Impact of the National Cancer Act on Grant Support

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Summary

The National Cancer Act of 1971 resulted in a threefold increase in appropriations for the National Cancer Institute (NCI) within a 4-year period. A major effect was the increase for the Grants Program from $93 million in fiscal year 1970 to more than $280 million in 1974.

Grant programs, administered by the Division of Cancer Research Resources and Centers, account for more than 50% of the total NCI extramural research budget and fall into four broad categories: research, training (including fellowships), cancer control, and construction. With the exception of the training area, funding for all grant programs has increased dramatically as a result of the Act. The cost of research has also risen, as reflected in the average twofold increase in cost per NCI traditional grant over the past 10 years. This rise in cost is due to a number of factors, including inflation, more sophisticated equipment and supplies and, in some cases, more ambitious projects.

The principal type of research grants include traditional, awarded for investigator-initiated research projects, and center, awarded for comprehensive and specialized cancer centers. While support for traditional grants has remained in the forefront of NCI funding, money for cancer center grants has increased at a greater rate in recent years, reflecting emphasis on the development of cancer centers throughout the country.

Compared to other institutes at the NIH, NCI is in a very favorable funding position; in fiscal year 1974, NCI awarded more money for its research grant programs than all of the other institutes (with the exception of the National Heart and Lung Institute) obligated for their entire budgets.

The Act has stimulated a large increase in new cancer applications received, and the increased funding has made it possible for NCI to award a greater number of grants. Young investigators have competed well for the additional monies made available by the Act, and funding for cancer research outside the United States, still only a small part of NCI’s budget, has increased.

Introduction

The National Cancer Act of 1971 (12) and concomitant increase in funding for the NCI (2) 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 monies to cancer research might jeopardize other biomedical research 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 approval rates and award rates? Have young investigators received a fair share of the additional monies? This review will answer these and other questions and will focus on NCI grant-supported programs rather than budget formulation, which was discussed in a recent publication (9).

History

NCI is the oldest institute of NIH and the progenitor of many biomedical research programs funded by the Federal government. In 1937, the National Cancer Institute Act (6) was signed by President Franklin D. Roosevelt to establish “in the Public Health Service a division which shall be known as the National Cancer Institute . . .” in order to conduct “. . . studies relating to the cause, diagnosis, and treatment of cancer.” This Act authorized an appropriation of $700,000 for each fiscal year. In 1938, the National Advisory Cancer Council recommended approval of the first awards for fellowships in cancer research.

In 1944, the Public Health Service Act (8) incorporated the NCI as a division of the NIH. The Act also revised and consolidated into a single law the existing laws relating to the USPHS and removed the $700,000 limit on the annual appropriation.

Each year during the late 1950’s and early 1960’s Congress increased funds to the NIH, with NCI obtaining a large share of the appropriations. By 1967, however, annual appropriations to NIH, including NCI, began to plateau, and the cost of inflation was not offset. As a net result, NCI supported less research during 1967 to 1970 than in prior years. In order to continue funding new research projects, existing programs had to be reduced by 10 to 15%.
The Federal government, as of fiscal year 1969, was spending less than $200 million dollars a year for cancer research, or $0.89 per person. The paucity of this sum is better appreciated when one realizes that the annual expenditure per person for space research to land astronauts on the moon was $19.00 (10). This measure of national effort did not appear to reflect the impact of cancer, which is even more staggering now than in 1970. Fifty million Americans now living will eventually have some form of cancer, involving 2 out of 3 American families; about 1,295,000 newly diagnosed cases of cancer, including skin cancer, can be expected in this country in 1974; and about 355,000 will die from cancer during the current year (11).

As a step toward increasing the national effort against cancer, the National Cancer Act was signed into law by the President in December 1971. Before passage of this Act, the total NCI budget was $181 million; in fiscal year 1974, the total NCI budget was more than $580 million, including funds released by the Office of Management and Budget.

