Life-Science Research Within US Academic Medical Centers

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Context Besides the generic "basic" vs "applied" labels, little information is known about the types of life-science research conducted within academic medical centers (AMCs).

Objective To determine the relative proportion, characteristics, funding, and productivity of AMC faculty by the type of research they conduct.

Design Mailed survey conducted in 2007 of 3080 life-science faculty at the 50 universities with medical schools that received the most funding from the National Institutes of Health in 2004. Response rate was 74%.

Setting and Participants Research faculty affiliated with a medical school or teaching hospital, representing 77% of respondents (n=1663).

Main Outcome Measures Type of research (basic, translational, clinical trials, health services research/clinical epidemiology, multimode, other), total funding, industry funding, publications, professional activities, patenting behavior, and industry relationships.

Results Among AMC research faculty, 33.6% exclusively conducted basic science research as principal investigators compared with translational researchers (9.1%), clinical trial investigators (7.1%), and health services researchers/clinical epidemiologists (9.0%). While principal investigators garnered a mean of $410 755 in total annual research funding, 22.1% of all AMC research faculty were unsponsored, a proportion that ranged from 11.5% for basic science researchers to 46.8% for health services researchers ($P<.001$). The average AMC faculty member received $33 417 in industry-sponsored funding, with most of this money concentrated among clinical trial ($110 869) and multimode ($59 916) principal investigators. Translational (61.3%), clinical trial (67.3%), and multimode (70.9%) researchers were significantly more likely than basic science researchers (41.9%) to report a relationship with industry and that these relationships contributed to their most important scientific work ($P<.05$ for all comparisons).

Conclusion The research function of AMCs is active and diverse, incorporating a substantial proportion of faculty who are conducting research and publishing without sponsorship.

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Encompassing 60% of all research money to universities, the academic, life-science research enterprise is large and growing, representing $28.8 billion in research and development expenditures in 2006.[1] While there is general consensus on the need for continued government investment in life-science research,[2,3] a more nuanced debate has emerged. With limited public funds, what types and kinds of research should take precedence, especially within the field of life sciences where new and more efficient treatments are needed?[4,5]

Researchers and policy experts disagree about whether the current emphasis is correct, arguing alternatively for more funding of basic research,[6] translational infrastructure,[7-10] or clinical trial capabilities.[11-13] Many believe that taxpayer-supported research should be driven by public health need as well as scientific opportunity.[14] Most recently, the American Recovery and Reinvestment Act of 2009 allocated significant new money for comparative effectiveness and health services research[15,16] in an attempt to prioritize the study of "health-care practices to try to determine the best treatments, devices, and procedures for almost any ailment or disease."[17]

To establish policies and priorities, a better empirical picture is needed of what the academic medical center (AMC) research enterprise looks like, but beyond generic classifications such as "basic" and "applied," these data do not exist. The purpose of this study was to quantitatively document the state of academic research in AMCs through a survey of research faculty. A novel method was used to categorize types of researchers and document the relative proportion, characteristics, funding, and productivity of each group.

For editorial comment see p 1001.

METHODS

Sample Selection

The data presented here were collected from a survey of life-science faculty conducted between September 2006 and February 2007. The survey sample was selected in a 3-step process similar to that used in previous

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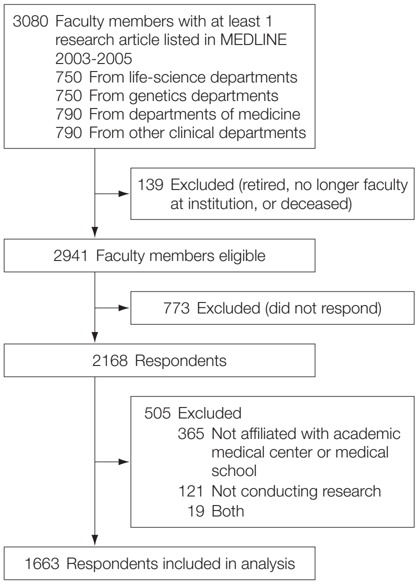
Figure. Study Sample Flow Chart



