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Centralized Oversight of Physician–Scientist Faculty Development at Vanderbilt: Early Outcomes

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Abstract

Purpose—In 2000, faced with a national concern over the decreasing number of physician–scientists, Vanderbilt School of Medicine established the institutionally funded Vanderbilt Physician–Scientist Development (VPSD) program to provide centralized oversight and financial support for physician–scientist career development. In 2002, Vanderbilt developed the National Institutes of Health (NIH)-funded Vanderbilt Clinical Research Scholars (VCRS) program using a similar model of centralized oversight. The authors evaluate the impact of the VPSD and VCRS programs on early career outcomes of physician–scientists.

Method—Physician–scientists who entered the VPSD or VCRS programs from 2000 through 2006 were compared with Vanderbilt physician–scientists who received NIH career development funding during the same period without participating in the VPSD or VCRS programs.

Results—Seventy-five percent of VPSD and 60% of VCRS participants achieved individual career award funding at a younger age than the comparison cohort. This shift to career development award funding at a younger age among VPSD and VCRS scholars was accompanied by a 2.6-fold increase in the number of new K awards funded and a rate of growth in K-award dollars at Vanderbilt that outpaced the national rate of growth in K-award funding.

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Conclusions—Analysis of the early outcomes of the VPSD and VCRS programs suggests that centralized oversight can catalyze growth in the number of funded physician–scientists at an institution. Investment in this model of career development for physician–scientists may have had an additive effect on the recruitment and retention of talented trainees and junior faculty.

Advances in biomedical science today provide an unprecedented opportunity to improve human health. The translation of scientific and technological advances into better health requires the training of physician–scientists who are equipped with the scientific and clinical skills to make discoveries at the bench, at the bedside, and in the general population. Yet, increased personal debt after graduation from medical school, financial incentives to practice medicine, and the competing time demands of family, practice, and administrative duties all conspire to dissuade physicians from pursuing careers in academia.[1–5] At the same time, decreasing clinical revenues at academic health centers and a declining rate of growth of the National Institutes of Health (NIH) budget have limited the intramural and extramural resources available to physician–scientists and have lengthened the time to receive independent funding. As of 2006, the funding rate for new R01 grants from the NIH was 16.6%, and the mean age of physician–scientists who achieve independent funding has increased to 44.2 years for MDs and 42.3 years for MD/PhDs.[6] This increased age at which investigators are awarded independent funding may adversely effect the recruitment of physician–scientists to academic research careers.

In 2000, faced with a declining number of physician–scientists among its junior faculty, Vanderbilt School of Medicine established the Vanderbilt Physician–Scientist Development (VPSD) program to promote the career development of physician–scientists. The VPSD is an institutionally funded program that provides up to two years of salary support to new assistant professor physician–scientists who spend 75% of their time conducting research under the direct supervision of an established Vanderbilt investigator. The program requires awardees to work within the research space and program of the mentor, ensuring a close supervisory relationship while eliminating the need for the awardees to obtain their own supplies or equipment. In addition, the candidate's department chair provides $25,000 support for supplies to the mentor and commits to provide space and start-up funds for the scholar as he or she emerges from the VPSD program.

Candidates are interviewed and selected on a competitive basis by an advisory committee of Vanderbilt Medical Center faculty representing both basic science and clinical departments. One purpose of the interview is to help the candidate select an appropriate mentor, but there is not a designated pool of potential mentors. The committee selects VPSD scholars on the basis of the training credentials of the applicant, the quality of the chosen mentor and his or her research environment, and the quality of a research proposal submitted by the applicant. Interdepartmental mentoring relationships are encouraged. VPSD scholars are required to submit an application for external individual career development funding within the first year of the program.

A key feature of the VPSD program is its centralized structure and oversight. Department chairs and research mentors, as well as participants, are held accountable for the adequacy of protected time and the quality of the mentorship. The progress of VPSD scholars is monitored at six-month intervals by the associate dean for clinical and translational scientist development and the advisory committee.