NCI Apportionments

The NCI, in order to fulfill its legislated mission, supports intramural and extramural studies relating to the cause, prevention, control, and methods of diagnosis, treatment, and rehabilitation of cancer. The Institute is organized into 5 major divisions to carry out its mission.

1. The Division of Cancer Cause and Prevention evaluates the etiology and natural history of cancer and mechanisms of cancer induction by viruses and environmental carcinogenic chemicals and conducts demographic studies to determine the causes of cancer.

2. The Division of Cancer Biology and Diagnosis directs the Institute’s general laboratory and clinical research activities, plans and manages collaborative programs in immunology and breast cancer, and serves as the national focal point for programs in detection and diagnosis.

3. The DCT evaluates cancer therapy and is responsible for development of a program utilizing combination modalities, including chemotherapeutic, surgical, radiological, and certain immunological techniques. In addition, this division administers a total drug development program.

4. The DCCR, the newest of the NCI divisions, supports contracts and some grants for the identification, field testing, evaluation, demonstration, and promotion of the widespread application of available and new methods for reducing the incidence, morbidity, and mortality from cancer and for rehabilitating the cancer patient.

5. The DCRRC is responsible for managing all grant-supported activities, including the review and coordination of programs involving investigator-initiated research, program projects, clinical cooperative studies, organ site programs, cancer centers, and manpower-training programs. DCRRC also manages grants for some of the programs supported by the DCCR.

Intramural research is conducted in NCI’s own facilities. The first 3 divisions are involved in some aspects of intramural research, as well as in studies done under contract. The last 2 divisions are concerned solely with the support of projects in institutions outside the NCI.

Chart 1 represents NCI programs for fiscal year 1974, indicating percentage of total obligations for each division within NCI. DCRRC obligated the largest portion, 48%; Division of Cancer Cause and Prevention, 19%; DCT, 13%; Division of Cancer Biology and Diagnosis, 7%; and DCCR, 6%, while Task Forces for cancers of the breast and lung and supporting services received 6%. Six % of the total obligations were used for construction, with 5% funded through the grants mechanism and 1% funded through contracts. Therefore in fiscal year 1974, the grants program was responsible for $280,585,000, which represents 48% of NCI’s total budget.

Research Grants (A)

Of the total dollars obligated for grants, 78% was used for research, 11% was for construction, 9% was for training, and 2% went for cancer control (Chart 2). Within the research grant programs, traditional grants received the largest portion of the obligations, $93,775,000 or 43%. Traditional grants are awarded for research projects directed by individual investigators and are the main type of extramural program supported by NCI and NIH. Despite recent emphasis on centers, support for individual investiga-
Training Programs (C)

The Clinical Trials Program operates in close association with the DCT and is responsible for supporting more than 20 Clinical Cooperative Groups involved in multiprotocol treatment studies using combined modalities. Cooperative studies at first involved only chemotherapy but have expanded to include surgery, radiation therapy, and in some cases immunotherapy.

In association with clinical trials, the Supportive Care Program funds blood platelet research for the management of thrombocytopenia (decrease in blood platelet level) in leukemic patients undergoing intensive chemotherapy. This program also supports research on reverse isolation techniques designed to prevent serious infections in patients treated with anticancer drugs; such infections cause death in as high as 60% of patients with acute leukemia (1).

The National Organ Site Cancer Program consists of grant-supported national projects of targeted cancer research. Each national project is a planned and integrated research effort oriented toward cancer of a specific organ site. To date, organ site programs have been organized for cancers of the bladder, large bowel, and prostate; plans for additional national projects are now being considered.

The Career Awards item in Chart 2 includes Research Career Awards and Research Career Development Awards, initiated in 1961 by NIH. The first of these were made to well-established, highly regarded scientists until mandatory retirement. Since this program was discontinued in 1964, NCI presently supports only 9 awardees. The second program was designed to foster the development of young scientists with outstanding potential for careers of independent cancer research. NCI presently supports over 60 awardees.

