The Parker B. Francis Fellowship Program
Analysis of 31 Years of Career Development Support

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***Rationale*: The Parker B. Francis (PBF) Fellowship Program has supported more than 750 M.D., M.D./Ph.D., and Ph.D. fellows since 1976, but there is little information about the effectiveness of the program in fostering successful careers and producing important research.**

***Objectives*: To survey all past PBF Fellows to obtain information about their productivity and career pathways.**

***Methods*: We obtained e-mail addresses for 526 (74%) of the 712 PBF awardees from 1976 to 2006, then sent an e-mail survey to the 526 past fellows and received 365 replies (69% response rate, 49% overall). Survey questions addressed time in research, areas of research, current position and responsibilities, and research funding.**

***Measurements and Main Results*: Seventy percent of the 365 respondents spend 25% or greater effort in research and 56% report 50% or more effort in research. Respondents have published an average of 2.7 peer-reviewed publications per year, totaling more than 15,678 peer-reviewed publications, of which 1,875 appeared in high-impact journals. Respondents have received more than $1.8 billion in direct research funding since their PBF Fellowships began. Ph.D. awardees spend more time in research than M.D. awardees, and current research effort did not differ by gender. PBF awardees have become prominent leaders in universities, the National Institutes of Health, health care, and industry.**

***Conclusions*: The PBF Program has been highly successful in producing a large number of scientific and clinical leaders in pulmonary and critical care medicine. The results provide comprehensive data about the success of this career development program and provide a model for programs designed to build the workforce in pulmonary and critical care medicine.**

Keywords: research training; fellowship support; survey; career development

Advancements in medical knowledge involve collaborations by multidisciplinary teams working on important clinical problems in patient care. Because these teams include clinical scientists with M.D. training and laboratory scientists with M.D. or Ph.D. training, the support of scientific career development for clinical and laboratory-based scientists is an essential part of increasing the pipeline of qualified investigators who can advance patient care through medical research (1).

The Parker B. Francis (PBF) Fellowship Program was inaugurated in 1975 to support career development for clinical and laboratory scientists embarking on careers in pulmonary, critical care, and sleep medicine. More than 750 people have received support, and many of the awardees have had distinguished research and clinical careers, but comprehensive data about the effectiveness of this and other such programs have not been readily available.

We surveyed individuals who received a PBF Award during the years 1976 to 2006 and obtained quantitative data about the research output and career development of the awardees. The results indicate that the PBF Program has been effective in producing high-quality investigators and leaders in pulmonary medicine and research who have made significant contributions to understanding the scientific basis of lung disease and developing new treatments for patients.

METHODS

We attempted to locate the 712 past PBF Fellows who received awards between 1976 and 2006. We obtained e-mail addresses for 526 (74%) of the 1976 to 2006 Fellows using the PBF Fellowship Program database and internet searching (*see* Table E1 in the online supplement). We sent a written survey and request for a CV to the 526 past fellows via e-mail and then sent e-mail reminders every 2 to 3 weeks for 3 months. When respondent data were incomplete, we sent follow-up e-mails and/or conducted PubMed searches to obtain publication data. Survey questions assessed the proportion of PBF Fellows currently in pulmonary research, areas of research and research effort, current titles and institution, patents obtained, research awards received since the start of their PBF Fellowship, and the number and importance of peer-reviewed publications (*see* online supplement). Analysis of the survey data was approved by the University of Washington Institutional Review Board.

Data about the area of research, research funding, publication record, and leadership role were abstracted from each respondent's survey responses and curriculum vitae. In cases in which research dollars for specific awards were not reported, we used average annual award dollars for each grant category and the reported duration of the award (e.g., $125,000/yr for a K award, $50,000-$100,000/yr for other career development awards, $250,000/yr for a recent R01 award, $1.5 million/yr for a Program Project Grant award). Peer-reviewed publications since receiving the PBF Fellowship award were counted and notations were made of peer-reviewed publications in which the respondent was first, second or last author. We designated as "leaders" respondents who held leadership roles in academia (department chair or vice chair, dean or vice dean, division director or director of a major institute), health care (hospital director or chief of medicine), the pharmaceutical industry (CEO or research director), or the National Institutes of Health (NIH; director of a division or institute).

From the 526 e-mailed surveys we received 365 completed surveys (69% survey response rate) representing a 51% overall sampling of the

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712 PBF awardees between 1976 and 2006 (Table E1), which compares favorably with other surveys of physician/scientists (2, 3). One study reported an average response rate of 61% for questionnaires mailed to physicians (2). A survey of 113 authors publishing survey results in medical journals reported an average response rate of 60% (3). The results were validated in part by searching PubMed for publications of respondents and nonrespondents. For comparison, we contacted the NIH and private funding organizations for information about their awardees (*see* online supplement).

