Grant Length and Budget Stability at the National Institutes of Health

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Summary. Decreasing the length of grant awards for biomedical research has been suggested as a means of ensuring greater accountability. An analysis of grant programs of the National Institutes of Health and, in particular, at the National Cancer Institute, revealed that the length recommended for grants is closely related to their perceived scientific merit. A principal conclusion is that selectively increasing the length of grants for only the most outstanding applications competing for renewal might improve research productivity while reducing research costs and easing the growing burden on the peer review process.

The review committees at the National Institutes of Health (NIH) have tended in recent years to shorten the lengths of grants for biomedical research, a trend that has caused debate both at NIH and in the world it serves.

Proponents of longer term grants argue that a system in which researchers must compete repeatedly for federal funds creates instability in the research community and takes away from research time. They maintain that more frequent, and thus more numerous, applications also put unnecessary pressure on the already overburdened peer review process and may discourage outstanding scientists from serving on review groups.

Advocates of shorter term grants say that the hardships are outweighed by the increase in accountability, improvement in budgetary flexibility, and the increased availability of funding for innovative and unorthodox research. Somewhere in the middle are those who would like to alter the lengths of grants for some or all of the above reasons, but who recognize that a major change might result in significant budgetary instability. Although NIH is seeking to maintain as high a level of funding stability as possible in the face of economic constraints, nevertheless it must avoid committing funds on a large scale for any extended period.

For this reason and on the basis of several models developed at NIH for projecting the effect on the budget of selectively increasing the lengths of grants, it appears that an increase can be recommended only for applications competing for renewal that receive the highest priority ratings from reviewers.

The NIH receives both new grant applications and applications to renew grants beyond the period previously recommended. These applications must compete for the funds available at a particular institute for research support. A large proportion of the funds—somewhere between two-thirds and three-fourths of the research budget—are already committed each year to what are termed noncompeting renewals, that is, continuations of grants for the project periods recommended during the review process.

In this article I discuss only competing grant applications, both new and renewal, including those for traditional grants—research projects initiated and conducted by individual investigators—and those for program project grants, which support multidisciplinary efforts of a relatively large group of investigators. Traditional grants are by far the most numerous.

Dual Review

Applications to NIH undergo a two-stage review. First, the NIH Division of Research Grants assigns the application to an initial review group (IRG), which is a peer review panel, and to the appropriate bureau, institute, or division. The members of IRG's, usually 12 to 16 scientists appointed for 4-year terms, are chosen from outside the government. Most are from universities and are widely recognized as experts in their specific disciplines.

The second part of the dual-review process includes a council review (*1*). Each grant-awarding unit in the NIH has a national advisory council that must review the work of the IRG's and recommend approval of an application before a grant can be awarded. National advisory council members are appointed for 4-year terms by the secretary of the Department of Health and Human Services on the advice of the particular institute concerned. Half of the members must be authorities in scientific and health fields directly related to the program interests of the Institute; the others are lay members who are noted for their interest or activity in national health problems. The councils usually accept an IRG appraisal with regard to scientific considerations, but they may have occasion to modify the recommendation for various reasons, such as a determination of the needs of the NIH and the missions of the individual institutes, the total pattern of research in universities and other institutions, the need for the initiation of research in new areas, the degree of relevance of the proposed research to the missions of the institutes, and other matters of policy.

In the case of the National Cancer Institute (NCI), the IRG makes recommendations to the National Cancer Advisory Board, a 29-member council appointed by the President. The board reviews all IRG recommendations, and the Institute then funds, usually in priority order, as many of the recommended applications as its budget allows. This figure, the number of grant awards as a percentage of the number of recommended applications, constitutes the award rate.

The Trend Toward Shorter Grant Periods

Throughout the NIH, 7-year grants have been phased out—the last 7-year grant was awarded in 1966 (*2*). The 5-year grants at NCI have recently dropped to 10 percent of the competing research grants awarded annually (Fig. 1). But the only clear trend discernible is the generally steady increase in 3-year awards, which have risen from 45 percent (in 1967) to 71 percent of all awards (79 percent of all new traditional grants). These percentages are based on approximately 1100 grants in 1967 and approx-

