National Institutes of Health funding for cardiothoracic surgical research

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Objective: Our objective was determine the status of National Institutes of Health (NIH) funding for cardiothoracic surgery research.

Summary Background Data: (1) Funding from the NIH is critical if new procedures and devices are to be developed. (2) The success rate for NIH applications coming from cardiothoracic surgery faculty is thought to be inferior. (3) Per capita numbers of surgical NIH application and awards and application success rate have recently been found to be below the average for the NIH.

Methods: Application and award data for full-time academic cardiothoracic surgeons were obtained by matching records in the NIH IMPAC II database with membership rosters of The Society of Thoracic Surgeons and The American Association for Thoracic Surgery. Manpower data were obtained from 1999, 2003, and 2005 reports of the STS/AATS Workforce committee. Society membership was used as a surrogate for investigator experience.

Results: The number of NIH applications has increased steeply in the past 7 years; however, the number of awards has remained constant. This pattern was observed for surgery and cardiothoracic surgery as well. Until 2003, the cardiothoracic surgery application success rate was actually higher than that of surgery and the NIH as a whole (between 25% and 40%). Since then, however, the cardiothoracic surgery application success rate has declined steeply and is now only 14%. NIH applications and awards per 100 cardiothoracic surgeons, although similar to those of surgery, are very much less than the NIH as a whole.

Conclusion: Per capita NIH funding of cardiothoracic surgeons is very much less than that of the NIH as a whole. The primary cause is the low per capita number of applications submitted by cardiothoracic surgeons. Junior cardiothoracic faculty should be encouraged to apply for career development awards. However, since the ability to shift cost from clinical to academic faculty is declining, affirmative action from the NIH may be necessary.

National Institutes of Health (NIH) funding for cardiothoracic (CT) surgery research is important, especially if new procedures are to be developed and established procedures are to evolve. Critical areas in need of innovation include robotics, endovascular therapies of the great vessels and cardiac valves, and heart failure procedures and devices.

It has been suggested that NIH applications from CT surgeons have a lower-than-average funding success rate. Along those lines, we recently found a small but statistically significant difference between total NIH and surgical application success rates

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during the period from 1982 to 2005 (29% vs 25%; $P < .01$).¹ However, the persistently low percent of NIH funding going to surgical investigators was due primarily to the very small number of surgical applications rather than the difference in funding success. As a result, the number of grants per 100 faculty members was more than 4 times higher among nonsurgical than among surgical faculties at US medical schools.¹

This current study uses NIH application and award data in combination with CT manpower data to calculate application success rates and application and award data per 100 CT surgery faculty. We tested the hypothesis that application success rate and applications per 100 CT surgery faculty were different from those of surgery faculty and the NIH as a whole.

Methods

In our previous study, NIH research project grant (RPG) application information and success rates were obtained using the NIH 2005 Consolidated Grant Applicant and Fellow File and published tables from the NIH Office of Extramural Research Web site.¹ Information about faculty members at accredited allopathic US medical schools was obtained from the American Association of Medical Colleges (AAMC) faculty roster. However, the Consolidated Grant Applicant and Fellow File was discontinued in 2006. Therefore, in this study RPG application data were obtained from the NIH Information, Management, Planning, and Coordination II System (IMPAC II; 1999 to present) and the NIH Office of Extramural Research Web site.

IMPAC II and AAMC records in which the “Department” and “Division” fields contained the words “Orthopedics,” “Neurosurgery,” “Surgery,” or “Urology” were identified and used to calculate numbers of applications from and awards to surgical faculty and the numbers of surgical faculty.

Identification of NIH applications and awards from CT faculty was more difficult inasmuch as the information stored in the

“Department” and “Division” fields of both the NIH IMPAC II and AAMC databases was not sufficient to identify all CT records. Therefore, the current Society of Thoracic Surgeons (STS) and American Association for Thoracic Surgery (AATS) member rosters were obtained and a custom SAS-based program (SAS 9.1; SAS Institute, Inc, Cary, NC) was used to match IMPAC II with STS and AATS membership data. Ambiguous records were adjudicated by one of the authors (M.R.). Manpower was obtained from the 1999, 2003, and 2005 reports of the STS/AATS Workforce committee²⁻⁴ and used to calculate CT faculty manpower as follows:

$$\text{CT faculty} = \text{Total STS/AATS membership} \cdot \% \text{ Respondants} \cdot \% \text{ Active practicing members} \cdot \% \text{ Teaching} \cdot \% \text{ Full-time teaching.}$$

Statistical Analysis

Research program grant data and data per 100 faculty were calculated and compared by the paired t test. The Bonferroni correction for multiple comparisons was used when appropriate. Linear regression was used to determine yearly rates of change. Society membership was used as a surrogate for investigator age. Statistical analysis was performed with SAS software (SAS version 9.1; SAS Institute, Inc, Cary, NC).

Results

NIH applications and awards to the NIH as a whole and surgical and CT surgical scientists between 1999 and 2006 are seen in Figure 1. Although the number of NIH applications has increased steeply in the past 7 years, the number of awards has remained constant. As seen in Figure 1, B and C, surgery as a whole and CT surgery follow the same general pattern. Surgical and CT surgical awards are a very small percentage of total NIH awards (Figure 2).