RESULTS

Of the survey respondents, 74% were men and 26% were women (Table 1), matching the gender distribution of the 1976 to 2006 fellow classes (75% men, 25% women). Forty-nine percent (n = 177) of the returned surveys were from M.D. scientists, 42% (n = 154) were from Ph.D. scientists, and 9% (n = 34) were from M.D./Ph.D. scientists. The response rates varied by degree: 59% for M.D.s, 87% for M.D./Ph.D.s, and 81% for Ph.D.s (Table E2).

Important changes in the demographics of the awardees have occurred over time (Tables 1 and E3). In the first 11 years of the program, the majority of the awardees were M.D.s (75%), and only 22% were Ph.D.s, whereas 3% held combined M.D./Ph.D. degrees. In the second decade (1987–1996), more than half of the awardees were M.D.s (58%), but the proportion of Ph.D.s increased to 31%. In the most recent decade (1997–2006), only 25% of the awardees have been M.D.s, whereas the proportion of Ph.D. scientists has increased to 62%. These changes reflect the recent applicant pool; in 2009 and 2010, applicants were 29% M.D.s, 7% M.D./Ph.D.s, and 64% Ph.D.s, and awardees were 30% M.D.s, 10% M.D./Ph.D.s, and 60% Ph.D.s.

The gender distribution of the PBF Awardees also has changed over time (Table 1). From 1976 to 1986, 81% of the awardees were men and 19% were women. By 1997 to 2006 the percentage of women had increased to 33%. Of the 2009 and 2010 PBF Fellowship applicants, 38% were women, so the increase in women awardees over time parallels the increased number of women in the applicant pool.

Current Research Activity

The percentage of time that PBF awardees spend in research has varied with time since receiving the award (Figures 1A, E1, and E2). Seventy percent (255) of all respondents reported currently spending 25% or more time in research (Table 1). The distribution of reported research time differed for the initial fellows (1976–1986) versus the more recent fellows (1997–2006). Of the PBF Fellows from the first 11 years of the program, 51% still spend 25% or more time in research, whereas 34% still spend more than half of their time in research. The Ph.D. respondents spend more time in research than M.D. respondents. Of the recent fellows (1997–2006), 89% spend 25% or more time in research, and 82% spend 50% or more time in research. Of these recent awardees, the Ph.D.s and M.D.s report spending equivalent percentages of time in research. The proportion of respondents spending 50% or more time in research has declined more for M.D.s than for the Ph.D.s (Table 1). Of the recent M.D. awardees (1997–2006), 76% still spend more than half of their time in research versus only 25% of the initial M.D. awardees. Of the recent Ph.D. awardees, 84% spend more than half of their time in research as compared with 55% of the Ph.D. awardees in the first decade of the program. There were no gender differences in the trends with regard to research time.

The broad research categories and the distribution of research areas of the M.D. and Ph.D. scientists who currently spend 25% or more of their time in research are shown in Table 2. Most of the Ph.D. awardees (79%) report spending time in basic research, whereas among the M.D. awardees there was a more balanced distribution of research between basic, clinical, and translational categories. There were no significant differences between male and female respondents in the distribution of research areas (Table 2).

Productivity—Publications

Productivity of the PBF awardees in terms of publications was measured by the total number of peer-reviewed publications and the number of peer-reviewed publications on which the PBF Fellows were listed as first, second, or last author. The number of peer-reviewed publications per fellow per year ranged from one to four (Figure 1B). The mean number of publications per fellow per year was 2.7 ± 2.2 (mean and SD), with a median of 2.2/yr (Table 3). The mean number of publications as first, second, or last author was 1.8 ± 1.5/yr (mean and SD), with a median of 1.5/yr (Tables 3 and E4).

Overall, the M.D.s had a mean of 2.5 peer-reviewed publications per year and 1.6 publications per year as first, second, or last author (Table 3). The Ph.D. respondents had slightly higher average productivity, with 2.8 peer-reviewed publications per year and 1.9 publications per year as first, second or last author.