GRSG's are awarded to institutions receiving at least $100,000 in other grant support. GRSG funds allow an institution to provide "seed" money to beginning investigators and interim support to experienced investigators. Scientific Evaluation, listed on Chart 2, represents money spent for the review of grants.

Construction (B)

The 1971 Act gave NCI the authority for construction. As a result of the National Cancer Act Amendments of 1974 (5), NCI is now able to "award grants for new construction as well as alterations and renovations for improvement of basic research laboratory facilities, including those related to biohazard control, as deemed necessary for the National Cancer Program." This new authority is particularly important for the expanded effort in the development and planning for new cancer research centers. In fiscal year 1972, the first year of the Construction Program, NCI awarded $44 million to 17 institutions; in 1973, it awarded $33 million to 17 institutions, and in 1974, $32 million were allocated to 8 institutions.

Training Programs (C)

At present, there are 4 training programs, all in the process of being phased out. The "old" clinical training program, established to upgrade cancer teaching in medical and dental schools, and the graduate training program, for pre- and postdoctoral traineeships, will be completely phased out by the end of fiscal year 1978. In fiscal year 1974, 2.6% of total grant money was obligated to the Clinical Training Program and 3.6% was obligated to the Graduate Training Program. Fellowships, awarded directly to individuals, rather than to institutions, for research training either in the United States or abroad account for 2% of the total 1974 budget for grants. The NIH Research Manpower Program was introduced in July 1973 by the Secretary of the Department of Health, Education, and Welfare. In response to this program, NIH received over 3,000 applications, 550 of which were assigned to NCI; of these, NCI awarded 361. Budget levels for these 4 programs decreased from $18.4 million in fiscal year 1972 to $13.9 million in 1973, but with the release of impounded training funds by the Office of Management and Budget this amount increased to $23.6 million in fiscal year 1974.

To replace legislative authority for the programs now being phased out, the President signed into law the National Research Service Award Act of 1974 (7). Awards made under this new Act may be made either to individuals for research projects or to institutions that will select individuals for training in research. These awards will be made for pre- and postdoctoral training but not for M.D. residency training. Because of special authority provided by the National Cancer Act of 1971, NCI will also be permitted to make awards for certain types of clinical training. The 1974 Act requires that all awards be made in areas where there is a shortage of manpower, as indicated in studies by the National Academy of Sciences.

NCI will also administer the new Clinical Education Program, designed to foster the educational aspects of the old Clinical Training Program. Initially, this program will receive $4 to $5 million for fiscal year 1975.

Cancer Control (D)

In fiscal year 1974, $6 million, 2% of the budget for DCRRC, was awarded for grants in the area of cancer control. Beginning in fiscal year 1975, cancer control grants will continue to be administered by DCRRC but will be supported by funds from the newly formed DCCR.

Funding by Mechanism

NCI obligations continued upward until 1967, when increases began to level off; by 1970 there was actually a slight decrease. Between 1967 and 1970, inflation caused a significant cutback in research "buying power."

Chart 3 indicates that funding for contracts increased significantly in 1965. This was the year the Special Virus-Leukemia Program (now the Virus Cancer Program) was established with a starting sum of $10 million to expand and intensify research on viruses and leukemia and other related diseases, making NCI the first institute to engage in any large-scale contracting programming at NIH. Other areas of categorical disease research included acute leukemia, the
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Funding Comparison by Grant Type

Traditional Grants. Recognizing that many advances have resulted from traditional, i.e., investigator-initiated research grants, NCI and the other institutes at NIH have funded competing renewal and new applications at the highest levels their budgets would allow. In 1962, $30 million was awarded for traditional grants but only a few million for center and program project grants (Chart 4). However, in 1968, when the dollars obligated by NCI began to plateau as funds appropriated by Congress leveled off, there was a downward trend in the number of individual or traditional grants awarded with a resultant decrease in dollars awarded. This was due mainly to the decision to maintain ongoing projects at the expense of new proposals and to fund centers and program projects at continuously higher levels.

