCI canvassed the other Institutes to determine if applications with excellent priority scores, 100 to 150, were going unfunded. This practice was initiated in response to the claim that there were a significant number of applications that fell into this category; upon investigation, however, this was not found to be the case. NCI only "picked up" 3 or 4 applications annually through this procedure, and these were so basic in nature that they could easily be considered cancer related.

Despite the rarity of such occurrences, it should be empha-

2 Figure supplied by Office of Program Planning and Evaluation, Office of the Director, NIH. Using FY 1975 as a base line of $100, FY 1977 equivalent dollars would be 116.5. By the same measure, FY 1978 equivalent dollars would be 124.4, or an increase of 7.9 dollars (6.8%) over the previous year.
communicating and promoting the widespread application of available and new methods for reducing the incidence, morbidity, and mortality from cancer; and serves as the focal point of a coordinated national effort to control cancer.

Division of Cancer Research Resources and Centers (DCRRC), recently reorganized, was formerly responsible for directing all grant-supported activities. In the reorganization, most existing grants and grant-awarding authority were transferred from DCRRC to the other 4 divisions in order to give them authority over grants in their respective areas. DCRRC's primary responsibility is now administering grant activities, including peer review. Contained within DCRRC are the following branches: Review and Referral; Research Analysis and Evaluation; Grants Administration; Research Facilities; and the Organ Site Program. However, these will soon be moved to a newly formed division. In addition, a Contracts and Grants Policy Branch will be created to establish and oversee institute policies governing use of all grants and contracts.

In the final phase of NCI Director Arthur C. Upton's reorganization, scheduled to occur near the end of FY 1979, the Division of Cancer Control and Rehabilitation will be phased out, with its programs being divided between 2 new divisions, the Division of Cancer Resources, Centers, and Community Programs and the Division of Cancer Prevention. This latter division will be made up of existing prevention programs in the phased-out control division as well as pertinent programs now housed in the Division of Cancer Cause and Prevention and elsewhere. The Resources, Centers, and Community Programs division is expected to comprise the construction, organ sites, and professional education programs formerly administered by the DCRRC. This final phase of the reorganization will complete the separation of program from review.

Intramural research is conducted in NCI's own facilities. The first 3 divisions listed above are involved in some aspects of intramural research, as well as studies done under grant and contract. The Division of Cancer Control and Rehabilitation is concerned solely with the support of projects in institutions outside the NCI, while the DCRRC is devoted exclusively to extramural program review.

Chart 1 represents the percentage of funding for all NCI programs (divisions) in FY 1978. The Division of Cancer Treatment's portion of the total NCI obligations was nearly $226 million, or 25.8%, followed by: Division of Cancer Cause and Prevention with 25.5%; Division of Cancer Biology and Diagnosis with 17.9%; Division of Cancer Research Resources and Centers, which fell from 43% in FY 1977 to 8.1% in FY 1977 as a result of the reorganization; and the Division of Cancer Control with 7.3%. Cancer centers support constituted 7.4% of the total obligations, with the remaining 8% being allotted to the Office of the Director and the NCI Management Fund.

Chart 2 depicts the proportion of NCI grant funds by major

**NCI Programs, Fiscal Year 1978**

**Actual Obligations $873,227,000**

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<thead>
<tr>
<th>Division</th>
<th>Actual Obligations</th>
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<tr>
<td>Office of the Director</td>
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<tr>
<td>NCI Management Fund &amp; Supporting Services</td>
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<td>Division of Cancer Control</td>
<td>(63,529,000)</td>
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<tr>
<td>Cancer Centers Support</td>
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<tr>
<td>Division of Cancer Research Resources &amp; Centers</td>
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<tr>
<td>Division of Cancer Biology &amp; Diagnosis</td>
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<tr>
<td>Division of Cancer Cause &amp; Prevention</td>
<td>(222,592,000)</td>
</tr>
<tr>
<td>Division of Cancer Treatment</td>
<td>(225,525,000)</td>
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Chart 1. NCI programs, FY 1978.
A. RESEARCH PROGRAMS

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<tr>
<th>Program Type</th>
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<tbody>
<tr>
<td>Traditional</td>
<td>364,750,000</td>
<td>42.4%</td>
</tr>
<tr>
<td>Conference</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
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<td>Young Investigators</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
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<td>Program Projects</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
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<td>Center Support</td>
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</tr>
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<td>CREGs</td>
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<td>Clinical Cooperatives</td>
<td>42,481,000</td>
<td>57.6%</td>
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<tr>
<td>Organ Site</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
<tr>
<td>Radiation Development</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
<tr>
<td>Scientific Evaluation</td>
<td>42,481,000</td>
<td>57.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>364,750,000</strong></td>
<td><strong>100.0%</strong></td>
</tr>
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B. CONSTRUCTION

