

- vascular mortality. Presented at the annual meeting of the American Heart Association, 1978
24. Roehmholdt ME, Palumbo PJ, Whisnant JP, Elveback LR: Transient ischemic attack and stroke in a community-based diabetic cohort. *Mayo Clin Proc* **58**: 56-58, 1983
  25. Kannel WB, Wolf PA, McGee DL, Dawber TR, McNamara P, Castelli WP: Systolic blood pressure, arterial rigidity, and risk of stroke: the Framingham study. *JAMA* **245**: 1225-1229, 1981
  26. Tanigaki M, Shimamoto T, Konishi M, et al: The effect of community control of hypertension on incidence rates for stroke in 8 populations in Japan. *Nippon Koshu Eisei Zasshi (Japanese Public Health Journal)* **28**: 123-135, 1981
  27. Robinson SC, Brucer M: Range of normal blood pressure: a statistical and clinical study of 11,383 persons. *Arch Intern Med* **64**: 409-444, 1939
  28. United States Department of Health, Education and Welfare National Health Survey. National Center for Health Statistics: Hypertension and Hypertensive Heart Disease in Adults, United States 1960-62. (Series 11, no. 13, Publication no. 1000.) Washington DC, Government Printing Office, 1966
  29. Carey RM, Reid RA, Ayers CR, Lynch SS, McLain WL III, Vaughan ED Jr. The Charlottesville blood-pressure survey: value of repeated blood-pressure measurements. *JAMA* **236**: 847-851, 1976
  30. Berkson DM, Brown MC, Stanton H, et al: Changing trends in hypertension detection and control. the Chicago experience. *Am J Public Health* **70**: 389-393, 1980
  31. Schoenberger JA, Stamler J, Shekelle RB, Shekelle S: Current status of hypertension control in an industrial population. *JAMA* **222**: 559-562, 1972
  32. Stamler J, Stamler R, Riedlinger WF, Algera G, Roberts RH: Hypertension screening of 1 million Americans: community hypertension evaluation clinic (CHEC) program, 1973 through 1975. *JAMA* **235**: 2299-2306, 1976
  33. Veterans Administration Cooperative Study Group on Antihypertensive Agents: Effects of treatment on morbidity in hypertension: results in patients with diastolic blood pressures averaging 115 through 129 mm Hg. *JAMA* **202**: 1028-1034, 1967
  34. Veterans Administration Cooperative Study Group on Antihypertensive Agents: Effects of treatment on morbidity in hypertension II. Results in patients with diastolic blood pressure averaging 90 through 114 mm Hg. *JAMA* **213**: 1143-1152, 1970
  35. Smith WM: Treatment of mild hypertension: results of a ten-year intervention trial. *Circ Res* **40** (SI): 98-105, 1977
  36. Helgeland A: Treatment of mild hypertension: a five year controlled drug trial. the Oslo study. *Am J Med* **69**: 725-732, 1980
  37. Berglund G, Sannerstedt R, Andersson O, et al: Coronary heart-disease after treatment of hypertension. *Lancet* **1**: 1-5, 1978
  38. Report by the Management Committee: The Australian therapeutic trial in mild hypertension. *Lancet* **1**: 1261-1267, 1980
  39. Report of Medical Research Council Working Party on Mild to Moderate Hypertension: Randomised controlled trial of treatment for mild hypertension: design and pilot trial. *Br Med J* **1**: 1437-1440, 1977
  40. Hypertension Detection and Follow-Up Program Cooperative Group: Five-year findings of the hypertension detection and follow-up program. III. Reduction in stroke incidence among persons with high blood pressure. *JAMA* **247**: 633-638, 1982
  41. Joossens JV, Kesteloot H, Amery A: Salt intake and mortality from stroke (letter to the editor). *N Engl J Med* **300**: 1396, 1979
  42. Miall WE: Follow-up study of arterial pressure in the population of a Welsh mining valley. *Br Med J* **2**: 1204-1210, 1959
  43. Finn R, McConnochie K, Box DEO, Fennerty AG, Green JR: Blood pressure and salt intake: an intra-population study (letter to the editor). *Lancet* **1**: 1097, 1981
  44. Sasaki N, Takahashi M, Fukushi S, Takemore K: Changes in salt intake and blood-pressure. *Lancet* **2**: 632, 1981
  45. Dahl LK: Salt and hypertension. *Am J Clin Nutr* **25**: 231-244, 1972
  46. Katsuki S, Hirota Y: Recent trends in incidence of cerebral hemorrhage and infarction in Japan: a report based on death rate, autopsy case and prospective study on cerebrovascular disease. *Jpn Heart J* **7**: 26-34, 1966
  47. Okazaki H, Whisnant JP: Clinical pathology of hypertensive intracerebral hemorrhage. In Mizukami M, et al (eds) *Hypertensive Intracerebral Hemorrhage*. New York, Raven Press 177-180, 1983
  48. Garraway WM, Whisnant JP, Kurland LT, O'Fallon WM: Changing pattern of cerebral infarction: 1945-1974. *Stroke* **10**: 657-663, 1979