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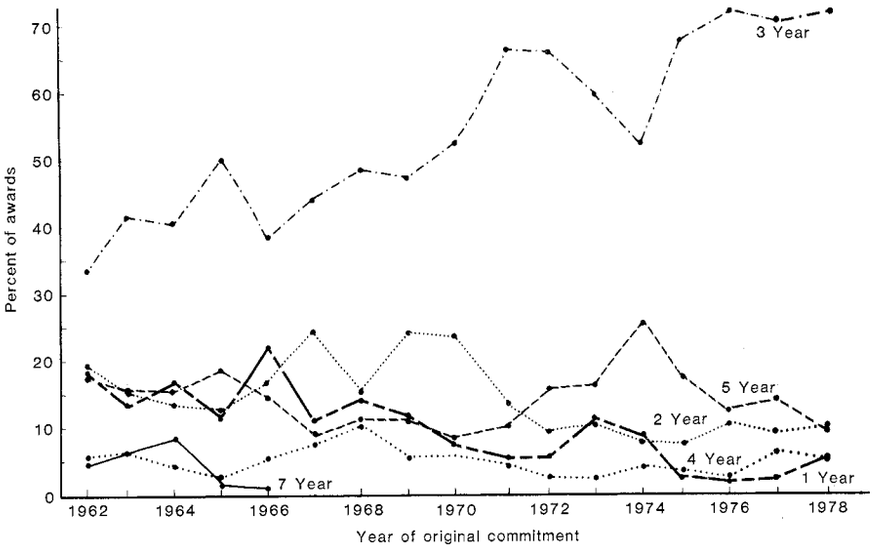


Fig. 1. Length of commitment for research grants at the National Cancer Institute. New grants and those renewed are included but supplements are not included.

imately 1900 grants a decade later. The trend to award 3-year grants appears to hold throughout NIH in that the average length of research grants at all institutes has been between 3.0 and 3.1 years for the last 5 years (*3*).

The NIH gives two main reasons for shortening grant lengths or terms. (i) The NIH budget for research grant support has failed to keep pace with the biomedical inflation factor (*4*) for the past several years. (ii) Tighter budgets have created demands for increased accountability in disbursing research funds. This pressure for more accountability has come in part from the scientific community itself, from Congress, and from the public. It was heightened by a 1976 report by the General Accounting Office (*5*) that called on NIH to review grants annually to ensure that "those [projects] with the greatest scientific merit are funded."

The NIH opposed the recommendation for annual review, arguing that research cannot be evaluated as easily as the report implied (*6*):

> Most scientists agree that it takes approximately two to three years for most projects to be developed enough to produce the kind of tangible results necessary to evaluate progress. That the average period of support recommended by the peer review groups is about three years attests to this judgment. In most instances, sufficient evidence would not be available in less time on which to make intelligent funding decisions.

Nonetheless, pressure is growing from the Congress and the public for scientific breakthroughs and demonstrations of the results of research—clear evidence of improved treatments, cures for chronic illnesses, and immediate respite from the staggering costs of health care. The pressure has been particularly intense on the NCI whose budget has quadrupled since the National Cancer Act of 1971 and which is now being asked to account for its unprecedented congressional support (*7*).

At the same time that the lengths of grants have been decreasing, both new and renewal applications have risen dramatically. At NCI, for example, 23 percent more applications were received in fiscal year (FY) 1977 than in the previous year (Fig. 2). Since the National Cancer Act of 1971, the number of applications has more than tripled, but the number of initial reviewers or study section members has increased by just 14 percent. A similar pattern exists for the NIH as a whole; 2223 more grant applications were reviewed in FY 1977 than in FY 1976, an increase of more than 14 percent; the number of reviewers, however, increased only from 780 to 789, an increase of 1.2 percent (*8*).

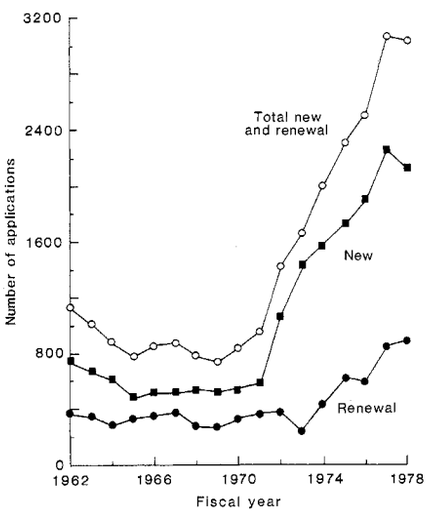


Fig. 2. Competitive research applications reviewed by the National Cancer Institute. Figures include all programs except construction, training, careers, fellowships, scientific evaluation, cancer control, and biomedical research support grants.

The increasing burden on the review process means that the NIH may have difficulty recruiting outstanding members for its study sections, that the quality of reviews could suffer as a result of the sheer number of applications, and that the quality and productivity of biomedical research could suffer if too many scientists are drawn away from their laboratories to review the work of others. While it is difficult to generalize about the average time required to review a single grant application, the burden on reviewers can be characterized by the fact that nearly 25,000 applications must be reviewed annually—a process that takes from 7 to 9 months to complete.

