

Biomedical Sciences

Research in the medical sciences provides a firm foundation for improving human health. The Burroughs Wellcome Fund is committed to fostering the development of the next generation of academic medical scientists. By providing funding to help bridge the gap between the postdoctoral and early faculty years, BWF hopes to bolster the careers of the most promising up and coming scientists. But BWF's support doesn't stop with its funding. Through biennial meetings and mentoring networks, BWF helps provide vital career advice to give scientists, early in their careers, the information they need to be successful.

Career Awards for Medical Scientists

Five-year awards for physician scientists provide \$700,000 to bridge advanced postdoctoral/fellowship training and the early years of faculty service. This award addresses the on-going problem of increasing the number of physician scientists and will help facilitate the transition to a career in research.

Collaborative Research Travel Grants

Provide up to \$15,000 in support for researchers from degree-granting institutions to travel to a laboratory to acquire a new research technique or to facilitate a collaboration. Consideration is given to applicants who hold a Ph.D. or are studying for a Ph.D. in mathematics, physics, chemistry, computer science, statistics, or engineering who are interested in investigating research opportunities in the biological sciences or to biologists interested in working with physical scientists, mathematicians, engineers, chemists, statisticians, or computer scientists to incorporate their ideas and approaches to answering biological questions.

Program Outcomes

Performance based on selected outcomes of grantees from Burroughs Wellcome Fund's Career Awards in the Biomedical Sciences (1995-2006) and Career Awards in the Medical Sciences (2007-date) programs.

Background

"Career Development" has been a major theme of the Burroughs Wellcome Fund (BWF) since it became an independent foundation in 1994. Shortly thereafter, BWF's first foray into career development was the Career Awards in the Biomedical Sciences (CABS) which provided bridging support for young scientists to help them make the critical transition from postdoctoral fellow to independent investigator. This program was modeled after one of the first bridging award programs, the Markey Charitable Trust Scholars Program, that funded 113 scholars from 1985 through 1991. The Markey program set the gold standard for bridging awards. The results of an extensive evaluation of the Markey program were published in 2006 by the The National Academies Press.¹ The data from that study showed that the Markey Scholars were highly productive, met the goals of the program, and that the selection process was effective in identifying candidates that could advance quickly to independence.

The first CABS recipients were approved by the Board in April 1995 with the primary goal of helping awardees achieve research independence by obtaining a tenure-track faculty position within the academic research environment. The program was part of the BWF grants portfolio from 1995 to 2006 and provided support to 241 young scientists for a financial commitment in excess of \$100 million.

BWF's Evaluation Philosophy

BWF's core mission is "the advancement of the medical sciences by supporting research and other scientific and educational activities." To accomplish this mission BWF has focused on investing in human capital through the development of outstanding scientists early in their careers and the development of investigators in targeted areas of science that are undervalued or under funded. Since 1994, BWF programs have been developed to accomplish this mission.

Because of the large financial commitment the Board made to the CABS program, an evaluation strategy was put into place early in the program's history. The program staff operated under the assumption that the BWF Board wanted to know whether the program was meeting its goal of fostering independence. The basic evaluation strategy, which has been carried forward to this day, includes terrain mapping by the BWF Board, annual scientific advisory committee meetings, review of progress reports, awardee convening activities, and evaluation of faculty offer letters. In addition, certain key outcomes are looked at which include time to independence, start-up packages, major awards, significant scholarly publications, and grant support. The ultimate acid test, however, is whether awardees obtain tenure and sufficient funding to support independence at mid-career.

BWF's evaluation strategy has been graphically displayed in former BWF program officer Martin Ionescu-Pioggia and consultant Georgine Pion's 2006 paper.² The figure, known as the evaluation pyramid, demonstrates how information flows from the base of the pyramid to the BWF Board demonstrating the higher activity or group involvement the greater the impact. It should be noted that the ultimate decisions are made by the BWF Board but Program Scientific Advisory Committees have more impact on decisions than evaluation and/or outcomes studies.

CABS Outcomes

Three formal outcomes studies have been done on the CABS program. Two of the studies have been published.

1. The Pion and Ionescu-Pioggia study which was published in 2003³ looked at outcomes for the first five years (1995-1999) of the program. At the time of the writing, 77 percent of the 101 awardees including all of the first two cohorts (1995 and 1996) had received tenure-track faculty appointments and of those 78 percent had attracted external funding. The reported results indicate that the program was fulfilling its aim to foster active and productive academic research careers. An interesting outcome from this study was that of the 33 awardees who had completed the program, the time from last degree to first faculty appointment was 5.1 years for Ph.D.s (n=18) and 7.2 years for physician scientists (n=15).