## Federal Funding for Research in Stroke and Trauma — A Clinical Investigator's Viewpoint

JAMES F. TOOLE, M.D., AND WILLIAM W. TOOLE

OUR FEDERAL BIOMEDICAL RESEARCH ESTABLISHMENT utilizes three mechanisms for funding research designed to increase knowledge related to stroke and trauma to the nervous system. The first mechanism would be center programs targeted toward a designated goal. A second would be individually initiated research. Both of these are conditional gifts awarded to an institution or an individual on behalf of an investigator. The conduct of the investigation is not the responsibility of government and the principal investigator must develop internal mechanisms to assure adequate progress in his research. A third mechanism is the use of contracts which are task oriented projects with clearly defined goals and timetables supervised

by federal employees. Compliance with specifications is the responsibility of government officials.

Which of these three funding mechanisms returns most for the taxpayer's investment — a large number of small awards to individuals pursuing endeavors which spring from their own initiative, or fewer large awards made to teams which have been assembled for the purpose of answering carefully defined hypotheses? The former allows an individual to pursue his own research questions, while the latter requires a group of investigators to coordinate activities with one another and proceed together toward a common goal. Do basic scientists achieve more when functioning independently (individual grantees) or in conjunction with clinical investigators (program projects)? Does research accomplishment fare better with grantee directed or with the federally supervised contract mechanism?

From the Department of Neurology, Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, North Carolina 27103  
Received June 15, 1983; revision accepted July 17, 1983.

It would seem reasonable to expect that such important policy questions would have been answered long ago by analyses by our colleagues employed by the federal government, and if not by them, by social scientists. One is therefore extremely surprised to discover that although the subject excites continuing debate, the questions have not been addressed in depth.<sup>1</sup> Furthermore, systematic attempts to gather the necessary data have been frustrated, perhaps in part, by the suspicion that the sum total of much time and effort may end with equivocal results and only enhance divisiveness in the research community.

As a consequence, the individuals in charge of setting up biomedical research portfolios have chosen the prudent course of balancing their investments just as one might do with one's own capital, selecting dependable blue chips for the majority of their investment with few, if any, rapid growth risks. In this regard, the peer review system has come to be a major influence fostering this conservatism perhaps so much so that it discourages novel ideas and inventiveness. A researcher whose ideas deviate too much from the thinking of his peers in review sections will not be funded. Yet our nation has been built by independent thinkers beginning first with the founding of our government, and then by a succession of experimentalists such as Franklin with his kite, Fulton on the Hudson, McCormick on the Prairie, Edison in Menlo Park, and those two bicycle repairmen from Akron at Kitty Hawk, North Carolina. Despite obstacles, our best researchers still have this innovative urge and need to understand. After all, why would they choose a career with such uncertain rewards if they did not. However most are becoming frustrated and some discouraged by increasing difficulties with funding.

It is our perception that there has been a fundamental change in the mechanics of research. Our forefathers had no access to federal support and therefore no need to write applications, no peer review, no progress reports, and no competitive renewal; today's investigators, largely underwritten by the federal establishment, do all with great frequency. While there is great merit in compelling the investigator to crystalize his thoughts, describe his hypothesis and means for answering it, reduce his plan to paper, and defend it

before his peers, it is germane to point out that only the individual with results to show can write a strong application. Yet in most cases research cannot be initiated unless the monies are provided in advance. Therefore the system tends to eliminate new or deviant ideas and/or the individual with no track record-fostering conservatism and, in the opinion of many, constricted thinking. Yet the peer review system is the best possible means for quality assurance and alternative systems would allow political pressure or special pleading. We must recognize both extremes, each with its shortcomings, and chart a careful course between them.