Shorter versus Longer Grants

Of primary concern in evaluating the feasibility of increasing the percentage of grants awarded for 4- or 5-year periods throughout NIH is scientific merit. The advantages and disadvantages of various grant lengths must also be considered from the point of view of both the sponsor and the recipient. For the federal government and, by extension, the public, the major advantages of shorter grants are increased accountability and economy. Theoretically, by limiting initial funding to 2 or 3 years, the awarding institute can scrutinize research productivity, cut short unproductive projects, and redirect funds into the most promising areas. It then becomes possible to fund (i) more projects that appear likely to yield valuable information even though they received good but not outstanding priority ratings, because of reservations by review group members; and (ii) more young investigators (*9*) and a wider range of research, including more high-risk and unorthodox projects.

On the other hand, longer term grants, which provide greater stability for the scientific community as well as for individual projects, allow for the funding of research that requires extensive laboratory or clinical facilities and studies that are likely to require time to collect detailed data. No researcher can afford to assemble a highly qualified staff, clinicians, technicians, and consultants, as well as complex laboratory equipment, when funding may be terminated while the project is still in its initial stages. Furthermore, to prematurely discontinue research designed to produce results over a longer period can be just as wasteful as continuing to support unpromising endeavors.

In addition, shorter term grants, which require researchers to prepare applications more frequently, necessarily detract from the time that can be spent on research (*10*). In this circumstance, scientists might liken themselves to the politician who must constantly run for reelection.

Frequent applications are expensive for NIH as well as for the applicants. The NIH Division of Research Grants estimates that, even allowing for inflation, the average administrative cost of reviewing a single grant application—now approximately $911 (*8*)—has more than doubled over the past decade. The largest increases have come in consultant travel fees, staff salaries, and computer operations and reproduction costs (*11*).

Length of Grants and Priority Scores

Short-term grants have some clear disadvantages, but the use of longer grants to ease the burden on the review process can be defended only if the merit of all research being supported will not be diminished. A reliable indication of the relative importance or scientific merit of a research proposal at NIH is the priority score assigned by the IRG to an application recommended for funding (*12*). Funding determinations are principally made, within the available grant budget, according to the relative ranking of applications as determined by priority scores. But, whereas in the 1960's as much as 95 percent of the recommended applications were funded; in 1980, only 30 to 40 percent can be funded.

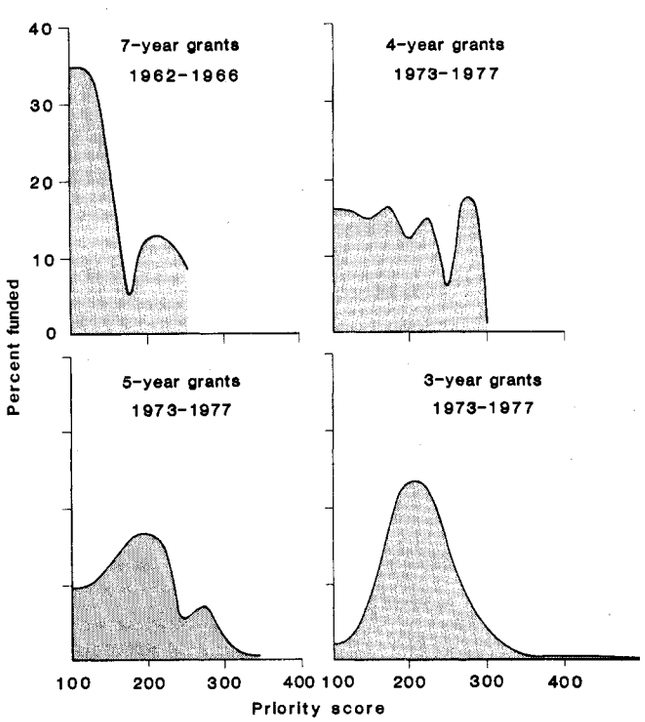
If peer reviewers have historically tended to approve longer grants only when they view the proposed research as outstanding, it is reasonable to assume that, should grant lengths be selectively increased, a similar standard would prevail. To assess the past correlation between the period for which a grant was awarded and the perceived scientific merit of the project, the priority scores for NCI grants of various lengths were examined.

To arrive at a priority score, the reviewers weigh various criteria in assessing scientific merit: the importance of the proposed research problem; the originality of the approach; the training, experience, and research competence or promise of the investigators; the adequacy of the experimental design; the suitability of the facilities; and the appropriateness of the requested budget to the work proposed. The final decision of the review group is made by majority vote of the members. Each IRG member also then assigns a number from 1 to 5 (1 being the highest) to applications. The results are averaged and multiplied by 100 to produce the raw priority score (*13*). The review group as a whole makes a recommendation about length after deciding whether the applicant's requested project period is justified and reasonable. If the reviewers believe that the requested projected period is necessary to achieve scientifically valid and important objectives, cost is not a factor in recommending that length.