In 2002, Vanderbilt was awarded funding for the Vanderbilt Clinical Research Scholars (VCRS) program, a National Center for Research Resources-funded K12 program, to support the career development of physician–scientists engaged in clinical and translational research. Unlike VPSD scholars, VCRS participants may be selected in the last year of

fellowship before appointment to the faculty, must apply for external individual career development funding within two years, and may receive up to three years of program funding. Like the internally funded VPSD, however, the VCRS program was designed to provide centralized oversight of mentorship. Thus, individuals in the VPSD and VCRS and their mentors complete an agreement at the start of their training and a written progress report every six months. Members of the VPSD and VCRS participate in the Annual Visiting Scholar Day during which they meet in small groups with a nationally prominent physician–scientist. They present their research at an annual retreat and participate in a monthly career development seminar series that covers topics such as promotion and tenure, managing a research group, and time management.

To measure the impact of these centralized career development programs, we compared early career outcomes for physician–scientists who entered the VPSD or VCRS programs from 2000 through 2006 with those for Vanderbilt physician–scientists who received NIH career development funding during the same period without participating in the VPSD or VCRS.

Method

Data collection

Data were collected for VPSD participants from 2000 to 2006 and for VCRS participants from 2002 (the starting year of the VCRS program) to 2006. The comparison cohort consisted of all physician–scientists who did not participate in these programs and who obtained mentored K-award funding from 2000 to 2006. A physician–scientist was defined as an investigator holding either an MD degree or holding MD/PhD degrees. For VPSD and VCRS scholars, the entry year was defined as the year the scholar was selected to the program. For the comparison cohort, the entry year was defined as the year of K-award funding. Race was self-defined by 92.7% of participants in the VPSD and 100% of participants in the VCRS. Data on race were not available for the comparison cohort.

Information regarding funding from the NIH, other federal agencies, foundations, and industry received through September 30, 2007 was obtained from the eRA Commons Computer Retrieval of Information on Scientific Projects, the NIH Division of Information Sciences, the Vanderbilt Office of Grants and Contracts Management, and the Nashville Veterans Affairs (VA) Office of Research. Government career development awards tracked were the NIH Mentored Research Career Awards (primarily K08 and K23, but also K01, K07, K22, K25, and K99), R03 or R21 awards, and the Veterans Affairs career development award. Competing research awards other than R03, R15, and R21 were considered independent funding. Approval was obtained from the Vanderbilt University institutional review board for this program evaluation (IRB #071313).

Statistical analysis

Information regarding grant funding and publications was collected through September 30, 2007. Where indicated, data are presented as means and 95% confidence intervals (95% CI). Continuous variables were compared among groups using a one-way analysis of variance, followed by a Dunnett T3 test. Categorical variables were assessed using a chi-square test. Cox proportional-hazard regression analysis was used to assess factors associated with “time to conversion” from K-award funding to R-award funding. The time to conversion was calculated as the date of R-award funding minus the date of K-award funding for those who achieved R-award funding. For others, it was calculated as September 30, 2007 (the final date of the analysis period) minus the date of K-award funding.

Results

Characteristics of physician–scientists

Physician–scientists entering the VPSD and VCRS programs were significantly younger than physician–scientists in the comparison cohort of K awardees (see Table 1). While approximately one fourth of the physician–scientists in the VPSD and the comparison cohort were women and one third were MD/PhDs, an increased proportion of VCRS scholars were women, and none were MD/PhDs. Approximately 7% of the VPSD and VCRS scholars described themselves as members of underrepresented minority groups. Approximately two thirds of the physician–scientists who participated in the VPSD conducted basic science research.

Success in obtaining career development funding

As of September 2007, 75% (41) of the VPSD scholars had achieved government or foundation career development funding, in a mean time of 1.8 years after entry into the program (see Table 1). Fifty-two percent have been awarded an NIH individual K award (K01, K07, K08, K22, or K23), and/or R03 or R21 funding. Sixty percent of VCRS scholars had received career development funding from the NIH or private foundations in a mean of 2.4 years (see Table 1). Participants in the VPSD and VCRS programs achieved NIH career development funding at a significantly younger age than did those in the comparison cohort. There was no association of gender or the type of degree with the likelihood of receiving NIH career development funding. The distribution of men and women was the same among all K08- and K23-funded physician–scientists: 80% (45) men and 20% (11) women. Fifty percent of R03, R21, and other K awardees and 33% of VA career development awardees were women (six and two women, respectively). Sixty percent (3) of minority participants in the VPSD and VCRS programs achieved NIH career development funding.