2. An unpublished comparative study done in 2005 by Pion and Ionescu-Pioggia⁴ looked at four award cycles, 1996-1999, and compared outcomes among three groups: awardees (n=37); finalists who did not receive an award (n=22); and those that were disapproved (n=126). The analyses indicated that the awardees typically outperformed those who applied but did not receive an award and provided evidence that the program was a sound investment for the BWF.
3. The Pion and Cordray comparative study was published in 2008.⁵ Using propensity analysis the authors addressed the impact of the CABS program by examining outcomes among three comparison groups who applied to the program from 1996 to 1999. Even though awardees performed better than the comparison groups, the authors concluded that it was almost impossible to remove selection biases from program biases. Strategies were offered to better improve outcome measurements.



Since the three formal studies looked at outcomes from 1995 through 1999, an additional analysis, looking at selected outcomes, was done in March 2010 for the 2001–06 classes.

The **2001** award year produced 175 eligible proposals and 23 awardees. Two individuals left the program from the 2001 class—a physician scientist that took a faculty position at the Pasteur Institute in Paris and another awardee who left the program to work on a Gates Grand Challenge project. The remaining 21 all transitioned to tenure-track faculty appointments and 12 currently have tenure. All except two have current funding from NIH or NSF.

For **2002**, 177 proposals were received and 17 awards made. Fourteen of the 17 have received tenure-track faculty appointments including three at Canadian institutions (two at the University of British Columbia and one at the University of Toronto). Seven of the 14 are currently associate professors and the remaining seven are assistant professors. Nine of the 11 awardees with US faculty appointments have current NIH funding. Of the three remaining awardees, one left the program for a research position in China and another left the program to take a position with Novartis. A third awardee has not transitioned and is currently a postdoctoral fellow at Harvard.

The **2003** award year produced 179 eligible proposals and 13 awards. All of the awardees have transitioned to a tenure-track faculty appointment and two are currently associate professors. Eleven of the 13 have current funding from NIH or NSF. There are two in this cohort that have been particularly successful in obtaining NIH funding. One currently has NIH funding, which includes a New Investigator Award, totaling \$3,716,836 and another has \$2,528,867 in NIH funding.

At the application deadline for the **2004** award year, 167 eligible applications were received and 16 awards were made. Of the 16 awardees, one left the program after the postdoctoral portion of the award to become a science writer. The remaining 15 have remained in academic science and all have tenure-track positions—14 at US institutions and one at a Canadian institution (University of Toronto). Five of the 15 currently have tenure. Of the 14 awardees with US faculty appointments, 12 have NIH support. Among the group there are 14 ROIs (range 0-3; median 1) and total NIH support of \$14,127,090. Five currently have NIH support in excess of \$1 million. In addition, three of the 2004 cohort have received Howard Hughes Medical Institute's Early Career Scientist awards.

Award year **2005** was the next to the last CABS' awardee class. At the application deadline 173 proposals were received and 22 awards made. Eighteen have tenure-track faculty appointments (one is at the University of British Columbia) and all 18 are assistant professors. Of the remaining four, two are postdoctoral fellows, one is at Janelia Farms, and one is with the intramural program at NIH. Twelve of the assistant professors have current NIH or NSF support.

The last class, **2006**, was made up of 24 young scientists who were selected from 177 proposals. Nineteen have become independent investigators—16 have tenure-track faculty appointments at degree granting institutions and three are at research institutes but have faculty appointments at a closely affiliated degree granting institution. Two are still in postdoctoral positions and have not transitioned. Of the three that did not complete the program, one is with the intramural program at NIH, one is working in science publishing, and other is working in Japan. Three awardees have ROIs and three have an NIH New Innovator award.

Other Outcomes

One hundred awardees in the 2001-2006 classes transitioned to become independent investigators. Sixty-seven were Ph.D.s and 33 were physician scientists. Of the Ph.D.s who accepted faculty positions, 92 percent transferred institutions while 45 percent of the physician scientists made such a transfer.

The publication record was examined for the 2001, 2002, and 2004 classes. Forty-nine awardees contributed to 1,074 publications for an average of 22 papers per awardee (range: 2 to 60; median: 20). Twenty-one (44%) of the awardees had papers in one of the *Nature* publications and 12 (24%) had a publication in *Science*. An interesting observation is that one in three of the awardees had published in *Public Library of Science (PloS)*.