TABLE 1. DESCRIPTIVE DATA FOR SURVEY RESPONDENTS: GENDER, DEGREES HELD, RESEARCH EFFORT (N = 365)

	1976–1986			1987–1996			1997–2006			All Years: 1976–2006		
	n (%)	Research ⩾ 25% n (%)	Research ⩾ 50% n (%)	n (%)	Research ⩾ 25% n (%)	Research ⩾ 50% n (%)	n (%)	Research ⩾ 25% n (%)	Research ⩾ 50% n (%)	n (%)	Research ⩾ 25% n (%)	Research ⩾ 50% n (%)
TOTAL	n = 140	71 (51)	48 (34)	n = 94	67 (71)	48 (51)	n = 131	117 (89)	107 (82)	n = 365	255 (70)	203 (56)
Men	113 (81)	55 (49)	38 (34)	70 (74)	51 (73)	36 (51)	88 (67)	80 (93)	74 (84)	271 (74)	186 (69)	148 (55)
Women	27 (19)	16 (59)	10 (37)	24 (26)	16 (67)	12 (50)	43 (33)	37 (86)	33 (77)	94 (26)	69 (73)	55 (59)
M.D.	97 (69)	42 (43)	24 (25)	47 (50)	27 (57)	14 (30)	33 (25)	28 (85)	25 (76)	177 (49)	97 (55)	63 (36)
Men	80 (82)	35 (83)	21 (88)	32 (68)	18 (67)	9 (64)	24 (73	21 (75)	19 (76)	136 (77)	74 (76)	49 (78)
Women	17 (18)	7 (17)	3 (12)	15 (32)	9 (33)	5 (36)	9 (27)	7 (25)	6 (24)	41 (23)	23 (24)	14 (22)
M.D./Ph.D.	5 (4)	5 (100)	3 (60)	11 (12)	10 (91)	7 (64)	18 (14)	17 (94)	15 (83)	34 (9)	32 (94)	25 (74)
Men	3 (60)	3 (60)	2 (67)	9 (82)	8 (80)	5 (71)	10 (56)	10 (59)	9 (60)	22 (65)	21 (66)	16 (64)
Women	2 (40)	2 (40)	1 (33)	2 (18)	2 (20)	2 (29)	8 (44)	7 (41)	6 (40)	12 (35)	11 (34)	9 (36)
Ph.D.	38 (27)	24 (63)	21 (55)	36 (38)	30 (83)	27 (75)	80 (61)	72 (90)	67 (84)	154 (42)	126 (82)	115 (75)
Men	30 (79)	17 (71)	15 (71)	29 (81)	25 (83)	22 (81)	54 (68)	49 (68)	46 (69)	113 (73)	91 (72)	83 (72)
Women	8 (21)	7 (29)	6 (29)	7 (19)	5 (17)	5 (19)	26 (32)	23 (32)	21 (31)	41 (27)	35 (28)	32 (28)

Shown are the number of respondents who report spending 25% or more, or 50% or more of their time in research. The people with 50% or more time in research are a subgroup of the people reporting 25% or more time in research.