studies.[18,19] First, the 50 US universities and medical centers that received the most extramural research support from the National Institutes of Health (NIH) in 2004 were identified. Second, within these institutions, all life-science departments and programs were identified in 4 survey strata: departments of medicine, other clinical departments, nonclinical life-science departments, and genetics departments or programs. Other clinical departments included those receiving the most NIH funding in 2003: anesthesiology, neurology, neurosurgery, obstetrics/gynecology, otolaryngology, pathology, pediatrics, psychiatry, radiation/oncology, and surgery. The nonclinical category consisted of medical school departments and graduate academic programs in anatomy/cell biology, biochemistry, microbiology, pharmacology, and physiology/biophysics. These represented nonclinical departments that received the most NIH funding in 2003. Using *Peterson's Guide to Graduate Programs*, all US medical school departments and graduate programs that offer doctoral-level training in genetics were identified. If 2 programs existed within the same institution, both were selected for the sample.

Third, faculty names and addresses were drawn from departmental Web sites and from the Association of American Medical Colleges (AAMC) faculty roster. From the faculty list, a random sample of 790 faculty was selected from each of the 2 clinical strata (departments of medicine and other clinical departments) and 750 faculty from each of the 2 nonclinical strata (life-science departments and genetics departments/programs), yielding a total of 3080 faculty. To avoid the inclusion of fellows and hospital staff members not truly functioning as researchers, clinical faculty members were eligible for the sample if they had published at least 1 research article listed in the National Library of Medicine MEDLINE database for the period from 2003 through 2005.

Survey Design and Administration

The survey instrument was a modified version of an instrument administered to life-science faculty in 1985 and separately in 1995.[18,19] While many items were identical to past surveys, new questions were developed using 2 focus groups of scientists at medical schools and 10 confidential personal interviews with scientists across the United States. In addition, the new survey items were pretested using 11 cognitive interviews conducted by experienced survey researchers.

The survey was conducted by mail between September 2006 and February 2007 by the Center for Survey Research at the University of Massachusetts. Sampled faculty members were sent a survey instrument, a cover letter, a fact sheet answering frequently asked questions about the study, a postage-paid return envelope, and an incentive of $20 cash. As in the past, the survey instrument contained no identifying information. Participants were instructed to return the completed survey in a pre-addressed envelope and return a postcard separately that included the respondent's identification number. This step provided anonymity for the respondent's survey results and prevented additional mailings to participants who had completed the survey. Telephone reminder calls were made to all individuals who did not send in a postcard indicating participation. This study was approved by institutional review boards at both the Massachusetts General Hospital and University of Massachusetts Boston.

Of the 3080 faculty researchers in the original sample, 139 were ineligible because they were retired, no longer faculty at the institution, or deceased (FIGURE). Of the eligible 2941 faculty members, 2168 completed the survey, for an overall response rate of 74%.[20] Faculty members who did not respond to our survey did not differ significantly by academic rank, employment within a medical school, or level of institutional NIH funding.

Despite the extensive sample development processes, 505 respondents were excluded because they were not conducting research (n=121), were not affiliated with an AMC or medical school (n=365), or both (n=19). This process resulted in a final analytic group of 1663 faculty (Figure).

Key Variables

To gauge the magnitude of funded research, faculty respondents reported their total research funding based on the question, "What is the total budget this fiscal year for grants and contracts from any source on which you are the Principal Investigator? (Please include only research projects funded through your university, and exclude overhead/indirect costs.)" Faculty who reported zero dollars were assumed to be unsponsored. Respondents were queried on the amount of industry funding in the same manner.

Because some types of research labels are confusing or not widely understood,[21] respondents were asked to self-describe the stage of their research by responding to the following question: "Which of the following types of research are you currently conducting? (Check all that apply.)" Survey categories included basic science research, early clinical/phase I clinical trials, phase II clinical trials, phase III clinical trials, health services research/clinical epidemiology, other clinical research, and not currently involved in research.

