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ABSTRACT

An examination of the changes over a ten-year period (from 1972 to 1982) in the number, distribution, and characteristics of Ph.D. faculty of clinical departments of medical schools is provided in this report. Trends in the training and research involvements of this group are stated with special emphasis on an analysis of the factors associated with the migration of basic scientists into clinical departments. Topics of this study include: (1) previous studies (identifying findings from related reports and meetings); (2) number and distribution of Ph.D. faculty in clinical departments (presenting data from FY 1972 and FY 1982); (3) a statistical profile of faculty members (including data on age, rank, salary, specialty fields, and research activity); (4) growth of basic science in clinical departments (examining the nature of investigation, expansion of clinical department, and the decline in research involvement); and (5) future outlook (projecting trends and addressing concerns). A list of 32 reference notes are provided and the seven appendices present the data in tabular form. (ML)

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BASIC SCIENTISTS IN CLINICAL DEPARTMENTS:
A FAST-GROWING COMPONENT OF MEDICAL SCHOOL FACULTIES

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Prepared under the auspices of the

Committee on National Needs for Biomedical and Behavioral Research Personnel

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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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ABSTRACT

Clinical investigation has traditionally been conducted by physicians interested in discovering the underlying causes and effective treatments of disease and in formulating general principles from individual case studies. As knowledge in the basic biomedical sciences has expanded, clinical investigation has become more integrated with those sciences. This integration appears to have accelerated with the rapid development of sophisticated instrumentation and technologies, whose applications to medical investigation opened up more opportunities for basic scientists to participate in clinically oriented research. At the same time, financial pressures in medical schools have led to a large-scale recruitment of physicians concerned primarily with providing revenue-generating service to patients and less with clinical research. The confluence of these forces in the 1970s resulted in a sustained flow of basic scientists into clinical departments of medical schools where they contribute substantially to the research activities of those departments.

Continuation of the trend is anticipated for the 1980s but at a somewhat reduced rate. The increasing professionalization of biomedical research and the tendency to form interdisciplinary teams are among the factors favorable to continued growth. On the other hand, the expansion of clinical faculties is likely to proceed more slowly because of potential surpluses in many medical specialties and efforts to limit Medicaid/Medicare expenditures. These factors will tend to inhibit the movement of basic scientists into clinical departments.

Between 1972 and 1982, applications per faculty member in clinical departments for NIH/ADAMHA research grants increased by 139 percent for Ph.D.s and declined by 2 percent for M.D.s; awards per faculty member rose 57 percent for Ph.D.s and dropped 20 percent for M.D.s. Some observers are concerned about the effect of these trends on clinical research. That concern is based on the vital role that physicians must play in clinical investigations.

INTRODUCTION

Clinical investigation has undergone remarkable change since its origination in the 1920s, when salaried clinical scientists first appeared at the hospital of The Rockefeller Institute, The Johns Hopkins Hospital, and at some hospitals associated with the Harvard Medical School (1). The major efforts of clinical investigation have moved from the bedside, where patient contact and research were closely linked, toward the basic science laboratory and its emphasis on cell cultures, enzyme systems, and animal models (3, 4).[1]

The science practiced by early clinical investigators is aptly defined in King's description of the Rockefeller concept (2)--"the careful study of a few patients, the use of advanced tools of discrimination to identify process, the formulation of general principles regarding the disease in question, principles that go beyond the individual case."

A physician-patient relationship was a key element in that definition of clinical investigation and, of course, the physician was always the principal investigator. Gradually, as Gill (30) so poignantly shows, medical science has become more quantitative and oriented to such basic sciences as biochemistry, molecular biology, and immunology.

The shift toward laboratory-oriented research has accelerated in recent years and has provided more opportunities for non-medically trained scientists to engage in clinical investigation. One of the more visible manifestations of this change has been a growth in the rate at which Ph.D. scientists have obtained full-time faculty appointments in clinical departments of medical schools and their substantial involvement in the research activities of those departments.

Sensing the implications of this development for a perceived decline of physicians' interest in research, the Institute of Medicine (IOM) Committee on National Needs for Biomedical and Behavioral Research Personnel, in its 1978 report, called for careful study of the extent to which basic scientists could supplement and enrich the supply of clinical investigators (9). In this paper we extend and update earlier analyses from the literature, identifying changes over a 10-year period (from 1972 to 1982) in number and distribution of Ph.D. faculty in clinical departments, as well as in selected characteristics of that faculty subpopulation. Trends in the research training and research involvement of the group are given special emphasis. Finally, we examine the underlying factors associated with the migration of basic scientists into clinical departments and the outlook for its continuation.

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[1]Definitions and classifications of clinical investigation abound. Despite the "dwindling bedside connection" (5), a number of observers continue to emphasize in their definitions of "true" clinical investigation the primacy of physicians as investigators, the proximate involvement of human subjects, and the interactive relationship between investigator and experimental subject (6, 7, 8). Moreover, the uniqueness of the physician-scientist's role in clinical investigation was articulated in the 1981 report of the Institute of Medicine (9).

PREVIOUS STUDIES

A number of publications have dealt with various aspects of that development. For example, the function of the basic scientist in a clinical department was the theme of a 1979 symposium in which a panel of six basic scientists with sole or primary faculty appointments in clinical departments described their individual roles in two main areas of activity: research and teaching. Also considered were problems associated with their positions, such as those of maintaining professional identity and academic advancement (10).

Fishman and Jolly traced changes in the number and departmental distribution of that faculty group over a nine-year period ending in 1979 (11). In addition, those authors noted that the fraction of Ph.D. faculty in clinical departments is virtually similar in research-oriented and other medical schools. Although their major role was found to be in research, often combined with teaching, relatively large numbers of Ph.D.s in certain specialty departments were found to engage in activities related to patient care.

The increasing presence of Ph.D. faculty in clinical departments has prompted questions as to the proportion of current clinical research in which a basic scientist can appropriately play the primary investigative role. Two studies based on the use of similar taxonomies attempted to shed light on that issue through analyses of "human-related" research grants from a single institute over the period from 1970 to 1978 and from all NIH institutes for 1979 (12, 7). The results of those studies suggest that the majority of "human-related" projects, which constituted from 3 percent to about 30 percent of the institutes' extramural totals, probably would require an M.D. investigator to play the lead role.

The participation of basic scientists in clinical departments has also been examined from the perspective of one type of clinical specialty. Kendig, in an editorial view, describes the contributions made by Ph.D. faculty to anesthesia research, lists the doctoral fields from which these scientists were drawn, and comments on the benefits of such an association to the basic scientist (13). More recently, Blankenship presented data on members of the American Physiological Society, who are employed in clinical departments of medical schools, observing that about one-fifth of that group have received the Ph.D. degree only (14). He points to three main factors that will influence employment opportunities for Ph.D. recipients in clinical departments. These are levels of training funds, funding of basic vs. clinical research, and future supply of M.D. investigators. He also suggests that information on the number of non-faculty positions occupied by Ph.D.s would be useful.

The general subject was aired in 1981 at a joint meeting of the Panel on Basic Biomedical Sciences and Panel on Clinical Sciences of the Committee on National Needs for Biomedical and Behavioral Research Personnel. Topics ranged from available data sources to models of Ph.D. involvement in clinical investigation. As an outgrowth of that joint meeting, this paper follows up a preliminary discussion in the committee's 1983 report (9).

NUMBER AND DISTRIBUTION OF PH.D. FACULTY IN CLINICAL DEPARTMENTS

In 1972, there were approximately 3,500 Ph.D. scientists with full-time faculty appointments in clinical departments of U.S. medical schools, including pathology departments (Table 1). By 1982, that number had risen to almost 5,900 full-time faculty members. Although the Ph.D. component of clinical department faculty is still small relative to the M.D. component, it has grown at a fairly brisk rate in recent years. As can be seen from the following tabulation, the Ph.D. component's annual growth rate of 5.3 percent between 1972 and 1982 was the fastest among various degree types and for the overall clinical faculty.

	Annual growth rate in clinical departments 1972-1982
Ph.D.	5.3%
M.D.	4.4%
M.D./Ph.D.	3.2%
Other	1.3%
Total FT Faculty	4.2%

Another aspect of this growth is revealed by changes between 1971 and 1982 in the percentage of newly hired Ph.D. faculty with primary appointments in clinical departments. The following tabulation in Table 2 indicates a sharp rise to 1979 for that percentage, with a subsequent flattening through 1982. Of particular interest is the fact that since 1979 more new Ph.D. medical school faculty members have been appointed to clinical departments than to basic science departments.

Increase in size of the Ph.D. faculty did not occur uniformly among the various clinical specialties which, for purposes of this study, are divided into four departmental groups: medical, hospital-based, surgical, and psychiatric (see footnote to Table 1 for definition of these groups). The largest rate of increase (91 percent) was in the medical specialties. The lowest rate (34 percent) was in departments of psychiatry which nevertheless exhibited the highest Ph.D. fraction of faculty among the various departmental groups at both ends of the decade. The medical specialties retained a preponderant share of total Ph.D. clinical faculty during this 10-year period, while the psychiatry departments' percentage declined. Virtually no change is evident in percentage share for the surgical and hospital-based departmental groups. Appendix Tables A1 and A2 provide detail in terms of the individual clinical and basic science departments.

TABLE 1 Full-Time Faculty in U.S. Medical Schools, 1972 and 1982, by Degree Type and Department

	FY1972					FY1982[a]				
	Faculty Degree Type					Faculty Degree Type				
Medical School Department	M.D.	M.D./ Ph.D.	Ph.D	Other	Total	M.D.	M.D./ Ph.D.	Ph.D.	Other	Total
Basic Science										
N	752	540	5,059	292	6,643	650	438	6,886	319	8,293
%	11.3	8.1	76.2	4.4	100.0	7.8	5.3	83.0	3.8	100.0
Total Clinical[b]										
N	18,504	1,440	3,496	2,244	25,684	28,515	1,988	5,868	2,562	38,933
%	72.0	5.6	13.6	8.7	100.0	73.2	5.1	15.1	6.6	100.0
a. Medical										
N	8,590	619	1,117	873	11,199	14,081	916	2,140	1,028	18,155
%	76.7	5.5	10.0	7.8	100.0	77.6	5.0	11.8	5.7	100.0
b. Hospital										
N	4,277	385	801	592	6,055	6,168	540	1,436	666	8,810
%	70.6	6.4	13.2	9.8	100.0	70.0	6.1	16.3	7.6	100.0
c. Surgical										
N	3,856	342	546	284	5,028	5,779	394	921	398	7,492
%	76.7	6.8	10.9	5.6	100.0	77.1	5.3	12.3	5.3	100.0
d. Psychiatry										
N	1,781	94	1,032	495	3,402	2,487	138	1,381	470	4,476
%	52.4	2.8	30.3	14.6	100.0	55.6	3.1	30.9	10.5	100.0
Other										
N	397	43	580	978	1,998	395	49	907	936	2,287
%	19.9	2.1	29.0	49.0	100.0	17.3	2.1	40.0	40.9	100.0
TOTAL										
N	19,653	2,023	9,135	3,514	34,325	29,560	2,475	13,661	3,817	49,513
%	57.3	5.9	26.6	10.2	100.0	59.7	5.0	27.6	7.7	100.0

[a] These data for FY 1982 differ slightly from those shown in the IOM committee's report for 1983 (9). For that report the data were derived as of January 1982, while for this paper, the data were derived as of March 31, 1982. Slight changes in the Faculty Roster between January and March account for the differences.

[b] Clinical departments are categorized as follows: Medical (dermatology, family practice, internal medicine, neurology, pediatrics, other clinical); Hospital (anesthesiology, pathology, physical medicine, radiology); Surgical (ob./gyn., ophthalmology, orthopedics, otolaryngology, surgery); Psychiatry.

SOURCE: AAMC Faculty Roster System, special tabulation prepared by G. Bowden, NIH.

TABLE 2 Percentage of Newly Hired Ph.D. Faculty in Medical Schools with Appointments in Clinical Departments

1970-71	41.1%
1974-75	45.6%
1978-79	53.4%
1981-82	52.9%

SOURCE: 1970-79 data are from Fishman and Jolly (11). 1981-82 data are from G. Bowden, NIH.

A STATISTICAL PROFILE OF FACULTY MEMBERS

Despite the growing presence of Ph.D. scientists on clinical department faculties, little is known about them as a group. What characteristics distinguish them from other medical school faculty groups? The discussion that follows relies principally on special tabulations of data from the Faculty Roster System of the Association of American Medical Colleges (AAMC) and from the Consolidated Grant Applicant File which is maintained by the National Research Council under contract with the National Institutes of Health (NIH).[2] The AAMC Faculty Roster is thought to contain information on about 85 percent of all members of U.S. medical school faculties. Hence, the data presented below are derived essentially from the complete population, rather than from any sampling procedure. Similarly, the Consolidated Grant Applicant File contains records of all applications for research grants submitted to the NIH and the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA). However, less is known about the coverage in the Faculty Roster of Ph.D.s with non-faculty appointments in medical schools, often called research associates. In 1983, there were an estimated 700 research associates in clinical departments[3] and an unknown number in various other designations. Some schools consider them to be faculty appointments and include them in the Faculty Roster count while others do not. The extent to which they are captured in the Faculty Roster is unknown, but it is thought to be low. Thus the data presented in this paper could be missing a part of this non-faculty group of Ph.D.s.

