Special Article

DISTRIBUTION OF RESEARCH AWARDS FROM THE NATIONAL INSTITUTES OF HEALTH AMONG MEDICAL SCHOOLS

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ABSTRACT

Background Previous studies have demonstrated that a small number of the 125 medical schools in the United States receive a disproportionately large share of the research awards granted by the National Institutes of Health (NIH). We assessed whether the distribution of NIH research awards to medical schools changed between 1986 and 1997.

Methods We used NIH data to rank medical schools in each year from 1986 to 1997 according to the number of awards each school received (as a measure of each school's activity in research, also referred to as research intensity). The proportion of awards received by schools ranked 1 to 10, 11 to 30, 31 to 50, and 51 or lower in research activity was then calculated, and changes over time were examined. We also examined changes in the distribution of awards and changes in award amounts according to the type of department, the type of academic degree held by the principal investigator, and the awarding institute.

Results Between 1986 and 1997, the proportion of research awards granted by the NIH to the 10 most research-intensive medical schools increased slightly (from 24.6 percent of all awards to 27.1 percent), whereas the 75 least research-intensive medical schools (those ranked 51 or lower) received proportionately fewer awards (declining from 24.3 percent to 21.8 percent). The increased proportion of awards to top-10 schools consisted primarily of increases in awards to clinical departments, awards to physicians, and awards from highly competitive NIH institutes. Basic-science departments received a smaller proportion of awards than clinical departments, both in 1986 and in 1997.

Conclusions Research funded by the NIH is becoming more concentrated in the medical schools that are most active in research. (N Engl J Med 2000;342: 250-5.)

THE National Institutes of Health (NIH) are the principal source of research support for medical schools in the United States. In 1997, the NIH awarded medical schools a total of 17,445 research grants and contracts, together worth $5 billion.[1] By comparison, research grants and contracts awarded to medical schools from all sources that year totaled $7.8 billion.[2]

These funds are not evenly distributed among the 125 U.S. medical schools. In 1981, 75 percent of NIH research dollars were awarded to just 40 schools.[3] The reasons offered to explain this uneven distribution include economies of scale; the performance of less research at some institutions, because of the high costs of modern biomedical facilities and equipment and restricted availability of institutional funds to support the research faculty; and the lower priority accorded to research at some schools, especially so-called community-based institutions. It has been suggested that a research environment in which resources in general are restricted would lead to even further concentration of research among a handful of institutions.[3]

In recent years, additional factors have arisen that may hamper the ability of some medical schools to support research. The implementation of managed care and the increasing competitiveness of local health care markets may reduce the ability of some medical schools to subsidize the cost of research not supported by grants.[4-6] Faculty members in these schools may be encouraged to devote more effort to clinical activities that will generate revenue. Ultimately, these institutions may find themselves at a disadvantage in the competition for NIH awards.[7] In addition, the growth of for-profit organizations that perform research has diverted funds for clinical research away from medical schools.[8]

Are these factors reducing the participation of some medical schools in research and serving to concentrate greater research activity in others? There is limited empirical support for this hypothesis. Although research funding has become more widely dispersed among universities, this has not been the case for medical schools.[9] Among departments of medicine in medical schools, those that received the largest number of NIH awards received increasingly larger numbers of awards between 1980 and 1994 than did departments engaged in less research activity.[10] However, the distribution of research awards among medical

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schools as a whole has been unclear. We investigated changes in the distribution of NIH research awards among medical schools from 1986 to 1997 and changes in the patterns of distribution according to the medical school department, the academic degree held by the principal investigator, and the awarding NIH institute.

METHODS

Data on research awards from the NIH to U.S. medical schools from 1986 to 1997 were obtained from the NIH. These data included the number of research awards and the value (in dollars) of the awards to each medical school according to the department, the degree held by the principal investigator, and the awarding institute (including the National Institute on Alcohol Abuse and Alcoholism, the National Institute on Drug Abuse, and the National Institute of Mental Health, which in 1992 rejoined the NIH). The dollar amounts included funds awarded directly to medical schools (the sum of direct and indirect costs) and excluded funds awarded to affiliated institutions and hospitals, training awards, and contracts.