Figures 3 and 4 illustrate the relation between lengths of grants and priority scores at NCI. Data were obtained for recipients of investigator-initiated grants and program project grants that were awarded for 3, 4, 5, and 7 years. New grants and grants that were renewed were treated separately (Figs. 3 and 4, respectively) because the award rates are much higher for renewals than for new applications.

Data were included for all 7-year grants awarded between FY 1962 and 1966, the last year that 7-year grants were made (*14*), a random selection of half of all 5-year grants awarded between FY 1973 to 1977, since these were more than twice as numerous as 4-year grants, and all 4-year grants awarded between FY 1973 to 1977, which constituted an average of only 3.8 percent of all grants per year. Because of the large number of 3-year grants, the percentage in each priority score range (100 to 125, 126 to 150, and so forth) was used, and similar percentages were computed for 4-, 5-, and 7-year grants. Percentages were based on the total number of grants in each category. For example, 1956 3-year grants awarded between FY 1973 and 1977 were selected for comparison; of these 35, or 1.8 percent, fell in the 100 to 125 priority score range.

Priority scores are referred to as ex-



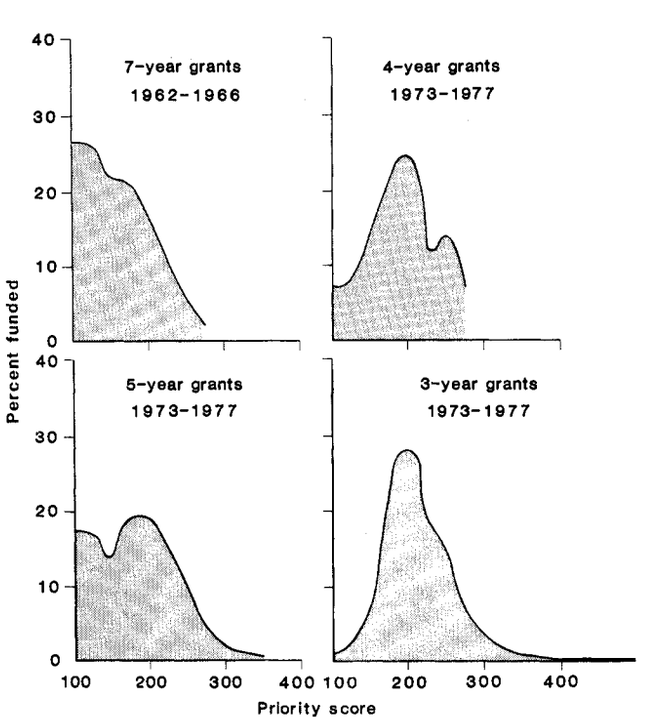


Fig. 3 (left). Relation between new grants awarded by the National Cancer Institute for various periods of time and priority scores assigned by initial review panels (100 is the highest priority score). Fig. 4 (right). Relation between grants renewed by the National Cancer Institute for various periods and priority scores (100 is the highest priority score).

ceptional (100 to 150), highly recommended (151 to 200), recommended (201 to 250), meritorious (251 to 300), or worthy if funding available (300 plus). Priority scores are, however, more indicative than precise in evaluating relative scientific merit. Because the NIH believes that real differences in merit are reflected by differences of as much as 30 points or more (*6*), ratings were set up in 50-point ranges for this study (*15*).

If those research projects judged by the initial review groups to be most deserving are receiving funds for longer periods, a correspondingly higher percentage of the longer term grants could be expected in the best priority score ranges. Figures 3 and 4 indicate that a marked distribution of longer term grants in the better priority score ranges does in fact exist (*16*).

The relation is especially evident for renewal applications (Fig. 4), in that 48 percent of all 7-year grants received priority scores in the exceptional range, 38 percent received priority scores in the highly recommended range, 10 percent received recommended ratings, and only 2 percent received the worthy if funding available rating (*17*). As the length of award decreased, so did the number of grants receiving more favorable priority scores. For example, 32 percent of 5-year, 19 percent of 4-year, and only 10 percent of 3-year awards received exceptional priority scores, but 39 percent of 5-year, 47 percent of 4-year, and 44 percent of 3-year grants received priority scores in the recommended, meritorious, or worthy ranges. Figure 3 indicates that there is a similar correlation between longer grants and better priority scores for new applications as well.

By and large, the initial review groups have tended to limit the recommended period of performance to 3 years for applications with priority scores in the middle ranges and to 4 or 5 years for applications in the higher ranges. When 7-year grants were awarded, it appears that they were reserved for the highest priority applications.