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[2]We are indebted to George Bowden, Office of the Director, NIH, who derived much of the basic data shown in this report from the Faculty Roster System.

[3]This estimate is provided by George Bowden, NIH. It is based on special tabulations from the National Science Foundation's Survey of Graduate Science and Engineering Students and Postdoctorates, 1983.

For purposes of description, we focus on selected demographic, training, and employment characteristics. Specifically, we will present data on the following characteristics of faculty members: (a) age, (b) rank and tenure status, (c) salary, (d) secondary appointments, (e) field of doctorate, (f) research training, (g) research participation, and (h) research grant activity. In addition, changes that have occurred generally between 1972 and 1982 are examined, with emphasis on comparisons between basic science and clinical departments and between M.D. and Ph.D. faculty. It should be emphasized that the resulting statistical profile, particularly the research-related measures, does not purport to represent an evaluation of the various faculty subgroups.

Faculty Age

The median age of all medical school faculty members increased between 1972 and 1982. This change is probably the result of a slower rate of expansion than occurred in the previous decade. Slower growth has meant fewer opportunities for young scientists and clinicians to move into academic positions, therefore faculty age distribution shifted upward.

In terms of career age, defined as years since receipt of the M.D. or Ph.D. degree, the median for Ph.D. faculty members in clinical departments rose from 8.7 to 11.3 years over the decade (Table 3). Despite an overall rise of 30 percent in career age since 1972, clinical department Ph.D.s retained their status as youngest of the four faculty subgroups detailed in Table 3. The oldest in each year were M.D. faculty members in basic science departments, a finding that is in keeping with the 14 percent decrease shown in Table 1 to have occurred in that group.

About 46 percent of the Ph.D.s in clinical departments were within 10 years of having received the doctorate, compared with 21 percent for their departmental colleagues with the M.D. degree (Appendix Tables A3-A6). Comparable figures for Ph.D. and M.D. faculty members in basic science departments were 33 percent and 7 percent, respectively.

These findings provide additional evidence that despite a general slowing of growth, recruitment of Ph.D. clinical faculty continued to outpace that of the other three subgroups between 1972 and 1982.

Academic Rank and Tenure Status

Because Ph.D. faculty in clinical departments have the lowest career age, it is not surprising to find that they tended to concentrate at the lower academic ranks in 1982, particularly in the medical specialty departments. Approximately 50 percent of clinical faculty Ph.D.s held the rank of assistant professor or below, compared with 45 percent of their M.D. departmental colleagues and 3[illegible] percent of Ph.D. faculty in basic science departments (Table 4). Of M.D.s with primary appointments in basic science departments--the oldest faculty subgroup--only about 13 percent were at the assistant professor level or lower.

TABLE 3 Median Career Age of Medical School Faculty, 1972 and 1982[a]

	Basic Science Departments		Clinical Departments	
	M.D.s	Ph.D.s	M.D.s	Ph.D.s
1972	18.6	10.2	15.4	8.7
1982	24.3	13.9	17.4	11.3
% Change 1972-82	+30.6%	+36.3%	+13.0%	+29.9%

[a]Career age is defined as years since receipt of M.D. or Ph.D. degree.

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

TABLE 4 Distribution of Academic Rank in Medical School Faculty, 1982

	Basic Science Departments				Clinical Departments			
	M.D.s		Ph.D.s		M.D.s		Ph.D.s	
Rank	N	%	N	%	N	%	N	%
Professor	429	66.0	2,398	34.8	8,281	29.0	1,143	19.5
Associate Prof.	131	20.2	2,212	32.1	7,112	24.9	1,647	28.1
Assistant Prof.	72	11.1	1,943	28.2	10,677	37.4	2,547	43.4
Instructor	11	1.7	194	2.8	2,249	7.9	393	6.7
Other & Unknown	7	1.1	139	2.0	196	0.7	138	2.4
TOTAL	650	100.0	6,886	100.0	28,515	100.0	5,868	100.0

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

Regardless of degree type, tenure and tenure-track appointments were notably less common in clinical departments than in basic science departments (Table 5). In fact, only a four percentage point differential separates Ph.D. from M.D. faculty in clinical departments (53 percent vs. 49 percent on tenure and tenure-track appointments). For Ph.D. faculty, the low frequency of tenure and tenure-track appointments probably reflects a lack of income-producing options, should grant and contract support be discontinued. Advancement for a large proportion of those Ph.D. scientists may follow a research track, rather than the regular academic track. Moreover, non-tenure tracks for M.D. faculty in clinical departments are widely used in most medical schools, particularly for individuals who derive most of their income from clinical practice, including salaries from affiliated hospitals or Veterans Administration hospitals. By contrast, at least 72 percent of faculty members in basic science departments, regardless of degree, were either tenured or had tenure-track appointments.

Although data on academic rank and tenure status are not available for 1972, the career age patterns suggest that similar differences among faculty subgroups existed in that earlier year.

TABLE 5 Distribution of Tenure Status of Medical School Faculty, 1982

	Basic Science Departments				Clinical Departments			
	M.D.s		Ph.D.s		M.D.s		Ph.D.s	
Tenure Status	N	%	N	%	N	%	N	%
Tenure	415	63.9	3,450	50.1	8,640	30.3	1,584	27.0
Tenure-Track	58	9.0	1,480	21.5	6,359	22.3	1,285	21.9
No Tenure	57	8.7	868	12.6	7,870	27.6	1,872	31.9
Other & Unknown	120	18.4	1,088	15.8	5,646	19.8	1,127	19.2
TOTAL	650	100.0	6,886	100.0	28,515	100.0	5,868	100.0

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

Secondary Appointments

It is important for Ph.D. scientists who have appointments in clinical departments to maintain professional links with basic science departments. This was emphasized by each of the participants in the previously mentioned symposium in 1979 (10). One means of effecting such links is through secondary appointments, which can provide an opportunity for involvement in the graduate program of the relevant basic science department. In 1982, secondary appointments in basic science departments were held by 13 percent of Ph.D. faculty in clinical departments (Table 6). Among the four departmental groups of clinical specialties, secondary appointments were most common in the surgical group. This finding is entirely consistent with the impressive performance, detailed below, of Ph.D. faculty in the surgical departments in their measures of NIH/ADAMHA research grant activity, as well as in the percent of Ph.D. clinical faculty with postdoctoral research training.

The frequency and departmental distribution of these secondary appointments has not changed appreciably from the pattern in 1979 reported by Fishman and Jolly (11).

TABLE 6 Ph.D.s in Clinical Departments with Secondary Appointments in Basic Science Departments, 1982

Clinical Science Dept.	Total Ph.D.s	Joint Appointment in Basic Science Dept. N	%
Total Clinical	5,868	757	12.9
a) Medical	2,140	302	14.1
b) Hospital	1,436	178	12.4
c) Surgical	921	224	24.3
d) Psychiatry	1,381	53	3.8

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH, as adjusted by the authors. Bowden's data were for March 31, 1982. The authors' adjustments make these data compatible with other data in this report, which generally reflect faculty status as of January 1, 1982.

Salary

Partially offsetting their lesser degree of employment security (Table 5), Ph.D. faculty at all academic ranks in clinical departments received slightly higher salaries than their Ph.D. colleagues in basic science departments (Figures 1, 2, and 3). It is evident from Figure 1 and Appendix Table 7 that a difference of about $2,000 per year in mean salary (base compensation only) at the professorial level has persisted from FY1979 to FY1985.[4]

Among the four clinical departmental groups, average salary for Ph.D.s was highest in the hospital-based specialties, probably reflecting the greater likelihood of their engagement in remunerative service activity such as in clinical pathology laboratory and radiologic physics (Appendix Table 7).

Within basic science departments, M.D.s receive salaries appreciably above those of Ph.D.s. This difference is most striking at the assistant professor level (Figure 3) where the average M.D. salary has grown from 114 percent of the average Ph.D. salary in FY1979 to 141 percent in FY1985. This phenomenon at the entry level may represent a market reaction to concern over the decrease in M.D. faculty employed in basic science departments (Table 1).

The salary differential between M.D.s in clinical departments and other faculty members (both M.D.s and Ph.D.s) is even more pronounced. For example, at the full-professor level, salaries of M.D.s in clinical departments in 1985 were 145 percent of the salaries of M.D.s and 175 percent of Ph.D.s in basic science departments. Similar differentials occur at other academic ranks. In general, medical school salaries of M.D.s have risen faster than those of Ph.D.s over the 1979-85 period regardless of department and academic rank.

Doctoral Fields

The doctoral fields for 1982 Ph.D. faculty in clinical and in basic science departments are displayed in Table 7. The five most frequent feeder fields for Ph.D.s in clinical departments, accounting for 58.2 percent of the total, were: psychology (25.8 percent), biochemistry (14.3 percent), microbiology (5.8 percent), physiology (5.1 percent), and "other"[5] (7.2 percent).

For Ph.D.s in basic science departments, the most common doctoral disciplines, representing 67.8 percent of the total, were: biochemistry (25.2 percent), physiology (14.5 percent), anatomy (11.5 percent), microbiology (11.0 percent), and chemistry (5.6 percent). Table 8 shows that very little change has occurred since 1972 in these frequency distributions in either the clinical or basic science departments.

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[4] Salary is defined here as base compensation which is fixed, usually annually, by the institution. It excludes fringe benefits and is normally not influenced by practice earnings.

[5] Includes miscellaneous titles, such as agriculture, education, business, ethics, communications, etc.

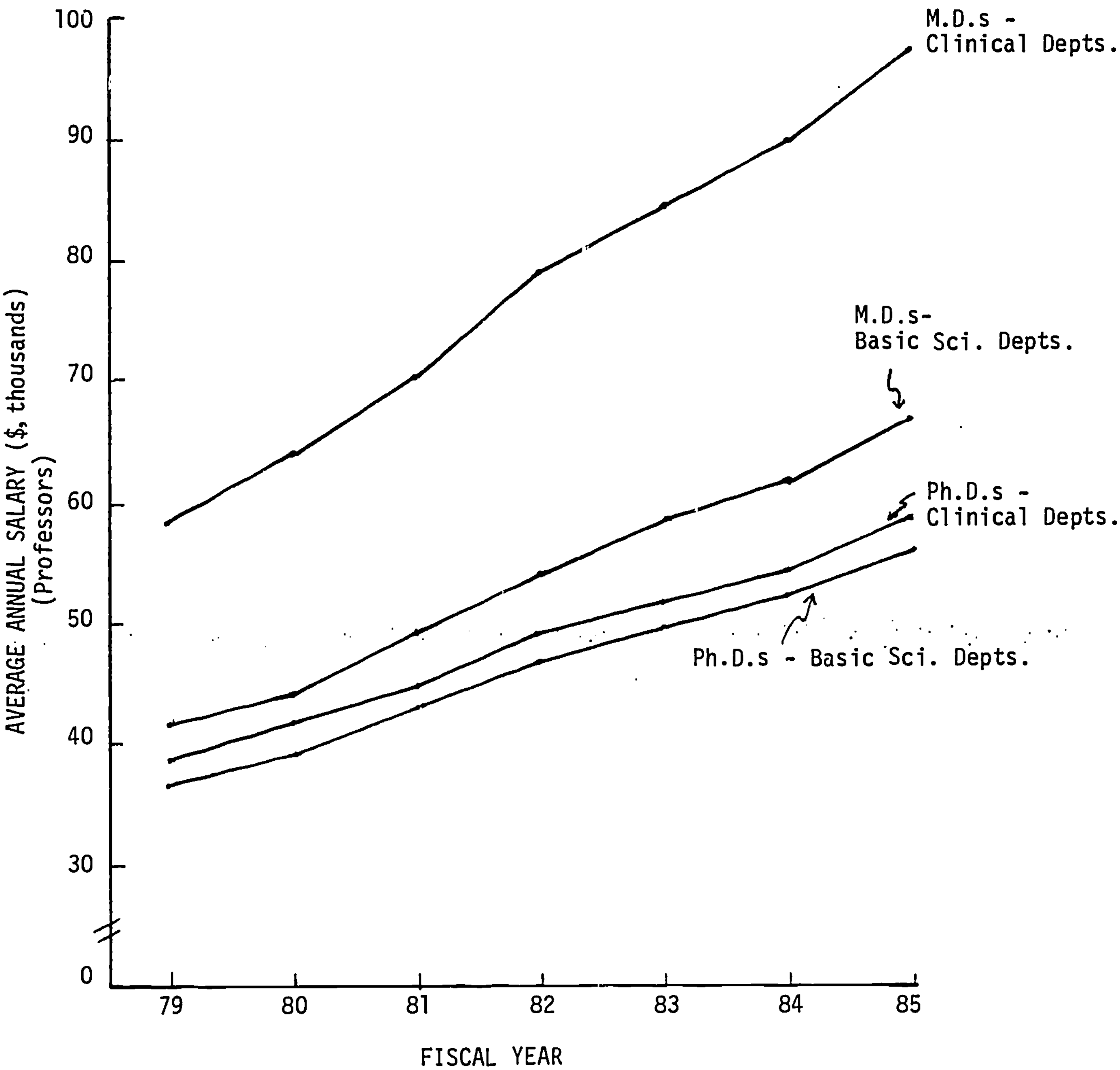

FIGURE 1 Average annual salary of full-time professors in U.S. medical schools, by department and degree type, 1979-85. Only individuals receiving a base salary are included. Not counted are faculty members who receive income from practice plans.