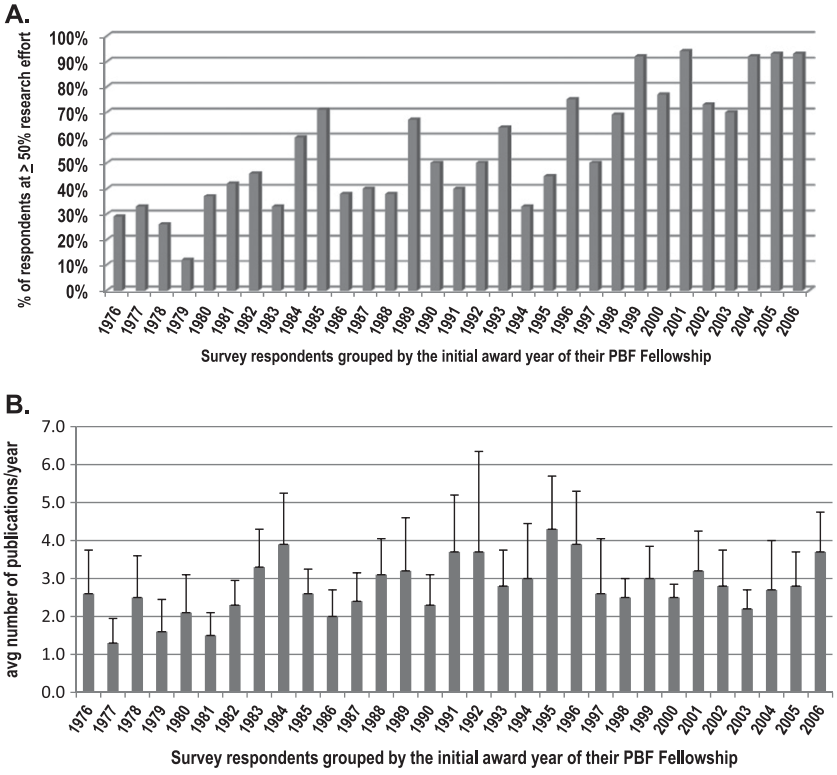

Figure 1. (*A*) Percentage of survey respondents (n = 365) currently in research at 50% or greater effort, grouped by Fellow Class (designated by the initial award year of the Parker B. Francis [PBF] Fellowship). (*B*) Average number of peer-reviewed publications per year published by survey respondents (designated by the initial award year of the PBF Fellowship). Error bars show standard deviations.

The M.D./Ph.D. awardees had the highest productivity, with 3.5 peer-reviewed publications per year and 2.3 publications per year as first, second, or last author. The men reported slightly higher publication productivity than the women (Table 3).

The 365 respondents from 1976 to 2006 reported 15,678 peer-reviewed publications, of which 1,875 appeared in high-impact scientific journals (Figures 2A and 2B). The highest number of high-impact publications appeared in the *American Journal of Respiratory and Critical Care Medicine*. The PBF Fellows also have published papers in other high-impact journals, including the *New England Journal of Medicine*, *JAMA*, *Science*, and the *Nature* series of journals. A PubMed search for a subset of survey respondents, nonrespondents, and nonsurveyed fellows validated the self-reported publications and suggested that survey nonrespondents and nonsurveyed fellows had fewer publications than respondents (*see* online supplement). Comparable productivity information about awardees of other organizations is not readily available.

Productivity—Research Funding

The 365 PBF respondents have received more than $1.8 billion in direct research funding since the start of their PBF Fellowships (Tables 4 and E4). Of the 211 M.D. and M.D./Ph.D. respondents, 28% reported receiving an NIH K08 or K23 award (27% of the M.D.s vs. 32% of the M.D./Ph.D.s). Forty-four percent of all respondents reported having been the principal investigator on one or more NIH R01 awards: 38% of the M.D. respondents, 47% of the M.D./Ph.D. respondents, and 50% of the Ph.D. respondents. These results compare favorably with data for NIH K awardees who are farther along in their careers at the time of the award (*see* online supplement). On average, the M.D. scientists have received almost 50% more funding than the Ph.D. scientists ($5.9 million/fellow vs. $4.1 million/fellow). Some of the 365 respondents also report having served as the director of an NIH Program Project or other large multiproject grant: 10% of the M.D. respondents, 9% of the M.D./Ph.D. respondents, and 5% of the Ph.D. respondents. Female respondents have received fewer grants in all categories. Of the M.D. and M.D./Ph.D. awardees, 29% of the men and 25% of the women received NIH K Awards and 42% of the men and 32% of the women had received an NIH R01. Of the Ph.D. awardees, 52% of men and 44% of women have been the principal investigator on an NIH R01. Despite the narrow gender differences in awards received, there were consistent differences in the total amount of funding received by men and women, regardless of their degree training (Tables 4 and E4). In each degree category, the men received more funding than the women.

Research funding received by each PBF Fellow Class, with the corresponding investment by the Francis Family Foundation and the research funding return on investment (multiplier) is shown in Table E5. The research funding multiplier ranged from 278 for the initial group of fellows entering in 1976 to 5 for fellows entering in 2006. The overall research return on investment multiplier from 1976 to 2006 was 63, meaning that during their careers, the PBF awardees received $63 in direct research funding for every dollar invested by the Francis Family Foundation during their fellowship.

Productivity—Other Measures

Many of the PBF Fellows have become leaders in medical care and research. Although leadership is difficult to measure, we identified leaders as awardees who held leadership roles in academia, health care, the pharmaceutical industry, or the NIH. By these criteria, 85 (23%) of the 365 respondents have had important leadership roles. As expected, the number of leaders increased with time since fellowship (Tables E4 and E6). Since the 1987 to 1996 decade, an identical proportion of men and women awardees have held leadership roles (29% of men vs. 29% of women); however, from 1976 to 1986, 41% of the