Success in obtaining independent funding

Nationally, from 2000 through 2006, the average time for conversion from either a K08 or K23 award to an independent award (R01) was 5.6 years (Office of Extramural Research, NIH, Summary of K08 and K23 Recipients Who Received R01 Awards, fiscal years 2000 – 2006. January 31, 2007, unpublished report). Historically, during the past 15 years at Vanderbilt, 43% (40) of physician–scientist K awardees achieved independent funding, in a mean time of 3.9 ± 1.7 years. With an average follow-up time of 4.7 years, 42% (14) of physician–scientists in the individual K-award comparison group obtained independent funding from 2000 to the present. The follow-up since K award was shorter for VPSD and VCRS participants. Seven VPSD scholars (four men and three women) achieved independent funding during the analysis period. Four of the VPSD scholars received an R01 as their first NIH award. Hence, to date, the interval from K-award funding to independent funding was significantly shorter for VPSD scholars than for the comparison group (see Table 1). This is reflected in a nonsignificant trend toward younger age at independent funding. After controlling for year of independent funding and prior K award, however, age at independent funding was lower for VPSD scholars than for the comparison group ($P = .03$). No VCRS scholar had achieved independent funding after an average follow-up of 1.4 years since award funding.

Because the follow-up since K-award funding was significantly shorter for VPSD or VCRS participants than for the comparison group, we used a survival analysis to compare rates of conversion from K to independent funding (see Figure 1). There were no significant differences in time from career development funding to achievement of independent funding between the VPSD and comparison group over the period of follow-up. Furthermore, there was no effect of gender, race, or degree on time to conversion.

Productivity as measured by publications

Overall, scholars in the VPSD program published fewer articles per year than those in the K-award comparison group (see Table 1). When calculated per year since career development award funding, the difference in publication rates between scholars in the VPSD program and those in the K-award comparison group was no longer statistically significant, whereas VCRS scholars published significantly more articles per year. Among all groups combined, women tended to publish fewer articles per year ($P = .05$), but the number of publications per year since career development award funding was similar for men and women ($P = .13$). Individuals with MD/PhD degrees published fewer articles per year than did those with MD degrees ($P = .04$), but the number of publications per year since receiving career development award funding was not significantly different ($P = .08$).

Impact on the institution

In the eight years before the start of the VSPD program, a mean of 3.0 (95% CI, 1.6–4.3) new NIH career development grants were awarded to Vanderbilt physician–scientists each year. In the first four years of the VPSD program, this number more than doubled to 7.0 (95% CI, 5.7–8.3, $P = .001$ versus the annual number of career development awards in the preceding eight years), and, from 2004 through September 30, 2007, the number of career development grants awarded to Vanderbilt physician–scientists increased an additional 57% to 11.0 (7.6–14.4) per year ($P = .003$ versus the prior four years, see Figure 2). From fiscal year 2000 to fiscal year 2006, the Vanderbilt School of Medicine invested $3.2 million in the VPSD program. As of September 30, 2007, VPSD scholars had been awarded $36.2 million in funding (see Figure 3). Figure 4 shows the growth in all K-award funding at Vanderbilt during the period from 2000 to 2007. Total K-award funding increased 220% from 2000 through 2006. K08 funding grew 93%, and K23 funding grew 241%. By comparison, total NIH dollars awarded nationally to K mechanisms increased 88% over the same period. Nationally, K08 funding rose 13% and K23 funding grew 246% from 2000 to 2006.[7]

Discussion

Since 2000, Vanderbilt has invested in the career development of junior faculty physician–scientists through its VPSD program. The program also served as a model for the NIH-funded VCRS program, promoting the career development of physician–scientists training in clinical and translational research. Analysis of the early outcomes of these two efforts suggests that centralized oversight of mentorship can catalyze a growth in the number of funded physician–scientists at an institution. Among participants in the VPSD and VCRS programs, 75% (41) and 60% (9), respectively, have achieved individual career award funding in a mean of 1.8 to 2.4 years after program entry and at a younger age than did their counterparts who did not participate in these programs. This shift to a younger age of career development award funding among VPSD and VCRS scholars was accompanied by a 2.6-fold increase in the number of new K awards funded and a rate of growth in K-award dollars at Vanderbilt that outpaced the national rate of growth in K-award funding.