### Grants to Individuals or Centers

The individually initiated research grant is and must remain the foundation upon which applied programs are built. Only by increasing our fund of new knowledge can new knowledge be acquired. However the individual research grant has the potential for isolating its recipient from his colleagues in other disciplines.<sup>2,3</sup> In the pursuit of new discoveries and continued funding, he must produce at a high rate results which can be assessed by his peers, most of whom are also his competitors working in the same area. Judgements can be swift. A NIH priority score of 170 often means no money and possibly the end of a research career, pitting colleagues against one another in a competitive way, creating the antithesis of research which is the free exchange of information.

In contrast, the program project approach is constructed on the theory that the total of the cooperative research effort will be greater than the sum of its individual components. A center forces interaction between basic and clinical researchers and establishes a climate of creative collaboration.<sup>4,5</sup>

It is worth noting that individual project applications are rarely site visited but that the program projects generally are, so that writing skills and production of data are the only measures assessed in the former. This dichotomy and its effect upon research needs further consideration.<sup>4</sup>

### Targeted Monies

One might ask why so little of our gross national product goes into biomedical research and environmental preservation and so much into weapons. By far one of the most important questions of our era, it is nevertheless too complex a subject for this short consideration of research programming. More to the point is the realization that in only some circumstances is there a relationship between the socioeconomic effects of a disease and the sums invested in seeking to reduce its impact.<sup>6-8</sup> Although we put enormous investment of scarce research funds in efforts to control our most common killers, heart disease and cancer, the funds designated for the third and fourth ranking, stroke and trauma, are less than the cost of one small jet aircraft (table 1).\*

TABLE 1 *Leading Diseases and the Research Investment in Millions of 1980 Dollars\**

Frequency of disorder	Costs			Research investment by NIH
	Direct	Indirect	Total	
1 Cancer	8,963	23,327	32,263	989
2 Motor vehicle injuries	6,653	13,467	20,120	16.8 (trauma to nervous sys.)
3 Heart disease	3,472	15,645	19,117	550
4 Stroke	3,300	5,698	8,998	16.7

Derived from 1975 costs using the following assumptions: 1) The incidence of the four conditions is unchanged; 2) 1975 dollars were inflated using GNP of 127.25 in 1975; 177.36 in 1980.

\*Modified from Hartunian, Smart, and Thompson.<sup>12</sup>

\*The investment in stroke research by the American Heart Association was \$499,763 in 1981-82.

Regarding stroke and trauma research funding, there is slim likelihood that more monies will become available because there is no organized public demand for it and also because research ideas are too often poorly presented by clinical investigators. It is simple to say that stroke is a disease of old people who are ready to die and that trauma to the nervous system would largely be avoided if automobile safety were improved and alcoholism controlled. However, fully 25% of strokes occur in people below age 65 and 20% are employed when stroke occurs. Furthermore trauma will remain the greatest cause of disability and death in our young adult population. Investigators devoted to stroke and nervous system trauma research must make their cause known because a vocal constituency is the key to research funding.

Consider the Federal War on Cancer. It was politically mandated using the premise that if the nation invested enough money and directed sufficient scientific effort, we would conquer cancer just as we had constructed the atomic bomb and had propelled man to the moon. Have the results been commensurate with the investment? So far it seems not, but is our time frame appropriate? How long should a billion dollars be invested each year before results are required? Should there be stricter assessment of achievement of interim goals and objectives?<sup>10, 11</sup>

However, such sustained national efforts can be successful. Remember the poliomyelitis epidemics and the March of Dimes — very relevant in the centennial year of Franklin D. Roosevelt. It is truly a monument to the American way, volunteerism, funding of scientists by private philanthropy, and a targeted research effort. The total time was barely 20 years and the investment was 41 million pre-inflation dollars.<sup>12</sup>

### **What Are The Ingredients For Setting Up a Successful Center? Do Centers Have Life Cycles?**

Let us consider these two questions as they relate to research, the generation of new ideas and their impact on training and the institution. Generally center grantees are a more seasoned commodity comprised almost exclusively of established investigators. They may shelter some younger investigators, because of a halo effect for projects which are "not of the first rank." This can help these neophytes initiate a research career.<sup>1, 5</sup> A center becomes a focal point for satellite research and a source of pride for the institution. It gets publicity and draws attention of laymen and professionals to a disease entity, which in turn also attracts young investigators, both to the institution and into the field.