This study included all 125 medical schools in the United States. During the period we studied, the Medical College of Pennsylvania and Hahnemann University School of Medicine merged. To prevent this merger from distorting measures of fund distribution, we treated these two schools as if they had been a single school for the entire period. In addition, the Oral Roberts University School of Medicine closed during the study period. However, since this school received no NIH awards during this time, its closure did not affect measures of the distribution of awards.

In analyses that distinguished awards to clinical departments from awards to basic-science departments, we used the NIH definitions of department types, except that pathology was classified as a clinical department. Analyses that examined awards according to the principal investigator's degree differentiated investigators with a medical degree (including those with an M.D. and those with both an M.D. and a Ph.D.) from those with a Ph.D. but not an M.D.

For each year of the study, medical schools were ranked according to their research activity, defined as the number of NIH research awards each school received in a given year (also referred to as research intensity). For each year the schools were then divided into the following categories: from 1 to 10, from 11 to 30, from 31 to 50, and 51 or lower in research intensity. The share of all NIH awards that each category of school received was then calculated. For each category of school, the share of NIH award dollars each year was also calculated. Results are presented in terms of 1986 dollars, with adjustment for inflation according to the Biomedical Research and Development Price Index of the NIH.[11] In addition, analyses that distinguished the direct-cost and indirect-cost (i.e., administrative) components of awards were conducted, but the results of these analyses did not differ from those of the total value of awards and hence are not presented.

For each year of the study, the number and value of NIH research awards granted specifically to clinical departments, basic-science departments, investigators with an M.D., and investigators with a Ph.D. were calculated. Finally, the proportion of research awards administered each year to the most research-intensive schools by each of the eight NIH institutes with the largest extramural budgets was calculated. As a measure of the competitiveness of the application process at the various institutes, the overall rate of application for each institute for each year was calculated with use of NIH data.[12] Institutes that approved funding for more than 30 percent of applications were considered less competitive than the others.

RESULTS

The proportion of NIH research awards granted to the U.S. medical schools with the greatest research activity increased slightly between 1986 and 1997 (Table 1). The 10 most research-intensive schools in 1986 (those that received the largest number of NIH awards that year) were Johns Hopkins University; the University of California, San Francisco; Yale University; the University of California, Los Angeles; the University of Pennsylvania; the University of Michigan; the University of Washington; Washington University; Stanford University; and Duke University; these 10 medical schools received 24.6 percent of the research awards granted that year. The 10 most research-intensive schools in 1997 (Johns Hopkins University; the University of California, San Francisco; Yale University; the University of Pennsylvania; Washington University; the University of Washington; the University of Michigan; Duke University; Case Western Reserve University; and the University of Pittsburgh) received 27.1 percent of NIH awards that year. In contrast, the 75 schools that received the fewest NIH awards in 1986 received 24.3 percent of the grants awarded that year, and those with the fewest awards in 1997 received 21.8 percent of grants. The shares of NIH awards received by schools ranked 11 to 30 and those ranked 31 to 50 remained nearly constant between 1986 and 1997.

The pattern of NIH awards granted specifically to clinical departments was similar. The 10 most research-intensive medical schools received 30.0 percent of the awards granted to clinical departments in 1986 and 32.6 percent of those granted in 1997. The 75 least research-intensive schools received 17.9 percent of the awards to clinical departments in 1986 and 15.9 percent of these awards in 1997. Again, the shares of awards received by schools ranked 11 to 30 or 31 to 50 remained almost constant during the study period. In contrast, NIH awards to basic-science departments changed less: the 10 most research-intensive schools received 20.3 percent of the awards granted to these departments in 1986 and 20.7 percent of these awards in 1997.

Similarly, the proportion of NIH awards to investigators with an M.D. degree at top-10 schools relative to other schools increased over time, more so than the proportion of awards to those with a Ph.D. at top-10 schools. At the 10 schools with the most research activity, the share of awards to those with an M.D. increased from 30.6 percent to 34.4 percent between 1986 and 1997, whereas the share received by investigators with an M.D. at the 75 medical schools with the least research activity fell from 16.7 percent to 13.9 percent during this period. In contrast, the share of awards to those with a Ph.D. at the 10 most research-intensive schools increased only from 21.4 percent to 22.7 percent during these years.