Based on these responses, researchers were grouped into 6 mutually exclusive categories of researcher type. *Basic science researchers* were defined as respondents who reported conducting only basic science research. *Translational researchers*, defined as "the transfer of new understandings of disease mechanisms gained in the laboratory into the development of new methods for diagnosis, therapy, and prevention and their first testing in humans,"[11] represented what Sung et al[11] defined as the first translational block. Respondents were considered translational researchers if they conducted phase I research only, phase I/phase II research only, basic/phase I research, or basic/phase I/phase II research. *Clinical trial researchers* were defined as respondents who conducted phase II research only, phase III research only, or both. *Health services/clinical epidemiology researchers* and *other clinical researchers* were respectively defined as respondents who indicated they only conducted this 1 type of research. Finally, *multimode researchers* were defined as any combination of these types (for instance, a respondent who indicated he or she conducted both basic science research and phase III clinical trials). While factor analyses yielded similar groupings, categories were defined in this way for ease of interpretation, representing many of the prototypical stages of product development.

Statistical Analysis

The data were analyzed using standard statistical techniques using Stata/SE 10.1 for Windows (Stata Corp, College Station, Texas). All data were weighted to adjust for differential nonresponse and probability of selection within sampling strata. All tests were 2-sided and tested at the $P=.05$ level. For univariate statistics, means and standard deviations were calculated. Bivariate analyses of differences in proportions and means were tested using χ^2 tests. Comparisons across researcher type were made against the reference case of basic science researchers. To determine the characteristics of sponsored vs unsponsored researchers, a logistic regression was conducted using sex, race/ethnicity (self-identified), academic rank, and academic degree as independent variables.

RESULTS

Prevalence of Research Activities

Among research faculty within AMCs, more than half (54.7%) conducted basic science research as principal investigators as part of their research program. Just less than a quarter (22.8%) of all AMC research faculty were currently involved in a phase III trial, while approximately 15.8% were associated with a phase II trial and 14.9% an early clinical/phase I trial. In addition, 24.7% conducted health services research or clinical epidemiology. Finally, 27.5% of faculty indicated that they were involved with additional "other clinical research" activities, including nutrition research, informatics studies, medical education, and quality improvement research.

Descriptive Statistics of Researchers

Based on the combination of research activities selected, research faculty were categorized into 6 mutually exclusive researcher types (TABLE 1). One-third (33.6%) of AMC faculty members exclusively conducted basic science research. In comparison, translational researchers, clinical trial investigators, and health services researchers/clinical epidemiologists each made up less than 10% of AMC staff (9.1%, 7.1%, and 9.0%, respectively). Those who solely conducted other clinical research represented 11.6% of research staff and were generally less focused on research, allocating 10.2 hours to research each week and publishing at rates roughly half those of their basic science peers (36.6 vs 66.6 career publications, 2.1 vs 3.7 publications per year, $P<.001$ for both).

A large group of investigators (29.7%) could not be categorized into only 1 type of research. Of the 387 respondents classified as multimode, 57.9% performed basic science research, 60.7% had conducted a clinical trial, and 51.7% worked on health services or clinical epidemiological research. Compared with their basic research colleagues, these multimode research faculty achieved greater publication outputs, both over their careers (83.2 vs 66.6 publications, $P=.009$) and over the last 3 years (4.4 vs 3.7 publications per year, $P=.005$).

Faculty in earlier stages of research were significantly more likely to patent; among AMC faculty, nearly half of basic scientists (42.6%) and translational researchers (40.8%) had applied for a patent, approximately twice the proportion of their peers ($P<.001$). Women were overrepresented in nonlaboratory settings, disproportionately choosing to conduct health services (39.5%) and other clinical research (52.8%) vs basic science (26.1%) ($P=.01$ and $P<.001$, respectively).

Research Funding

In 2007, each AMC faculty member had a mean of \$410 755 in research funding as a principal investigator from all sources (TABLE 2). Of AMC researchers, basic science and multimode researchers garnered the most principal investigator funding (\$472 541 and \$539 455, respectively) followed by their departmental peers who conducted clinical trials (\$409 072) and translational research (\$403 293), although none of these differences were statistically significant at conventional levels. Health services researchers and other research faculty had significantly less (\$303 002, $P=.04$ and \$73 375, $P<.001$ compared with basic science researchers), nearly half of whom were conducting research without any funding (health services/clinical epidemiology researchers, 46.8%; other clinical, 56.6%; $P<.001$ for both compared with basic science researchers).