- Total $12,000,000

C. TRAINING & EDUCATION PROGRAMS

- Fellowships $34,481,000
- Clinical Education $17,503,000
- Career Awards $17,503,000
- Graduate Training $17,503,000
- Training $17,503,000

D. REVIEW AND APPROVAL

- Total $10,503,000

E. CANCER CONTROL GRANTS

- Total $17,601,000

Chart 2. NCI grant programs, FY 1978. CREG, Cancer Research Emphasis Grant.

Funding Impact of the National Cancer Act

NCI GRANT PROGRAMS, FISCAL YEAR 1978
Actual Obligations $439,335,000

A. Research Programs. Of the total amount obligated for grants, 83% was used for research, 8% for training and education, 4% for cancer control, 3% for construction, and 2% for review and approval. Of the research programs, traditional grants received the largest portion of the obligations, $154 million or 42%. Allocations to the research grant programs increased 23% in FY 1978, a startling contrast to the 7.5% increase the previous year and further evidence of the Institute's renewed commitment to grants for basic research.

Traditional grants are awarded for research projects that are initiated and conducted by individual investigators and are the main type of extramural program supported by NCI and NIH. Since the passage of the National Cancer Act, obligations for traditional grant support have steadily increased from $55 million in FY 1972 to $154 million in FY 1978, an overall increase of 180%.

B. Construction. The Act of 1971 and the subsequent amendments of 1974 gave NCI the authority to construct new facilities as well as to make "alterations and renovations" toward the "improvement of basic research laboratory facilities," including "biohazard control." In FY 1972, the initial year of the Construction Program, $44 million was awarded to 17 institutions; in 1974, $32 million was allocated to 8 institutions, while in 1978, $12 million was made available to 9 institutions. These funds will actually contribute to the construction of $23 million worth of cancer research space, since the grantee institutions provide "matching" funds of between 25 and 50% of the total construction amount. The required match was 25% from 1972 through September 1978; on October 1, 1978, grantee institutions were required to provide at least 50% of the total construction costs. Decreasing construction allocations represent the completion of the post-Act construction boom, and emphasis is now on funding the research being conducted in the facilities rather than on constructing new laboratory space.

In FY 1978, most funds appropriated under the construction program were allocated for alterations and renovations, in order to maintain compliance with Federal regulations governing biohazard containment, recombinant DNA safeguards, animal care, and protection of human subjects. These alterations...
and renovations are necessary, if only to permit currently funded science to continue. They enable many promising experiments to be conducted, efforts which otherwise would have to be terminated for noncompliance with the biohazard containment provisions of the Occupational Safety and Health Act. In addition, these improved research facilities reduce human overcrowding, increase work space, advance safety, and help to produce a better quality laboratory animal model. A minimal amount of new construction was initiated in FY 1978.

C. Training and Education Programs. Both the clinical training program, established to upgrade cancer teaching in medical and dental schools, and the graduate training program, which supports pre- and postdoctoral trainees, are being phased out and were discontinued at the end of FY 1978.

To replace legislative authority for the programs currently being phased out, the National Research Service Award Act of 1974 (8) was signed into law. Under its provisions, awards may be made either to individuals for research projects or to institutions that will select individuals for training in research. These awards are to be made for pre- and postdoctoral training but not for M.D. residency training. In FY 1978, fellowship obligations were nearly $20 million, an increase of 83% since 1975. Pre- and postdoctoral candidates may also receive full-time research fellowship support grants through the Research Manpower Branch of DCRRC.

The Clinical Manpower Branch promotes cancer education activities in institutions providing education for physicians and dentists through the use of clinical cancer education grants. From its initiation in FY 1975, with funding between $4 and $5 million, obligations for the Clinical Cancer Education Program have increased to $10 million in FY 1978.

Research Career Awards (RCA's) and Research Career Development Awards (RCDA's) had combined 1978 obligations of $4.4 million, or 12.8% of the total Training and Education allotment. In 1978, there were 6 ongoing RCA's totalling $169,000, down from 11 RCA's in the early 1970's. The RCA program began in 1961 and reached a peak of 21 RCA's; however, a new career award has not been made since 1964. The ongoing awards are being allowed to run their course. There are 121 active RCDA's, accounting for $4.2 million in grants.