In 1986, the concentration of NIH award dollars (Table 2) was greater than the concentration of individual research awards. However, the change between 1986 and 1997 in the concentration of awards was

TABLE 1. NUMBER OF RESEARCH AWARDS GRANTED BY THE NATIONAL INSTITUTES OF HEALTH TO MEDICAL SCHOOLS, RANKED ACCORDING TO RESEARCH INTENSITY.

CATEGORY	RANK OF SCHOOL*	NO. OF AWARDS	
		1986	1997
		no. (%)	
All awards	1–10	3,133 (24.6)	4,517 (27.1)
	11–30	4,062 (31.8)	5,322 (31.9)
	31–50	2,461 (19.3)	3,218 (19.3)
	≥51	3,101 (24.3)	3,640 (21.8)
	All schools	12,757	16,697
Awards to clinical departments	1–10	2,148 (30.0)	3,311 (32.6)
	11–30	2,467 (34.5)	3,406 (33.6)
	31–50	1,259 (17.6)	1,822 (18.0)
	≥51	1,283 (17.9)	1,609 (15.9)
	All schools	7,157	10,148
Awards to basic-science departments	1–10	956 (20.3)	1,033 (20.7)
	11–30	1,323 (28.1)	1,479 (29.6)
	31–50	953 (20.2)	1,072 (21.5)
	≥51	1,480 (31.4)	1,408 (28.2)
	All schools	4,712	4,992
Awards to principal investigators with an M.D.	1–10	1,594 (30.6)	2,394 (34.4)
	11–30	1,827 (35.0)	2,404 (34.5)
	31–50	922 (17.7)	1,200 (17.2)
	≥51	873 (16.7)	968 (13.9)
	All schools	5,216	6,966
Awards to principal investigators with a Ph.D.	1–10	1,509 (21.4)	2,161 (22.7)
	11–30	2,118 (30.1)	2,849 (29.9)
	31–50	1,416 (20.1)	1,973 (20.7)
	≥51	2,003 (28.4)	2,546 (26.7)
	All schools	7,046	9,529

*Schools were ranked in descending order each year according to the number of NIH awards they received, as a measure of the intensity of research activity at each school. Because of rounding, not all percentages total 100.

not accompanied by a proportionate change in the concentration of research dollars. For example, the increase between 1986 and 1997 in the proportion of NIH research awards granted to the 10 medical schools with the most research activity, from 24.6 percent to 27.1 percent, was associated with a more moderate increase in the top 10 schools' share of NIH research dollars during this period, from 28.5 percent to 29.4 percent. The mean value (in constant 1986 dollars) of the NIH awards received by the 10 most research intensive schools fell from $198,000 per award in 1986 to $197,000 in 1997. In contrast, the mean award value rose from $185,000 per award in 1986 to $191,000 in 1997 for schools ranked 11 to 30 in research activity, from $158,000 to $170,000 for schools ranked 31 to 50, and from $133,000 to $156,000 for the 75 schools least active in research.

The distribution of awards granted by specific institutes within the NIH to the 10 most research-intensive schools also varied during the study period. Among less competitive institutes (those that approved funding for more than 30 percent of applications), little change in the distribution of awards to these schools was observed from 1986 to 1997. In contrast, most of the highly competitive institutes awarded a higher proportion of grants to top-10 schools in 1997 than in 1986 (Table 3). The exception was the National Institute of Mental Health, which awarded a smaller proportion of grants to top-10 schools in 1997 than in 1986, but whose awards were highly concentrated in a few schools throughout this period.

DISCUSSION

From 1986 to 1997, the proportion of NIH research awards to the 10 medical schools with the most research activity (those that received the greatest number of awards) increased slightly. This finding is consistent with predictions made in 1981[3] and with data that indicate that research awards are concentrated among departments of medicine.[10] The current study demonstrates that this pattern applies to medical schools as a group and that it has continued through 1997.