The differences in the time patterns in the above figure are statistically significant as shown by a regression analysis. Salaries were regressed on year using categorial variables for department and degree types. An interaction effect due to M.D.s in clinical departments is highly significant ($P < 0.01$). Salary vs. year regressions depend on the particular degree-department combination.

Data are from the Annual Medical School Faculty Salary Survey conducted by the AAMC. See Appendix Table 7.

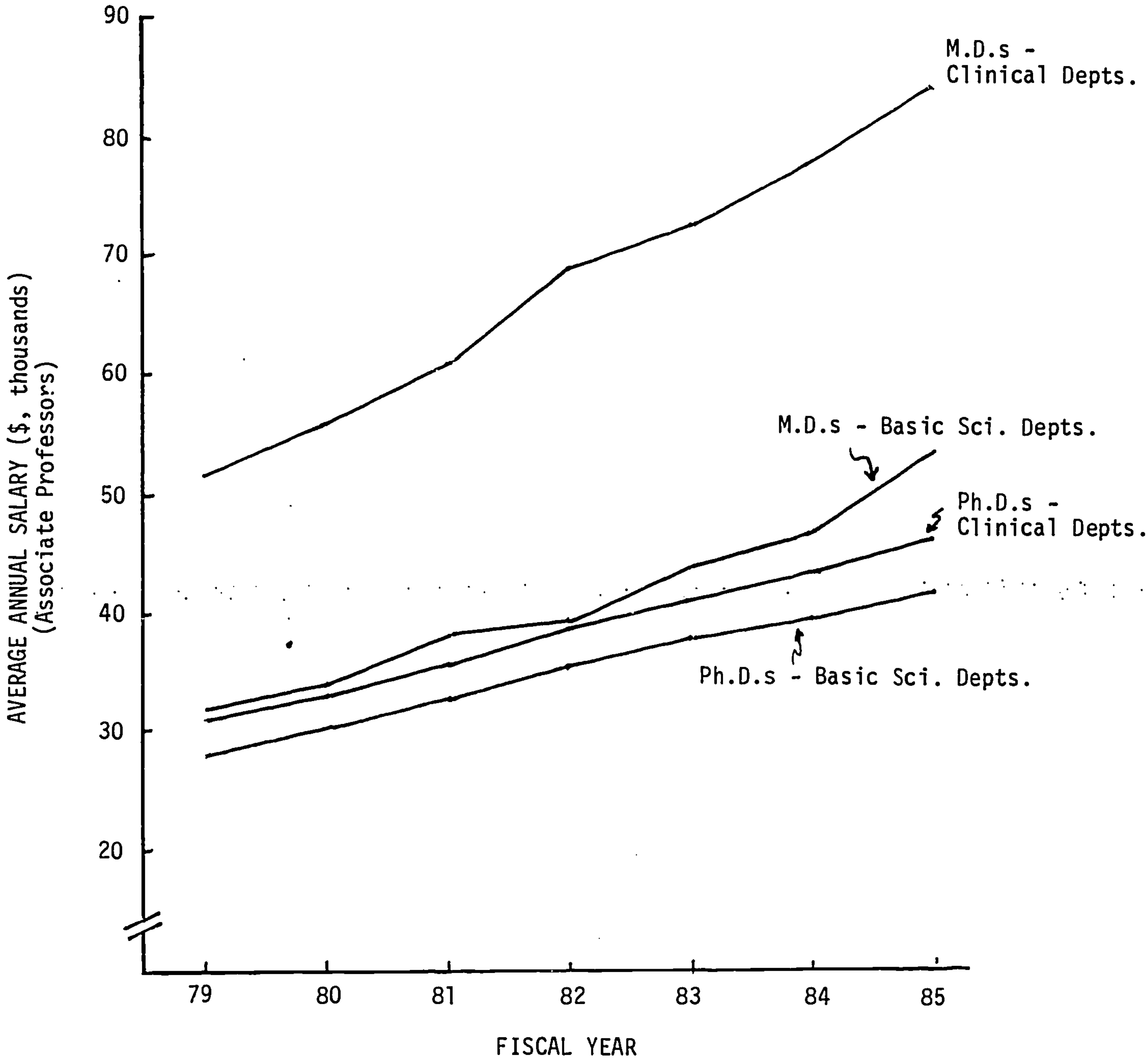

FIGURE 2 Average annual salary of full-time associate professors in U.S. medical schools, by department and degree type, 1979-85. Only individuals receiving a base salary are included. Not counted are faculty members who receive income from practice plans. Data are from the Annual Medical School Faculty Salary Survey conducted by the AAMC. See Appendix Table 7.

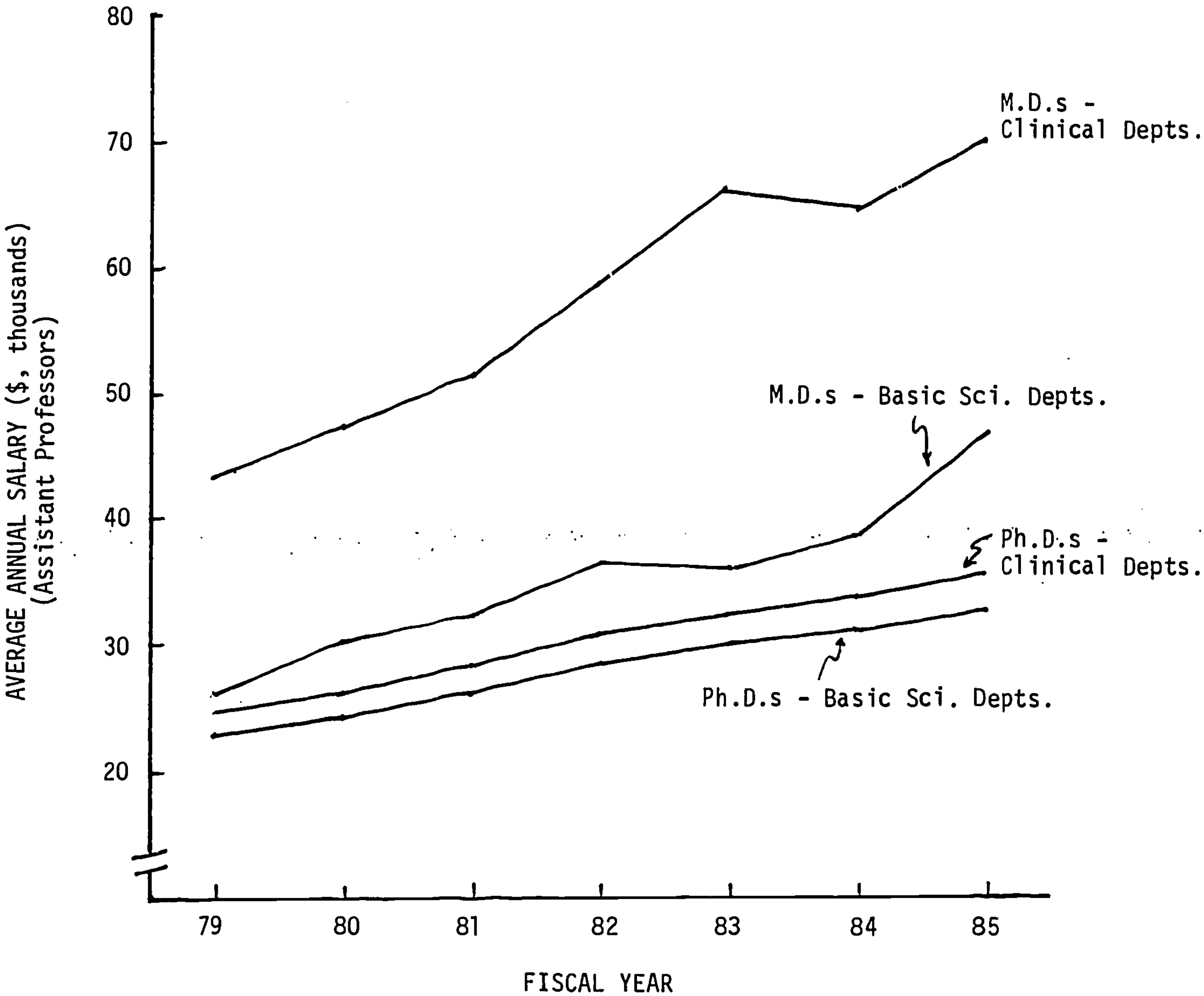

FIGURE 3 Average annual salary of full-time assistant professors in U.S. medical schools, by department and degree type, 1979-85. Only individuals receiving a base salary are included. Not counted are faculty members who receive income from practice plans. Data are from the Annual Medical School Faculty Salary Survey conducted by the AAMC. See Appendix Table 7.

TABLE 7 Field of Doctorate for Full-Time Ph.D.s on Medical School Faculties, 1982
(percent of department total)

Ph.D. Field	Medical School Department: Basic	Clinical[a]	Psychiatry	Other	Total
Allied Health	0.2	3.2	0.7	6.4	1.9
Anatomy	11.5	1.8	0.4	6.4	7.0
Biochemistry	25.2	14.3	2.6	8.3	19.4
Biology	3.3	1.8	0.4	1.1	2.5
Biophysics	2.7	1.6	0.1	1.1	2.1
Bioscience, Other	1.1	0.8	0.5	0.5	0.9
Botany	0.4	0.2	0.0	0.1	0.3
Chemistry	5.6	5.0	1.2	4.3	5.3
Clinical Pathology	0.1	0.3	0.0	0.2	0.2
Ecology	0.1	0.03	0.0	0.0	0.04
Endocrinology	0.6	0.5	0.0	0.6	0.5
Engineering	0.8	3.3	0.1	2.7	2.0
Entomology	0.1	0.03	0.0	0.0	0.05
Genetics	2.1	1.7	0.4	1.1	1.9
Immunology	1.6	1.5	0.0	0.5	1.5
Information Sci.	0.1	0.2	0.1	0.5	0.1
Mathematics	0.2	2.3	0.7	6.4	1.5
Microbiology	11.0	5.8	0.1	5.5	8.4
Neurobiology	0.3	0.2	0.3	0.2	0.3
Nutrition	0.2	0.5	0.0	0.9	0.4
Oncology	0.2	0.3	0.0	0.0	0.1
Other Medical Sci.	0.25	2.58	0.2	0.4	1.03
Other Physical Sci.	0.1	0.2	0.0	0.0	0.1
Other Social Sci.	0.6	4.1	5.8	4.9	2.4
Pathology (Nonclin.)	0.3	1.5	0.1	1.5	0.9
Pharmacology	8.5	2.4	1.5	4.7	5.7
Physics	0.9	3.7	0.2	0.7	2.1
Physiology	14.5	5.1	0.9	7.0	10.0
Psychology	2.5	25.8	77.2	12.6	13.2
Public Health	0.1	1.1	0.3	0.9	0.6
Social Work	0.0	0.5	1.6	0.3	0.3
Zoology	3.1	1.2	0.1	1.3	2.2
Other	2.0	7.2	4.6	18.8	5.3
TOTAL %	100.0	100.0	100.0	100.0	100.0
N	6,886	5,868	1,381	907	13,661

[a]/Includes departments of psychiatry.

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

TABLE 8 Field of Doctorate for Full-Time Ph.D.s on Medical School Faculties, 1972
(percent of department total)
(Revised - See pg. 4) - DO NOT USE IN THIS REPORT.