D. Review and Approval. In FY 1978, $10.5 million (or 2.4% of the total obligations for NCI grant programs) were utilized for the review and approval of grant applications, an increase of 13% over FY 1977. This represented a sharp drop from the 24% increase of the previous year, which is indicative of the fact that, for the first time since the Act, the number of competing NCI applications requiring review actually declined, albeit by less than 2%. By contrast, the number of competing applications had risen by 23% from FY 1976 to 1977.

E. Cancer Control. Funds allotted for cancer control grants, which support the identification, testing, and evaluation of discrete or individual intervention techniques, increased by 7% in FY 1978, in keeping with the increased emphasis on disease prevention. Seventy-one cancer control grants totalling $17.6 million were awarded. The effect of the Department of Health, Education, and Welfare's prevention initiative was further evidenced by the increase in the Division of Cancer Cause and Prevention's share of the total NCI obligations from 17.0 to 25.5%.
project is initiated by NCI and when monitoring progress is required during the conduct of the work. Contracts are utilized less frequently than grants as a means of funding; nevertheless, they constitute a significant portion of the Institute's annual spending.

During this period of negligible "real" growth, every effort has been made to maintain the strength of the grants program, often at the expense of contracts. In FY 1978, contract support had to be held at the 1976 level, in order that the NIH emphasis on investigator-initiated research could be upheld. The growth in contract support prior to 1977 had paralleled that of grants.

Funding Comparison by Grant Type

Traditional Grants. Because many advances have resulted from traditional, investigator-initiated grants, NCI and other Institutes at NIH have funded competing renewal and new applications at the highest possible levels. In FY 1962, $30 million was awarded for traditional grants, while center, Core and Program Project, grants constituted significantly smaller apportionments. Beginning in FY 1968, however, this trend was reversed. Because Congressional appropriations leveled off and NCI obligations subsequently reached a plateau, the number of funded individual or traditional grants decreased. At the same time, the funding level for centers and program projects increased, due to an emphasis on research of a multidisciplinary nature. The concept of "centerness" evolved as program projects became larger and more encompassing. Further erosion of individual, investigator-initiated research grants then occurred because, as budgets became tighter, the decision was made to emphasize team rather than individual efforts. It was decided to keep program projects at their present status, since these involved several investigators as opposed to the single investigator funded through each traditional grant (3).

Center Grants. The increase in funding of centers allows a continued, rapid translation of biomedical knowledge to patient treatment, inasmuch as the center acts as the focal point for this transfer. NCI currently recognizes 2 principal types of cancer centers, comprehensive and noncomprehensive, the latter designation being divided into clinical and nonclinical centers. A Comprehensive Cancer Center houses a multidisciplinary cancer program which meets all scientific and administrative criteria considered essential by the National Cancer Advisory Board, e.g., an environment of excellence in basic science and clinical research and demonstrated leadership in developing community outreach programs (1). Programs of this type are usually supported by a core grant, along with program project and traditional grants, and less often by contracts. The goal of these centers, in addition to multidisciplinary research on all types of cancer programs, is to facilitate the application of research knowledge to general clinical practice so that no citizen will be denied appropriate professional advice and care because of a lack of facilities and current knowledge. Comprehensive Centers which, until recently, developed solely from cancer research institutions, now encompass medical schools across the country, because these not only provide competent investigators in fundamental research but also train the physicians ultimately responsible for the care of cancer patients.

The Clinical and Non-Clinical Cancer Centers contain some, but not all, of the elements characteristic of a Comprehensive Cancer Center. They also usually consist of multidisciplinary cancer programs but often do not encompass the full scope of basic, clinical, and outreach programs that characterize Comprehensive Centers. The Clinical and Non-Clinical programs are supported by the same type of grants and contracts as a Comprehensive Center, and they too are eligible for core grants. Currently, NCI recognizes 67 cancer centers: 21 comprehensive; 27 clinical; and 19 nonclinical. Some Comprehensive Centers, if they have multiple core grants, may comprise more than one institution.

Due to both the phasing out of large "umbrella" grants used for multiple research projects and the virtual elimination of exploratory grants, core grants will be used more extensively in the immediate future. They rose by 3 grants and $9.2 million in FY 1978. Core grants are designed to support the administration, common services, and collaborative activities of cancer centers and to provide "seed" money for the development of new programs within the centers. It is anticipated that the use of core rather than umbrella grants will facilitate and improve both the quality of the review process and the fiscal accountability of the funded institutions.