The two career development programs described here were supported by a combination of institutional investment and NIH funding. Combined institutional and NIH investment in career development holds many advantages, including decreased vulnerability to declines in either institutional revenue or NIH funding. Although the cost of investing in career development programs may be daunting for institutions, the data on funding outcomes for participants in the VPSD program support such an investment. During a seven-year period, Vanderbilt realized an 11-fold return on investment in the VPSD program, as measured by funding awarded to VPSD participants.

The short period of follow-up after career development funding does not permit us to assess the success of all participants in the two intensively mentored career development VPSD and VCRS programs in obtaining independent NIH funding. Based on survival analysis, the rate of conversion from K-award-equivalent grants to R-award-equivalent grants seems to be similar for VPSD participants who obtained individual career development funding and for physician–scientists in the comparison cohort. After controlling for funding year and prior K-award funding, participants in the VPSD have, thus far, obtained independent funding at an earlier age. Because of the short follow-up, however, only a small number of VPSD participants and no VCRS participants have achieved independent funding, so it is premature to conclude that this trend toward receiving support at a younger age will continue.

Analyzing the outcomes of career development programs poses many challenges in addition to the time required to observe outcomes. The current analysis focused largely on NIH funding and may have underestimated success. Program assignment was not randomized. VPSD and VCRS participants were selected competitively, which may have introduced a bias favoring these programs. Conversely, selecting a comparison cohort of individuals who achieved K- award funding without the benefit of an intensive career development program could have introduced a bias in favor of the comparison group based on “survival of the fittest.” Although it may have been possible to use historical controls, this raises issues associated with changes in environmental factors outside the institution, such as shifting funding lines. Finally, it is not possible to distinguish the impact of investing in career development on the recruitment and retention of talented trainees and junior faculty from the impact of the mentoring/oversight program per se.

This analysis also highlights challenges in promoting the career development of physician–scientists. Only 7% of all participants in the VPSD and VCRS programs combined described themselves as members of underrepresented minorities. This figure is similar to the percentage of underrepresented minorities among faculty in academic medicine, but it is lower than the percentage of underrepresented minorities among medical students and in the general population,[8,9] despite proactive recruitment of underrepresented minority faculty to Vanderbilt and to the VPSD and VCRS programs during the period of study. Importantly, minority participants of the VPSD and VCRS competed successfully for career development funding. Given the increased proportion of medical students from underrepresented minority groups, the data suggest that medical educators must refine the approaches used to attract minority students to become physician–scientists, thus increasing the diversity of those who are prepared to make discoveries and assume leadership roles in academic medicine.

The percentage of women in the VPSD program and the comparison cohort, but not the VCRS program, was also lower than the percentage of medical students and residents who are women. Women currently represent 49% of all medical students.[9] Therefore, the ability of academic health centers to sustain the pipeline of physician–scientists will depend on their ability to attract and retain women investigators.[10] The reason for a greater representation of women in the VCRS program is not clear, although perhaps women are more likely to become involved in clinical and translational research than in basic research. However, there was no difference in the proportion of men and women achieving K08 versus K23 funding. Across groups, women tended to write fewer articles than men. Previous studies have reported differences between men and women in publication rates and in authorship of articles published in major journals.[11,12] Although some have attributed decreased rates of publishing among women to the conflicting time demands of family responsibilities or perceived biases, the reason for this gender difference in publication rate requires further investigation. Importantly, men and women in the VPSD and VCRS

programs competed with equal success for career development funding, and publication rates were similar among men and women after career development funding.