Despite its many shortcomings the most common method for judging production is numbers of publications and literature citations. One must understand however that centers are targeted toward a disease so that they include clinicians who usually publish more slowly than basic scientists, because their effort is also engaged in patient responsibilities and because patient related experiments are harder to design because of

ethical and legal restrictions. Furthermore numbers accumulate slowly and statistical conclusions are often very difficult to reach.

One of the most impressive aspects of a center is how it stabilizes personnel, attracts people of diverse interests from many disciplines, and gives them an opportunity to work together. Moreover a center program spawns individual research grants and perhaps even other center programs, because the initial center attracts the critical mass of individuals who begin work and they in turn attract others so that spinoff programs can be initiated.

According to Comroe<sup>21</sup> the essence of a center is cross disciplinary contacts and encouragement of novices under the direction of a leader who is willing to place his personal interest secondary to the development of the group. On the other hand, some centers stretch and perhaps strain the administrative fabric of the institution. They cross departmental lines and vie for space so that deans and departmental heads may feel threatened. However, these very attributes distinctly improve communication at the operational level between basic and clinical scientists.<sup>3</sup>

There has been a dramatic decline in clinical research and this in turn has had a negative effect upon center programs. Some of the reasons are:

1. Clinical research by its nature is not as scientifically exacting as bench research because patient variables are so difficult to control.
2. Decline in funds for research increases the clinicians commitment to patient care.
3. Ethical and legal strictures and malpractice exposure limit performing research on human beings.
4. Clinicians must have the Ph.D. investigator beside them in order to compete in study sections. However, in clinical departments the Ph.D. has no track for academic advancement. Therefore the best research minds are not attracted to clinical research.
5. There is a dearth of hypotheses and design for testing them because of the multiplicity of variables and the lengthy time frames necessary for investigations on human beings.
6. The technologic explosion exceeds the capacity of one department or discipline to perform research; yet in most institutions, traditional administrative structure impedes multidisciplinary research.

There seems to be a proper size for centers. Mega centers under the direction of one person administering multiple millions of dollars have been severely criticized: huge sums divert too many scarce research dollars into one location; there is no good way to assess the scientific worth of the many projects being performed; the variation in quality is too great; and they develop too much according to the personality, and perhaps the whim, of the program director. Therefore one concludes that there is an ideal size for centers and that their administration must be carefully monitored.

From the institutional point of view, the program project puts so many eggs in one basket that it is a high risk operation. What happens if the program proj-

ect is not funded? The impact can be as devastating to an institution as the closing of a factory is to a community.

Center grants were first initiated by our predecessors in clinical science as a means for drawing investigators' attention to areas in need of research. They were started not in an environment, such as today's, in which center applications must face off against individual projects. With the two in head to head competition for the same dollars we ask which is better. The unequivocal answer is that we need both no matter what the relative merits of one or the other mechanism may be! Does good research go unfunded? Not in the past, but definitely so in the present and almost certainly in the future.<sup>14-16</sup> Are promising young investigators discouraged from the field because of uncertainty of funding? Young scientists considering a career in clinical or basic research express the view, "If the professor can't get a grant how can I?" and they are abandoning the field.

Comroe recalls<sup>13</sup> that when he first applied for his cardiovascular research institute, the time and energy he spent for producing the application to assemble 50 scientists was far less than an individual investigator now puts into preparing a request for a small sum. The system has gone awry because there is no relationship between the time and effort invested in preparing the application and the sum for which one asks. He and others note an increasingly important problem in today's short term funding of research; three years is simply not long enough for centers to develop programs, to have accomplishments and for site visit teams to assess progress and their potential for the future accurately.<sup>17, 18</sup>

Many use the Rockefeller Institute as an example of an ideal cross disciplinary institution with enormous research accomplishments. It is said that the greatest reason for its success has been stable funding, careful selection of scientists from multiple disciplines housed together and allowed to interact. It has proved to be excellent climate in which to train young investigators by having them rub shoulders with scientists with broad ranging ideas.

