ASSOCIATION OF PROFESSORS OF MEDICINE PHYSICIAN-SCIENTIST INITIATIVE

RECOMMENDATIONS FOR

Revitalizing the Nation's Physician-Scientist Workforce

APM
Association of Professors of Medicine

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Introduction to the Association of Professors of Medicine Physician-Scientist Initiative

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Physician-scientists, because of their perspective of asking scientific questions influenced by their experience of caring for patients, are uniquely positioned to perform research that directly benefits patients. Yet, the physician-scientist workforce is shrinking and aging, portending decreases in the effectiveness of the medical enterprise to discover new treatments and cures. Recognizing the detrimental effects of a physician-scientist shortage, the Association of Professors of Medicine (APM)—the organization of departments of internal medicine represented by chairs and appointed leaders at medical schools and affiliated teaching hospitals in the United States and Canada—has begun a long-term initiative to identify, develop, and implement substantive and practical solutions that will ensure the survival, growth, and diversity of the physician-scientist workforce.

The APM Physician-Scientist Initiative—led by Principal Investigator Andrew I. Schafer, MD—is planned in linked phases. Phase I focused on evaluating the physician-scientist problem and creating a set of recommendations for growing, revitalizing, and diversifying the physician-scientist workforce. This goal was achieved through a series of structured surveys and focus groups (results summarized in Appendix A), which in turn helped inform the agenda for the APM Physician-Scientist Initiative Consensus Conference, "Revitalization of the Nation's Physician-Scientist Workforce," in November 2007. The consensus conference (planning committee, Appendix B) assembled leaders of the academic, medical, and research communities; representatives from the various governing bodies that influence, fund, and regulate biomedical research and academia; respected experts on issues facing the physician-scientist workforce; and young physician-scientists (conference participants are listed in Appendix C).

THE PHYSICIAN-SCIENTIST WORKFORCE IS SHRINKING AND AGING, PORTENDING DECREASES IN THE EFFECTIVENESS OF THE MEDICAL ENTERPRISE TO DISCOVER NEW TREATMENTS AND CURES.

Following plenary lectures presenting the perspectives of academia, industry, and the federal government, the conference was largely interactive, with targeted breakout groups focused on specific aspects of the physician-scientist career path (see Appendix D). Breakout group participants proposed their single, best, articulated recommendation for enhancing the highlighted areas, while the full group debated and discussed additional opportunities to improve the pipeline, whether via entry or improved retention. The complete list of 30 recommendations emanating from the conference breakout sessions and general group discussions is provided—in no priority order—in Appendix E. Participants provided a preliminary assessment of the recommendations followed by a more detailed, analytical assessment post-conference, prioritizing, commenting, and editing the recommendations to create a more sharply focused action plan.

While Phase I of the initiative was intended to understand the driving contemporary forces that shape the problem today and to formulate specific recommendations, Phase II will expand and activate a coalition group of key leadership organizations to move the agenda forward by developing next steps, a coordinated national strategy, and oversight of implementation of the action plan.

Background on Physician-Scientists

The term "physician-scientists" is broadly defined as physicians (MDs or MD-PhDs) who devote the majority of their professional effort to seeking new knowledge about health and disease through research. They represent the entire continuum of biomedical investigation, from basic research in the laboratory to translational and patient-oriented research and their application to the health of the population.

The number of physicians electing to pursue a research career has steadily declined. The percentage of physicians engaged in research as their major professional activity in the United States has decreased from a peak of 4.6 percent in 1985 to 1.8 percent in 2003. At the same time, the absolute number of physician-scientists dropped from a peak of 23,268 in 1985 to 14,340 in 1995; this decline subsequently leveled off, coinciding with the period of doubling of the National Institutes of Health (NIH) budget from 1998 to 2003.[1]

The academic medical community and NIH have long been aware of jeopardy to the physician-scientist career path. In 1994, the Institute of Medicine published the outcome of its study to overcome barriers to career paths for clinical research.[2] In 1996, then NIH Director Harold Varmus, MD, authorized an NIH committee, chaired by David G. Nathan, MD, to propose recommendations to address the perceived shortfall of clinical investigators. The Nathan Committee found that the climate for clinical research performed by physician-scientists was in jeopardy of deteriorating. The committee supported, among its recommendations, the creation of new career development awards for patient-oriented research and loan repayment programs to assist clinical investigators in paying off their increasing educational debt.[3] More recently, the Association of American Medical Colleges (AAMC) published reports of two Task Forces on Clinical Research to address the perceived shortfall in the clinical investigator workforce.[4,5] Focusing again primarily on clinical (rather than basic laboratory) research performed by physician-scientists, the recently published AAMC Clinical Research Task Force II produced 12 recommendations. The recommendations included incorporation of the principles of clinical research in undergraduate and graduate medical education curricula and the acceleration of training in clinical research through comprehensive re-structuring.

However, despite these past efforts, recent developments require a major reassessment of the situation. The NIH budget has stagnated, and the increasing unpredictability of federal support for biomedical research will likely discourage many more young physicians from pursuing a career in research. Dramatic generational changes in the priorities of recent medical school graduates, including the desire for work-life balance and more controllable career lifestyles, will have profound implications—though not necessarily negative—for the future of research careers. In addition, the disappearance of the gender gap among medical school graduates should be assessed in light of observations that, in the current climate, women find physician-scientist careers less attractive than their male counterparts.