NCI and NIH Funding Comparisons

NCI is one of 11 NIH institutes and, as mentioned earlier, the first to be established. The remaining institutes, in order of their establishment, are: NHLBI; the National Institute of Dental Research; the National Institute of Neurological and Communicative Disorders and Stroke; the National Institute of Arthritis, Metabolism, and Digestive Diseases; the National Institute of Allergy and Infectious Diseases; the National Institute of Child Health and Human Development; the National Institute of General Medical Sciences; the National Institute of Environmental Health Sciences; the National Eye Institute; and the National Institute on Aging. Chart 4 demonstrates FY 1978 funding patterns (grants and contracts) for all institutes, in descending order of dollars awarded.

Distribution of Funds. Although NCI allocates the lowest percentage of its budget for research grants, it still awards more total dollars for research grant programs alone than each of the other institutes (with the exception of NHLBI) allocates for its entire budget, due to its broader mandate. NCI also allot a greater percentage of its budget for contracts than do the other institutes, although this figure is diminishing. In addition, NCI supports 2 unique programs, construction and cancer control. Institutes making the most marked gains, in percentage, in extramural awards from FY 1977–78 were the Eye Institute (37%), the Allergy Institute (19%), and the Neurology Institute (15%), in sharp contrast to the Cancer Institute's modest 5.8% increase.

Competing Awards. Passage of the National Cancer Act in 1971 resulted in a significant increase in the number of competing research grants awarded by NCI, reversing a 5-year downward trend in the number of grants awarded by both NCI and NIH. Since 1971, the number of competing grants awarded by NCI has increased each year and in FY 1978 rose by 23%, an encouraging development in light of the negligible 0.6% increase the previous year. Once again, this trend is reflective of the new director's commitment to the basic research grant.
programs of the Institute.

Throughout the NIH, in fact, competing grant awards increased significantly in FY 1978 and, for the first time in many years, the growth represented more than just an increase in awards by NCI and NHLBI. As the dotted line on Chart 5 indicates, if NCI and NHLBI grants were excluded, the trend for the remaining institutes was downward until 1974.

It should be noted that the overwhelming majority of competing grants (71% in FY 1978) are awarded for a period of 3 years. When an Institute funds a large number of new and renewal grants in any one fiscal year, these awards are classified as "noncompeting" in the following year. These funds which have been committed for second-year support of prior grants, however, leave fewer dollars that can be used toward competing grant awards in the subsequent year. Thus, in the austere funding environment of recent years, it is not unusual

Source: NIH, DRG, Statistics and Analysis Branch

Chart 4. NIH extramural awards by Institute/Division and activity, FY 1978. RES. TRNG., Research Training; R & D, Research and Development; NIGMS, National Institute of General Medical Sciences; NIAMDD, National Institute of Arthritis, Metabolism, and Digestive Diseases; DRR, Division of Research Resources; NICHD, National Institute of Child Health and Human Development; NINCDS, National Institute of Neurological and Communicative Disorders and Stroke; NIAID, National Institute of Allergy and Infectious Diseases; NEI, National Eye Institute; NIDR, National Institute of Dental Research; NIEHS, National Institute of Environmental Health Sciences; NIA, National Institute on Aging; DRG, Division of Research Grants.

Chart 5. Number of new and renewal NCI and NIH competing research grants awarded, FY's 1962 to 1978.

*For all years 34 to 71% of NCI grants were awarded for 3 year periods.
for the number of competing grants to decrease in the year immediately following a year in which a peak number of awards was made (Chart 5).

**Increase in Applications (Burden on the Review Process).**
As a result of the Act, NCI received and reviewed more grant applications than at any previous time in its history. New applications, requesting support for research projects not previously funded, have been the primary component in the sharp rise in grant applications (Chart 6). Renewal applications, which request continued support for previously funded projects, do not increase in number as dramatically as new proposals, largely because they are reviewed in a cyclical pattern, with grants awarded for 2-, 3-, or 5-year periods of performance.

In FY 1977, the number of NCI competing applications requiring review skyrocketed; never before has the sheer number of such applications increased so dramatically. In all, 571 more competing applications were reviewed in FY 1977 than in FY 1976, 23% more than were considered in the previous review cycle. Surprisingly, this trend did not continue in FY 1978 as, for the first time since 1968–69, the total number of new and renewal competing research applications decreased from the previous year (from 3074 to 3030). The decline took place exclusively in the new (Type 1) applications, which fell by 5.3%, while the renewal requests (comprising a lesser number of applications) rose by nearly 8%. By contrast, new and renewal applications had increased by 18 and 39%, respectively, in FY 1977.