NIH grant application success rates from all medical school faculty, surgery, and CT surgery faculty by year

Figure 1. A, Number of NIH applications and awards from all medical school faculty from 1999 to 2006. B, Number of NIH applications and awards from surgical medical school faculty from 1999 to 2006. C, Number of NIH applications and awards from CT surgery medical school faculty from 1999 to 2006.

Figure 2. Percentage of total NIH applications and awards from and to surgery and CT surgery faculty by year from 1999 to 2006.

Figure 3. NIH grant application success rates by year from 1999 to 2006. Data from all medical school faculty, surgery, and CT surgery faculty are shown.

from 1999 to 2006 are seen in Figure 3. Although the CT surgery application success rate has declined steeply and is now 14%, until 2003 CT surgery application success rate was actually higher than that of surgery or the NIH as a whole (between 25% and 40%).

Numbers of medical school, surgery, and CT surgery faculty by year from 1999 to 2006 are seen in Figure 4. Relative changes in medical school and surgery faculty manpower appear similar, increasing by 23.1% and 26.1%, respectively, over the 7 years. CT surgery faculty manpower did not increase as rapidly (11.7%), although data points are more sparse and inferences are therefore less certain.

NIH applications and awards per 100 medical school, surgery, and CT surgery faculty by year from 1999 to 2006 are seen in Figure 5. NIH applications per 100 medical school faculty increased by 34.6% between 1999 and 2005. However, applications per 100 surgery and CT surgery faculty and NIH awards per 100 medical school faculty were relatively unchanged over the 7 years. On the other hand, although NIH awards per 100 CT surgery faculty were slightly higher than for surgery, awards to both surgical groups had a slight downward trend between 1999 and 2006. In 2005, NIH awards per 100 medical school faculty

were 3.32 time higher than awards per 100 CT surgery faculty.

Society membership was used as a surrogate for CT surgery investigator age and/or experience. With that in mind, the effect of society membership on NIH applications, awards, and application success rate is seen in Figure 6.

Discussion

We found that per capita NIH funding to CT surgeons is very much less than to the NIH as a whole. The primary cause is the low per capita number of applications submitted by CT surgeons. The lower success rate for CT surgical applications in the past 3 years was a secondary cause.

The Effect of Center for Scientific Review (CSR) Reorganization

NIH applications from CT surgery faculty have traditionally been assigned to a small number of surgical NIH study sections. However, in 2000 the NIH began to reorganize the CSR, a process that was in part driven by the desire to have study sections "... review applications that apply to a given disease/organ system"⁵ Although one of the 24

Figure 4. A, Numbers of medical school faculty by year from 1999 to 2006. B, Numbers of surgery and CT surgery faculty by year from 1999 to 2006.

reorganized Integrated Review Groups (IRG; collection of related study sections) was the Surgery, Applied Imaging and Applied Bioengineering IRG,⁶ the perceived effect was to distribute applications submitted by CT surgical faculty to other IRGs and study sections with few if any surgical members. The decline in CT surgical application funding rate since 2003 may be related to the CSR reorganization and reallocation of grants to nonsurgical study sections. A proposal to send most applications from CT surgical faculty to the Surgery, Anesthesia and Trauma and the Bioengineering, Technology and Surgical Sciences study sections has therefore been made to the CSR. However, continued monitoring of application success rate is warranted.

Factors that Decrease Surgical Applications

Economic pressure. As academic surgeons decide how much of their time to devote to translational research efforts, institutional and departmental pressure for clinical productivity continues to mount. The financial status of academic medical centers was substantially affected by the managed care revolution of the 1990s⁷ and by subsequent reductions in Medicare reimbursement, which may have been upward of 50% over the past 10 years.⁸ As a consequence, clinically generated revenue declined and cost shifting to support teaching and research missions has become more difficult.⁷ An estimate that surgeons are working 25% harder in 2000 to maintain the same income level⁷ is further evidence that

Figure 5. A, NIH applications per 100 medical school faculty by year from 1999 to 2006. B, NIH awards per 100 medical school faculty, surgery faculty, and CT surgery faculty by year from 1999 to 2006. In each case, data from all medical school faculty, surgery, and CT surgery faculty are shown.

Figure 6. A, Number of NIH applications from CT surgeons from 1999 to 2006. B, Number of NIH awards to CT surgeons from 1999 to 2006. C, NIH application success rate for applications submitted by CT surgeons from 1999 to 2006. In each case, data are subdivided by STS/AATS society membership.

funds to support teaching and research are minimal. Furthermore, decisions regarding a commitment to academic research are often made at the outset of a surgeon's career, precisely when financial pressure from the increasing cost of medical school⁹ and the concerns about reimbursement for surgical practice¹⁰ may be the greatest.