[1] Ley TJ, Rosenberg LE. The physician-scientist pipeline in 2005. Build it, and they will come. JAMA 2005; 294:1343-1351.
[2] Kelley W, Randolph M, eds. Careers in Clinical Research: Obstacles and Opportunities. Washington, DC. National Academy Press; 1994.
[3] Nathan DG. Clinical research: perceptions, reality, and proposed solutions. JAMA 1998; 280:1427-1431.
[4] Association of American Medical Colleges. For the Health of the Public: Ensuring the Future of Clinical Research. Ralph Snyderman, M.D., Washington, DC: AAMC, 2000.
[5] Promoting Translational and Clinical Science: The Critical Role of Medical Schools and Teaching Hospitals. Report of the AAMC's Task Force II on Clinical Research. Washington, DC: AAMC, 2006.

WOMEN FIND PHYSICIAN-SCIENTIST CAREERS LESS ATTRACTIVE THAN THEIR MALE COUNTERPARTS.

Demographics of the Physician-Scientist Workforce in 2007

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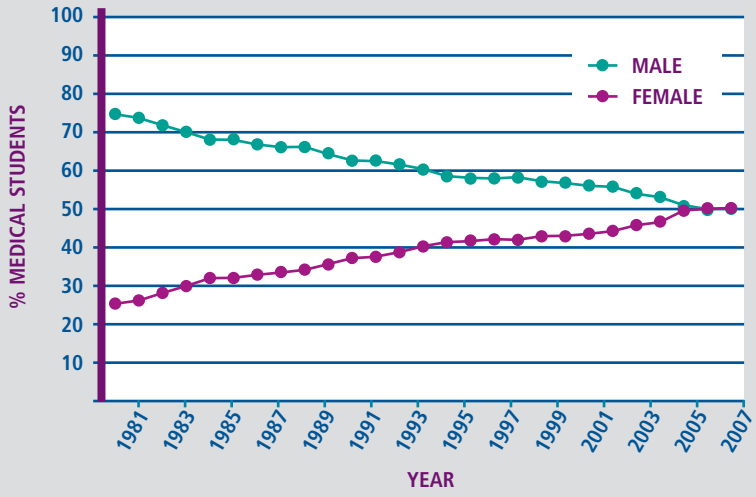
Currently, there are approximately 15,000 physicians conducting research in the United States, and this number has been constant for two decades. Assuming an average career of 25 years, 500 to 1,000 new physicians are required to enter the research pipeline each year to maintain steady state. However, the demographics of physicians are changing: women now comprise half of all matriculating medical students (see Figure 1), and longstanding data shows that women are more likely to drop out of the pipeline.

In addition, funded physician-scientists are getting older, as demonstrated by National Institutes of Health (NIH) data showing a steady increase in the proportion of individuals over the age of 50 with research project grants (RPGs). This proportion is projected to reach 50% in 2008. Growth in the number of RPG applicants in the past decade has largely come from PhD applicants; for both experienced and previously unfunded applicants, MD representation has remained constant. While physician-scientists appear not to be disadvantaged in obtaining funding, Howard B. Dickler, MD, and colleagues have reported small but significant reductions in success rates for first-time MD R01-applicants, MDs submitting for competitive renewals, and for MDs submitting applications in clinical research arenas.[6]

Medical school debt is on the rise. Medical school tuition, for public and private institutions, has steadily increased, as inflation-adjusted first year residency salaries have remained constant for decades. According to the Association of American Medical Colleges, 85% of students carry debt of at least $100,000 at graduation, and about 25% consider debt a factor that influences their career choice (Figure 2). While NIH's Loan Repayment Programs (LRP) offer assistance to MD applicants—who have the most debt at approximately $130,000—almost half of the applicants are PhDs. MD-PhD candidates, who have the least debt, have the highest LRP funding rates. Since the LRP program is now entering its sixth year, it is still too soon to assess the effectiveness of LRPs in promoting young physician-scientists to enter the pathway. Finally, the increased cost of medical school raises concerns over whether some MD-PhD students are sincere about the physician-scientist pathway, or whether they are more interested in a subsidized medical school education.

Figure 1: Matriculating Medical Students by Gender
Data from Association of American Medical Colleges' Data Book 2007



CURRENTLY, THERE ARE ABOUT 15,000 PHYSICIANS CONDUCTING RESEARCH IN THE UNITED STATES.

This snapshot of the research demographic raises a number of questions over the future of the physician-scientist workforce:

- How can academic medicine make the physician-scientist pathway more accommodating to women?

- Should additional trainees be encouraged to enter the career path, when projections for research budgets are flat?

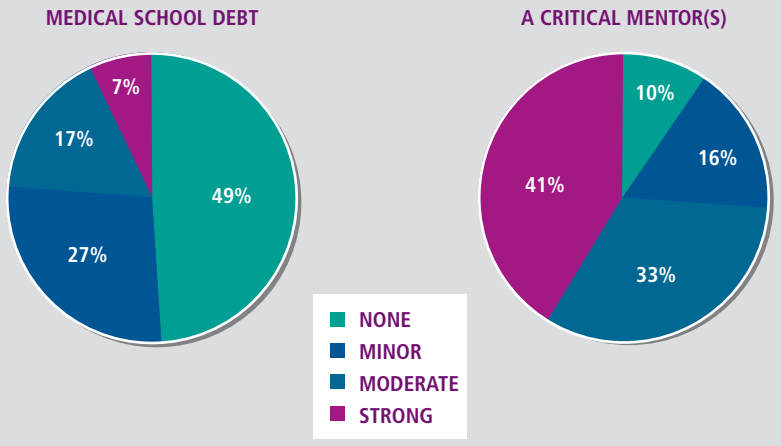
- Should NIH expand the LRP program, is the applicant pool expandable, and when can success be assessed?

- Should first-time R01 applicants receive preferential funding to support entry into the pipeline (as funded investigators continue to age)?