Funding of centers was increased so that there could be continued, rapid translation of biomedical knowledge to patient treatment. Program projects were sustained since they involved several investigators working conjointly, rather than the single principal investigator supported by a traditional grant. Highly qualified investigators who did not receive grant funds for individual research projects were, in some cases, picked up by the larger program projects (4).

With passage of the Act, there has been a dramatic reversal in number of traditional grants awarded, surpassing considerably the high point of 1965. NCI, in fiscal year 1974, awarded more than 1600 traditional grants, an increase of 25% over the previous year; at the same time chronic leukemias and multiple myeloma, lymphomas and Hodgkin's disease, breast cancer, brain tumors, solid tumors, choriocarcinoma, and lung cancer.

Gains in cancer research depend on a broad scope of biomedical sciences that involve the broadly based research strategy of the National Cancer Plan. The Plan is committed to 2 main thrusts, an intensified effort in all aspects of fundamental research and an intensified emphasis on quick follow-up of new scientific leads in a planned and coordinated fashion. The grant programs are responsible for supporting basic research proposed by individual investigators as well as those working as a team. The contract programs, in addition to supporting some basic science, are principally responsible for funding applied research or research that lends itself to stepwise advancement.

Since passage of the National Cancer Act, NCI total obligations have more than tripled, clearly manifested by the increases in grant and contract support and funding for intramural programs. At no time, however, have the contract programs received more than 50% of NCI extramural research obligations. The National Cancer Advisory Board has stated that at least 50% of the total NCI obligations should be used to fund grant programs. It is anticipated in the next few years that the grant programs will receive as much as 50 to 60% of the total obligations.

Chart 3. NCI obligations for fiscal year 1964 to 1974.

Chart 4. NCI traditional grants, center grants, and exploratory projects.
there was a 35% increase in dollars awarded, $70 million in 1973 compared to $94 million in 1974.

In 13 years, total dollars awarded by the Institute for investigator-initiated research has increased more than 3-fold. Unfortunately, appropriations for the other institutes at NIH, with the exception of the NHLI, have not increased, at least not enough to offset inflation.

As a result of the decrease in budgets of the other institutes, NCI is making every effort to fund outstanding applications assigned initially to other institutes but not payable because of lack of funds. These applications are designated as dually assigned, with NCI the secondary assignee, since the proposed research is relevant to programs supported by both institutes (3).

In the last 3 years alone NCI has funded more than 50 traditional grants for which it was secondary assignee. This is in keeping with the Institute's philosophy that outstanding fundamental research should be supported because much information about biological processes is potentially relevant to the cancer problem.

Center and Program Projects Grants. One of the goals of NCI for more than a decade has been the development of multidisciplinary cancer research centers. The trend for center grants has been continuously upward, even when obligations for traditional grants plateaued and then decreased during fiscal years 1965 through 1970. The National Cancer Act of 1971 gave further stimulus to this trend by calling for the development of 15 new Comprehensive Cancer Centers, a vital element in the intensified development and implementation of a nationwide cancer program. The 1974 amendments to the Act (5) removed this limit on the number of Comprehensive Cancer Centers.

Presently, NCI recognizes 2 types of cancer centers, comprehensive and specialized. A Comprehensive Cancer Center is defined as a multidisciplinary cancer program which meets all the scientific and administrative criteria considered essential by the National Cancer Advisory Board (2). Such a program usually is supported by a core grant along with program project and traditional grants, as well as contracts. The goal of these centers, in addition to multidisciplinary research on all types of cancer problems, is translation of research results into general clinical practice so that no citizen will be denied appropriate professional advice and care because of lack of facilities and current knowledge.

Until only a few years ago, cancer research institutions were the base from which Comprehensive Centers developed. Now, medical schools across the country are an important part of this base because they not only provide competent investigators in fundamental research but also train the physicians ultimately responsible for the care of cancer patients.