	Medical School Department						Medical School Department				
Ph.D Field	Basic	Clinical[a]/	Psychiatry	Other	Total	Ph.D. Field	Basic	Clinical[a]/	Psychiatry	Other	Total
Allied Health	0.2	4.2	0.5	8.3	2.3	Neurology	-	-	-	-	-
Anatomy	12.3	1.5	0.5	5.3	7.8	Nutrition	0.2	0.5	0.1	0.3	0.4
Anesthesiology	0.0	0.0	0.0	0.2	0.0	Ob/Gyn.	0.0	0.0	0.0	0.0	0.0
Biochemistry	24.3	12.9	2.2	6.9	18.8	Oncology	0.1	0.0	0.0	0.0	0.1
Biology	3.3	1.3	0.6	0.9	2.4	Other Medical Sci.	0.0	0.1	0.0	0.2	0.1
Biophysics	2.4	1.2	0.1	1.4	1.9	Other Physical Sci.	0.0	0.2	0.1	0.0	0.1
Bioscience, Other	0.6	0.3	0.1	0.5	0.5	Other Social Sci.	0.4	4.6	7.8	4.8	2.3
Botany	0.5	0.2	0.0	0.2	0.3	Pathology (Nonclin.)	0.2	1.1	0.0	2.6	0.7
Chemistry	7.5	6.2	1.3	4.3	6.8	Pharmacology	8.1	1.6	1.0	4.0	5.4
Clinical Pathology	0.1	0.2	0.0	0.3	0.2	Physical Medicine	0.0	0.0	0.0	0.0	0.0
Ecology	0.1	0.0	0.0	0.0	0.1	Physics	0.9	2.8	0.4	1.7	1.7
Endocrinology	0.7	0.4	0.0	0.5	0.6	Physiology	14.6	4.8	1.2	5.2	10.3
Engineering	0.5	2.5	0.2	3.1	1.5	Psychiatry	0.0	0.0	0.2	0.0	0.0
Entomology	-	-	-	-	-	Psychology	1.6	28.5	72.5	12.6	12.6
Genetics	1.7	1.6	0.5	0.9	1.6	Public Health	0.1	1.0	0.1	0.3	0.5
Geriatrics	-	-	-	-	-	Radiology	0.1	2.0	0.0	0.3	0.8
Immunology	0.8	0.5	0.0	0.2	0.7	Social Work	0.0	0.6	1.2	0.3	0.3
Information Sci.	0.0	0.0	0.1	0.3	0.1	Surgery	0.0	0.0	0.0	0.0	0.0
Internal Medicine	0.1	0.1	0.0	0.0	0.1	Zoology	4.2	1.2	0.3	1.4	2.9
Mathematics	0.2	2.4	0.5	10.5	1.7	Other	2.4	8.0	8.6	18.1	5.6
Microbiology	11.6	5.7	0.2	4.3	8.9						
Neurobiology	0.0	0.0	0.0	0.0	0.0	TOTAL %	100.0	100.0	100.0	100.0	100.0
						N	5,059	3,496	1,032	580	9,135

[a]/Includes departments of psychiatry.

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

With two exceptions, the doctoral disciplines of Ph.D. faculty in both clinical and basic science departments reflect the general distribution of disciplines in the doctoral scientist labor force. As a "feeder" field, anatomy appeared more frequently in basic science departments than in the overall science/engineering labor force. This is probably a reflection of changes that began with the growth of biological electron microscopy, and of the role of anatomists in development of the field of cell biology. The prominence of psychology as a doctoral field for Ph.D. faculty in clinical departments derives from the large involvement of psychologists in patient care in departments of psychiatry.

Postdoctoral Research Training

It is evident from Table 9 that significant changes have taken place in the postdoctoral research preparation of clinical department faculty between 1972 and 1981. At the beginning of that period, for example, M.D. clinical faculty are seen to have had more postdoctoral research training than their departmental Ph.D. colleagues. By 1981, however, the percent of M.D. faculty with at least one year of postdoctoral research training was down somewhat from 28 percent to 26 percent, while Ph.D. faculty in that training category had increased from 20 percent to 32 percent.

TABLE 9 Amount of Postdoctoral Research Training for Medical School Faculty, 1972 and 1981

Years of Postdoctoral Research Training	Basic Science Departments				Clinical Departments			
	M.D.s		Ph.D.s		M.D.s		Ph.D.s	
1972	N	%	N	%	N	%	N	%
None	358	47.6	3,226	63.8	13,394	72.4	2,816	80.5
One or more	394	52.4	1,833	36.2	5,110	27.6	680	19.5
TOTAL	752	100.0	5,059	100.0	18,504	100.0	3,496	100.0
1981								
None	295	43.8	3,160	47.8	19,822	74.0	3,677	68.0
One or more	378	56.2	3,446	52.2	6,968	26.0	1,732	32.0
TOTAL	673	100.0	6,606	100.0	26,790	100.0	5,409	100.0
% Change 1972-81								
None	-17.6%		-2.0%		48.0%		30.6%	
One or more	-4.1%		88.0%		36.4%		154.7%	

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

Among clinical specialties, surgical departments maintained the lead in percent of Ph.D. faculty with some postdoctoral research training (Appendix Tables A5 and A6). This is consistent with their performance on three indicators of NIH/ADAMHA grant activity--rates of applications per faculty member, approvals per application, and awards per faculty member. These are described under the section on Research Grant Activity below.

It is worth noting that Ph.D. scientists had not only obtained faculty positions in clinical departments since 1972 at a faster rate than M.D.s, but also that their research training had grown considerably. M.D. faculty in clinical departments showed the highest percent of change in the NONE category--a finding that reflects increased recruitment of teacher-clinicians over the nine-year period. By contrast, there was a huge increase of 155 percent in number of Ph.D. faculty in clinical departments who had one or more years of postdoctoral training. Despite the magnitude of that change over the nine-year period, it should be emphasized that postdoctoral research training continues to be a more common characteristic of basic science department faculty--Ph.D. and M.D.--than of faculty in clinical departments. That finding is consistent with the relatively sharp difference in both years between all basic science faculty and clinical department Ph.D.s, who reported no research participation (Table 10).

TABLE 10 Degree of Research Involvement of Medical School Faculty, 1972 and 1982

	Basic Science Departments				Clinical Departments			
Research Involvement	M.D.s		Ph.D.s		M.D.s		Ph.D.s	
1972	N	%	N	%	N	%	N	%
None	77	10.2	313	6.2	6,308	34.1	514	14.7
Some	601	79.9	4,275	84.5	10,756	58.1	2,425	69.4
Primary	61	8.1	402	7.9	510	2.8	402	11.5
Other & Unknown	13	1.7	69	1.4	930	5.0	155	4.4
TOTAL	752	100.0	5,059	100.0	18,504	100.0	3,496	100.0
1982	N	%	N	%	N	%	N	%
None	57	8.8	325	4.7	10,524	36.9	807	13.8
Some	501	77.1	5,461	79.3	15,497	54.3	3,587	61.1
Primary	72	11.1	957	13.9	1,135	4.0	1,178	20.1
Other & Unknown	20	3.0	143	2.1	1,359	4.8	296	5.0
TOTAL	650	100.0	6,886	100.0	28,515	100.0	5,868	100.0

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

The aggregate amount of postdoctoral research training completed by faculty is a key indicator of the research capability of medical schools. Length of such training, for example, has been shown to have the greatest influence on approval rate on first research grant applications, with other significant factors being the institution conferring the degree and the place of employment (15). Although applicable to both Ph.D.s and M.D.s, that association has special significance for physicians, who even after two years of fellowship experience often remain less well-trained for research than the Ph.D. scientist who has been preparing for such a career since the baccalaureate. That view receives further support from a recent study by Oates of the research training of M.D. investigators believed to have made scientific contributions. Almost half of a sample of physicians holding membership concurrently in the Association of American Physicians and the American Society for Clinical Investigation reported having completed four or more years of conventional research training (16). That finding, as the author observes, contrasts sharply with a commonly held notion that two years of research training equip the physician for a research career.[6]

Research Participation

The role of Ph.D. faculty in clinical departments is generally perceived to be research-related (10, 11). More than 80 percent of their number devoted some of their time (at least 10 percent) to research in both 1972 and 1982 (Table 10). Their research participation was substantially greater, by this measure, than that of their physician colleagues, but less than that of either Ph.D. or M.D. faculty in basic science departments. Relatively constant over the decade was the proportion of clinical department Ph.D.s reporting "NONE" as the measure of their research participation.

Clinical department Ph.D.s were more likely than their counterparts in basic science departments to report research as a primary responsibility. Moreover, the increase in that category from 12 to 20 percent between 1972 and 1982 suggests that Ph.D.s may have been recruited in clinical departments to compensate for the failure of the M.D. group

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[6]Data from the DRG Payback File and Trainee Appointment File show that the median length of NIH support for post-Ph.D. and post-M.D. NRSA fellows and trainees, as of May 1983, was 24 and 12 months, respectively.

to maintain its share of the total research effort.[7] Although more M.D.s in clinical departments were involved in research in 1982 then in 1972, the increase in number involved was not as rapid as for the Ph.D. segment. Consequently, M.D.s lost ground relative to total clinical faculty research involvement.

Research Grant Activity

Perhaps the most revealing data on research activity of medical school faculty members relate to their application and success rates in the highly competitive world of NIH/ADAMHA research grants. Table 11 shows the data in terms of absolute numbers of applications, approvals, and awards, and Table 12 presents the same data in terms of rates.

The number of applications for NIH/ADAMHA research grants submitted by all medical school faculty members increased substantially during the decade ending in 1982 (Table 11). A similar pattern pertains to grant application approvals and awards.

For physicians in clinical departments, applications for NIH/ADAMHA research grants have generally kept pace with the growth in M.D. faculty size between 1972 and 1982 but have fallen behind relative to total applications. The number of grant applications from such M.D.s increased by 52 percent, compared with a 54 percent increase in number of M.D.s in clinical departments (Table 11 and Table 1); hence applications per faculty member for this group declined slightly (Table 12). In terms of share of total applications from M.D.s and Ph.D.s in all departments, applications from physicians in clinical departments has declined from 48 percent in 1972 to 34 percent in 1982.

For Ph.D. faculty members, however, there has been a sharp increase in applications for NIH/ADAMHA grants over and above the growth in numbers. Applications per Ph.D. faculty member in clinical departments rose 139 percent between 1972 and 1982.

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[7]Sherman, in an unpublished study, examined the possibility that these trends, coupled with a decline in the number of physicians entering NIH-supported training programs, would be reflected in a change over time in relative numbers of M.D. and Ph.D. authors of clinical research papers (31). From a database of 43 journals in clinical medicine with a strong research emphasis, no consistent trend of increase or decrease was observed in the percent of M.D. (and M.D./Ph.D.) first authors, which averaged about 81 percent annually between 1970 and 1980. The percentage of Ph.D.s among first authors was higher in the last four years of the series (about 9.0 percent) than in the first three years (about 7.6 percent).

The sensitivity of these measures, however, may have been blunted by the exclusion in the database of key journals, owing to their editorial practice of not listing authors' degrees. Moreover, there is at least fragmentary evidence of a tendency for Ph.D. clinical investigators to publish more frequently in journals related to their doctoral training fields than in that of clinical specialty journals included in the survey.

TABLE 11 NIH/ADAMHA Research Grant Activity by Medical School Faculty Members, 1972 and 1982

Research Grant Activity	Basic Science Departments: M.D.s N	Basic Science Departments: M.D.s % of Total	Basic Science Departments: Ph.D.s N	Basic Science Departments: Ph.D.s % of Total	Clinical Departments: M.D.s N	Clinical Departments: M.D.s % of Total	Clinical Departments: Ph.D.s N	Clinical Departments: Ph.D.s % of Total	Total N	Total %
1972										
Applications	259	5.7	1,504	33.2	2,160	47.7	608	13.4	4,531	100.0
Approvals	196	6.8	1,159	40.2	1,145	39.7	383	13.2	2,883	100.0
Awards	149	7.1	696	33.3	992	47.5	251	12.0	2,088	100.0
1982										
Applications	371	3.8	3,632	37.3	3,287	33.8	2,440	25.1	9,730	100.0
Approvals	340	4.5	3,213	39.2	2,657	32.4	1,987	24.2	8,197	100.0
Awards	160	5.4	1,117	37.6	1,032	34.7	664	22.3	2,97[illegible]	100.0
% Change 1972-82										
Applications	+43%		+141%		+52%		+301%		+115%	
Approvals	+73%		+177%		+84%		+419%		+184%	
Awards	+7%		+69%		+4%		+165%		+42%	

SOURCE: National Research Council, Consolidated Grant Applicant File.

Table 12 Application, Approval, and Award Rates for NIH/ADAMHA Research Grants by Medical School Faculty Members, 1972 and 1982.

Rates	Basic Science Departments: M.D.s	Basic Science Departments: Ph.D.s	Clinical Departments: M.D.s	Clinical Departments: Ph.D.s
1972				
Applications per faculty member	0.34	0.30	0.117	0.17
Approvals per application	0.76	0.77	0.67	0.63
Awards per application	0.57	0.46	0.46	0.41
Awards per faculty member	0.20	0.14	0.05	0.07
1982				
Applications per faculty member	0.57	0.53	0.115	0.42
Approvals per application	0.92	0.88	0.81	0.81
Awards per application	0.43	0.31	0.31	0.27
Awards per faculty member	0.25	0.16	0.04	0.11
% Change 1972-82				
Applications per faculty member	+66%	+77%	-2%	+139%
Approvals per application	+21%	+15%	+21%	+29%
Awards per application	-25%	-33%	-32%	-34%
Awards per faculty member	+25%	+14%	-20%	+57%

SOURCE: National Research Council, Consolidated Grant Applicant File.

Although recommendations of approval rose for all faculty subgroups over the 10-year period, Ph.D. investigators in clinical departments again showed the strongest increase--both in absolute numbers (Table 11) and in ratio of approvals to applications (Table 12).

Continuing the pattern, the number of research grants awarded to Ph.D.s in clinical departments by the NIH or ADAMHA increased by 165 percent between 1972 and 1982--by far the fastest growth of any of the faculty subgroups.