[6] Dickler HB, Fang D, Heinig SJ, Johnson E, Korn D. New physician-investigators receiving National Institutes of Health research project grants: a historical perspective on the "endangered species." JAMA 2007;297:2496-501.

WHILE NIH'S LOAN REPAYMENT PROGRAMS (LRP) OFFER ASSISTANCE TO MD APPLICANTS—WHO HAVE THE MOST DEBT AT APPROXIMATELY $130,000—ALMOST HALF OF THE APPLICANTS ARE PHDS. MD-PHD CANDIDATES, WHO HAVE THE LEAST DEBT, HAVE THE HIGHEST LRP FUNDING RATES.

FIGURE 2: STRENGTH OF INFLUENCES ON CAREER CHOICE (2005-2007)
Medical Student Responses to Association of American Medical Colleges' Graduation Questionnaire



The Importance of the Physician-Scientist to the Biotechnology and Pharmaceutical Industries

Roger Perlmutter, MD, PhD
Executive Vice-President of Research and Development
Amgen, Inc.

Disease-oriented research has changed dramatically since the 1970s, and as such, fundamental research in disease-oriented programs, along with more stable funding platforms, increased remuneration, and freedom from restraints imposed by academic career ladders, has attracted many physician-scientists to the pharmaceutical and biotechnology industries.

The model that once inspired entry into the physician-scientist pathway is now extinct. Research is often predicated on large amounts of data that require mathematical modeling and analysis led by investigative teams of cellular and molecular biologists, physicists, and engineers. Despite exposure to many basic science disciplines, physician-scientists are not effectively trained in these areas. The biotechnology and pharmaceutical industries remain attractive places for physician-scientists to work because they work with teams of professionals from various disciplines, aligned around the same disease-centered goal. Because of their clinical background, physician-scientists are often best able to guide drug development and are, therefore, key players in industry's overall mission. However, there is no substitute for content expertise, and assuming well-trained minds can conquer any discipline would be a mistake. Physician-scientists need not be jacks of all trades; they should focus on questions relevant to patients.

At Amgen, approximately 3% of the research and development workforce are MDs, but heads of regulatory affairs, exploratory research, and clinical research all hold MD degrees.

As many physician-scientists move from academia to industry, many have suggested that the biotechnology and pharmaceutical industries should play an active role in training and supporting the physician-scientist workforce. Yet, industry will always attract top physician-scientists regardless of whether it provides funding support. Therefore, any assistance would be only a philanthropic exercise, not one in which all companies feel compelled to participate. Without a compelling business case for industry involvement in revitalizing the workforce, it is unlikely academic health centers can unburden their own training investment responsibilities.

BECAUSE OF THEIR CLINICAL BACKGROUND, PHYSICIAN-SCIENTISTS ARE OFTEN BEST ABLE TO GUIDE DRUG DEVELOPMENT AND ARE, THEREFORE, KEY PLAYERS IN INDUSTRY'S OVERALL MISSION.

Issues Faced by Government Entities in Supporting the Physician-Scientist Workforce

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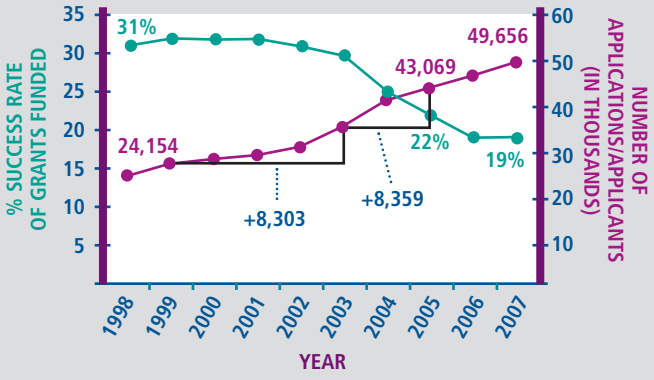
National Institutes of Health

In the current research arena, there are anomalies that threaten the future viability of the physician-scientist workforce. There is an imbalance between the supply of National Institutes of Health (NIH) funds and the demand for NIH grants. Since 2003, the NIH budget has failed to keep pace with inflation. While nominal funding has risen by $600 million between fiscal year (FY) 2004 and FY 2007, due to an 8.3% loss in purchasing power, the net decrease is $2.3 billion. Yet, NIH has experienced a 100% growth in applications and 75% growth in applicants in the same period. Meanwhile, aging medical school faculty and NIH principal investigators consume the available budget and resources, leaving little room for the next generation of physician-scientists.

NIH has taken steps to respond to these challenges. Institutes have adjusted portfolios to support trainees and career development while also increasing funding lines for new investigators. Budgets have been reorganized to fund more competing grants (a 3% increase in 2007) and NIH has assessed its peer review process to reduce the need for multiple applications. The National Heart, Lung, and Blood Institute has raised the payline for new investigators 5% above the R01 payline, while new investigators with priority scores six to 10 points above the payline may still be able to achieve funding via an extended review. Across NIH, new mechanisms such as the NIH Director's Pioneer Awards, Pathways to Independence Awards, and Clinical and Translational Science Awards are dedicated to advancing research areas where physician-scientists are particularly likely to succeed.

Yet, NIH is still assessing the best response to managing the dichotomization of its research arena. How much attention should NIH give to trainees and new investigators? Does the loan repayment program provide junior investigators the freedom to make economic-independent career decisions? How can NIH better support female investigators so they are more effectively utilized? Along with academia and the biotechnology and pharmaceutical industries, NIH shares the goals of encouraging physician-scientists to pursue research careers and supporting them as they attain independent principal investigator status and stable funding. There is interplay between what actions NIH can take and how the other stakeholders can impact change. Attention must be given to the balance of new and experienced faculty at academic medical centers in light of attrition. While continuing to support the research elite, all entities must ensure there is room for the next generation of physician-scientists.