A Worthwhile Investment

Improvements in human health depend to an important degree on the availability of physician–scientists with the scientific knowledge and clinical skills to make discoveries and translate them into effective therapies and practice. In recent years, concern over the declining number of physician–scientists has spurred new initiatives to fund the development of this human resource. Optimizing the outcome of these initiatives requires both oversight and the development of metrics of success. Our analysis of the VPSD and VCRS programs illustrates one institution's experience in investing in, developing, and evaluating a centralized infrastructure to support the career development of physician–scientists. The analysis illustrates some of the methodological challenges of tracking the outcomes of a career development program, challenges related to comparison groups, sample size, and follow-up duration. The analysis suggests, however, that the use of simple metrics can highlight both early successes and areas needing attention. Most important, the analysis indicates that investment in a centralized infrastructure for the mentoring and development of physician–scientists can yield rapid growth in a cadre of physician–scientists who achieve career development funding at a younger age.

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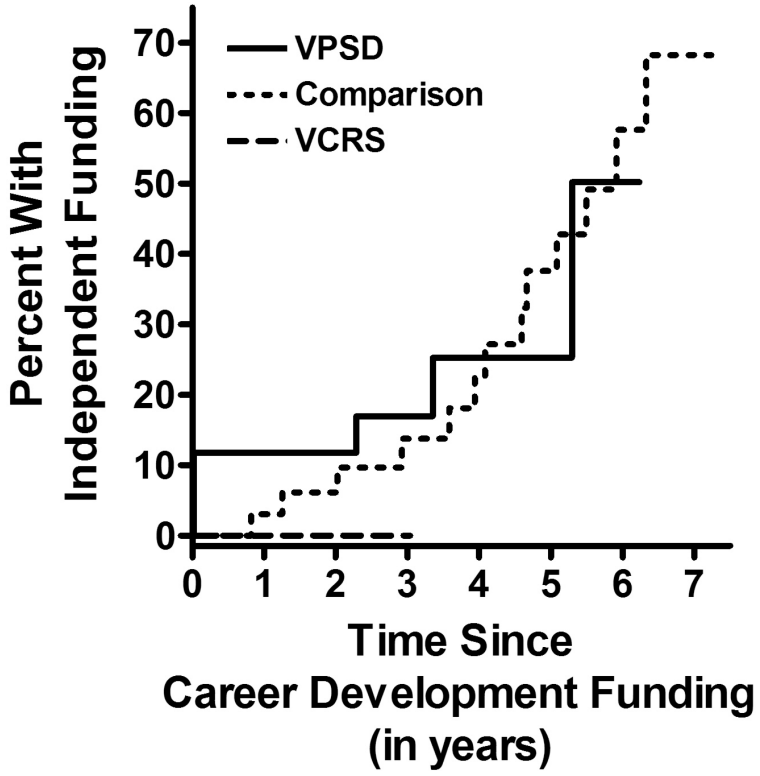

Figure 1.
Time to scholars' independent funding. Survival analysis shows the time from career development funding to first independent funding for faculty who entered the VPSD and VCRS programs versus the comparison cohort of faculty who obtained individual National Institutes of Health career development funding during the same period without participating in the VPSD or VCRS. (VPSD stands for Vanderbilt Physician–Scientist Development program; VCRS stands for Vanderbilt Clinical Research Scholars program. Both programs encourage the career development of physician–scientists.)

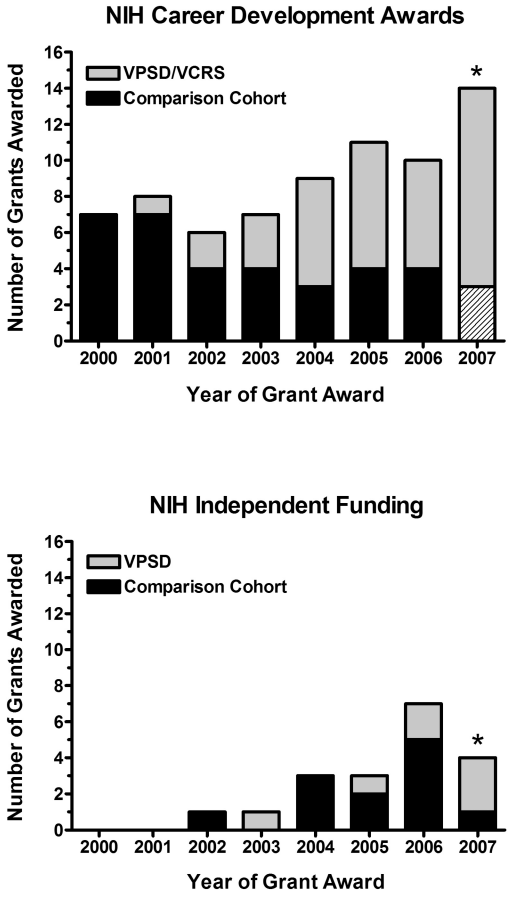

Figure 2.