However, these averages masked large differences in the distribution of funding: nearly a quarter (22.1%) of faculty conduct research without any grants as a principal investigator while the remainder garnered an average of \$548 711 across all sponsorship sources. Except for faculty conducting other clinical research, mean funding levels among researchers with any research funding as a principal investigator were more similar (basic science researchers, \$534 079; translational researchers, \$520 402; clinical trial researchers, \$511 053; health services/clinical epidemiology researchers, \$571 703; other clinical researchers, \$169 106; multimode researchers, \$645 396). The average AMC faculty member received \$33 417 in industry-sponsored funding, with most of this money concentrated among clinical trial (\$110 869) and multimode (\$59 916) principal investigators.

In multivariate logistic regressions controlling for the type of researcher, faculty with and without research sponsorship were not significantly different by sex or race/ethnicity. Junior faculty were less likely to garner their own funding as a principal investigator; compared with full professors (15.9%), assistant professors (26.5%) and associate professors (24.8%) were twice as likely to be unsponsored (odds ratio [OR], 2.23; 95% confidence interval [CI], 1.44-3.47; $P<.001$; and OR, 1.64; 95% CI, 1.07-2.51; $P=.02$, respectively). However, the largest differentiator was found among physician-scientists. Compared with researchers with MD degrees, those with PhDs and MD-PhDs were nearly 3 times as likely to be funded (MD = 35.3% unsponsored vs PhD = 13.4% and MD-PhD = 12.7%; OR, 2.79; 95% CI, 1.80-4.32; $P<.001$; and OR, 2.99; 95% CI, 1.51-5.93, respectively; $P=.002$). Faculty without funding as a principal investigator were associated with significantly fewer hours devoted to research activities (11.9 vs 29.4 hours per week, $P<.001$) and significantly greater hours devoted to patient care (22.3 vs 9.8 hours per week, $P<.001$).

Industry Relationships

More than half (51.9%) of all AMC research faculty maintain some relation-

Table 1. Descriptive Statistics by Faculty Department and Type of Researcher

			Researcher Type									
			Translational		Clinical Trial		HS/CE		Other Clinical		Multimode	
	All	Basic Science	Value	*P* Value[a]	Value	*P* Value[a]	Value	*P* Value[a]	Value	*P* Value[a]	Value	*P* Value[a]
Survey respondents, unweighted No.[b]	1663	820	148		77		107		124		387	
% of research faculty	100	33.6	9.1		7.1		9.0		11.6		29.7	
Individual or Academic Characteristics												
Male sex, %	70.7	73.9	72.9	.84	77.4	.55	60.5	.01	47.2	<.001	77.0	.33
Time since professional degree, mean, y	23.0	22.3	21.8	.68	25.8	.006	20.0	.03	21.8	.70	23.7	.06
Holds PhD, %	37.5	70.4	24.7	<.001	6.2	<.001	21.8	<.001	15.9	<.001	20.2	<.001
Holds MD-PhD, %	9.5	12.2	12.6	.90	4.3	.04	6.1	.08	3.2	.003	12.4	.95
Full professor, %	40.8	41.5	45.4	.48	42.0	.92	28.7	.02	26.8	.004	47.2	.10
Professional service activities, mean, No.	1.6	1.7	1.9	.31	1.5	.27	1.7	.93	1.0	<.001	2.0	.01
Allocation of Work Activities												
Research time, mean, h/wk	23.1	36.2	24.6	<.001	12.9	<.001	18.0	<.001	10.2	<.001	22.8	<.001
Patient care time, mean, h/wk	14.5	2.8	13.2	<.001	24.9	<.001	16.7	<.001	25.2	<.001	17.5	<.001
Administration time, mean, h/wk	8.4	6.5	7.9	.09	10.9	.001	10.1	.004	9.3	.01	8.9	<.001
Teaching time, mean, h/wk	7.9	7.7	7.3	.55	7.7	.91	6.8	.17	8.8	.26	7.3	.33
Other professional activity time, mean, h/wk	3.7	3.3	3.6	.50	4.1	.10	4.0	.23	3.3	.99	4.2	.006
Research Characteristics												
Laboratory/group members, mean, No. of FTEs	6.6	7.2	6.9	.76	5.9	.52	5.4	.11	3.2	<.001	8.2	.42
Career publications, mean, No.	63.9	66.6	72.5	.48	64.5	.81	48.9	.02	36.6	<.001	83.2	.009
Publications per y last 3 y, mean, No.	3.5	3.7	4.2	.16	3.0	.04	3.7	.91	2.1	<.001	4.4	.005
Journal impact score last 5 publications, mean	6.0	6.7	5.9	.03	5.8	.06	5.4	.001	4.4	<.001	6.0	.03
Applied for a patent, %	28.3	42.6	40.8	.75	18.2	<.001	6.9	<.001	13.0	<.001	26.3	<.001