Figure 3:
National Research Capacity and Demand for Grants Surges at End of Doubling Period: Success Rates Fall



Workforce Issues: NIH PI and Medical School Faculty (1980-2006)

	1980	1998	2006
NUMBER AND AVERAGE AGE OF NIH PIs	14,887 39.1	17,761 42.7	25,419 50.8
NUMBER AND AVERAGE AGE OF NIH NEW PIs	1,843 37.2	1,355 39.0	1,346 42.4
NUMBER OF MEDICAL SCHOOL FACULTY POSITIONS	53,552	73,413	121,468
AVERAGE AGE OF MEDICAL SCHOOL FACULTY	43.1	45.2	48.7
AVERAGE AGE OF FIRST TIME ASSISTANT PROFESSOR	33.9	35.4	37.7

ALL ENTITIES MUST ENSURE THERE IS ROOM FOR THE NEXT GENERATION OF PHYSICIAN-SCIENTISTS.

Action Plan for Revitalizing the Nation's Physician-Scientist Workforce: Four Major Recommendations

OF THE 30 RECOMMENDATIONS PROPOSED BY THE BREAKOUT GROUPS AND THEN DISCUSSED BY ALL CONFERENCE PARTICIPANTS (SEE APPENDIX E), THE FOLLOWING FOUR MAJOR RECOMMENDATIONS WERE MOST HIGHLY PRIORITIZED BY POLLING ALL CONFERENCE PARTICIPANTS.

1 ATTENTION AND RESOURCES SHOULD BE DIRECTED AT REPAIRING THE "LEAKING" PHYSICIAN-SCIENTIST PIPELINE. *Traditionally, physician-scientists have been developed en masse, with institutions launching numerous careers in the hopes of retaining a relatively low yield of successful, independent investigators.*

- Institutions should consolidate their focus on accommodating, retaining, and then fully supporting the most promising physician-scientist faculty members with sufficient and more stable resources, competitive salaries, mentoring, and protected time for research.
- The National Institutes of Health (NIH) should optimize its mechanisms of support for the career development (K) award, including increased salary support, flexibility in award length to accommodate time out for family responsibilities, and financial support for mentors commensurate with effort. With thoughtful guidance and peer review, NIH should implement a mechanism to prematurely terminate clearly non-productive K awards. This should be done without discouraging high-risk, innovative research by committed trainees.
- NIH should substantially increase support for first time R awards, since a major vulnerable point in the pipeline occurs in the transition to independence.
- NIH should direct funds to study and monitor its investigator workforce, particularly tracking applicants over time, analyzing the effectiveness of its grant mechanisms, and studying the impact of policy changes on career decisions. Academic societies should track data on trends in physician-scientists who join the biotechnology and pharmaceutical industries.

2 MAJOR CHANGES SHOULD BE MADE TO THE CONTEMPORARY APPROACH TO MENTORING PHYSICIAN-SCIENTISTS. *The success of physician-scientists today requires institutionally mandated, career-long, multi-dimensional guidance and support by teams of skilled mentors who contribute dedicated effort to this activity.*

- Institutions should create and implement formalized mentoring programs for physician-scientists that incorporate several contemporary facets.

  • Mentees may require team-based mentoring by groups of mentors who have complementary skills and insights into various aspects of a physician-scientist career.
  • Institutions should organize multi-generational mentoring groups to acknowledge and reconcile the striking generational differences in attitudes toward work-life balance and controllable lifestyles.
  • Institutions should ensure that mentors reflect the diversity of the workforce and that mentors are trained in approaches to mentoring junior faculty of different genders, races, and ethnicities.
- Mentoring programs should include formalized training in career negotiation and tracks, grant writing and management, and presentations and publications as well as scientific guidance.
- Institutions should provide formalized training in mentoring skills for mentors and establish evaluation systems to ensure effective mentoring.
- Mentors should receive financial support commensurate with professional effort from the institution and/or granting agency.
- NIH should expand mentoring awards in scope and amount for senior physician-scientists through the K series to support and enhance dedicated mentoring of junior physician-scientists, enabling better utilization of the time and effort of many senior researchers, and potentially freeing up additional R01-type awards for junior and mid-career investigators.

3 **INSTITUTIONS SHOULD PROACTIVELY PROMOTE THE ADVANCEMENT AND MINIMIZE THE ATTRITION OF WOMEN IN PHYSICIAN-SCIENTIST CAREERS.** *The demographics of medical school graduates are rapidly transforming, with female graduates anticipated to comprise the majority in the coming years. Academic medicine must take advantage of this opportunity to expand the physician-scientist workforce to include female faculty. Yet, women physicians generally find research careers less appealing and accommodating than men.*

- Institutions should ensure that men and women of equal academic standing receive equivalent protected time, start-up packages, bridge funding, space, and access to other resources.
- Institutions should substantively increase the flexibility of time-based review in the promotion process and in the tenure clock for investigators who need additional time to move to successful independent funding.
- Institutions should aggressively support the provision of easily accessible on-site child care, the development of lab schools, and other initiatives that equalize opportunities for women to succeed as physician-scientists, remain productive in physician-scientist careers, and attain leadership positions in academic medicine.