NIH Studies on the Grants Process

Three studies completed at NIH in 1979 underscore the range of viewpoints on the question of lengths of grants. The first was a survey of opinions, attitudes, and suggestions elicited from senior executive staff in all the institutes. The other studies include one that appears to call for maintaining present project periods, and one that supports increasing the lengths of some grants.

Overall NIH study. This survey sought opinions concerning "thinner grant applications and longer awards." All 11 directors of bureaus, institutes, and divisions responded; 8 favored increasing the average length of grants, at least in principle, and 3 recommended no change from the current 3-year average. None was in favor of shortening grant lengths, but the directors did question the feasibility of lengthening periods of performance. Briefly, the survey revealed that (*18*):

> With respect to proposed efforts to reduce the size of grant applications and encourage longer award periods, there is general support for the former but widespread concern about the latter (*19*). The data analyses and commitment base forecasts provided by the NIAID [see the National Institute of Allergy and Infectious Diseases survey below] were particularly effective in underscoring the need for caution in doing anything that would effect the average length of awards.

Table 1. The relation between priority scores and recommendations for reductions in grant periods is shown for 692 randomly selected grant applications in FY 1979.

Normalized priority score	Applications recommended for reductions in period of support			
	New		Renewal	
	N	Percent	*N*	Percent
100 to 150	1	1	1	2
151 to 200	8	10	11	16
201 to 250	22	27	30	44
251 to 300	23	28	19	28
301 to 350	20	24	6	9
351 to 400	6	7	1	2
401 to 500	2	2	0	
Total	82		68	

After this survey, the Office of the Director, NIH, studied factors that might affect a proposal to increase grant periods. Among the findings were the following. (i) Most applicants only request 3 years of support, and the majority of these are recommended for 3-year grants. (ii) Most applications are recommended for the period of support requested (72 percent of new applications and 56 percent of those competing for renewal). (iii) More applicants competing for renewal of their grants request longer periods of support than do new applicants, which undoubtedly contributes to their applications being reduced more often. (iv) Reductions in dollars are more frequently recommended than are reductions in length (*20*). In addition, results from an FY 1979 survey of 692 applications that were reduced in period indicate that recommendations for reductions are most often made for applications receiving normalized priority scores (*13*) in the 200 to 300 range (Table 1).

Recognition should be given to the fact that a feedback mechanism exists between reviewers' actions and applicants' submissions. Through interaction with peers who are members of initial review groups, applicants learn about the prevailing climate in Washington and structure their requests accordingly. The NIH found that during one 5-year period, the average number of years of support requested was 3.5, and the average number of years recommended was 3.0 for both new and renewal applications combined. The number of applications evaluated in any one review cycle had no apparent bearing on this trend. Among the institutes, however, variations in average grant lengths can be found (*21*).

With respect to dollar awards, the picture is more complex. First, there are many more new applications than requests for renewals; for example, there were 9300 new applications and 3800 applications for renewals in FY 1978. Second, more applications for renewals are recommended for funding than new applications (92 percent versus 72 percent). Third, the total dollar difference between the amount requested and the amount recommended is comparable for the two types of applications; for example, $497 million was cut back from the 9300 new applications in FY 1978, and $415 million was trimmed from 3800 applications for renewals. The conclusions that can be drawn are that applications for renewals contain larger dollar requests than the average new application and that these are then cut back appreciably by the review panels. Investigators apparently "up the ante" with successive applications.

Retaining present policy on grant lengths. An analysis of grants that was conducted by the National Institute of Allergy and Infectious Diseases (NIAID) led to the conclusion that grant lengths should not be increased. This determination stemmed from the finding that (*22*):

> A large number of [NIAID's] applications—particularly the new ones—are approved for three years. Of those that are approved for three years, about 75 percent reapply at the end of three years. However, it is interesting that less than two-thirds of those that reapply get refunded. We interpret this to mean that there was good reason for approving the application for only three years and that the application only deserved that trial period.
>
> Based on the evidence that a large number of our three-year awards were seriously in need of examination and review at the end of three years, we do not favor longer awards.

Selectively increasing grant lengths. A study conducted by the National Institute of Neurological and Communicative Disorders and Stroke (NINCDS) of applications received between FY 1975 and

1979 concluded that some "established investigators of excellence" merited support for longer periods. The NINCDS has proposed an investigator program project award designed to provide such investigators with "stability of support . . . to encourage their attention to the more difficult and sometimes unpopular research problems" (*23*). Among the unpopular studies are investigations in epidemiology and carcinogenesis that require many years of data collection and yield fewer publishable results.