Abbreviations: FTEs, full-time equivalents; HS/CE, health services/clinical epidemiology.
[a] *P* values calculated compared with reference subgroup of basic science researchers.
[b] Survey respondent numbers are unweighted; values for individual cells in table may vary slightly depending on proportion of respondents who left the question blank. All other data are weighted by sampling strata.

ship to industry (TABLE 3), with roles ranging from a start-up company founder to a scientific advisory board member to an industry consultant. Compared with basic science researchers, translational, clinical trial, and multimode researchers were significantly more likely to report a relationship and to report that these relationships contributed to their most important scientific work ($P < .05$ for all comparisons).

Of the 28.3% of faculty who shared data, expertise, or materials with industry within the past 3 years, a substantially greater proportion documented positive outcomes than negative outcomes. Translational and multimode researchers were more likely to share with industry and report that this cooperation led to new lines of research and more sponsored research funding. Interestingly, basic science researchers experienced a greater ratio of negative consequences to positive outcomes compared with their peers (Table 3).

COMMENT

Taken in their entirety, these data create a composite view of the current landscape of the AMC research enterprise. The results document the prevalence of several types of clinical research as well as demonstrate that the characteristics and stresses of clinical researchers often differ by the type of research they conduct. As a byproduct, these data also provide national benchmarks for funding and productivity that could be considered for academic promotion. Several specific implications are warranted.

First, contrary to popular belief,[22] the "valley of death" for translational research actually appeared to be quite fertile within AMCs. At the time of this survey in 2007, 22 of 50 institutions were participating members of the Clinical and Translational Science Awards (CTSA) consortium; another 12 joined in 2008.[23] In general, translational researchers were well funded and scientifically productive. Data regarding their academic status and funding by rank did not suggest they were subject to widespread disadvantages for their research or career trajectories.[24] Translational researchers' patenting behavior and relationships with industry underscored the critical role they serve in developing basic research findings into useful advances for patient care.

Second, multimode investigators represented an understudied population. These investigators, who conducted research across the spectrum of research activities, reported both substantial scientific and commercializing characteristics. Because of their age and rank, these researchers likely represented the mature product of a successful scientific research career, managing laboratories that were larger, more productive, and better funded to investigate both the scientific and clinical implications of a research stream. In this current scientific climate where research is too often described in terms of either

Table 2. Annual Research Funding by Type of Researcher

	Researcher Type						
	All	Basic Science	Translational	Clinical Trial	HS/CE	Other Clinical	Multimode
Survey respondents, unweighted No.[a]	1663	820	148	77	107	124	387
Total funding, all sources							
Mean, $	410 755	472 541	403 293	409 072	303 002	73 375	539 455
P value[b]			.33	.61	.04	<.001	.54
Median, $	190 000	255 000	250 000	75 000	10 000	0	186 000
Interquartile range, $	10 000-465 000	125 000-500 000	40 000-600 000	10 000-300 000	0-300 000	0-75 000	46 000-500 000
Had no funding, %	22.1	11.5	22.5	20.0	46.8	56.6	16.4
P value[b]			.01	.08	<.001	<.001	.08
Mean funding by rank							
Full professor, $	690 541	761 332	577 974	477 814	622 788	115 094	865 029
P value[b]			.46	.006	.009	<.001	.04
Associate professor, $	254 801	310 701	363 349	355 139	193 772	78 635	275 321
P value[b]			.11	.19	<.001	<.001	.03
Assistant professor, $	179 931	231 495	185 316	334 671	158 858	32 658	197 814
P value[b]			.06	.55	.002	<.001	.95
Industry funding							
Mean, $	33 417	14 381	29 487	110 869	19 827	5561	59 916
P value[b]			<.001	<.001	.25	.005	<.001
Had industry funding, %	20.1	8.6	25.6	48.2	13.2	4.9	38.6
P value[b]			<.001	<.001	.16	.06	<.001