4 **THE PHYSICIAN-SCIENTIST WORKFORCE SHOULD BE STRENGTHENED BY EARLIER AND MORE COORDINATED EFFORTS TO IDENTIFY AND PREPARE SUCCESSFUL FUTURE INVESTIGATORS WITH A MORE ENDURING COMMITMENT TO RESEARCH CAREERS.**

- Universities should broaden the focus of undergraduate premedical education curricula to place more emphasis on the physical sciences and quantitative skills, molecular biology and genetics, biostatistics, and ethics. In turn, the Association of American Medical Colleges should alter the Medical College Admission Test to reflect the curriculum changes.
- Medical schools should partner with the pre-medical advisor community to promote the physician-scientist pathway to undergraduate students.
- Research-intensive medical schools should alter their admissions committee culture to accommodate more applicants with strong research interests, including special sub-committees that make decisions related to research-interested students.
- Research-intensive medical schools should place interest and resources in medical student research by providing a full-year of research and stipends for approved full-time student researchers.

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National Institutes of Health
- Office of the Director
- National Cancer Institute
- National Center for Complementary and Alternative Medicine
- National Center on Minority Health and Health Disparities
- National Eye Institute
- National Heart, Lung, and Blood Institute
- National Institute of Allergy and Infectious Diseases
- National Institute of Arthritis and Musculoskeletal and Skin Diseases
- National Institute of Biomedical Imaging and Bioengineering
- National Institute of Child Health and Human Development
- National Institute of Diabetes and Digestive and Kidney Diseases
- National Institute of Environmental Health Sciences
- National Institute of Mental Health

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American Academy of Allergy, Asthma, and Immunology
American Gastroenterological Association
American Society of Clinical Oncology
American Society of Nephrology

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APPENDIX A

Summary of Surveys and Focus Groups

In October 2006, APM distributed a survey to leaders in academic medicine to assess opinions on the status of the physician-scientist workforce. Recipients included members of APM, the Association of Specialty Professors, the Association of American Physicians, the American Society for Clinical Investigation, and the American Federation for Medical Research. In addition to chairs of departments of internal medicine, surveys were distributed to chairs of departments of psychiatry, pediatrics, obstetrics and gynecology, and dermatology. The survey was intended to elicit respondents' opinions and views regarding attraction to and retention within the physician-scientist career path, both currently and when they entered the pipeline. In January 2007, a similar (but modified) survey was sent to all program directors of MD-PhD programs. Between October 2006 and May 2007, APM held seven facilitated focus groups with junior faculty and fellows at six different institutions to explore views about career supports and barriers.

Detailed results of the survey data are available from APM. The following represents a summary overview of data collected through these processes.

A SURVEY OF LEADERS IN ACADEMIC MEDICINE

Respondent demographics:

Total respondents: 880
Gender: 85% male
Median year of obtaining MD: 1977 (range: 1942-2002)
Median year of first faculty appointment: 1983 (range: 1948-2004)

Type of research conducted by respondent:

Basic laboratory: 32%
Clinical/patient-oriented research: 32%
Translational: 25%
Health services: 8%