Centers other than comprehensive are referred to as Specialized Cancer Centers. These too consist of multidisciplinary cancer programs that usually, but not always, involve clinical investigations and contain some, but not all, of the elements characteristic of a Comprehensive Cancer Center. Such a program may be supported by the same type of grants and contracts as a Comprehensive Center, except that it may not have a core grant.

Core grants will be used more extensively in the immediate future. They are designed to support the administration, common services, and collaborative activities of cancer centers and to provide "seed" money for development of new programs within the centers. Large "umbrella" grants used for multiple research projects will be deemphasized and phased out, and individual components of these grants may be supported by traditional grants. The use of core rather than "umbrella" grants will facilitate and improve the quality of the review process itself as well as fiscal accountability.

Institutions may plan the development and operation of a cancer center with support provided by an exploratory grant. As indicated in Chart 4, the number of exploratory projects has increased considerably over the last few years, although dollar amounts have remained relatively modest. This type of grant has permitted institutions, with the participation of community leaders, to examine and analyze carefully various options for developing a program consistent with local needs and organizational structure.

NCI and NIH Funding Comparisons

NCI is one of 11 institutes of the NIH. The other institutes include: National Eye Institute; Dental Research: Allergy and Infectious Diseases; Neurological Diseases and Stroke; Child Health and Human Development; Arthritis, Metabolism, and Digestive Diseases; General Medical Sciences; NHLI; Environmental Health Sciences; and Aging, authorized just this year. Chart 5 includes funding patterns for all institutes except the National Institute of Environmental Health Sciences and the National Institute of Aging.

Distribution of Funds. Because NCI has a broader mandate than the other institutes, it allots a lower percentage of its budget for research grants. As indicated in Chart 5, NCI allots a greater percentage of its budget for contracts than do the other institutes and, in addition, supports 2 unique programs, construction and cancer control. In spite of the way NCI divides its budget on a percentage basis, it still awards more total dollars for its research grant programs alone than the other institutes obligate for their entire budgets, with the exception of NHLI.

Competing Awards. Chart 6 compares the number of competing research grants awarded by NIH with those of NCI. From fiscal years 1966 to 1970 the number of grants awarded by both NCI and NIH decreased steadily, but the number of grants awarded by NCI beginning in 1971 increased dramatically as a result of the Act. In fiscal year 1974 NCI awarded almost twice as many grants as it did in fiscal year 1970, the nadir year for grants awarded. The slight upward trend in number of grants awarded by NIH collectively reflects the additional funding for NCI and NHLI. The dotted line indicates that, if NCI and NHLI grants are excluded, the trend for the remaining institutes was downward until 1974.

Increase in Applications. As a result of the Act, NCI has
received and reviewed more applications than ever before in its history, thus reversing a downward trend experienced in the early 1960's. As indicated in Chart 7, new applications, those requesting support for research projects not previously funded, have been responsible for the large total increase in applications reviewed. Renewal applications, those requesting continued support for previously funded projects, are reviewed in a cyclical pattern (Chart 7, lower line), since grants are awarded for 2, 3, or 5 years.

Of major importance to cancer research is the fact that NCI has also awarded more grants than ever before in its history. While NCI may not have funded as large a percentage of its total approved applications as some of the other institutes at NIH, it has funded a larger number of investigator-initiated grants than each of the other institutes.

Traditional Grants: Approval 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 8 and 9). In the case of NCI, award rates started to fall off dramatically beginning in 1968 as a result of the leveling off of Congressional appropriations. Consequently, there was a steady downward trend in the percentage of traditional grants awarded, particularly new grants; in 1970 the Institute reached its all-time low level, awarding only 30% of approved new grants. With passage of the Act of 1971 this trend was reversed. Within the last 4 years, at least 50% of all approved new applications have been awarded.