Abbreviation: HS/CE, health services/clinical epidemiology.
[a] Survey respondent numbers are unweighted; values for individual cells in table may vary slightly depending on proportion of respondents who left the question blank. All other data are weighted by sampling strata.
[b] *P* values calculated compared with reference subgroup of basic science researchers.

basic or applied categories, more study is needed in the operations and outcomes of the multidisciplinary principal investigators and their laboratories. For example, what is the role of "topic experts" who study a biological problem through all the aspects of development vs "domain experts" who focus on 1 aspect of development, like some clinical trialists? More research is needed to describe these roles and the interplay between these functions, especially ways to organizationally combine the attributes of both to enhance productivity.

Third, the findings also demonstrate the important role of industrial collaboration in scientific advancement. Academic-industry relationships provide substantial, tangible benefits to both the science and the scientist. Among AMC faculty with the greatest involvement with industry (translational, clinical trial, and multimode researchers), nearly half reported it contributed to their most important scientific work and led to research that would not otherwise have been possible. Even though the relative magnitude of industry funding was one-half to one-tenth of total funding, researchers reported that working with industry opened new lines of research and formed productive collaborations. Current policies and initiatives to restrict academic-industry relationships should balance the advantages to clinical development against the threats to scientific integrity.[25-27]

Several limitations of this study should be noted. Because the survey population was drawn from the AAMC faculty roster, the sample does not include life-science researchers who are not affiliated with a medical school or teaching hospital, thereby likely missing a substantial pool of basic science investigators. Consequently, generalizations of these results are not applicable outside the population of life-science faculty within research-intensive AMCs. Further, it included only the subset of faculty who had published a research article in the past 3 years, which may underrepresent new or young researchers and may include many patient-centric physicians who see research as a side pursuit. Like all survey-based analyses, this study likely suffers from the potential biases within the self-reported responses, especially on the amount and nature of industrial and total funding. The specific question regarding funding asked only about grants and contracts as a principal investigator. Consequently, some "unsponsored" researchers may have been supported on other contracts, including faculty with salary support from

Table 3. Involvement With Industry by Type of Researcher

	Researcher Type						
	All	Basic Science	Translational	Clinical Trial	HS/CE	Other Clinical	Multimode
Survey respondents, unweighted No.[a]	1663	820	148	77	107	124	387
Any relationship with industry, %[b]	51.9	41.9	61.3	67.3	40.4	35.4	70.9
P value[c]			<.001	<.001	.79	.21	<.001
Relationship contributed to most important scientific work, %[d]	40.7	32.5	54.9	59.1	35.6	24.2	42.1
P value[c]			.002	.001	.72	.34	.04
Shared information, data, expertise, or materials with industry scientists in the last 3 y, %	28.3	28.8	42.5	33.0	15.0	13.3	39.0
P value[c]			.007	.48	.004	.001	.002
Sharing opened a new line of research, %	38.6	26.9	47.3	42.4	27.5	3.9	49.2
P value[c]			.01	.14	.97	.04	<.001
Sharing led to research that would not otherwise have been possible, %	44.1	36.6	46.7	39.5	40.8	31.0	53.7
P value[c]			.23	.80	.73	.68	.005
Formed collaborations leading to publications, %	45.2	33.5	52.5	44.8	50.0	15.5	55.0
P value[c]			.02	.23	.18	.15	<.001
Formed collaborations leading to sponsored research, %	39.0	23.5	47.3	52.9	50.0	23.2	47.1
P value[c]			.003	.006	.02	.99	<.001
Experienced a negative outcome, %[e]	15.6	15.4	10.9	13.2	0.0	3.9	20.6
P value[c]			.42	.79	.15	.25	.05

Abbreviation: HS/CE, health services/clinical epidemiology.
[a] Survey respondent numbers are unweighted; values for individual cells in table may vary slightly depending on proportion of respondents who left the question blank. All other data are weighted by sampling strata.
[b] Relationships included corporate founder, member of the board of directors, member of scientific advisory board, officer/executive, employee, consultant, paid speaker, recipient of funding for university research or students/fellows, or recipient of royalties or license fees based on a patent.
[c] *P* values calculated compared with reference subgroup of basic science researchers.
[d] Respondents answering "to some extent" or "to a great extent."
[e] Negative outcomes included had your ideas appropriated without fair compensation; "scooped" by another scientist; compromised the ability of a graduate student, postdoctoral fellow, or junior faculty member to publish; or unable to commercialize your results.

the Veterans Administration. Faculty members who did not respond to the survey may differ systematically from those who did, although no significant differences by known characteristics were detected.