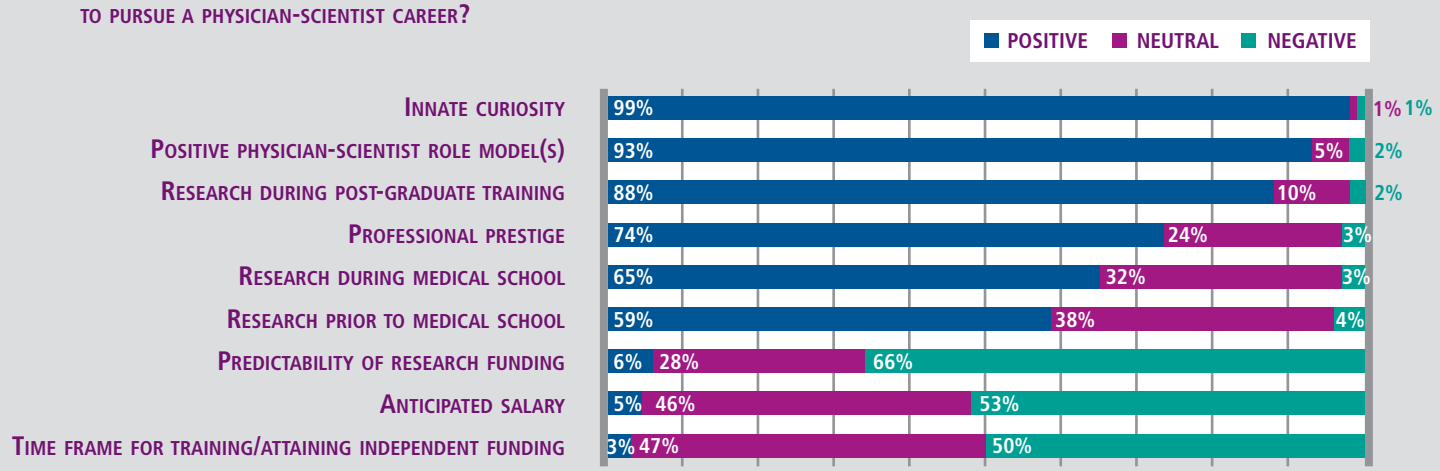
NIH funding rank of current institution

First quartile: 48%
Second quartile: 16%
Third and fourth quartiles: 16%

QUESTIONS AND RESPONSES

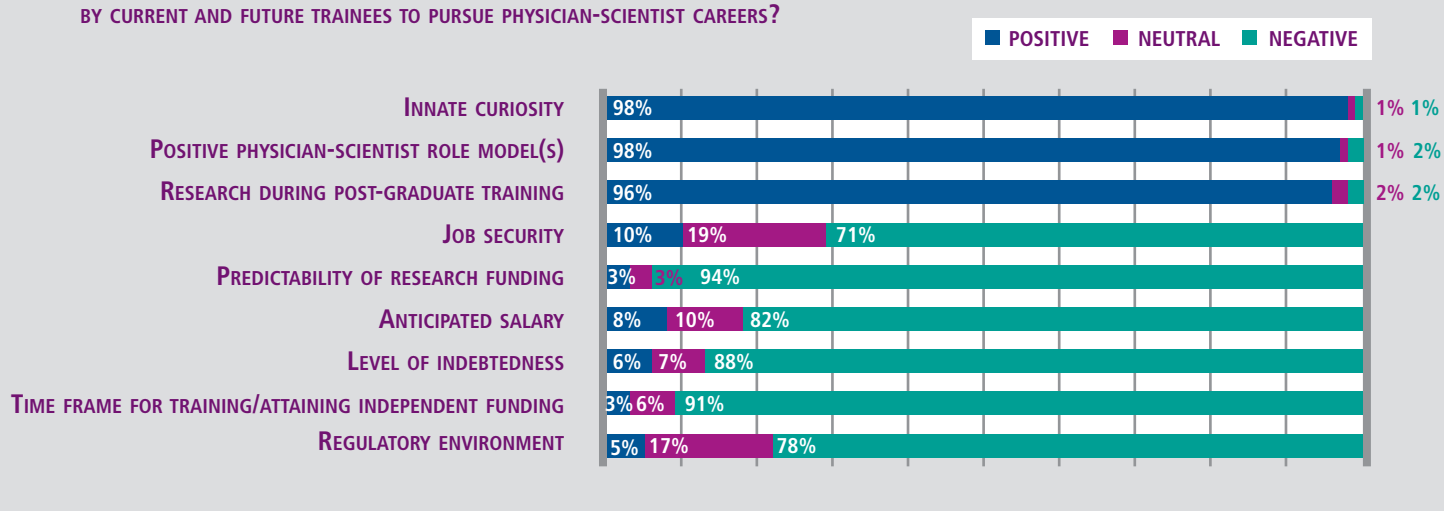
1. What were the most important factors (positive or negative) that influenced your personal decision to pursue a physician-scientist career?

FIGURE 4: WHAT WERE THE MOST IMPORTANT FACTORS (POSITIVE OR NEGATIVE) THAT INFLUENCED YOUR PERSONAL DECISION TO PURSUE A PHYSICIAN-SCIENTIST CAREER?



2. What do you think are the most important factors (positive or negative) that influence decisions by current and future trainees to pursue physician-scientist careers?

FIGURE 5: WHAT DO YOU THINK ARE THE MOST IMPORTANT FACTORS (POSITIVE OR NEGATIVE) THAT INFLUENCE DECISIONS BY CURRENT AND FUTURE TRAINEES TO PURSUE PHYSICIAN-SCIENTIST CAREERS?



3. What components of the local research environment do you think are most important for the success of young faculty?

Utmost Importance:
Mentoring (67%)
Availability of adequate start-up support (57%)

Very Important:
Critical mass of investigators (58%)
Access to strong trainees (55%)
Research intensity of medical school (54%)

4. What were the most important factors (positive or negative) that influenced your decision to remain in a research career?

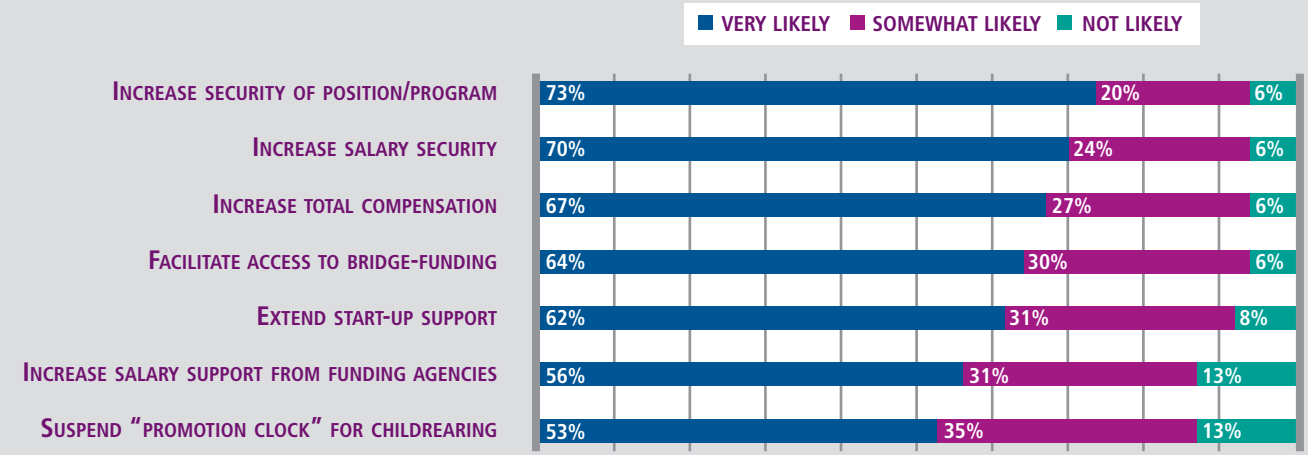
Strongly Positive:
Interest and enjoyment (84%)
Innate curiosity (70%)
Role models (53%)

Weakly or Strongly Positive:
Opportunities to learn new science (91%)
Professional prestige (82%)
Leadership opportunities (79%)

Weakly or Strongly Negative:
Unpredictable funding (94%)
Indebtedness (83%)
Salary (79%)

5. What do you think is the relative likelihood of future initiatives to expand the physician-scientist workforce pipeline?