TABLE 2. TYPES AND AREAS OF RESEARCH FOR 255 SURVEY RESPONDENTS REPORTING ⩾ 25% EFFORT IN RESEARCH

Area of Research	All (*N = 255*)	M.D. (*n = 97*)	M.D./Ph.D. (*n = 32*)	Ph.D. (*n = 126*)	Men (*n = 186*)	Women (*n = 69*)
Basic	149 (59)	34 (35)	15 (47)	100 (79)	104 (56)	45 (65)
Clinical	29 (11)	23 (24)	4 (12)	2 (2)	23 (12)	6 (9)
Translational	77 (30)	40 (41)	13 (41)	24 (19)	59 (32)	18 (26)
Areas of research						
Allergy	5 (2)	3 (3)	2 (6)	0	2 (1)	3 (4)
Asthma	2 (1)	2 (2)	0	0	1 (1)	1 (1)
Behavioral science	3 (1)	2 (2)	1 (3)	0	3 (2)	0
Cancer	7 (3)	3 (3)	0	4 (3)	7 (4)	0
Clinical problems	12 (5)	7 (7)	3 (9)	2 (2)	9 (5)	3 (4)
Critical care	14 (5)	10 (10)	1 (3)	3 (2)	11 (6)	3 (4)
Environmental and occupational health	2 (1)	1 (1)	0	1 (1)	2 (1)	0
Genetics	14 (5)	5 (5)	3 (9)	6 (5)	9 (5)	5 (7)
Immunology	29 (11)	11 (11)	4 (13)	14 (11)	22 (12)	7 (10)
Inflammation	20 (8)	7 (7)	3 (9)	10 (8)	11 (6)	9 (13)
Microbiology	2 (1)	0	0	2 (2)	1 (1)	1 (1)
Pediatrics	4 (2)	4 (4)	0	0	2 (1)	2 (3)
Pulmonary circulation	22 (9)	8 (8)	3 (9)	11 (9)	14 (8)	8 (12)
Pulmonary infections	8 (3)	3 (3)	1 (3)	4 (3)	6 (3)	2 (3)
Respiratory cell and molecular biology	57 (22)	18 (18)	9 (28)	30 (24)	41 (22)	16 (23)
Respiratory neurobiology	24 (9)	4 (4)	0	20 (16)	22 (12)	2 (3)
Respiratory physiology	18 (7)	4 (4)	1 (3)	13 (10)	15 (8)	3 (4)
Respiratory structure	4 (2)	2 (2)	0	2 (2)	3 (2)	1 (1)
Sleep	3 (1)	1 (1)	0	2 (2)	2 (1)	1 (1)
Tuberculosis	4 (2)	2 (2)	0	2 (2)	2 (1)	2 (3)
Transplantation	1 (< 1)	0	1 (3)	0	1 (< 1)	0

Data are presented as n (%).

men have had leadership roles versus 30% of the women. Importantly, some of the nonrespondents also have had significant leadership roles, including serving as medical school deans, university presidents, presidents of major professional societies, and CEOs of pharmaceutical or biotechnology companies. Thirty-six of the respondents have served as mentors of PBF Fellows, and the 365 survey respondents have been awarded a total of 212 patents (Table E4).

Comparisons by Gender

As noted, the PBF Fellows have been predominantly male (75% of the PBF Fellows sent surveys and 74% of respondents). The proportion of women has increased from 18 to 33% from 1976 to 2006 (Table 1). The proportions of women and men did not differ for degrees held, types of research, or retention in research; however, differences in productivity were noted for women versus men in each of the three fellowship decades (Tables 5 and E4). Of the survey respondents, the women have received less grant support, slightly fewer R01 awards, fewer patents, and fewer have become leaders (Table 5). Of note, a similar proportion of men and women M.D.s have become leaders (35% men vs. 34% women, Table E4), but there was a major difference in the proportion of men and women Ph.D. scientists who have become leaders (15% men vs. 2% women). For the more recent group of past fellows (1997–2006), disparities between men and women in research funding and NIH R01 awards were smaller.

DISCUSSION

The purpose of this study was to provide comprehensive data about the effectiveness of the PBF Fellowship Program in promoting training and research in pulmonary diseases. Because the PBF Program has trained more than 750 fellows, the results provide an in-depth look at markers of outcome in a large number of people who have embarked on academic careers in pulmonary research. The results show that the PBF Program has been remarkably successful in supporting individuals who have spent a significant portion of their careers in research and have made important contributions to science in the broadly defined fields of pulmonary, critical care, and sleep medicine. The PBF awardees have published more than 15,000 scientific papers, have generated more than $1.8 billion in direct research dollars during their careers, and have become international leaders in pulmonary medicine and research. The direct cost of supporting these fellows has been approximately $30 million, resulting in a multiplier of more than 60-fold for career research dollars received versus initial fellowship costs.