Award rates, defined as awards per application, are less useful as a measure of grant activity. NIH/ADAMHA grant funds have failed to keep pace with the marked increase in applications, and hence, award rates have declined between 1972 and 1982 for all faculty subgroups. When awards are measured per faculty member, however, intergroup differences are clearly distinguishable. The highest rate of improvement (57 percent) was exhibited by Ph.D. faculty in clinical departments, followed by basic science department M.D.s (25 percent) and Ph.D.s (14 percent). Running counter to that trend for the decade, M.D. faculty members in clinical departments experienced a 20 percent drop in awards per faculty member. This should not be taken as an indication of reduced quality of grant applications from M.D.s. The drop in awards per faculty member is probably a result of the failure of M.D. clinical faculty to increase their rate of grant applications per faculty member. In fact, over the 10-year period, approvals per application for M.D.s in clinical departments exhibited a 21 percent improvement.

It is clear from these data that Ph.D. faculty in clinical departments consistently registered the largest increases in grant activity. That performance, it should be noted, is in line with comparative changes that have occurred in the last decade in postdoctoral research training of medical school faculty, as discussed above. It may reflect also the differential change among the four faculty groups in the percentage reporting research as their primary responsibility (Table 10).

It is difficult, on the basis of available data, to separate the Ph.D. faculty recruited by clinical departments to conduct research from those expected primarily to provide clinical service. Despite the fact that most Ph.D.s in those departments participate to some extent in research (Table 10), large numbers have traditionally provided direct input to patient care. Examples are dosimetricians in radiation therapy, audiologists in otolaryngology, biochemists in pathology, and psychometricians and clinical psychologists in psychiatry. Differential emphasis on the recruitment of Ph.D.s for research may explain in part the differences in research grant activity among the four clinical departmental groups.

Ph.D. faculty in surgical departments are a good case in point. Consistent with their lead in percent of Ph.D. faculty with some postdoctoral research training, in percent reporting primary involvement in research, and frequency of holding secondary appointments in basic science departments, they had the highest NIH/ADAMHA application and approval rates in both 1972 and 1982 (Appendix Tables A5 and A6). Surgical department Ph.D.s were also first in the rate of grant awards per faculty member for both years.

Over the 10-year period, grant applications from M.D. faculty in surgical departments fell by 31 percent and awards per faculty member decreased by 41 percent (Appendix Tables A3 and A4). Consequently, though small in numbers, Ph.D. faculty in surgical departments appear to have assumed a major role in NIH/ADAMHA sponsored research activity in those departments.

The foregoing data apply solely to faculty members designated as principal investigators on NIH/ADAMHA grant applications and awards. An analysis of staffing patterns for NIH-funded projects in clinical departments indicates that the increase in research activity of Ph.D. faculty in that setting is not limited to the role of principal investigator.[8] As can be seen from Figure 4, Ph.D. scientists in 1973 constituted approximately 28 percent of the total paid full-time equivalent employment on NIH grants with a performance site in clinical departments. By 1978, this share had grown to 34 percent. During the same period, the share contributed by M.D.s declined from 32 percent to 28 percent.

ACCOUNTING FOR THE GROWTH OF BASIC SCIENTISTS IN CLINICAL DEPARTMENTS

We see three fundamental reasons for the relatively high growth rate of Ph.D.s in clinical departments and for the increase in their research activity in those departments--reasons inherent in clinical investigation itself and the system in which that research is conducted.

1. Changing Nature of Clinical Investigation

An important factor in the growth of Ph.D. faculty in clinical departments has been the changing nature of clinical investigation. That change was first documented by Feinstein et al. in a survey of topics, sources, and sites of the research abstracts associated with the annual Atlantic City "Spring Meetings" of the American Federation for Clinical Research, the American Society for Clinical Investigation, and the Association of American Physicians for various years from 1953 though 1969 (17, 18, 19). Their findings indicated that the proportion of "clinical" topics--as evidenced by research that was patient-centered, disease-oriented, or concerned with human material--had progressively declined. Concurrently, the proportion of "basic" investigations, using materials that were neither of human origin nor diseased, increased steadily. It seems likely that in their exploration of disease mechanisms, design of new drugs, and other research objectives, those clinical investigators had become increasingly concerned with understanding such basic phenomena as enzyme kinetics, lipid metabolism, protein structure, transmembranal transport, etc.

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[8]An annual NIH survey, the Manpower Report, collected data from principal investigators regarding persons receiving salary from each grant over the 1973-1978 period.

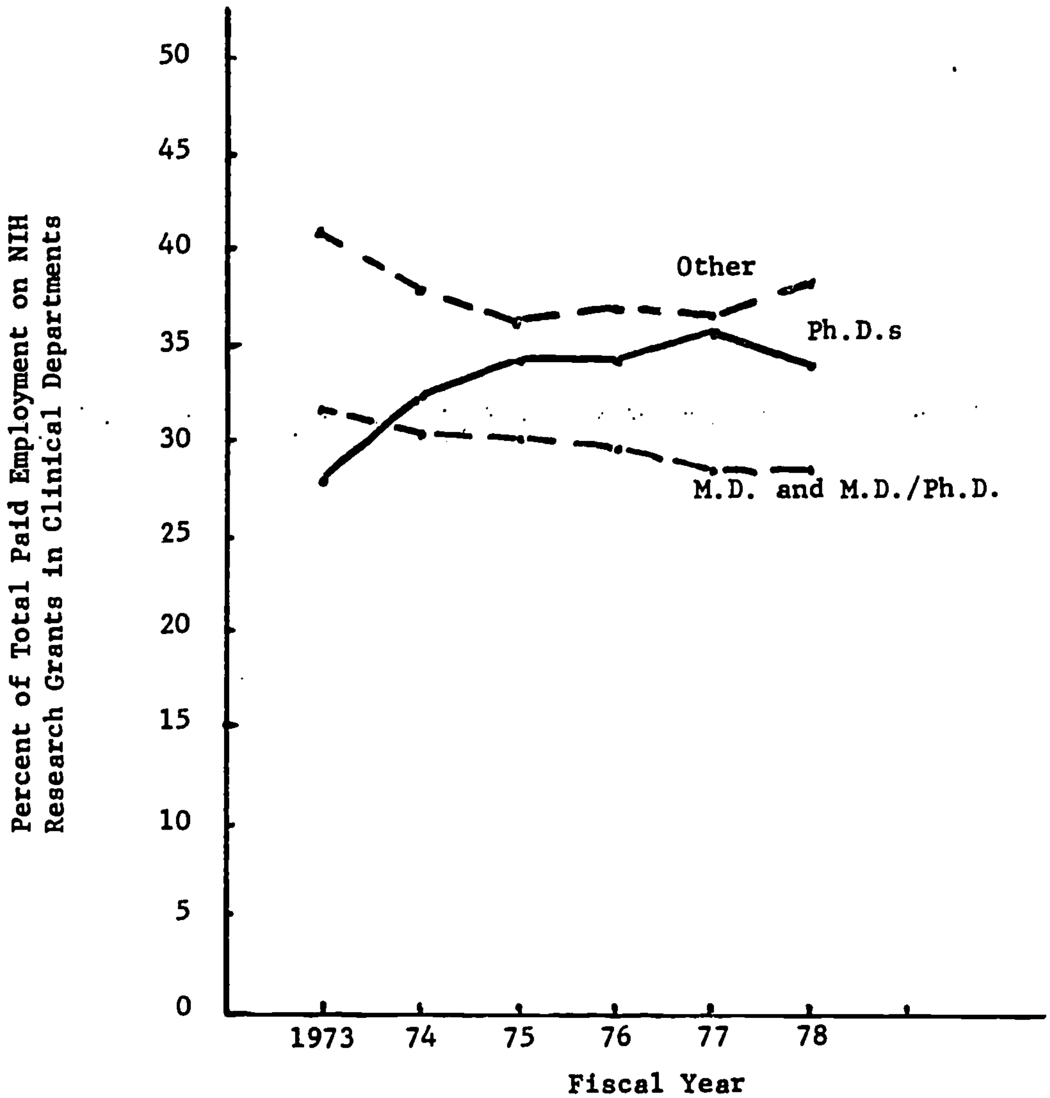

FIGURE 4 Participation of Ph.D., M.D., and other scientists on research grants in clinical departments sponsored by NIH, 1973-78. Data are shown as percentage of total paid full-time equivalent employment on the grants. Source is NIH Manpower Report 1973-78.

Those conclusions are reinforced by our analysis of NIH/ADAMHA research grant projects conducted in clinical departments of medical schools. Based on the NIH Central Scientific Classification System, grants were coded as "clinical" when the research required use of human subjects as individuals or in groups. Excluded from that category, therefore, were projects using human-derived materials in laboratory studies unrelated to patients; projects using non-human organisms as subjects; and other projects that could be regarded as having direct clinical implications, but that did not require the participation of human subjects. As shown in Table 13, only 22 percent of the grants in 1972 had been classified as "clinical," dropping to 18 percent in 1980. This finding permits the inference that over the eight-year period, more than three-quarters of all NIH/ADAMHA research grants in clinical departments of medical schools could technically have been planned and directed by non-physician scientists. The location of the research in this case is of particular importance, because it is the milieu for the preponderance of clinical investigation in the United States.

Table 13 Clinical Research Grants from NIH/ADAMHA in Medical Schools, 1972 and 1980[a]

	1972			1980		
	Total Grants	Clinical Grants[b] N	Clinical Grants[b] %	Total Grants	Clinical Grants[b] N	Clinical Grants[b] %
All Departments	1,999	285	14.3	2,760	293	10.6
Basic Science Depts.	822	34	4.1	1,279	20	1.6
Clinical Depts.	1,128	244	21.6	1,435	264	18.4
Other & Unknown	49	7	14.3	46	9	20.0

[a]Only competing grants in the research project (R) series are included here.

[b]Clinical grants are defined as those using human subjects as individuals or in groups. These were identified by means of the NIH Central Scientific Classification System. This is a classification system designed to supply broadly comprehensive retrieval categories for biomedical research activities receiving NIH/ADAMHA support. One of the four axes in that system (Axis III) is used to designate research materials in terms of "clinical" and "nonclinical" categories.

SOURCE: National Research Council, Consolidated Grant Applicant File.

Advances in molecular biology have resulted in a confluence of the biomedical sciences over the last two decades, merging basic disciplines such as genetics, biochemistry, immunology, with a host of clinical disciplines. This coalescence of biomedical science, in Arthur Kornberg's view, often makes a distinction between M.D. and Ph.D. investigators unimportant (20). Moreover, it helps to explain the observation of Fishman and Jolly (11) that research in clinical departments frequently "falls within the traditional purview of basic science departments."

An additional element in this changing face of clinical investigation has been the extraordinary development of sophisticated equipment and methodologies to aid in deciphering the fundamental biological processes of the human body. Such advances as recombinant DNA methods, monoclonal antibodies, complex computational systems, biological structure and function instrumentation, and micro-sensor technology, to mention a few, have significantly extended the limits of biomedical research capability. The increasing complexity of instrumentation and software in areas such as nuclear medicine, radiology, and cardiology require expertise that is currently met in large measure by scientists trained in mathematics, chemistry, and biophysics. It is relevant in this connection that the journal Clinical Research has since 1982 included faculty openings for Ph.D. scientists in departments of medicine and pediatrics as part of its "Positions Available" listing (27).

2. Expansion of Clinical Departments

Growth in the size of clinical departments has greatly enhanced the recruitment of basic scientists to clinical faculties. Full-time clinical faculty in U.S. medical schools increased strikingly in the last two decades. Between 1961 and 1982, the number increased by some 457 percent, while basic science faculty grew by about 229 percent (9). Petersdorf (25) traces the roots of this growth in large part to the expansion of departmental "missions from teaching and research to teaching, research, and service."

Before the mid-1960s, medical schools had derived relatively little support from patient care provided by the faculty of clinical departments. The emergence of Medicare, Medicaid, and other third-party payment mechanisms brought reimbursement for services previously provided charitably for the poor and aged, and in the process, stimulated faculty expansion. With increasing demands for service, patient care revenue has increased to a point where it is currently the largest single source of medical school support, accounting for almost 30 percent of total funding (26).

With increasing dependence on patient care income in order to bolster medical school and departmental budgets, clinical departments began to hire more clinicians and fewer physician researchers. Furthermore, these same financial pressures probably diverted a good many existing clinical faculty members into patient care activities and away from research. As Gill (30) has pointed out, there were "not only fewer physician-scientists available who were scientifically trained and truly talented, but with financial stringencies an important consideration, a clinician at least earned his own salary." Moreover, as M.D. faculty members became more involved in patient care, many clinical departments elected to add basic scientists to their faculties for the purpose of sustaining significant levels of research activity.