FIGURE 6: WHAT DO YOU THINK IS THE RELATIVE LIKELIHOOD OF FUTURE INITIATIVES TO EXPAND THE PHYSICIAN-SCIENTIST WORKFORCE PIPELINE?



SUBGROUP ANALYSIS OF RESPONSES

Gender: In terms of the local research environment, men perceived the research intensity of the medical school and access to strong trainees as more important than women. Women, however, placed more importance on the availability of bridge funding and flexibility in how professional effort is distributed. Women ranked a number of factors in retaining physician-scientists after the first few years more negatively than men: transition to other responsibilities within the current position, lifestyle, salary, and job security. They also had more positive opinions regarding the likelihood of success of some future initiatives, including increasing security for position/program, promoting part-time pathways, extending start-up support, facilitating access to bridge-funding, and suspending the "promotion or tenure clock" to accommodate childrearing.

NIH Funding Rank of Current Institution: Respondents from the first quartile provided higher ratings to early research experience as an influence on their own careers. Respondents from the third and fourth quartiles gave higher ratings to professional prestige and perceived requirement for a future academic leadership or administrative career.

B

SURVEY OF MD-PHD PROGRAM DIRECTORS

Demographics of Respondents

Total respondents: 48
Degrees: 56% MD; 73% PhD
Median duration of program directorship: Four years (range: 1-25 years)
Median year of first faculty appointment: 1986 (range: 1965-1998)

MAJOR SURVEY CONCLUSIONS:

1. There was strong consensus that graduates of MD-PhD programs should become physician-scientists.

2. Respondents suggested that to be a successful physician-scientist requires greater than 50% professional effort.

3. Respondents cited potential future initiatives that are very/extremely likely to succeed as: increase salary security (64%), increase position security (58%), create part-time pathways (58%), extend start-up support (58%), and reprioritize medical school admission criteria (56%).

4. Extending the length of MD-PhD training emerged in multiple questions as a significant disincentive to entering the physician-scientist pathway.

C

SUMMARY OF FOCUS GROUPS

Seven facilitated focus groups with junior physician-scientists (fellows, instructors, assistant professors, and a few associate professors) were conducted at six institutions: University of Pennsylvania School of Medicine, Johns Hopkins University School of Medicine, Mount Sinai School of Medicine, University of Minnesota School of Medicine, Jefferson Medical College of Thomas Jefferson University, and Harvard Medical School Beth Israel Deaconess Medical Center. While each institution has its own personality and to some extent, unique, local issues, there were some overarching conclusions that could be drawn from these discussions.

The majority of participants chose a research career because science is exciting, intellectually stimulating, and fun. Furthermore, for some participants, physician-scientist careers were considered to provide a nice balance (or alternative) to patient care as well as day-to-day independence and flexibility. The participants argued that their biggest worry is the constant drumbeat of funding. There was a clear realization that you are only in the game as long as the funding continues; roughly one-third of participants had already begun to think of changing or altering their career paths, largely in recognition of the inevitable burnout from chasing support. Most participants viewed difficulties in keeping people in the pipeline and helping them transition from career development awards to independent funding as the largest problem facing the future of the physician-scientist workforce.

APPENDIX B

Association of Professors of Medicine
Physician-Scientist Initiative Conference Planning Committee

(Titles and institutional affiliations as of the time of the conference)

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Director for Clinical Research
Association of American Medical Colleges

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APPENDIX D

Consensus Conference Breakout Group Topics

1. Attracting and Retaining Women Physician-Scientists
2. Selection Process and Educational Programs for Physician-Scientists
3. Effects of Generational Changes on the Future Physician-Scientist Workforce
4. Mentoring and Enhancing Programs to Nurture Late Bloomers
5. Recruiting Underrepresented Minority Physician-Scientists
6. Competitive Compensation Mechanisms for Physician-Scientists
7. Combined Degree (MD-PhD) Programs
8. Organizing Initiatives at Academic Health Centers to Facilitate the Development of Physician-Scientists
9. Supporting Physician-Scientists in the Transition from K Award to First R01
10. Supporting Physician-Scientists in the Transition from First R01 to Second (Competing) R01

APPENDIX E

Thirty Recommendations Emanating from the Conference Breakout Groups

THE FOUR MAJOR RECOMMENDATIONS OUTLINED ON PAGES 8 AND 9 WERE PRIORITIZED FROM THE FOLLOWING LIST OF 30

MENTORING

1 Institutions should create and implement formalized mentoring programs for junior physician-scientists. The programs should include:

a. Team-based mentoring. Mentees should have groups of mentors who have skills and insight into various aspects of a physician-scientist career.
b. Multi-generational mentoring groups.
c. Assistance and education on career negotiation and tracks, grant management and writing, presentations and publications, and scientific skills.
d. Support for the mentor. Mentors should receive financial support from the institution and/or granting agency.
e. Formalized training for mentors on how best to serve as a mentor.
f. Evaluation procedures to ensure mentors are providing proper support.

2 Institutions should implement mentoring programs for mid-career and tenured physician-scientists. These programs should require a yearly review of mid-level and tenured faculty. The reviews will include formal presentations to groups of senior faculty to ensure productivity and provide input on preliminary research for subsequent grant applications.

3 NIH should create a mentoring award for senior physician-scientists through the K series to support and enhance mentoring of junior physician-scientists. The award will better utilize the senior researcher's time and effort and will open up additional R01 awards for junior and mid-career investigators.