As might be expected, the award rates for renewal applications are higher than for new applications, since renewal applications request support for studies that have previously passed scientific review. Award rates for renewal applications also fell off dramatically in 1968, reaching a low point in 1970. In the following years the rates improved, so that in 1974 NCI was able to fund 59% of all approved applications (54% new; 79% renewal), an increase of 23 percentage points as a result of the Act.

Chart 8 shows that, on the average, approval rates for NIH renewal grants are about 25 percentage points higher than the rate for new grants. The NCI approval rate for renewal grants has ranged between 60 and 90%, and for new grants it has ranged between 40 and 70%. Immediately fol-
The year before the Act, more than 70% of NCI new applications went unfunded, representing a significant loss in fundamental cancer research. In fact, NCI funded a lower percentage of approved applications than did NIH collectively. This trend was reversed with passage of the Act.

However, the funding rate for NCI applications still is not dramatically greater than the rate for other institutes at NIH, in spite of the large increase in NCI funds. This is because NCI has a far greater number of approved...
applications than do the other institutes. Consequently, when NCI funds 50% of its applications, it is funding 3 to 4 times more applications than another institute funding the same percentage.

Funds for NCI-supported programs have increased since passage of the National Cancer Act of 1971, but not at the expense of basic research; the Institute is funding more basic research now than ever before in its history. At the same time, the budgets for other institutes have decreased; however, there is no evidence that the increased funding of cancer research has been responsible for the decreased funding of other biomedical programs. In fact, NCI, realizing the importance of other research, has consistently argued for additional funding for the other institutes at NIH, emphasizing that fundamental research for one disease is frequently applicable to other diseases.

Average Cost per Grant

As in all areas, inflationary costs have seriously affected the biomedical community. The average cost per grant for NCI research programs, which includes traditional and center grants, was just under $30,000 in 1962 compared to over $100,000 in 1974, an almost 4-fold increase in 13 years. This large increase was due to NCI’s decision to fund a greater number of higher priced grants such as program project and center grants, as well as increased costs of more sophisticated equipment and supplies, additional personnel and facilities, etc. The average cost per traditional grant alone was $30,000 in 1962 but double that in 1974.

Until 1970, as the average cost per grant increased, the number of grants awarded dropped significantly, from about 1600 in 1962 to about 1000 in 1970. This trend was reversed with passage of the Act.

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. Some of the country's most outstanding scientists have stated that not enough money has been awarded to academic institutions, where the brightest students learn to become 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.

Of those investigators 35 years of age and under applying for research support, 52% were funded for $3.1 million in fiscal year 1972, and 35% were funded for $3.6 million in fiscal year 1973. Of those applicants older than 35, only 32% were funded for a total of $9.2 million in 1972 and 25% for $12.3 million in 1973. As expected, the average award to younger investigators was somewhat less, $36,400 per grant, compared to $47,600 to the older investigator in 1972 and $42,800 and $54,700, respectively, in 1973. In addition, the disapproval rate for the older investigators was considerably higher than it was for the younger. Therefore, as the data indicate, young investigators did quite well in 1973 and "new blood" is being infused into the National Cancer Program.

Foreign Research Awards

Awards to foreign scientists started on a downward trend even before there was a marked net loss in funds available for research in this country (Chart 12). As new domestic research grant applications remained largely unfunded, it became necessary to apply more and more rigorous criteria and standards of selection for research proposals originating outside the United States.

An investigator doing research in a foreign country must meet certain criteria over and above the requirements for awards made in the United States. Research in another country must be unique in the sense that the same work is not being done in this country and that it cannot be done

FUNDING STATUS

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AVERAGE APPROVED FUNDED AWARD = $42.8 THOUSAND

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AVERAGE APPROVED FUNDED AWARD = $54.8 THOUSAND

Chart 11. Age of applicants and funding status for new NCI traditional grants in fiscal year 1973.
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Cancer research and more promising areas for accelerated exploration than ever before. 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 be translated into the materials and methods for cancer prevention and management that will benefit all Americans.

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