Time pressure. Resident work hour reductions have had an inevitable impact on surgical faculty. In a survey performed by Winslow, Bowman, and Klingensmith¹¹ in 2004, a shift in routine work and responsibility was observed from residents to faculty. In addition to a perception of more frequent "skill gaps" at night was a perceived loss of time for research. Increased documentation requirements may also be affecting the balance between clinical and academic work.^{7,12}

Surgical research training. The nature of surgical training may also place surgeons at a relative disadvantage for achieving academic success.¹³ Surgeons, for instance, often obtain their research experience early during residency, in an area that may or may not relate to their eventual choice of specialty. It is common for surgical Residency Review Committees to stipulate that a surgical training period must end with 2 years of uninterrupted clinical work. This period of uninterrupted clinical work is lengthened by the 2 or 3 years of CT surgery training. On the one hand, it is unlikely after 3 to 6 years of additional clinical training and because of the rapid change in technology and advances in translational research that the junior surgical investigator will be able to pursue the same line of research work. Furthermore, many newly appointed academic surgeons must invest considerable time simply establishing themselves as new investigators, just at

a time when they must also build a practice and clinical reputation.¹³

Age. The age distribution of physician scientists has shifted toward a larger percentage over 45,⁹ and the age of surgical investigators at their first RPG award, like that of their nonsurgical counterparts, is now 42 years. However, as documented by a recent survey of 850 senior academic surgeons, the research career spans of surgical investigators are relatively short.¹³ The percentage of surgeons engaged in research fell progressively with age, from approximately 75% during residency to 60% at age 39 and only 20% at age 59. Increases in clinical load and administrative duties were often cited. It should be obvious that the extended CT surgery training worsens this problem.

Current Solutions

It goes without saying that junior faculty should be encouraged to obtain career development awards such as the NIH K08, K23, and Veterans Affairs (VA) career development awards. The role of the Thoracic Surgery Foundation for Research and Education, which provides career development awards and small entry level research grants, is also of great importance. Career development awards provide time for the clinicians/CT surgeons to update their knowledge and research skills, giving them a better chance to compete for extramural funding. This time may partially compensate for the time lag between research fellowship during general surgery and their first faculty position. In addition, the new K99 awards, which convert to R type grants in the second half

of the award period, may help junior surgical faculty achieve initial funding.

Mentoring by more senior surgeon scientists and by non-clinician basic scientists is critical to this process, particularly by those who sit on study sections and editorial boards. Knowledge of the manuscript and grant review process can be enhanced by junior faculty participation in entry-level grant review where appropriate.

It is important to recognize that there are several steps in achieving a successful career in academic medicine and, in particular, academic CT surgery. The hardest step is the choice and pursuit of an area of investigation that is clinically important and matches the knowledge base and skills of the investigator. Thus pursuing a research project in an area of research where the investigator needs many years of training or a large infrastructure can only be accomplished if much of the groundwork is present at the time a new investigator embarks on this effort. This is where an experienced and knowledgeable mentor can be invaluable to a new faculty member wanting to establish a research career.

The Department of VA, which provides support, facilities, and a moderate amount of funding for biomedical research, may provide a protected environment for academic surgeons.^{14,15} Recent increases in VA physician salaries made possible by the VA Pay Bill of 2006 may significantly increase the ability of both the VA and academic affiliates to recruit and retain high-quality physicians.¹⁶ Both NIH and VA programs may also provide relief from medical school debt.

Affirmative Action

In our previous analysis of NIH funding for surgical research, we¹ proposed an “affirmative action” plan in which the NIH would commit to award a minimum number of grants to CT surgeon scientists. In an accompanying editorial, John Niederhuber,⁵ Director of the National Cancer Institute and a surgeon, suggested that our proposal was both short-sighted and counterproductive inasmuch as the NIH is obligated to fund the “best” science. Instead, Niederhuber suggests that, with appropriate leadership from department chairs, cost shifting from clinical to academic faculty can still be accomplished. For the reasons above, we believe that this approach alone is unlikely to succeed. It would be interesting to survey department and division chairs of CT surgery on this issue.

The NIH director, Dr Elias Zirhouni, has recently undertaken a survey of ways to improve the peer review process. We suggest that the CSR agree to cluster CT surgery proposals in study sections that have a sufficient number of CT surgeons as permanent members. The effect will be two-fold. First, grants will receive true peer review. Equally important, clustering will achieve the affirmative action that we seek by assuring that a minimum number of grants go to CT surgeon scientists.

Until affirmative action is present, it will be up to the professional societies and their research support foundations to set guidelines for department/divisions leaders and new investigators seeking seed funding to develop research projects. Requirement of a clearly defined pathway and infrastructure for successful establishment of a research career should be an important part of any grant or career development award.

Conclusions and Future Directions

Per capita NIH funding to CT surgeons is very much less than to the NIH as a whole. The primary cause is the low per capita number of applications submitted by CT surgeons, with lower funding rates in the past 3 years being a secondary cause. Junior CT surgery faculty members are encouraged to use existing career development mechanisms. However, since the ability to shift cost from clinical to academic faculty is declining, affirmative action from the NIH may be necessary to ensure ongoing translational research in the field of CT surgery.

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