The proportions of men and women who continue to devote significant amounts of time to research were very similar, whether they were M.D. or Ph.D. scientists. Notably, the proportion of M.D. awardees has declined from 69 to 25% over the life of the program, whereas the proportion of Ph.D. scientists has increased. The reason for this trend is not immediately apparent, because the goals of the program have not changed, and the grant review committees have consistently included leading M.D. and Ph.D. scientists. We have no evidence of a systematic bias against M.D. applicants in the PBF Fellowship Program; rather it is more likely that other factors affect the decisions that M.D. trainees make about research careers, including preexisting debt, length of time in training, and perceptions about earning potential and career satisfaction (4). In a recent survey of fellows training in pulmonary and critical care medicine, only 22% expressed interest in a research career, even though the number of trainees doing research in their third year increased from 35% in 2006 to 48% in 2009 (1). Although we lack precise data about the composition of the PBF applicant pools in prior years, in 2007 and 2008, Ph.D. applicants outnumbered M.D. applicants (64 vs. 29%, respectively), despite the fact that the overall number of applicants has remained steady at 50 to 60/yr. The 2007 and 2008 PBF awardees mirrored this M.D./Ph.D. distribution in the applicant pool (60% Ph.D. awardees vs. 30% M.D. awardees). This trend is consistent with national concerns about the decline in the number of physician/scientists in academic medicine (5).

TABLE 3. PUBLICATION PRODUCTIVITY BY DEGREES HELD AND GENDER FOR SURVEY RESPONDENTS (N = 365)

	Peer-Reviewed Publications, No./yr (SD)	Peer-Reviewed Publications as 1st, 2nd, or Last Author, No./yr (SD)
M.D. (n = 177)		
Mean	2.5 (2.6)	1.6 (1.8)
Median	1.8	1.2
M.D./Ph.D. (n = 34)		
Mean	3.5 (2.3)	2.3 (1.4)
Median	3.0	2.1
Ph.D. (n = 154)		
Mean	2.8 (1.7)	1.9 (1.2)
Median	2.4	1.7
Men (n = 271)		
Mean	2.9 (2.4)	1.9 (1.7)
Median	2.3	1.5
Women (n = 94)		
Mean	2.3 (1.5)	1.6 (1.0)
Median	2.0	1.4
Total (n = 365)		
Mean	2.7 (2.2)	1.8 (1.5)
Median	2.2	1.5

An important unanswered question is whether programs like the PBF Fellowship Program should emphasize training of physician scientists, or whether the program should continue to support what are perceived to be the most promising applications, regardless of the academic degrees of the applicants.

Some important distinctions can be made according to the type of educational degree held by the fellows. As expected, the percentage of time that awardees spend in research declines as they get farther from their fellowships; however, a high percentage of Ph.D. scientists report devoting more than 50% of time to research throughout their careers. In contrast, the proportion of M.D. awardees who continued to have significant time in research has declined over time. This might reflect the fact that the M.D. awardees have both clinical and research aspects to their careers, whereas the Ph.D. scientists have a heavier emphasis on laboratory investigation. A higher proportion of awardees with Ph.D. degrees reported receiving an NIH R01 award (50% for Ph.D. and 47% for M.D./Ph.D.) as compared with M.D. awardees (38%) (Table 4). Because the rate of R01 funding increases with time in research careers, these data are consistent with the higher percentage of time in research reported by the Ph.D. awardees (6).

The productivity of the PBF awardees in terms of publications and research funding has been remarkable. On average, the PBF awardees have published 2.7 peer-reviewed papers per year, with 1.8 peer-reviewed papers per year as first, second, or last author. A prior survey by Weinert and colleagues of 254 M.D. faculty (7% instructors or "other" entry-level positions, 38% assistant professors, 3% associate professors) in adult and pediatric pulmonary and critical care medicine showed an average of 1.5 publications per year per faculty member, of which half were peer-reviewed research papers (0.7/yr) (4). The average for the research-intensive respondents was 1.7/yr (4). The faculty respondents in that survey reported an average of 0.4 publications per year as first, second, or last author. Although exact comparisons are difficult, the 39 M.D. and M.D./Ph.D. PBF survey respondents who began in 2000 or later correspond most closely to the broader group of faculty in the survey by Weinert and colleagues (4). These recent PBF awardees report an average of 2.6 peer-reviewed publications per year and 1.7 peer-reviewed publications per year as first, second, or last author since beginning fellowship. The survey nonrespondents and the PBF Fellows for whom we had no contact information have lower publication productivity. In a PubMed search for 20% of each of these groups we found that productivity was similar to that reported in the Weinert and colleagues study (*see* online supplement), supporting the conclusion that the PBF awardees have a better track record than the broader group of faculty members in adult and pediatric pulmonary/critical care programs (4).