National Institutes of Health (NIH) career development and independent research awards. Top: Number of new NIH research career development awards granted to individuals who entered the VPSD program from 2000 through 2006 or the VCRS program from 2002 through 2006, and to physician–scientists who did not participate in either program (comparison cohort). NIH awards included are K01, K07, K08, K22, K23, K25, K99, R03, and R21. The striped bar indicates awards in 2007 to Vanderbilt physician–scientists not in the VPSD/VCRS programs and not included in the 2000–2006 comparison cohort. Before 2000, an average of three new career development awards were funded per year. Bottom: Number of NIH independent research awards granted to the VPSD and comparison cohort each year. (VPSD stands for Vanderbilt Physician–Scientist Development program; VCRS stands for Vanderbilt Clinical Research Scholars program. Both programs encourage the career development of physician–scientists.)

* Data for 2007 through September 30, 2007.

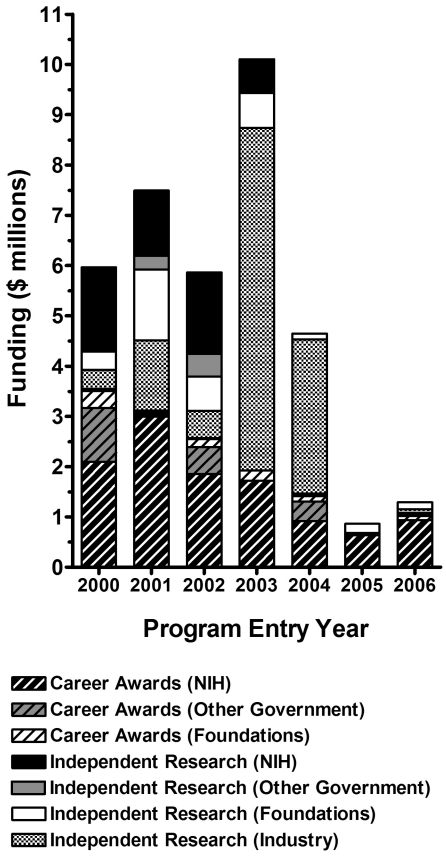

Figure 3.

Total funds awarded to VPSD scholars, by year of program entry. Cumulative direct and indirect funding and types of grants awarded to junior faculty who entered the VPSD program by year of program entry. The number of faculty who entered the VPSD program each year are as follows: 2000 (6), 2001 (7), 2002 (11), 2003 (8), 2004 (8), 2005 (7), and 2006 (8). (VPSD stands for Vanderbilt Physician–Scientist Development program. This program encourages the career development of physician–scientists.)