The NINCDS suggests the following advantages of its proposed investigator program project award. (i) A decision about long-term funding would be made through a review of accomplishments and a summary of problems to be addressed rather than through an assessment of proposed work. (ii) It would encourage investigators to address difficult research problems rather than safe ones. (iii) After 3 years, the grant would either be renewed for up to 5 years, or the investigator would be notified a year and a half in advance to seek support through the traditional research grant mechanism.

An observation made in the NINCDS study, that "the better the priority score, the longer the average recommended award period" (*24*), holds true throughout the NIH in that there appears to be a clear demarcation between applications with raw priority scores between 100 and 149 and those with numerically high (less favorable in this instance) scores (Table 2). There is also a clear distinction between new applications and applications for renewals; both the period of support requested and the period of support recommended are longer for renewals.

Budget Stability Models

The view that biomedical science and the public interests it serves would benefit from a stable level of funding for NIH research projects is attracting wide support. To address this issue, the NIH Division of Research Grants was asked to develop several models for generating alternative projections of total NIH awards for research. The models use the President's FY 1980 budget as a base and attempt to project various effects of reaching and maintaining a specified number of awards in as few years as possible (*25*). These so-called stability models take into account the factors necessary for maintaining fiscal stability in times of budgetary constraint; one of these factors is the length of grants.

The Division of Research Grants devised four models that would produce a fixed number of grants by 1985 and estimated the funds that would be expended in each situation (Table 3). It was assumed that an optimum number of grants to be reached gradually would be 15,000, of which one-third would be competing for available funds annually. Model A set the optimum average project period at the FY 1979 level of 3.2 years. Model B retained the optimum number of awards at 15,000 but increased the average project period to 3.5 years, thereby reducing the number of grants that could be funded annually by approximately 500, because of continuing commitments. In model C, the project period was kept at 3.5 years and the number of grants awarded each year was returned to the figure achieved in model A (4735), necessitating an increase in the total number of awards from 15,000 to 16,574. Model D uses the optimum number of annual awards of 5000 with an average project period of 3.5 years; in this case the number of grants would have to in-

Table 2. The relation between lengths of grants and priority scores is shown for new and renewal traditional research project applications reviewed between 1974 and 1977. [Source: Statistics and Analysis Branch, Division of Research Grants, NIH]

Year	Average number of years for grants		Average grant length on the basis of the following raw priority scores									
			100 to 149 (N = 2928)		150 to 159 (N = 7335)		200 to 249 (N = 6706)		250 to 299 (N = 5003)		300+ (N = 9068)	
	Requested	Recommended	Received (years)	Percent of request	Received (years)	Percent of request	Received (years)	Percent of request	Received (years)	Percent of request	Received (years)	Percent of request
						New applications						
1974	3.3	2.8	3.2	97	2.9	88	2.8	85	2.8	85	2.7	82
1975	3.3	2.9	3.3	100	2.9	88	2.9	88	2.8	85	2.8	85
1976	3.3	2.8	3.2	97	3.0	91	2.8	85	2.8	85	2.8	85
1977	3.3	2.9	3.2	97	3.0	91	2.8	85	2.8	85	2.8	85
						Renewal applications						
1974	4.0	3.3	4.2	105	3.5	88	3.1	77	3.0	75	2.9	72
1975	4.0	3.4	4.2	105	3.5	88	3.2	80	3.0	75	3.0	75
1976	4.0	3.3	4.1	102	3.6	90	3.1	77	3.0	75	2.9	72
1977	4.0	3.3	4.2	105	3.5	88	3.1	77	2.9	72	2.9	72

Table 3. Four alternative models for estimated funds to be awarded for NIH research projects are shown for FY 1981 to 1985. The dollar amounts are based on NIH average amounts for research projects by type of grant that were prepared for the President's budget for FY 1981; later inflation was not taken into account. Model A's project period is based on NIH experience for FY 1979 (through March 1979). The 3.5-year project period is based on projections from FY 1979 experience.

Model	Optimum grants (N)	Average project period (years)	Competing grants		Funds committed to noncompeting grants (10^3 dollars)					Total grants (10^3 dollars)				
			N	Amount (10^3 dollars)	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985+	FY 1981	FY 1982	FY 1983	FY 1984	FY 1985+
A	15,000	3.2	4735	431.1	914.5	857.3	958.8	955.2	975.2	1345.6	1288.4	1389.9	1386.6	1406.3
B	15,000	3.5	4284	389.7	907.7	801.1	961.1	999.4	1018.0	1297.4	1190.8	1350.8	1389.1	1407.7
C	16,574	3.5	4735	430.6	907.8	842.1	1039.2	1099.3	1124.7	1338.4	1272.7	1469.8	1529.9	1555.3
D	17,500	3.5	5000	454.8	907.8	866.2	1085.2	1158.2	1187.6	1362.6	1321.0	1540.0	1613.0	1642.4

crease to 17,500—a most unlikely event according to current budget forecasts.