The productivity of women PBF Fellows with regard to publications, research funding, patents, and leadership positions has been somewhat lower than that of the male fellows. This is consistent with data from other studies, showing that success rates for grant funding and advancement of women to leadership positions in academic medicine fall behind data for men (6–8). Jagsi and colleagues reported that 31.4% of K08 awardees were women and 43.7% were men (6). The rate of R01 award success at 5 years post K award was 22.7% overall, 18.8% among women, and 24.8% among men, whereas by 10 years the rate was 42.3% overall, 36.2% among women, and 45.6% among men. Female grant recipients received on average approximately 80 cents for each dollar received by male grant recipients (6). Similarly, fewer women have achieved leadership positions in academic medical centers. Although the reasons for the differences between academic success rates of men and women are not certain, family life and other competing issues for women have been cited as important factors (7, 8).

The PBF Fellows have an excellent record of retention in research, significantly greater than that of the pool of M.D.s and Ph.D.s who have completed fellowships in medical research. Of the 365 respondents, 255 (70%) report spending 25% or more time in research (Table 1); therefore, the maximum attrition rate of the respondents from research careers would be 30% over the survey period. For comparison, a study by the Association of American Medical Colleges (AAMC) reported that the 10-yr retention rate

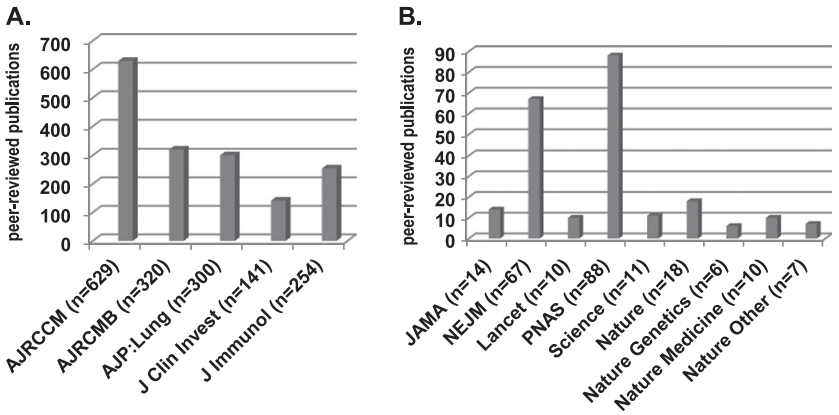

Figure 2. Peer-reviewed publications in selected high-impact journals published by 365 survey respondents (total publications = 1,875). The impact factor for all journals in *B* exceeds 27, with the exception of *Proceedings of the National Academy of Sciences* (PNAS, impact factor = 9.4). AJRCCM = American Journal of Respiratory and Critical Care Medicine; AJRCMB = American Journal of Respiratory Cell and Molecular Biology; AJP: Lung = American Journal of Physiology: Lung Cellular and Molecular Physiology; J Clin Invest = Journal of Clinical Investigation; J Immunol = Journal of Immunology; JAMA = Journal of the American Medical Association; NEJM = New England Journal of Medicine.

TABLE 4. RESEARCH FUNDING OF SURVEY RESPONDENTS (N = 365)

	Respondents Who Received NIH K Awards,* n (%)	Respondents Who Received NIH R01 Awards, n (%)	Respondents Who Received NIH PPG Awards, n (%)	Direct Research Dollars Since PBF Fellowship, Millions of Dollars (Average/Fellow)
M.D. (n = 177)	48 (27)	67 (38)	18 (10)	1,048.8 (5.9)
Men (n = 136)	38 (28)	53 (39)	16 (12)	907.9 (6.7)
Women (n = 41)	10 (24)	14 (34)	2 (5)	140.9 (3.4)
M.D./Ph.D. (n = 34)	11 (32)	16 (47)	3 (9)	200.7 (5.9)
Men (n = 22)	8 (36)	13 (59)	3 (14)	148.6 (6.8)
Women (n = 12)	3 (25)	3 (25)	0	52.1 (4.3)
Ph.D. (n = 154)	N/A	77 (50)	7 (5)	626.7 (4.1)
Men (n = 113)	N/A	59 (52)	4 (4)	487.7 (4.3)
Women (n = 41)	N/A	18 (44)	3 (7)	139.0 (3.4)
Total (n = 365)	59 (28†)	160 (44)	28 (8)	1,876.0 (5.1)

Definition of abbreviations: NIH = National Institutes of Health; PPG = Program Project Grant.