The increase in the proportion of awards concentrated in the 10 medical schools with the most research activity was greater among clinical departments than among basic-science departments and greater among principal investigators with an M.D. than among those with a Ph.D. Possible explanations are that investigators with a medical degree in medical schools that are less active in research have increas-

TABLE 2. VALUE OF RESEARCH AWARDS GRANTED BY THE NATIONAL INSTITUTES OF HEALTH TO MEDICAL SCHOOLS, RANKED ACCORDING TO RESEARCH INTENSITY.

CATEGORY	RANK OF SCHOOL*	VALUE OF AWARDS	
		1986	1997
		millions of dollars (%)	
All awards	1–10	620 (28.5)	890 (29.4)
	11–30	752 (34.6)	1,016 (33.6)
	31–50	389 (17.9)	548 (18.1)
	≥51	412 (19.0)	568 (18.8)
	All schools	2,173	3,022
Awards to clinical departments	1–10	451 (33.1)	663 (34.5)
	11–30	498 (36.5)	659 (34.3)
	31–50	215 (15.8)	340 (17.7)
	≥51	200 (14.7)	259 (13.5)
	All schools	1,364	1,921
Awards to basic-science departments	1–10	145 (22.3)	176 (23.1)
	11–30	209 (32.2)	237 (31.1)
	31–50	119 (18.3)	159 (20.8)
	≥51	176 (27.1)	191 (25.0)
	All schools	649	763
Awards to principal investigators with an M.D.	1–10	376 (33.3)	523 (35.6)
	11–30	413 (36.6)	521 (35.4)
	31–50	183 (16.2)	252 (17.1)
	≥51	157 (13.9)	175 (11.9)
	All schools	1,129	1,471
Awards to principal investigators with a Ph.D.	1–10	234 (24.4)	384 (25.3)
	11–30	317 (33.1)	480 (31.7)
	31–50	179 (18.7)	294 (19.4)
	≥51	228 (23.8)	357 (23.6)
	All schools	958	1,515

*Schools were ranked in descending order each year according to the dollar value (in 1986 dollars) of NIH awards they received, as a measure of the intensity of research activity. Because of rounding, not all percentages total 100.

ing difficulty competing for awards with physicians at the 10 most active schools, or that schools with less research activity have difficulty recruiting and retaining physician researchers. This possibility is consistent with the declining number of physicians who engage in research,[13-20] the decreasing number of first-time applications to the NIH by physicians,[21] and the diversion of clinical faculty away from research during periods when resources are restricted.[22-26]

The increasing proportion of NIH awards granted to the 10 most research-intensive medical schools was not accompanied by a proportionate increase in their share of research dollars. This apparent contradiction is explained by the narrowing gap between the mean value of individual awards granted to the top 10 research schools and those granted to other schools during this period. Our analyses indicate that changes in indirect costs do not explain these differences. The reasons for the narrowing gap may include NIH caps on salary,[27] limitations on increases in competitive grant renewals and in large research-center grants,[28] and distinct NIH review policies for grants with large budgets[29] that may discourage such applications. Each of these policies may disproportionately affect top-ranked institutions.

The proportion of awards granted to top-10 schools by highly competitive NIH institutes was higher in 1997 than in 1986. If fiercer competition favors schools with greater research activity,[3] then the budgets of individual NIH institutes may influence the degree to which awards are concentrated in research-intensive medical schools.

Several limitations of this study should be noted. First, only NIH-sponsored research was examined. Although other sources of research support often accompany NIH sponsorship, some schools may maintain research programs without NIH support, through grants from biotechnology and pharmaceutical companies. Second, awards to teaching hospitals and research foundations affiliated with medical schools were not included. Most of these institutions receive little research funding, but because several medical schools are affiliated with hospitals that receive considerable NIH support, analyses that included grants to these hospitals were conducted. Including these grants did not alter our finding of an increasing concentration of NIH research grants at research-intensive schools.