**Traditional Grants: Recommendation Rates.** Recognizing that many advances have resulted from traditional grant support, NCI and NIH have always placed a high priority on funding competing renewal and new applications (Charts 7 and 8). Because renewal applications request support for studies that have previously passed scientific review, their award rates are slightly higher than those for new applications.

The other significant factor in assessing funding patterns is the recommendation rate, which is the percentage of applications recommended for funding by the National Cancer Advisory Board based upon the total number of applications reviewed. The National Cancer Advisory Board makes the final decision to either concur with, reverse, or defer the recommendation of the initial review group (or study section), which is the body that site visits (where appropriate) and thoroughly reviews each application assigned to it. In the past, this percentage was referred to as the "approval rate." This created a great deal of confusion, however, because it gave applicants the mistaken impression that "approval" of an application meant that an award would be forthcoming. In point of fact, funding of "recommended" applications is, and always has been, dependent upon the availability of funds. Thus, the term "recommendation rate" was adopted to identify applications judged worthy of, but not necessarily guaranteed, support.

Prior to the Cancer Act of 1971, the NCI recommendation rate generally ranged between 60 and 75% for renewals and 40 and 50% for new applications; following the influx of funds after the Act, the rate averaged 82 and 63% (ranges of 78 to 88% and 57 to 68%) for renewals and new types, respectively. Recommendation rates for both new and renewal applications reached post-Act highs in 1974 to 1975 but have subsequently
declined due to budgetary constraints. There was a slight resurgence in FY 1978, however, as the NCI's recommendation rate increased by 6% for both new and renewal applications. The overall NIH increase was less pronounced. This past year, the NCI recommended more than two-thirds of the new grant applications that it received and almost 85% of the renewal requests.

Traditional Grants: Award Rates. The award rate is the percentage of competing applications actually funded, based on the total number recommended. Thus, if 1000 applications were submitted, and the recommendation and award rates were both 50%, only 250 (or 25%) of the submitted applications would be funded. Prior to the budgetary constraints of the late 1960's, the NCI award rate always greatly exceeded the recommendation rate. In other words, if a cancer application was judged meritorious, it was nearly certain to be funded, e.g., 96 and 100% award rates for new and renewal applications, respectively, in 1963. These halcyon years, prior to 1964, when NIH, including NCI, was able to fund more than 90% of all approved applications, have long since passed and may not be seen again. Even following the National Cancer Act, the award rates never approached those of the previous decade, peaking at 61% for new applications and 79% for renewal applications in FY's 1972 and 1974, respectively. From that time and until last year, the rate of renewals able to be funded had dropped steadily each year, falling to an all-time low of 46% in 1977, while the award rate for new applications also fell sharply. In FY 1978, seemingly all aspects of the NCI's research grant program received "a shot in the arm," and the award rate was no exception. During the last fiscal year, 39% of the recommended new applications and 56% of the renewals were awarded by the NCI, as compared to rates of less than 35 and 46% the previous year.

In simplest terms, this still means that more than 60% of the new applications that have been judged worthy of support on their scientific merit and more than 40% of the renewals, requesting support for studies that have already scored highly in scientific review, are going unfunded due to budgetary constraints.

Award rates for NIH, which had also been declining since 1975, experienced a similar resurgence, particularly for new applications. NIH award rates for new and renewal applications in FY 1978 were 44 and 61%, exactly 5% higher than the NCI rate for each type. This marked the first time since the National Cancer Act that NCI award rates for both types fell below those of the NIH, and its award rate for the 2 types combined is only about 60% of what it was a decade ago (FY 1968).

Although NCI's budget is significantly larger than that of other NIH institutes, the funding rate for its applications is not proportionately greater. This is because NCI has a much higher number of recommended applications than do the other institutes. Consequently, when NCI funds 50% of its applications, it is funding 3 to 4 times as many applications as another institute funding the same percentage.

A significant portion of NCI funds continues to be allocated for basic research. NCI, realizing the importance of these basic studies, has consistently argued for additional funding for all other NIH institutes, emphasizing that fundamental research for one disease is most often applicable to other disease processes.