The projections for various optimum numbers of total grants indicate that it would cost $236 million more in FY 1985 to implement model D, with its 3.5-year average grant length, than model A. Such an increase is not likely. Also, longer grants mean greater budgetary commitment for NIH over an extended period of time, a commitment that would seriously diminish the ability of NIH to respond to changing research needs and legislative priorities.

Conclusion

For outstanding applications competing for renewal, in particular, longer grants may be justified. Findings of a Rand Corporation study on peer review (*12*), for instance, showed that priority scores for applications for renewals correlated significantly better than those for new applications with the quality of research, as measured by publication citations. The Rand study also found that reviewers were willing to change the priority scores considerably on applications for grant renewals from those given to the original application for a new grant. If longer grants were awarded to new applications, the reviewers would not have as much opportunity to monitor what may be the most critical period of research, the "start-up" period (*26*).

Congress has urged greater accountability by favoring shorter lengths for research grants even though the increased frequency and volume of grant applications received by NIH are placing a severe strain on the peer review system. In light of the fact that data compiled for this article indicate that with few exceptions only the most highly rated research has received long-term support, there is no reason to believe that either the scientific merit of research or the budgetary flexibility and stability of the NIH would be compromised by selectively increasing grant lengths for the most favorably reviewed competing renewal applications. When necessary, the NIH could exercise its option (*27*) to terminate or, at least, reconsider, the support of a project for which the investigator has failed to show satisfactory progress or when the research no longer appears to be of public benefit.

Both Congress, during the last session (*28*), and the Carter Administration had announced support for the projected NIH goal of establishing and maintaining a stable level of 5000 new and competing research grants supported per year. The NIH director commented that, "The willingness of the Administration to signal to the Congress that both should assume a long-range commitment to homeostasis of the health sciences is of great moment in a time of economic uncertainty" (*29*).