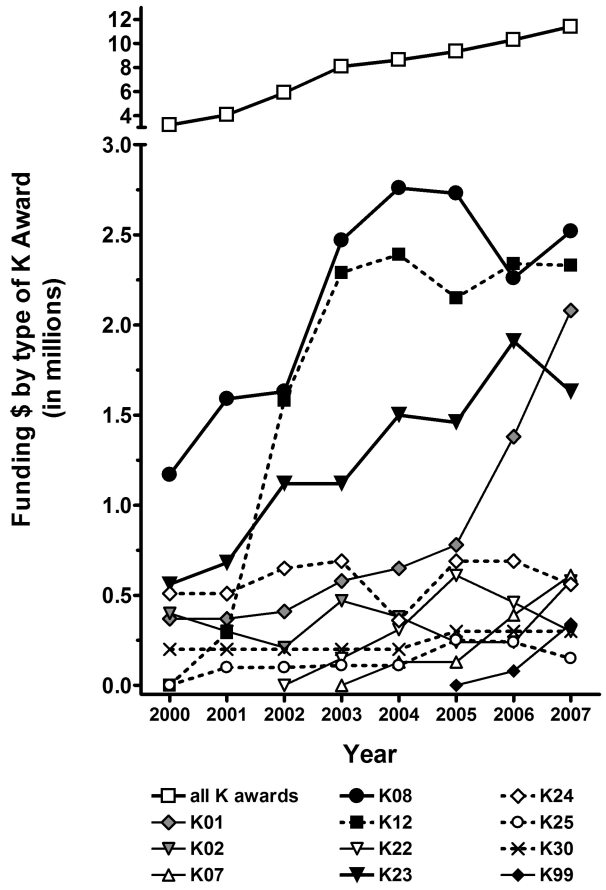

Figure 4.

K awards at Vanderbilt University (2000–2007). Vanderbilt K-award funding, by type of K award, since initiation of the Vanderbilt Physician–Scientist Development program in 2000 to encourage the career development of physician–scientists.

Table 1

Characteristics of Three Cohorts of Developing Physician–Scientists at Vanderbilt Medical Center, January 1, 2000, to September 30, 2007

Cohort characteristic	Physician–scientists in the Vanderbilt Physician–Scientist Development (VPSD) program (n = 55)	Physician–scientists in the Vanderbilt Clinical Research Scholars (VCRS) program (n = 15)	Comparison cohort: physician–scientists who received National Institutes of Health career development funding (n = 33)
Age at program entry—years (95% CI)	35.9 (34.9 to 36.8)	32.7 (31.0 to 34.4)*	39.0 (37.4 to 40.5)†‡
Degree—MD:MD/PhD (%)	38:17 (69:31)§	15:0 (100:0)	22:11 (67:33)‡
Gender—male:female (%)	41:14 (75:25)§	6:9 (40:60)	26:7 (79:21)‡
Race—white:black:Asian:Hispanic (%)	38:2:11:2 (69:4:20:4)	11:1:3:0 (73:7:20:0)	Data not available
Mean follow-up—years (95% CI)	4.1 (3.7 to 4.7)	3.2 (2.4 to 4.1)	4.7 (4.0 to 5.5)§
Career development award			
K08—n (%)	20 (36)	0	16 (48)
K23—n (%)	4 (7)	5 (33)	12 (36)
Other individual K award—n (%)	2 (4)	1 (7)	5 (15)
R03 or R21—n (%)	3 (5)	1 (7)	0 (0)
Veterans Affairs career development—n (%)	6 (11)	0 (0)	NA
Foundation—n (%)	22 (40)	5 (33)	NA
Industry—n (%)	16 (29)	2 (13)	NA
Any nonindustry career development funding—n (%)	41 (75)	9 (60)	33 (100)
Time from entry to career development funding—years (95% CI)	1.8 (1.3 to 2.3)§	2.4 (1.4 to 3.4)	NA
Age at career development funding—years (95% CI)	37.1 (35.7 to 38.4)	36.3 (33.2 to 39.4)	39.0 (37.4 to 40.5)/
Mean follow-up after K-award funding—years (95% CI)	2.5 (1.8 to 3.3)	1.4 (0.4 to 2.4)	4.7 (4.0 to 5.5)†‡
Independent funding—n (% of those with nonindustry funding)	7 (17)	0 (0)	14 (42)
Time from K award to independent funding—years (95% CI)	1.6 (–0.4 to 3.5)	NA	3.8 (2.9 to 4.8)¶
Age at independent funding—years (95% CI)	40.0 (37.5 to 42.5)	NA	41.8 (40.1 to 43.5)
Publications per person per year—n (95% CI)	1.6 (1.3 to 2.0)	1.7 (0.7 to 2.7)	2.6 (1.8 to 3.3)¶
Publications per person per year since career development award—n (95% CI)	1.9 (1.3 to 2.6)	6.0 (–1.0 to 13.0)†	2.6 (1.8 to 3.3)§

*$P < .01$ versus VPSD.

†$P < .005$ versus VPSD.

‡$P < .001$ versus VCRS.

§$P < .05$ versus VCRS.

/$P < .05$ versus VPSD and VCRS.

¶ $P < .05$ versus VPSD.