Average Cost per Grant

Biomedical research, like all other areas of endeavor, has been seriously affected by inflation. The average cost per grant for NCI research programs, including traditional and center grants, has more than quadrupled over the last 15 years, rising from just under $30,000 in 1963 to over $130,000 in 1978 (Chart 9). This increase was due in large measure to NCI's decision to fund a greater number of higher-priced grants, such as program project and center grants, as well as to the increased costs of more sophisticated equipment, supplies, additional personnel, facilities, etc. The average cost per tradi-
tional grant alone was $27,000 in 1962 but nearly 3 times that ($78,000) in 1978.

A few select facts will illustrate the magnitude of the inflationary problem: the total number of NCI research grants (excluding manpower, construction, and control) increased by just 129 from FY 1977 to 1978, while the average cost of each of these grants rose by nearly $7,000; total research grant dollars increased by over $34 million (or 10.4%), yet, as just stated, this permitted the funding of only an additional 129 grants, 4.9% more than the previous year; and the average cost of all types of NCI research grants combined has more than doubled, from $66,000 to $133,000, in the decade since FY 1969. This has occurred while the total number of grants, the divisor in figuring average cost, has continued to increase.

Funding of Young Investigators

Because the growth of overall NIH funds has slowed in recent years, the scientific community has expressed concern that young investigators are not receiving an adequate share of the limited funds, with some of the most outstanding scientists in the country stating that not enough money has been awarded to academic institutions training future research scientists. Experience shows that new ideas in science most often come from young investigators, those more apt to be mavericks in their approaches to research.

However, the fear of young investigators being excluded appears unfounded. A detailed study performed by NCI on over 5000 applicants reveals that young investigators actually fare much better than their older colleagues in terms of recommendation and award rates (Chart 10). In FY 1976, the last year of the study, younger investigators clearly surpassed older scientists in the percentage of both traditional grant applications recommended, 70.2% versus 60.8%, and awarded, 52.6% versus 38.8% of those recommended. These figures remained consistent for 3 separate fiscal years (5).

As expected, the average award to young investigators was somewhat less, $55,400 per grant, compared to $63,400 for the older investigators in 1976; however, this disparity was the smallest in recent years. In addition, the disapproval rate for the older investigators was considerably higher than it was for the younger.

In FY 1978, NCI's Young Investigators Research Grants Program issued the first of its awards intended expressly for the support of promising young scientists. The Young Investigators Research Grants Program made 45 awards totalling $1.5 million in its first year. These encouraging developments indicate that young investigators are indeed receiving a significant share of the NCI funds, thus assuring a constant infusion of "new blood" into the National Cancer Program.

Foreign Research Awards

Awards to foreign scientists, on a continuous decline from...
1962 to 1971, increased as a result of the Act, which called for NCI support of "research in the cancer field outside the United States by highly qualified foreign nationals which research can be expected to inure to the benefit of the American people" (6). Such awards support collaborative research involving American and foreign participants, as well as the training of both American scientists abroad and foreign scientists residing in the United States.

Because many domestic research grant applications have gone unfunded, it was necessary for a time for the NIH to apply more rigorous criteria and standards of selection for research proposals originating outside the United States. Now, however, foreign applications compete on an equal basis with domestic proposals (no longer having to "be unique" or requiring "unusual personnel or resources"). NIH policy, established before the Act, also required that the proposed foreign research fulfill the mission of the awarding institute and that the application fall within the upper third of the priority score ratings. If it does not make the top third, a foreign application may be taken to the Board as a "Special Action," but it will still probably not be funded if its priority is lower than the upper limit for domestic awards. A recent more lenient policy, implemented in May 1979, allows foreign applications to be funded if they fall within the top half of the priority ratings.

NCI foreign research awards suffered slightly in FY 1978 as a result of the increased emphasis on domestic traditional research grant programs. After experiencing their greatest ever dollar increase in 1977, foreign grant awards fell by 6% to $2.1 million in 1978. Despite this decrease, NCI grants continue to constitute more than one-third of all NIH foreign research award dollars.

**Conclusion**

As a result of the National Cancer Act of 1971 and its amendments of 1974, support for the National Cancer Program has increased by nearly $700 million since 1970, with 1978 obligations totalling over $900 million. However, money alone will not solve the cancer problem; it will take the talents of individual investigators, coupled with increased opportunities in cancer research and accelerated exploration, to progress in this effort. It is for these reasons that NCI, through its grants program, has made every effort to maintain high levels of support for investigator-initiated research, as indicated by the data that have been presented. Fundamental knowledge gained from such research aids in our understanding of the cancerous process and can often be translated into materials and methods for cancer prevention and management that will benefit all Americans.

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