3. Relative Decrease in Research Involvement of Physicians

The increase of Ph.D. faculty in clinical departments has occurred during a period of increased research activity by medical school faculty in general. M.D.s in clinical departments, however, have not kept pace, as pointed out earlier in the sections on Research Participation and Research Grant Activity. There has been a decrease in M.D. market share of competing NIH research grants, which fell from 36.1 percent in 1973 to 25.5 percent in 1983 (22). The drop in M.D. market share of NIH awards may be ascribed in part to a finding that clinical research grant requests, which involve human subjects in an interactive relationship with the physician investigator, are more often disapproved and more frequently assigned poorer priority scores than applications in which no human subjects are involved (32). According to Carter et al, however, most of the decline in M.D. market share is attributable to the fact that M.D.s have become less successful in obtaining their first research grant (23). Reflecting this reduced competitiveness, the proportion of M.D.s among all first-time principal investigators has gone down from 25 percent in 1973 to 19 percent in 1983 (22).

At the root of the reduced competitiveness of M.D.s has probably been an insufficiency of research training in relation to the increasingly complex demands of modern science. Reporting on recent NIH analyses, Wyngaarden observes that in programs where the median length of training is only 12 months, only 20 percent of the M.D. trainees ever apply for NIH grants and only 10 percent of the total ever receive a grant (21). The 12-month median, he notes, is applicable to more than half of the entrants to NIH training programs in clinical settings. By contrast, 43 percent of those with 30 months or more training seek NIH grants, and 70 percent of the total are successful. Moreover, M.D. fellows, while small in number compared to trainees, demonstrate considerably higher rates, owing to their usually longer research training.

In addition, there has been a diminution in number of physicians pursuing research training. M.D. trainees/fellows supported by NIH dropped from about 4,100 to 2,000 between 1968 and 1981 (23).[9] This represented a decline from 71.7 percent to 37.2 percent for M.D.s

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[9] Totals include other health professional doctorates (e.g., D.D.S., D.V.M. etc.)

as a proportion of total NIH postdoctoral trainees/fellows over the 14-year period. At the same time, Ph.D. participation almost doubled in absolute numbers. Some of the decline is artifactual and can be attributed to the cessation of NIH support for clinical training programs in the early 1970s. It is for that reason useful to look at data for the period since 1975, when NIH training authority was restricted to research (as opposed to clinical) training as a consequence of the National Research Service Awards (NRSA) legislation. The decrease in M.D. participation is seen to have continued to 1977 and then to have leveled off through 1981. Despite the arrest in decline, NRSA programs have nevertheless failed each year since 1975 to attract sufficient M.D.s to fill the number of faculty positions expected by the IOM committee to become available over the near term in clinical departments of medical schools.

Coincident with these indications of relatively less research involvement by M.D.s, the number of basic biomedical scientists holding postdoctoral appointments in the academic sector has risen at a fairly constant rate of 9 percent per year during the 1973-81 period (9). It is reasonable to assume that some of these basic biomedical scientists may have received training in clinical departments, because much of that postdoctoral expansion is known to have occurred within medical schools. With a relatively high number of faculty vacancies compared with those in basic science departments, clinical departments appear to have provided some Ph.D. faculty aspirants in the postdoctoral pool with an appropriate alternative to employment in a basic science setting.

Several other factors may also have influenced the number of M.D.s entering into research training. Included are cumulative debt load and deterrents such as the former gap between third-year residency salary and first-year traineeship stipends, as well as the disparity in income possibilities between research and many clinical practice specialties. Also important in this regard is a lengthening of clinical specialty training programs, and a change in the amounts of research experience that can be included during the post-residency fellowship years (24). Although specialty boards generally encourage the inclusion of research experience, it is becoming increasingly difficult to accomplish. This is probably the unintended consequence of a tendency on the part of specialty boards toward greater specificity in prescribing training requirements. That tendency, which currently takes the form of defining the minimum time to be alloted to various components of the "curriculum," reduces flexibility in the training programs. A significant element in the problem is the fact that hospitals, which usually finance the young physician's fellowship training, feel that those funds should support clinical rather than research activity.

FUTURE OUTLOOK

The changing nature of clinical investigation and the system in which it is performed should continue for the short term to favor the addition of Ph.D. scientists to clinical faculties. With scientific progress dependent on the fullest use of rapidly changing technologies, research training is likely to lengthen and to become more demanding. Moreover, the increasing professionalization of biomedical research, as well as the heightened competition for R and D funds, is likely to leave less room for the part-time investigator. In addition to a clearer delineation in the roles of M.D. and Ph.D. investigators, changes also are likely to occur in the organization of research. Several writers, for example, see a strong possibility that research requiring the tools of molecular biology will be conducted by interactive teams concentrating entirely on their research (30, 28). Although the effects of these changes cannot readily be quantified, their potential for reinforcing further the trend toward employment of Ph.D. faculty in the academic clinical setting seems clear.

The outlook beyond 1988 is more difficult to describe. A substantial slowing in the growth of full-time clinical faculty through 1988 is already in prospect. Restrictions being imposed on the Medicaid/Medicare reimbursement system will impede the growth of medical school revenues from clinical activites. Compared with increases of about 6 percent per year in size of clinical faculty throughout the 1970s, the IOM committee projects an annual rise of 1.3 percent from 1980-88 (9). Slower faculty growth should generally cut down the number of openings for new investigators. At the same time, the trend toward potential surpluses in almost all medical and surgical specialties, as well as in radiology, pathology, and anesthesiology, could have an appreciable impact on choice of research as a career option for physicians (29). Moreover, an exacerbation of financial difficulty might seriously affect the employment of Ph.D. faculty in clinical departments. This could result from their marginal tenure security and major involvement in research activities, which would have to be eliminated before the service programs were reduced. Such developments, over the long term, could sharply limit the continued expansion of Ph.D. faculty in clinical departments.

Although it encourages the involvement of basic scientists in clinical investigation, the IOM committee nevertheless has voiced repeatedly its concern about the altered balance in NIH awards between M.D. and Ph.D. investigators and its implications for progress in clinical research. That concern derives from a recognition of the physician-investigator's unique preparation for identifying research opportunities presented by human disease, for bringing clinical insights to bear in the laboratory, and for translating into clinical practice those advances in basic research that are pertinent to the pathogenesis and therapy of disease. It is often necessary to study patients intensively, permitting the clinical situation to guide the nature of the questions, as well as the manner of seeking their answers. In addition, ethical and professional considerations, such as would be involved in research with invasive procedures or use of critically ill patients, underscore the primacy of the physician's role in clinical investigation. In light of that irreplaceable function, the relatively low number of physicians currently undertaking research training remains an issue of serious concern.

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APPENDIXES

APPENDIX TABLE A1 Full-Time Medical School Faculty, by Degree Held and Department, 1972

Department	M.D. #	M.D. %	M.D./Ph.D. #	M.D./Ph.D. %	Ph.D. #	Ph.D. %	Other #	Other %	Total #	Total %
BASIC SCIENCE										
Anatomy	141	11.1	116	9.1	967	75.8	52	4.1	1,276	100.0
Biochemistry	71	4.6	63	4.1	1,359	88.4	45	2.9	1,538	100.0
Microbiology	117	10.9	59	5.5	829	77.0	71	6.6	1,076	100.0
Pharmacology	159	16.4	122	12.6	657	67.9	30	3.1	968	100.0
Physiology	206	15.6	147	11.2	912	69.2	52	3.9	1,317	100.0
Other	58	12.5	33	7.1	332	71.4	42	9.0	465	100.0
TOTAL	752	11.3	540	8.1	5,059	76.2	292	4.4	6,643	100.0
CLINICAL SCIENCE										
Anesthesiology	1,016	90.2	63	5.6	28	2.5	20	1.8	1,127	100.0
Dermatology	142	72.8	11	5.6	34	17.4	8	4.1	195	100.0
Family Practice	548	39.3	53	3.8	402	28.9	390	28.0	1,393	100.0
Internal Medicine	5,113	85.2	376	6.3	308	5.1	203	3.4	6,000	100.0
Neurology	574	74.0	61	7.9	104	13.4	37	4.8	776	100.0
Ob/Gyn.	879	76.8	76	6.6	133	11.6	57	5.0	1,145	100.0
Ophthalmology	306	65.1	42	8.9	90	19.1	32	6.8	470	100.0
Orthopedic Surgery	260	84.1	17	5.5	20	6.5	12	3.9	309	100.0
Otolaryngology	189	51.9	7	1.9	107	29.4	61	16.8	364	100.0
Pathology	1,608	64.8	232	9.4	396	16.0	244	9.8	2,480	100.0
Pediatrics	2,207	78.2	118	4.2	267	9.5	231	8.2	2,823	100.0
Physical Medicine	225	46.8	12	2.5	93	19.3	151	31.4	481	100.0
Psychiatry	1,781	52.4	94	2.8	1,032	30.3	495	14.6	3,402	100.0
Radiology	1,428	72.6	78	4.0	284	14.4	177	9.0	1,967	100.0
Surgery	2,222	81.1	200	7.3	196	7.2	122	4.5	2,740	100.0
Other	6	50.0	0	0.0	2	16.7	4	33.3	12	100.0
TOTAL	18,504	73.0	1,440	5.6	3,496	13.6	2,244	8.7	25,684	100.0
OTHER	397	19.9	43	2.2	580	29.0	978	48.9	1,998	100.0
GRAND TOTAL	19,653	57.3	2,023	5.9	9,135	26.6	3,514	10.2	34,325	100.0

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

APPENDIX TABLE A2 Full-Time Medical School Faculty, by Degree Held and Department, 1982

	M.D.		M.D./Ph.D.		Ph.D.		Other		Total	
Department	#	%	#	%	#	%	#	%	#	%
BASIC SCIENCE										
Anatomy	92	6.1	77	5.1	1,289	85.4	51	3.4	1,509	100.0
Biochemistry	65	3.6	55	3.0	1,640	90.5	52	2.9	1,812	100.0
Microbiology	112	8.1	50	3.6	1,148	83.0	74	5.4	1,384	100.0
Pharmacology	138	10.6	106	8.1	1,010	77.7	46	3.5	1,300	100.0
Physiology	151	9.3	113	6.9	1,308	80.3	57	3.5	1,629	100.0
Other	92	14.0	37	5.6	491	74.5	39	5.9	659	100.0
TOTAL	650	7.8	438	5.3	6,886	83.0	319	3.8	8,293	100.0
CLINICAL SCIENCE										
Anesthesiology	1,662	86.0	106	5.5	98	5.1	66	3.4	1,932	100.0
Dermatology	214	75.6	20	7.1	37	13.1	12	4.2	283	100.0
Family Practice	1,192	51.3	42	1.8	656	28.2	433	18.6	2,323	100.0
Internal Medicine	8,270	83.7	562	5.7	778	7.9	271	2.7	9,881	100.0
Neurology	917	71.5	98	7.6	218	17.0	49	3.8	1,282	100.0
Ob/Gyn.	1,285	77.2	84	5.1	216	13.0	80	4.8	1,665	100.0
Ophthalmology	478	65.5	43	5.9	165	22.6	44	6.0	730	100.0
Orthopedic Surgery	424	78.4	23	4.2	63	11.7	31	5.7	541	100.0
Otolaryngology	234	52.1	18	4.0	142	31.6	55	12.3	449	100.0
Pathology	1,982	60.1	298	9.0	748	22.7	272	8.2	3,300	100.0
Pediatrics	3,450	80.0	194	4.5	424	9.8	243	5.6	4,311	100.0
Physical Medicine	296	55.2	16	3.0	89	16.6	135	25.2	536	100.0
Psychiatry	2,487	55.6	138	3.1	1,381	30.9	470	10.5	4,476	100.0
Radiology	2,228	73.2	120	3.9	501	16.5	193	6.3	3,042	100.0
Surgery	3,358	81.8	226	5.5	335	8.2	188	4.6	4,107	100.0
Other	38	50.7	0	0.0	17	22.7	20	26.7	75	100.0
TOTAL	28,515	73.2	1,988	5.1	5,868	15.1	2,562	6.6	38,933	100.0
OTHER	395	17.3	49	2.1	907	40.0	936	40.9	2,287	100.0
GRAND TOTAL	29,560	59.7	2,475	5.0	13,661	27.6	3,817	7.7	49,513	100.0

SOURCE: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH.