Although this study ranked medical schools according to their level of research activity and did not

TABLE 3. RESEARCH AWARDS GRANTED BY INSTITUTES WITHIN THE NATIONAL INSTITUTES OF HEALTH.*

INSTITUTE	APPLICATIONS		RATE OF APPLICATION SUCCESS, 1986–1997†	SHARE OF AWARDS TO TOP-10 SCHOOLS†		ABSOLUTE CHANGE IN SHARE, 1986–1997
	1986	1997		1986	1997	
	no.			percent		
NICHD	1,934	1,438	23.5	29.8	32.5	2.7
NIMH	1,245	1,666	24.5	45.1	38.9	−6.2
NCI	2,833	3,520	27.2	25.0	27.9	2.9
NHLBI	2,561	2,771	27.4	24.2	29.1	4.9
NIDDK	1,856	1,961	28.6	27.2	31.6	4.4
NINDS	1,557	1,790	30.1	31.3	31.5	0.2
NIAID	1,577	1,993	30.2	29.9	30.3	0.4
NIGMS	2,260	2,514	34.1	29.5	28.9	−0.6
Other	4,070	6,568	29.1	25.6	27.4	1.8
Total	19,893	24,221	28.6	24.6	27.1	2.5

*Institutes are listed according to their competitiveness. Less competitive institutes were considered to be those that approved funding for more than 30 percent of applications. NICHD denotes the National Institute of Child Health and Human Development, NIMH the National Institute of Mental Health, NCI the National Cancer Institute, NHLBI the National Heart, Lung, and Blood Institute, NIDDK the National Institute of Diabetes and Digestive and Kidney Diseases, NINDS the National Institute of Neurological Disorders and Stroke, NIAID the National Institute of Allergy and Infectious Diseases, and NIGMS the National Institute of General Medical Sciences.

†The share of awards to top-10 schools is the proportion of awards received by the 10 medical schools that received the largest number of awards from a particular institute.

account for changes in the rank of individual institutions, shifts in rank were rare. Of the 10 medical schools with the most research activity in 1997, 8 were also on the top-10 list in 1986. Similarly, during the study period, only six schools ranked 11 to 50 in research activity were replaced by schools previously ranked 51 or lower.

These findings may interest administrators, researchers, and educators at medical schools as well as research policy makers. Administrators at schools that are highly active in research can be reasonably sure that their institutions will probably continue to lead in research and to benefit from increases in NIH funding. Schools ranked 11 to 50 in research activity will probably maintain their share of research awards and have only a limited chance of supplanting a top-10 school in this respect. Schools ranked 51 or lower, which constitute the majority of schools, may wish to reconsider their investment in a research mission that has minimal growth potential or may choose to concentrate limited research resources on successful basic-science programs. Similarly, investigators who work in the basic sciences or those who are affiliated with schools that are highly active in research may enjoy a sense of competitive advantage and security. In contrast, faculty members of schools with less research activity may need to focus their research projects and collaborate with other institutions to ensure the survival of research programs on their campuses. Educators who view research as an essential component of medical education should note that medical students and residents may receive less exposure to research as this activity becomes concentrated in fewer institutions. However, the greater stability of funding for research in the basic sciences, as compared with funding for clinical research, will probably allow many medical schools to retain a core of faculty members engaged in basic-science efforts.

Research policy makers may be interested in the relation between competition for NIH awards and concentration in the distribution of awards. If competition favors the funding of projects at research-intensive medical schools, then NIH funding may influence the proportion of schools that conduct research. If strong public support for medical research[30] continues to win healthy increases for the NIH in the federal budget, then the growing concentration of research in highly research-intensive schools may continue at a gradual pace. If, however, increases in the NIH budget[31,32] are smaller, then the trend toward concentration in the distribution of NIH funds may accelerate.

Perhaps the relevant question in research policy is whether and how the concentration of research in some institutions influences the advancement of science. Does concentrating research in fewer institutions retard or accelerate the pace of discovery? Is there an optimal distribution of research that would maximize the scientific return on society's investment? Insight into these questions may be gained through continued monitoring of trends in the distribution of NIH research awards among medical schools.

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