Overall, the findings in this study document many of the stresses in the research arena, especially for the clinician-researcher.[28] While 22% of all faculty are unsponsored as principal investigators, MDs made up almost three-fourths (72.8%) of this group.[29,30] Unsponsored physicians spent on average 7.3 hours per week on research. This finding likely underscores research publications being the coin of the realm in faculty promotion and tenure decisions. However, it may also reflect the stolen hours available to researchers after the pressures of generating clinical income and the inability to procure funding are considered. Data from the NIH suggest that MDs who applied for research program grants at the NIH are equally or more successful than PhD and MD-PhDs, although that was not always the case historically.[31] The difference in funding by degree in this study may reflect that MDs are less likely to apply for funding, choosing to cross-subsidize research time from their clinical duties. More research in this field is needed, including how well these faculty are able to leverage a network of funding using the infrastructure of the AMC, the quality of unsponsored research compared with funded projects (as judged by publications and impact), and the career trajectories of faculty who engage in this activity.[32] From a medical school perspective, unsponsored research, like unfunded clinical care, must be supported from other revenues—a potentially difficult proposition in the current economic climate.

Future funding options for clinician-researchers look bleak. MDs make up 90% of all clinical trial investigators within AMCs, nearly half of whom (48.2%) are dependent on biopharmaceutical and medical device sponsors. But according to Glickman and colleagues,[33] the clinical trial industry is rapidly moving overseas, leaving this once stable funding source for AMCs in jeopardy. Clearly additional research must examine the potential implications of this trend for clinical investigators in academic settings as well as for the quality and quantity of clinical research conducted in nonacademic settings.

This study cannot determine whether the results represent the right balance of research, but the results provide benchmark data and raise questions for future research. Is a large and well-funded basic-science workforce necessary in early stage exploratory research to discover and develop new biomedical findings? As the natural funnel of successful projects narrows, are fewer resources needed in hypothesis-confirming clinical studies? What is to be made of the second and third translational blocks that seek to implement clinical studies into medical practice and ensure evidence-based, high-quality care is delivered reliably?[34] What role should funding play in documenting which clinical interventions are most effective in everyday use?

The data in this study show that half of all faculty conduct basic science research as part of their portfolio. When generalized, faculty who exclusively conduct basic science research (33.6%) garnered more than $4.7 billion in total research funding across the top 50–funded AMCs. In comparison, $802 000 was collected by health services researchers and only $250 000 went toward "other clinical research," where studies center on patient outcomes and patient care (eg, nutrition, phase IV, psychology/behavioral, or quality improvement/safety studies). Although these sectors require less use of expensive equipment than basic science fields, these 2 groups each represent more faculty members than clinical trialists, yet half are unsponsored. To the extent that this research is being cross-subsidized from other internal funds, these investigations may be a net drain on resources within the AMC.

National policies can have a substantial effect on the nature of research performed in this country. For example, the strong state of translational medicine documented in this study is likely a reflection of the emphasis placed on this type of research by the NIH recently through its CTSA and Roadmap initiatives. In this vein, the massive investment in clinical effectiveness research put forward by the American Recovery and Reinvestment Act of 2009 may signal a change in emphasis and a potential new direction of AMC research. Compared with previous eras, research priorities probably will now stress efficiency in addition to innovation.

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Study concept and design: Zinner, Campbell.
Acquisition of data: Zinner, Campbell.
Analysis and interpretation of data: Zinner.
Drafting of the manuscript: Zinner, Campbell.
Critical revision of the manuscript for important intellectual content: Zinner, Campbell.
Statistical analysis: Zinner.
Obtained funding: Campbell.
Administrative, technical, or material support: Zinner, Campbell.
Study supervision: Campbell.
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> He has honor if he holds himself to an ideal of conduct though it is inconvenient, unprofitable, or dangerous to do so.
> —Walter Lippmann (1889-1974)