APPENDIX TABLE A3 Statistical Profile of Full-Time M.D. Faculty in Medical School Departments, 1982[a]

		Department															
				Clinical													
		Basic Sci.		Total Clin.		Medical		Hospital		Surgical		Psychiatry		Other Departments		All Departments	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
CAREER AGE (Yrs. since M.D. degree)	5 or less	3	0.5	667	2.3	363	2.6	201	3.3	68	1.2	35	1.4	6	1.5	676	2.3
	6-10	42	6.5	5,430	19.0	2,883	20.5	1,024	16.6	1,035	17.9	488	19.6	16	4.0	5,669	19.2
	11-15	61	9.4	5,202	18.2	2,397	17.0	1,196	19.4	1,113	19.3	496	19.9	24	6.1	5,773	19.5
	16-20	97	14.9	7,828	27.5	5,374	38.2	1,067	17.3	1,011	17.5	376	15.1	45	11.4	4,993	16.9
	21 or more	447	68.8	9,388	32.9	3,064	21.8	2,680	43.4	2,552	44.2	1,092	43.9	304	77.0	12,449	42.1
	TOTAL	650	100.0	28,515	100.0	14,081	100.0	6,168	100.0	5,779	100.0	2,487	100.0	395	100.0	29,560	100.0
	Median career age	24.3		17.4		16.8		18.6		18.8		18.5		25.4		18.5	
ACADEMIC RANK	Professor	429	66.0	8,281	29.0	4,013	28.5	1,682	27.3	1,953	33.8	633	25.5	91	23.0	8,801	29.8
	Assoc. Prof.	131	20.2	7,112	24.9	3,630	25.8	1,441	23.4	1,443	25.0	598	24.1	30	7.6	7,273	24.6
	Asst. Prof.	72	11.1	10,677	37.4	5,274	37.5	2,455	39.8	1,899	32.9	1,049	42.2	22	5.6	10,771	36.4
	Instructor	11	1.7	2,249	7.9	1,065	7.6	545	8.8	444	7.7	195	7.8	0	0.0	2,260	7.7
	Other & Unk.	7	1.1	196	0.7	99	0.7	45	0.7	40	0.7	12	0.5	252	63.8	455	1.5
	TOTAL	650	100.0	28,515	100.0	14,081	100.0	6,168	100.0	5,779	100.0	2,487	100.0	395	100.0	29,560	100.0
YEARS OF POSTDOCTORAL RESEARCH TRAINING (1981 faculty)	None	295	43.8	19,822	74.0	8,627	65.9	4,804	82.2	4,225	78.6	2,108	87.5	283	73.3	20,371	73.2
	1-2	189	28.1	4,660	17.4	2,899	22.2	700	11.9	847	15.9	198	8.2	72	18.7	4,913	17.7
	3-4	115	17.1	1,608	6.0	1,142	8.7	230	3.9	191	3.4	51	2.1	19	4.9	1,740	6.2
	5 or more	74	11.0	700	2.6	417	3.2	112	1.9	120	2.2	51	2.1	12	3.1	786	2.8
	TOTAL	673	100.0	26,790	100.0	13,085	100.0	5,846	100.0	5,373	100.0	2,408	100.0	386	100.0	27,810	100.0
	Median years	0.9		0.3		0.4		0.3		0.3		0.3		0.3		0.3	
TENURE STATUS	Tenured	415	63.9	8,640	30.3	4,267	30.3	1,721	27.9	1,953	33.8	683	27.5	215	54.2	9,223	31.2
	Tenured Track	58	9.0	6,359	22.3	3,126	22.2	1,425	23.1	1,271	22.0	542	21.8	30	7.7	6,444	21.8
	No Tenure	57	8.7	7,870	27.6	3,858	27.4	1,807	29.3	1,428	24.7	784	31.5	62	15.7	8,010	27.1
	Other & Unk.	120	18.4	5,646	19.8	2,830	20.1	1,215	19.7	1,127	19.5	478	19.2	88	22.4	5,883	19.9
	TOTAL	650	100.0	28,515	100.0	14,081	100.0	6,168	100.0	5,779	100.0	2,487	100.0	395	100.0	29,560	100.0
RESEARCH PARTICIPATION	None	57	8.8	10,524	36.9	4,692	33.3	2,546	41.3	2,100	36.3	1,186	47.7	232	58.7	10,813	36.6
	Some	501	77.1	15,497	54.3	7,890	56.0	3,164	51.3	3,323	57.5	1,120	45.0	141	35.7	16,139	54.6
	Primary	72	11.1	1,135	4.0	825	5.9	124	2.0	112	1.9	74	3.0	5	1.3	1,212	4.1
	Other & Unk.	20	3.0	1,359	4.8	674	4.8	334	5.4	244	4.2	107	4.3	17	4.3	1,396	4.7
	TOTAL	650	100.0	28,515	100.0	14,081	100.0	6,168	100.0	5,779	100.0	2,487	100.0	395	100.0	29,560	100.0
NIH/ADAMHA RESEARCH GRANT ACTIVITY			Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate(%)		Rate (%)
	Applications[c]	371	57.0	3,287	11.5	2,133	15.1	380	6.2	563	9.7	211	8.4	35	8.9	3,693	12.5
	Approvals[d]	340	91.6	2,657	80.8	1,800	84.4	322	84.7	421	74.8	114	54.0	32	91.4	3,029	82.0
	Awards[e]	160	43.1	1,032	31.4	712	33.4	104	27.4	155	27.5	61	28.9	12	34.3	1,204	32.6

[a]Excludes M.D.s who also hold a Ph.D. degree.
[b]Clinical departments are categorized as follows: Medical (dermatology, family practice, internal medicine, neurology, pediatrics, other clinical); Hospital (anesthesiology, pathology, physical medicine, radiology); Surgical (ob/gyn., ophthalmology, orthopedics, otolaryngology, surgery); Psychiatry.
[c]Application rate = # applications/# faculty members.
[d]Approval rate = # approved applications/# applications.
[e]Award rate = # awards/# applications.

SOURCES: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH; National Research Council, Consolidated Grant Applicant File.

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APPENDIX TABLE A4 Statistical Profile of Full-Time M.D. Faculty in Medical School Departments, 1972[a]/

		Department															
				Clinical[b]/													
		Basic Sci.		Total Clin.		Medical		Hospital		Surgical		Psychiatry		Other Departments		All Departments	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
CAREER AGE (Yrs. since M.D. degree)	5 or less	34	4.5	702	3.8	325	3.8	162	3.8	165	4.3	50	2.8	5	1.3	741	3.8
	6-10	110	14.6	4,092	22.1	2,040	23.7	925	21.6	749	19.4	378	21.2	31	7.8	4,233	21.5
	11-15	149	19.8	4,562	24.7	2,121	24.7	1,026	24.0	996	25.8	419	23.5	67	16.9	4,778	24.3
	16-20	132	17.6	3,435	18.6	1,585	18.5	843	19.7	697	18.1	310	17.4	75	18.9	3,642	18.5
	21 or more	327	43.5	5,713	30.9	2,519	29.3	1,321	30.9	1,249	32.4	624	35.0	219	55.2	6,259	31.9
	TOTAL	752	100.0	18,506	100.0	8,590	100.0	4,277	100.0	3,856	100.0	1,781	100.0	397	100.0	19,653	100.0
	Median career age	18.6		15.4		15.0		15.7		15.6		16.2		21.8		15.6	
YEARS OF POSTDOCTORAL RESEARCH TRAINING	None	358	47.6	13,394	72.4	5,486	63.9	3,432	80.2	2,919	75.7	1,557	87.4	292	73.5	14,044	71.5
	1-2	202	26.9	3,161	17.1	1,844	21.5	539	12.6	641	16.6	137	7.7	75	18.9	3,438	17.5
	3-4	116	15.5	1,261	6.8	850	9.9	195	4.6	172	4.5	44	2.5	18	4.6	1,395	7.1
	5 or more	76	10.0	682	3.7	404	4.7	111	2.6	124	3.2	43	2.4	12	3.1	770	3.9
	Unknown	0	0.0	6	0.0	6	0.1	0	0.0	0	0.0	0	0.0	0	0.0	6	0.0
	TOTAL	752	100.0	18,504	100.0	8,590	100.0	4,277	100.0	3,856	100.0	1,781	100.0	397	100.0	19,653	100.0
	Median years	0.7		0.3		0.4		0.3		0.3		0.3		0.3		0.3	
RESEARCH PARTICIPATION	None	77	10.2	6,308	34.1	2,515	29.3	1,711	40.0	1,226	31.8	856	48.1	245	61.7	6,630	33.7
	Some	601	79.9	10,756	58.1	5,270	61.4	2,301	53.8	2,399	62.2	786	44.1	133	33.5	11,490	58.5
	Primary	61	8.1	510	2.8	331	3.9	68	1.6	67	1.7	44	2.5	2	0.5	573	2.9
	Other & Unk.	13	1.7	930	5.0	474	5.5	197	4.6	164	4.3	95	5.3	17	4.3	960	4.9
	TOTAL	752	100.0	18,504	100.0	8,590	100.0	4,277	100.0	3,856	100.0	1,781	100.0	397	100.0	19,653	100.0
NIH/ADAMHA RESEARCH GRANT ACTIVITY			Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate(%)		Rate (%)
	Applications[c]/	259	34.4	2,160	11.7	1,197	13.9	325	7.6	488	12.7	150	8.4	57	14.4	2,476	12.6
	Approvals[d]/	196	75.7	1,445	66.9	864	72.2	215	66.2	286	58.6	80	53.3	37	64.9	1,678	67.8
	Awards[e]/	149	57.5	992	45.9	599	50.0	145	44.6	177	36.3	71	47.3	25	43.9	1,166	47.1

a/Excludes M.D.s who also hold a Ph.D. degree.
b/Clinical departments are categorized as follows: Medical (dermatology, family practice, internal medicine, neurology, pediatrics, other clinical); Hospital (anesthesiology, pathology, physical medicine, radiology); Surgical (ob/gyn., ophthalmology, orthopedics, otolaryngology, surgery); Psychiatry.
c/Application rate = # applications/# faculty members.
d/Approval rate = # approved applications/# applications.
e/Award rate = # awards/# applications.

SOURCES: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH; National Research Council, Consolidated Grant Applicant File.

APPENDIX TABLE A5 Statistical Profile of Full-Time Ph.D. Faculty in Medical School Departments, 1982[a]

		Department															
				Clinical													
		Basic Sci.		Total Clin.		Medical		Hospital		Surgical		Psychiatry		Other Departments		All Departments	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
CAREER AGE (Yrs. since Ph.D.)	5 or less	596	8.7	968	16.4	394	18.5	203	14.1	132	14.3	239	17.3	119	13.1	1,683	12.3
	6-10	1,652	24.0	1,723	29.4	672	31.5	406	28.3	276	30.0	369	26.7	230	25.4	3,605	26.4
	11-15	1,764	25.6	1,434	24.4	498	23.4	416	29.0	225	24.4	295	21.4	222	24.5	3,420	25.0
	16-20	1,022	14.8	673	11.5	218	10.2	176	12.3	115	12.5	164	11.9	135	14.9	1,830	13.4
	21 or more	1,852	26.9	1,070	18.2	348	16.3	235	16.4	173	18.8	314	22.7	201	22.2	3,123	22.9
	TOTAL	6,886	100.0	5,868	100.0	2,130	100.0	1,436	100.0	921	100.0	1,381	100.0	907	100.0	13,661	100.0
	Median career age	13.9		11.3		10.5		11.8		11.7		11.9		12.9		12.8	
ACADEMIC RANK	Professor	2,398	34.8	1,143	19.5	350	16.4	274	19.1	187	20.3	332	24.0	136	15.0	3,677	26.9
	Assoc. Prof.	2,212	32.1	1,647	28.1	579	27.2	456	31.8	276	30.0	336	24.3	157	17.3	4,016	29.4
	Asst. Prof.	1,943	28.2	2,547	43.4	986	46.3	614	42.7	376	40.8	571	41.4	171	18.9	4,661	34.1
	Instructor	194	2.8	393	6.7	138	6.5	71	4.9	62	6.7	122	8.8	14	1.5	601	4.4
	Other & Unk.	139	2.0	138	2.4	77	3.6	21	1.5	20	2.2	20	1.5	429	47.3	706	5.2
	TOTAL	6,886	100.0	5,868	100.0	2,130	100.0	1,436	100.0	921	100.0	1,381	100.0	907	100.0	13,661	100.0
YEARS OF POSTDOCTORAL RESEARCH TRAINING (1981 faculty)	None	3,160	47.8	3,677	68.0	1,255	64.6	825	63.8	486	59.4	1,081	81.7	637	71.4	7,459	57.8
	1-2	2,116	32.0	1,110	20.5	409	21.1	309	23.9	215	26.3	175	13.2	175	19.6	3,400	26.4
	3-4	976	14.8	431	8.0	206	10.6	101	7.8	83	10.1	41	3.1	57	6.4	1,464	11.4
	5 or more	354	5.4	191	3.5	72	3.7	59	4.5	34	4.2	26	2.0	23	2.6	568	4.4
	TOTAL	6,606	100.0	5,409	100.0	1,942	100.0	1,294	100.0	818	100.0	1,323	100.0	892	100.0	12,891	100.0
	Median years	0.6		0.4		0.4		0.4		0.4		0.3		0.4		0.4	
TENURE STATUS	Tenured	3,450	50.1	1,584	27.0	488	22.9	404	28.1	280	30.4	416	30.1	430	47.4	5,465	40.0
	Tenured Track	1,480	21.5	1,285	21.9	513	24.1	342	23.8	190	20.6	243	17.6	151	16.6	2,923	21.4
	No Tenure	868	12.6	1,872	31.9	716	33.6	424	29.6	276	30.0	450	32.6	152	16.8	2,896	21.2
	Other & Unk.	1,088	15.8	1,127	19.2	413	19.4	266	18.5	175	19.0	272	19.7	174	19.2	2,377	17.4
	TOTAL	6,886	100.0	5,868	100.0	2,130	100.0	1,436	100.0	921	100.0	1,381	100.0	907	100.0	13,661	100.0
RESEARCH PARTICIPATION	None	325	4.7	807	13.8	234	11.0	146	10.2	67	7.3	360	26.1	232	25.6	1,364	10.0
	Some	5,461	79.3	3,587	61.1	1,291	60.6	978	68.1	542	58.8	776	56.2	529	58.3	9,577	70.1
	Primary	957	13.9	1,178	20.1	483	22.7	248	17.3	263	28.6	184	13.3	91	10.0	2,226	16.3
	Other & Unk.	143	2.1	296	5.0	122	5.7	64	4.4	49	5.3	61	4.4	55	6.1	494	3.6
	TOTAL	6,886	100.0	5,868	100.0	2,130	100.0	1,436	100.0	921	100.0	1,381	100.0	907	100.0	13,661	100.0
NIH/ADAMHA RESEARCH GRANT ACTIVITY			Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate(%)		Rate (%)
	Applications	3,632	52.7	2,440	41.6	1,056	49.6	595	41.4	520	56.5	269	19.5	152	16.8	6,224	45.6
	Approvals[d]	3,213	88.4	1,987	81.4	853	80.8	502	84.4	451	86.7	181	67.3	113	74.3	5,213	83.8
	Awards[e]	1,117	30.8	664	27.2	258	24.4	174	29.2	152	29.2	80	29.7	24	15.8	1,865	30.0

[a]Excludes M.D.s who also hold a Ph.D. degree.
[b]Clinical departments are categorized as follows: Medical (dermatology, family practice, internal medicine, neurology, pediatrics, other clinical); Hospital (anesthesiology, pathology, physical medicine, radiology); Surgical (ob/gyn., ophthalmology, orthopedics, otolaryngology, surgery); Psychiatry.
[c]Application rate = # applications/# faculty members.
[d]Approval rate = # approved applications/# applications.
[e]Award rate = # awards/# applications.