K AWARDS

4 NIH should increase its support of the K award mechanism. In particular, the agency should:

a. Increase salary support to $100,000.
b. Open eligibility to include part-time researchers.
c. Increase the length of the award.
d. Provide monetary support (with corresponding committed effort) for mentors on K award grants.
e. Require mentor training for primary mentors on K awards.
f. Include mentor evaluation as part of the grant review process.
g. Require institutional program and track record as part of the K award application process.
h. Allow K award recipients to apply for their R01s earlier.
i. Create a mechanism to end non-productive K awards.

5 NIH should alter the eligibility requirements for the Pathways to Independence Award so K award recipients with three years or less of prior K support are eligible to apply.

6 NIH should fund grants dedicated to studying its investigator workforce, particularly tracking applicants over time, analyzing the effectiveness of its grant mechanisms, and studying the impact of policy decisions in terms of funding and career decisions.

7 K award recipients should be required to submit an R01-equivalent application in the second or third year of their K award. Failure to do so would lead to termination of a presumably non-productive K award.

R01 AWARDS

8 NIH should increase the length of first-time R01 awards to seven years. NIH should require an extensive review in the fourth year to ensure productivity, using the merit award review as a model.

9 NIH should require all first-time R01 recipients to serve as ad hoc study section reviewers in the third year of the grant.

10 NIH should offer a joint R01 which is co-submitted by a junior and senior investigator. During the second year of the award, the junior investigator will be responsible for the outcomes of the award.

11 NIH should develop a mechanism to supplement an R01. The supplement would provide funds to support salary and supplies for a mentee of the investigator (no age requirements, perhaps weight women, underrepresented minorities). To receive this funding, the institution should commit/protect time for the R01 awardee to mentor this person, so there is an incentive to mentor. In order to be eligible for this funding, R01 recipients should have received formal mentor training.

12 Institutions should create formalized bridge funding mechanisms for productive faculty . Institutions should partner with the pharmaceutical industry to create a mechanism for industry support in exchange for right of first refusal for any discoveries made from the research.

ADMISSIONS AND CURRICULUM

13 Universities should broaden the focus of undergraduate premedical education curricula to place more emphasis on the physical sciences and quantitative skills. In turn, the Association of American Medical Colleges should alter the Medical College Admission Test to reflect the curricula change.

14 Research intensive schools should be obligated to place interest and resources in medical student research via a fifth year of research. These institutions should alter their admissions committee culture to accommodate more applicants with strong research interests and provide stipends for approved full-time student researchers.

15 Medical school admissions committees should create special subcommittees that make decisions related to research-interested students.

16 Medical schools should partner with the pre-medical advisor community to promote the physician-scientist pathway to undergraduate students.

17 Combined degree (MD-PhD) programs should increase the pool of qualified candidates for MD-PhD programs by increasing outreach to undergraduates, medical school applicants, and first and second year medical students. More research passion (not just experience) should be a requirement for medical school. MD-PhD programs should increase the program size to accommodate the pool. The Federation of State Medical Boards and the National Board of Medical Examiners should maintain the USMLE step one.

18 Provide loan repayment for first year of medical school for transfer students into the MD-PhD program.

19 Institutions should create a grant mechanism similar to the Howard Hughes Medical Institute "Med into Grad" Program, which encourages individual institutions to develop programs to bridge the gap in the pipeline (created by clinical training requirements) from MD-PhD graduate to academic faculty member.

INSTITUTIONAL INITIATIVES

20 Institutions should integrate university, medical school, and graduate medical education with progression based on competencies (allow faster progression than presently the case to allow for research efforts).

21 Departments should set compensation for physician-scientists based on the amount of money that individual could make as a full-time clinician. Funding can come from a variety of sources (dean, hospital, practice plan). Institutions should consider the return of indirects as a means for concentrating resources on excellence.

22 Institutions should remove time-based review from the promotion process and halt the tenure clock indefinitely for investigators who need additional time to successfully move to independent funding.

23 Institutions should promote team-based research that includes interdisciplinary themes across the biomedical engineering and physical sciences (that also includes other non-medical disciplines) and develop the infrastructure at an institutional level to support clinical and translational research.

24 Institutions should allow investigators to work in academically-recognized, high-quality scientific teams for protracted periods of time. An individual's time commitment to the team could fluctuate according to work-life balance needs, but the team's efforts as a whole will remain constant.

25 Institutions should implement functional infrastructure platforms across silos to facilitate and catalyze clinical and basic research. Institutions need a toolbox of activities, such as proteomics, genomics, and core personnel (research nurses, hospitalists to cover the General Clinical Research Center equivalent) to facilitate and integrate research careers across specialties. The toolbox requires strategic and financial planning within academic medical centers and interaction across academic medical centers, e.g. phenotyping.

26 Medical schools should alter the Hippocratic Oath to include an obligation to the discovery and dissemination of new knowledge as a condition of entry into the medical profession.

27 Institutions should ensure that men and women of equal academic standing receive equivalent lab space, protected time, and start-up packages and future access to resources.

28 Institutions should reassess their approach to supporting physician-scientists early in the pipeline. Rather than encouraging large numbers of junior physician-scientists to enter the pathway, institutions should set a limit on the number of physician-scientist faculty they will accommodate and then fully support these faculty members with sufficient resources, salaries, and protected time. This recommendation is aimed at repairing the pipeline rather than necessarily expanding it.

29 Institutions should commit to making diversity a core institutional value and objective. Institutions should encourage the Liaison Committee on Medical Education to implement regulations that create a set of metrics and expectations that require institutions to address gender differentials and discrepancies in underrepresented minority representation in academic medicine.

30 Lobby the health provider and insurance industries to create research and development components in their companies and agencies to support research.

ASSOCIATION OF PROFESSORS OF MEDICINE PHYSICIAN-SCIENTIST INITIATIVE

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