References and Notes

1. G. N. Eaves, *Fed. Proc. Fed. Am. Soc. Exp. Biol.* **31**, 2 (1972).
2. Applicants may still request support for 7 years; however, funding for the sixth and seventh years must be reviewed competitively. Thus, for all practical purposes, the maximum length of commitment is 5 years. With the exception of one grant award in the last 13 years, all applications for 7-year awards have been reduced to 5-year periods.
3. Since the data were compiled for this article, there has been a gradual yet significant increase in the length of grants awarded by the various institutes at NIH. As of 30 June 1980, the average NIH project period awarded for traditional, investigator-initiated research grants rose from 3.11 in FY 1979 to 3.33 years in FY 1980. When it is considered that this across-the-board 7.1 percent increase in grant length applies to nearly 5000 grant awards, the increase appears even more significant. For the NCI alone, the average length of all grants has been extended from 3.15 to 3.39 years.
4. When $100 in FY 1975 is used as a baseline, equivalent dollars would be $107.30, $116.50, and $124.40 in FY 1976, 1977, and 1978, respectively. Thus, the biomedical inflation factor for FY 1978 would be 124.4 ÷ 116.5 − 1.0, or 6.8 percent.
5. General Accounting Office, *Better Controls Needed Over Biomedical Research Supported by the National Institutes of Health, DHEW* (HRD-76-58, Government Printing Office, Washington, D.C., 1976).
6. J. D. Young, "Comments of the DHEW on the Comptroller General's draft report to the Congress," appendix 1 (HRD-76-58, Government Printing Office, Washington, D.C., 1976).
7. J. T. Kalberer, Jr., and G. R. Newell, Jr., *Cancer Res.* **39**, 4274 (1979).
8. C. Douglas and S. Schiaffino, unpublished data.
9. J. T. Kalberer, Jr., *J. Natl. Cancer Inst.* **63**, 1097 (1979).
10. A study for the National Science Foundation conducted by B. L. R. Smith and J. J. Karlesky [*The State of Academic Science: The Universities in the Nation's Research Effort* (Change Magazine Press, New York, 1977)] reported that scientists from some of the most well-respected research centers pointed out that the time-consuming competition for scarce federal grants has reduced the time they are able to spend on science.
11. G. V. Teague and B. S. Heathington, *J. Soc. Res. Adm.* **11**, 37 (1979); D. S. Fredrickson, "The length of NIH research grant applications," draft report, 10 October 1978. NIH has issued new guidelines to reduce the length of applications.
12. G. M. Carter, "Peer review, citations, and biomedical research policy: NIH grants to medical school faculty"(R-1583-HEW, Rand Corporation, Santa Monica, Calif., 1974).
13. To compensate for differences between review groups, some of which consistently grade more strictly than others, priority ratings in several NIH components, including the NCI, were "normalized" by combining the scores with those from the two previous review cycles to arrive at a specific mean and standard deviation common to all study sections. This normalization process tends to bring all priority scores closer to the average range. For example, a proposal that received a priority score of 326 from an unusually low-grading study section could have a normalized score of 275.
14. Although data on 7-year grants had to be drawn from the 1960's, I believe that ignoring these grants would have meant not only excluding information on the longest grants ever awarded by NIH, but also excluding a useful illustration of the past history of the correlation between priority scores and lengths of grants. Comparisons should not be closely drawn between these and the other grants because of the many variables between the 1960's and 1970's, such as the size of research budgets, the size and magnitude of research enterprises and investigative staffs, and the extent of participation in the review process. In fact, no attempt is made to relate the priority score curves of the 1962 to 1966 period to those of 1973 to 1977, nor are relative comparisons of individual applications to priority scores made. Rather, an attempt is made to ascertain whether longer term grants are generally awarded to projects receiving higher priority ratings.
15. Despite these designations, an application with a priority score less favorable than 300 is not really a proposal without distinction, since only applications considered worthy of funding are rated. During the past 5 years, an average of 63 percent of the new applications reviewed by the IRG's were recommended for approval and assigned a rating.
16. The figures do not differentiate between traditional, investigator-initiated grants and those awarded in support of program projects and centers, because the number of program project and center grants constitutes a small proportion of the total awards in recent years—slightly over 200 in FY 1978 versus over 1900 traditional grants.
17. In Figs. 3 and 4, the "excellent" range encompasses applications receiving priority scores between 100 and 150. Thus, the statement that "48 percent of all 7-year awards received priority scores in the excellent range" refers to the fact (as shown in the top left quadrant of Fig. 4) that 26.7 percent of renewal applications were rated 100 to 125 and an additional 21.3 percent were rated between 126 and 150.
18. W. F. Raub, Extramural Research and Training, NIH, "Thinner grant applications and longer awards," memorandum of 8 January 1979.
19. Among the reasons given for concern over extending award lengths were that budgetary flexibility would be decreased, that appropriations would not offset the higher noncompeting base created by longer awards and would thus reduce the amount of money available for competing awards and funding of new investigators, and that the provision that all grant awards in excess of 3 years must have an "interim review of progress with the aid of extramural advisors" would do little, if anything, to reduce the burden on program staff.
20. C. Henley, National Eye Institute, "Progress on analysis of factors affecting proposed longer award periods," report to W. F. Raub, 30 March 1979, p. 1.
21. It is noteworthy that those Institutes that have been most strongly in favor of longer awards (NCI, NIA, NICHD, NINCDS) have traditionally been stricter in the length of their grant awards (3.0, 2.9, 2.8, and 2.9 years, respectively, in FY 1976) and that those that have expressed the greatest concern over longer awards (NIAID, NHLBI, NIAMDD) have generally exceeded the overall NIH average award lengths (3.6, 3.0, and 3.4 years respectively, for traditional grants in FY 1976, and 3.4, 4.8, and 4.1 years, respectively, for program project and center grants). Perhaps past practices play a large part in individual Institute attitudes toward this question, and the latter group may currently have too many long-term commitments to be in favor of further increasing the length of awards.
22. W. I. Gay, NIAID, memorandum to W. F. Raub, 15 December 1978. Data were drawn from all NIAID grants awarded in FY 1975, and 3-year grants competing again for renewal between FY 1977 and 1979 were assessed.
23. S. Goldring, "Proposal for long-term support of established investigators of excellence," memorandum to NINCDS director, 14 June 1979.
24. N. M. Davidian. "NINCDS proposal for long-term support of established investigators," memorandum to W. F. Raub, September 1979.
25. J. A. Brackett, presentation made at the NIH director's advisory council meeting, 29 May 1979.
26. J. C. James, "Comments on the manuscript," memorandum to the deputy director of the Division of Research Grants, 23 August 1979.
27. Department of Health, Education, and Welfare, *Grants Administration Manual* (Government Printing Office, Washington, D.C., 1978), chap. 1-85.
28. W. H. Natcher, *Hearings before the Subcommittee of the Committee on Appropriations*, U.S. House of Representatives, 96th Congress, 2nd sess., 25 February 1980, p. 19.
29. D. S. Fredrickson, "Research training stabilization in 1982 under consideration," speech to the annual meeting of the Endocrine Society, Washington, D.C., 18 June 1980.

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