* NIH K08 and/or K23 awards.

† 59 of 211 M.D. and M.D./Ph.D. respondents.

between 1981 and 1997 for faculty in the AAMC's national database was 62%, although the data do not provide insight about how many of these faculty continued to have research careers (9). The percentage of AAMC faculty leaving academic medicine ranged from 34 to 44%, depending on the primary degree (M.D. or Ph.D.) and specialty. For first-time AAMC assistant professors, the retention rate in academic medicine was 57% over 10 years. This group corresponds most closely to individuals supported by the Parker B. Francis Foundation. From this national perspective, the PBF Program has been able to identify and support individuals who have a high likelihood of remaining in academic research careers. The retention rates for men and women who were first-time assistant professors did not differ in either the AAMC or the PBF data (57 vs. 55% for AAMC men and women, respectively; 69 vs. 73% for PBF men and women, respectively), but the overall retention rates were higher for PBF fellows.

The pipeline for new investigators in pulmonary research is facing serious constraints (1). Although some data suggested that the decline in physician scientists in the 1980s and 1990s had stabilized by 2005, perhaps due to the NIH loan repayment program (established in 2002) and doubling of the NIH research budget (1998–2003) (10), the recent outlook has become more pessimistic. NIH paylines have declined significantly, philanthropic funding is decreasing because of the current economic climate, and the amount of debt that M.D. and Ph.D. scientists acquire during training is increasing. Private practice and industry salaries are significantly higher than university salaries, providing a competitive drain on the number of individuals who can afford to begin and remain in academic research careers. Funding opportunities like the PBF Fellowship Program provide important support at a key transition point in career development, creating a bridge between postdoctoral training and the first academic appointment. With continuing pressure to justify the value of public and philanthropic investment, concrete information from surveys such as this provides clear evidence that programs like the PBF Fellowship are successful in producing long-term researchers and leaders in the field. By fostering early scientific career development that emphasizes

TABLE 5. GENDER COMPARISON OF RESEARCH PRODUCTIVITY FOR SURVEY RESPONDENTS (N = 365)

	1976–1986		1987–1996		1997–2006		All Years: 1976–2006	
	n = 140		n = 94		n = 131		N = 365	
	Men 113 (81%)	Women 27 (19%)	Men 70 (74%)	Women 24 (26%)	Men 88 (67%)	Women 43 (33%)	Men 271 (74%)	Women 94 (26%)
Peer-reviewed publications/yr, mean (SD)	2.3 (2.0)	2.0 (1.3)	3.5 (3.2)	2.7 (1.7)	3.1 (2.0)	2.3 (1.5)	2.9 (2.4)	2.3 (1.5)
Publications/yr as 1st, 2nd, or last author, mean (SD)	1.6 (1.3)	1.5 (1.0)	2.3 (2.3)	1.7 (1.3)	2.0 (1.3)	1.5 (0.9)	1.9 (1.7)	1.6 (1.0)
Direct research money since PBF award, millions of dollars	881.9 (7.8/fellow)	152.5 (5.6/fellow)	392.9 (5.6/fellow)	109.7 (4.6/fellow)	269.4 (3.1/fellow)	69.8 (1.6/fellow)	1,544 (5.7/fellow)	332.0 (3.5/fellow)
Respondents reporting NIH R01 awards, n (%)	44 (39)	12 (44)	45 (64)	12 (50)	36 (41)	11 (26)	125 (46)	35 (37)
Respondents reporting NIH PPGs n (%)	14 (12)	2 (7)	7 (10)	2 (8)	2 (2)	1 (2)	23 (8)	5 (5)
Patents held, no.	71 (0.6/fellow)	3 (0.1/fellow)	67 (1.0/fellow)	12 (0.5/fellow)	41 (0.5/fellow)	18 (0.4/fellow)	179 (0.7/fellow)	33 (0.4/fellow)
Designated as leaders, n (%)	46 (41)	8 (30)	20 (29)	7 (29)	3 (3)	1 (2)	69 (25)	16 (17)

Definition of abbreviations: NIH = National Institutes of Health; PBF = Parker B. Francis; PPG = Program Project Grant.

strong mentoring, a productive scientific environment, and a novel research training proposal, the PBF Program has become a model for supporting career development and scientific advances in pulmonary and critical care medicine. The PBF Program provides a valuable guide for similar programs designed to serve patients by supporting the scientific workforce in all areas of medicine.

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