SOURCES: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH; National Research Council, Consolidated Grant Applicant File.

APPENDIX TABLE A6 Statistical Profile of Full-Time Ph.D. Faculty in Medical School Departments, 1972[a]

		Department															
				Clinical													
		Basic Sci.		Total Clin.		Medical		Hospital		Surgical		Psychiatry		Other Departments		All Departments	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
CAREER AGE (Yrs. since Ph.D.)	5 or less	1,384	27.4	1,214	34.7	379	34.0	297	37.1	181	33.2	357	34.6	191	32.9	2,789	30.5
	6-10	1,215	24.0	836	23.9	284	25.4	185	23.1	136	24.9	231	22.4	145	25.0	2,196	24.0
	11-15	841	16.6	480	13.7	147	13.2	96	12.0	77	14.1	160	15.5	77	13.3	1,398	15.3
	16-20	734	14.5	425	12.2	118	10.6	86	10.7	65	11.9	156	15.1	66	11.4	1,225	13.4
	21 or more	885	17.5	541	15.5	189	16.9	137	17.1	87	15.9	128	12.4	101	17.4	1,527	16.7
	TOTAL	5,059	100.0	3,496	100.0	1,117	100.0	801	100.0	546	100.0	1,032	100.0	580	100.0	9,135	100.0
	Median career age	10.2		8.7		8.7		8.3		8.9		8.9		8.9		9.5	
YEARS OF POSTDOCTORAL RESEARCH TRAINING	None	3,226	63.8	2,816	80.5	880	78.8	628	78.4	406	74.4	902	87.4	482	83.1	6,526	71.4
	1-2	1,210	23.9	445	12.7	142	12.7	120	15.0	96	17.6	87	8.5	72	12.4	1,727	18.9
	3-4	400	7.9	142	4.1	65	5.8	26	3.2	28	5.1	23	2.2	12	2.1	554	6.1
	5 or more	223	4.4	91	2.6	28	2.5	27	3.4	16	2.9	20	1.9	14	2.4	328	3.6
	Unknown	0	0.0	2	0.1	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0	2	0.0
	TOTAL	5,059	100.0	3,496	100.0	1,117	100.0	801	100.0	546	100.0	1,032	100.0	580	100.0	9,135	100.0
	Median years	0.4		0.3		0.3		0.3		0.3		0.3		0.3		0.3	
RESEARCH PARTICIPATION	None	313	6.2	514	14.7	140	12.5	91	11.4	42	7.7	241	23.4	150	25.9	977	10.7
	Some	4,275	84.5	2,425	69.4	785	70.3	607	75.8	388	71.1	645	62.5	362	62.4	7,062	77.3
	Primary	402	7.9	402	11.5	133	11.9	80	10.0	86	15.8	103	10.0	43	7.4	847	9.3
	Other & Unk.	69	1.4	155	4.4	59	5.3	23	2.9	30	5.5	43	4.2	25	4.3	249	2.7
	TOTAL	5,059	100.0	3,496	100.0	1,117	100.0	801	100.0	546	100.0	1,032	100.0	580	100.0	9,135	100.0
NIH/ADAMHA RESEARCH GRANT ACTIVITY			Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate (%)		Rate(%)		Rate (%)
	Applications[c]	1,504	29.7	608	17.4	204	18.3	118	14.7	164	30.0	122	11.8	88	15.2	2,200	24.1
	Approvals[d]	1,159	77.1	383	63.0	130	63.7	74	62.7	115	70.1	64	52.5	66	75.0	1,608	73.1
	Awards[e]	696	46.3	251	41.3	83	40.7	52	44.1	70	42.7	46	37.7	38	43.2	985	44.8

[a]Excludes M.D.s who also hold a Ph.D. degree.
[b]Clinical departments are categorized as follows: Medical (dermatology, family practice, internal medicine, neurology, pediatrics, other clinical); Hospital (anesthesiology, pathology, physical medicine, radiology); Surgical (ob/gyn., ophthalmology, orthopedics, otolaryngology, surgery); Psychiatry.
[c]Application rate = # applications/# faculty members.
[d]Approval rate = # approved applications/# applications.
[e]Award rate = # awards/# applications.

SOURCES: AAMC Faculty Roster System, special tabulations by G. Bowden, NIH; National Research Council, Consolidated Grant Applicant File.

APPENDIX TABLE A7 - Mean Annual Salary of Medical School Faculty, 1979-85, by Academic Rank and Department (Thousands of dollars)

	MD Faculty Receiving Only A Base Compensation						MD Faculty Receiving a Base Plus Supplement						PhD Faculty Receiving Only A Base Compensation					
	Assistant Professor		Associate Professor		Professor		Assistant Professor		Associate Professor		Professor		Assistant Professor		Associate Professor		Professor	
	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N	X̄	N
1978-79																		
Total Basic Science	26.3	106	31.8	145	41.7	320	-	-	-	-	-	-	23.0	1976	28.0	1661	36.9	1480
Medical Specialties	40.4	1142	49.5	613	56.0	665	42.0	1825	50.4	1189	59.7	1290	24.5	386	31.2	184	37.5	87
Hospital Based Specialties	47.2	564	53.8	320	60.0	320	51.7	1009	60.8	523	68.1	552	26.0	300	32.5	172	39.0	108
Surgical Specialties	48.5	293	57.7	179	67.1	193	52.7	657	66.7	463	76.1	188	23.9	188	30.5	116	38.4	70
Psychiatry	39.5	232	46.8	106	54.2	111	43.2	303	53.0	196	60.6	229	24.3	200	30.2	125	39.4	127
TOT. CLINICAL	43.1	2231	51.6	1218	58.5	1289							24.8	1074	31.2	597	38.7	392
1979-80																		
Total Basic Science	30.3	118	34.0	151	44.1	352	-	-	-	-	-	-	24.3	2023	30.4	1791	39.4	1611
Medical Specialties	43.6	1131	53.1	607	61.2	628	44.5	2070	54.3	1359	64.0	1470	25.8	426	32.4	225	40.2	112
Hospital Based Specialties	53.0	563	58.8	375	66.7	328	55.2	1027	64.6	529	73.1	576	27.8	306	34.4	217	43.4	114
Surgical Specialties	54.1	271	63.5	172	71.9	197	56.0	705	71.4	501	83.0	513	25.0	189	32.5	122	41.2	85
Psychiatry	42.0	225	50.2	118	58.2	110	45.4	363	55.9	210	65.1	250	25.6	183	32.2	118	42.1	129
TOT. CLINICAL	47.2	2190	55.9	1272	64.0	1263							26.2	1104	33.0	682	41.8	440
1980-81																		
Total Basic Sciences	32.2	96	37.7	137	49.0	363	-	-	-	-	-	-	26.4	2070	32.9	1915	43.0	1704
Medical Specialties	47.3	1226	56.9	686	67.5	717	48.1	2298	59.4	1406	70.2	1588	28.1	471	36.0	228	45.1	103
Hospital Based Specialties	58.0	625	66.0	336	72.1	333	62.0	1145	70.6	630	81.4	642	31.0	268	37.5	208	46.9	98
Surgical Specialties	58.6	288	70.2	195	80.2	205	62.8	757	79.3	499	92.4	564	27.2	184	34.8	125	44.1	80
Psychiatry	45.5	259	54.0	127	63.3	121	50.6	405	60.5	243	71.8	277	27.0	220	33.6	116	43.1	137
TOT. CLINICAL	51.3	2398	60.8	1344	70.1	1376							28.4	1143	35.8	677	44.7	418
1981-82																		
Total Basic Sciences	36.3	75	39.2	134	53.9	347	-	-	-	-	-	-	28.5	1954	35.5	1973	46.7	1747
Medical Specialties	53.1	1233	63.9	708	75.6	720	53.4	2231	66.3	1425	78.4	1624	30.5	497	37.8	253	47.5	118
Hospital Based Specialties	68.9	592	73.7	348	80.6	311	69.6	1203	80.0	619	91.5	679	32.3	294	40.4	226	52.8	110
Surgical Specialties	66.5	312	80.9	214	90.[illegible]	214	71.4	714	89.6	519	104.0	563	29.4	221	37.6	149	46.7	91
Psychiatry	52.1	204	60.9	116	70.3	116	55.8	359	66.5	231	79.4	270	29.7	203	37.7	100	48.4	113
TOT. CLINICAL	58.8	2341	68.7	1386	78.6	1361							30.6	1215	38.6	728	48.9	432
1982-83																		
Total Basic Sciences	36.0	82	43.5	129	58.0	369	-	-	-	-	-	-	30.0	2031	37.7	2086	49.3	1900
Medical Specialties	66.5	1258	68.5	783	81.8	767	57.0	2456	70.5	1669	83.5	1808	31.6	600	39.9	281	51.6	127
Hospital Based Specialties	68.9	570	78.4	304	85.8	320	75.3	1264	87.3	710	100.1	778	34.3	317	43.1	241	53.3	115
Surgical Specialties	67.9	306	86.2	195	97.4	203	79.1	762	99.4	586	112.4	635	31.5	223	39.9	163	49.0	102
Psychiatry	53.2	230	62.5	144	74.6	125	58.3	374	69.8	253	84.8	289	31.9	204	40.6	112	50.7	126
TOT. CLINICAL	66.0	2364	72.4	1426	84.3	1415							32.3	1394	41.0	797	51.2	470
1983-84																		
Total Basic Sciences	38.9	65	46.3	124	61.4	368	-	-	-	-	-	-	31.1	1985	39.3	2095	51.8	1912
Medical Specialties	59.8	1234	72.9	820	86.5	781	60.4	2564	75.3	1641	89.1	1865	33.4	545	42.5	268	52.4	123
Hospital Based Specialties	72.9	561	84.1	318	92.4	308	79.8	1304	91.6	751	105.7	803	35.9	317	44.2	246	57.6	133
Surgical Specialties	75.9	279	92.6	175	104.4	204	85.9	799	108.3	577	124.6	642	33.0	223	42.6	160	52.4	108
Psychiatry	55.4	234	69.0	133	79.2	126	62.0	392	72.4	244	89.1	296	32.9	215	42.6	133	53.3	135
TOT. CLINICAL	64.5	2308	77.4	1446	89.7	1419							33.9	1300	43.1	807	54.0	499
1984-85																		
Total Basic Sciences	46.6	60	53.3	116	66.7	361	-	-	-	-	-	-	33.0	1995	41.7	2229	55.5	2065
Medical Specialties	64.1	1120	77.7	731	92.5	758	64.1	2722	80.0	1792	94.5	1977	34.6	651	44.4	320	57.4	166
Hospital Based Specialties	78.1	495	92.7	279	101.3	259	84.7	1383	100.0	796	112.8	860	37.5	338	47.8	274	61.0	146
Surgical Specialties	83.2	259	96.8	188	115.2	190	89.6	855	116.3	638	134.5	663	34.6	247	45.8	173	55.7	136
Psychiatry	62.5	152	76.3	90	85.6	99	64.9	482	77.9	294	95.2	320	35.9	197	44.5	135	59.8	129
TOT. CLINICAL	69.9	2030	83.6	1288	97.0	1306							35.5	1433	45.7	902	58.4	577

SOURCE: AAMC, Annual Medical School Faculty Salary Survey, 1979-86.