In summary, one may say that the balanced research portfolio is made for the cautious, that the center has the most likelihood for approach to a clinically related goal because it forces cross-fertilization among disciplines as well as development of young investigators

with novel ideas, and that, unless there is a rapid infusion of funds which will attract young clinical investigators, research in the fields of stroke and nervous system trauma is in danger of foundering.

### Acknowledgments

Murray Goldstein, D.O., Director NINCDS; Michael G. Walker, M.D., Director Stroke and Trauma Program NINCDS; David E. Rogers, M.D., President, Robert Wood Johnson Foundation; William Raub, M.D., Associate Director, NIH.

### References

1. Carter GM, Lai CS, Lee CL: A comparison of large grants and research project grants awarded by the National Institutes of Health, October, 1978
2. Gorry GA: Decision analysis: principles for clinical application. North-Holland Biomedical Press, 1978
3. Gorry GA, Chamberlain RM, Price BS, DeBaake ME, Gotto AM: Communication patterns in a biomedical research center. *Journal of Medical Education* 53: 206-208, 1978
4. Comroe JH Jr: The evolution of biomedical science: past, present, future perspectives. *Journal of Medical Education*, 52: 3-10, 1977
5. Commissioning research (editorial). *Lancet* 1: 312-313, 1981
6. Hartunian NS, Smart CN, Thompson MS: The incidence and economic costs of major health impairments. Lexington Books, Lexington, Mass, 1981
7. Ibid: The incidence and economic costs of cancer, motor vehicle injuries, coronary heart disease and stroke. *Am Jour Pub Health* 70: 1249-1260, 1980
8. Shortell SM, LoGerfo JP. Health services research and public policy definitions, accomplishments, and potential. *Health Serv Res* 13: 230-238, 1978
9. Schneyer S, Landefeld JS, Sandifer FH: Biomedical research and illness: 1900-1979. *Milbank Mem Fund Q* 59: 44-58, 1981
10. Bulkley BH: Stewardship of the biomedical research enterprise: a view from the research community. *Council of Acad Soc AAMC*, January, 1982
11. Greenberg DS: Washington report. Health and science policies — a look ahead. *N Engl J Med* 299: 1475-1476, 1978
12. Cohn V. Four billion dimes. Minneapolis Star and Tribune Press, April 1955
13. Comroe JH Jr: Personal communication. October, 1982
14. Lowe RB: Health research at educational institutions: costs and accountability. The view from where the Department of HHS Inspector General sits (editorial). *Fed Proc* 39: 7a-10a, 1980
15. Wyngaarden J, in Walsh J: The Biomedical Science — 1975, report of a Macy Conference, Josiah Macy, Jr. Foundation, One Rockefeller Plaza, New York, 1975
16. Wyngaarden JB: The clinical investigator as an endangered species. *New Eng J Med* 301: 1254-1259, 1979
17. Kalberer JT Jr: Grant length and budget stability at the National Institutes of Health. *Science* 211: 675-680, 1981
18. Airlie House Paper — Outlook for Science and Technology: The Next Five Years, National Research Council, National Academy of Sciences, 1982



## Federal funding for research in stroke and trauma--a clinical investigator's viewpoint.

J F Toole and W W Toole

*Stroke*. 1984;15:168-171

doi: 10.1161/01.STR.15.1.168

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Copyright © 1984 American Heart Association, Inc. All rights reserved.

Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the  
World Wide Web at:

<http://stroke.ahajournals.org/content/15/1/168.citation>

**Permissions:** Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the [Permissions and Rights Question and Answer](#) document.

**Reprints:** Information about reprints can be found online at:  
<http://www.lww.com/reprints>

**Subscriptions:** Information about subscribing to *Stroke* is online at:  
<http://stroke.ahajournals.org/subscriptions/>