Summary Outcomes for the CABS Program (1995 – 2006)

The primary goal of the program, a tenure-track academic appointment, has obviously been met. Ninety-two percent received tenure-track faculty appointments or the equivalent and only 16 left the program before completion and those awardees who left the program before completion have remained in science. Of the four who have yet to transition, one as of this writing (6/2010) has a tenure-track faculty offer in hand.

- 241 awards made
- >\$100,000,000 financial commitment
- 16 awardees left program before completing award
 - 5 joined the NIH intramural program
 - 2 took positions in the pharmaceutical industry
 - 2 went to Janelia Farms
 - 3 took faculty positions outside North America
 - 2 became science writers
 - 1 left to work on Gates' Grand Challenges project
 - 1 left because of family reasons (now a science writer)
- 221 received tenure-track faculty appointments
- 4 have yet to transition

Mid-Career Outcomes for the First CABS Class (1995)

As of June 2010, the first CABS class continues to do very well. Three of the awardees from this cohort are currently serving on BWF advisory committees.

14 Awardees

- Gender: 4 females; 10 males
- Degree: 3 M.D.s; 4 M.D., Ph.D.s; 7 Ph.D.s

Current Position as of April 2010

- | | |
|--|---|
| ■ Professor: | 4 |
| ■ HHMI Investigator/Professor: | 2 |
| ■ Associate Professor: | 5 |
| ■ Associate Member Research Institute: | 1 |
| ■ President Pharmaceutical Company: | 1 |
| ■ Elementary School Teacher: | 1 |

Current Institutions as of April 2010

- | | |
|-----------------------------|---|
| ■ Columbia: | 1 |
| ■ Dartmouth | 1 |
| ■ Duke: | 1 |
| ■ Harvard: | 2 |
| ■ Northwestern: | 1 |
| ■ University of Chicago: | 2 |
| ■ University of Dundee: | 1 |
| ■ University of Washington: | 1 |
| ■ Vanderbilt: | 1 |

A Pivotal Report: *Bridges to Independence*

Sponsored by the National Research Council and published in 2005 by the National Academies Press,⁶ this publication represents the work done by the Committee on Bridges to Independence chaired by Thomas R. Cech. The report made numerous recommendations including the establishment of a NIH program to support scientists moving into their first independent positions. "The program should make 200 grants annually of \$500,000 each payable over five years. The award amount and duration is similar to the BWF Career Awards, which have shown success at fostering the independence of new investigators."

This document was the catalyst for the K99/R00 mechanism and started BWF thinking about a new direction for the CABS program.

A look at the last CABS cohort vis-à-vis the first NIH K99/R00 cohort

Just as BWF's CABS program was patterned after Markey's Scholars Program, NIH's K99/R00 program was patterned after BWF's CABS program. The major differences (and similarities) between the CABS program and the K99 mechanism follow.

CABS	K99
Five year award – 2 year mentored phase plus a three year independent phase	Five year award – 2 year mentored phase plus a three year independent phase
Total award ~ \$500,000	Total award ~ \$500,000
Awards per year ~ 20	Awards per year ~ 200
Institutional nomination	Open nomination
Interview finalists	No interviews
Awardee must be at a degree-granting institution	Awardee may be at most US profit, non-profit, or public institutions
US/Canadian citizen	No citizenship requirement
Must have at least 1 year but no more than 4 years of post-doctoral training	Must not have more than 5 years of postdoctoral training
Must have tenure-track appointment for independent phase of award	Does not require a tenure-track appointment for independent phase of award

The last CABS cohort (n=24) was approved by the BWF Board in May 2006 and the first K99 cohort (n=58) was announced by NIH in November 2006. Award start dates were September 1, 2006, for the CABS grantees and December 1, 2006, for the K99 grantees. One applicant applied for both a CABS award and the K99 and was successful with both applications. The individual turned down the K99 and accepted the CABS award so the actual number for the first K99 cohort is 57.

Current Selected NIH support

CABS	K99/R00
ROI = 3	ROI = 3
New Innovator Award = 3	R21 = 1
R21 = 1	
R03 = 1	
K08 = 1	
K21 = 1	

Eight of the K99/R00 awardees also applied for a BWF Career Award between 2003 and 2006: seven applied for a CABS award and one for a CASI award (Career Awards at the Scientific Interface). The CASI award provides bridging support for young scientists trained in engineering or the physical, chemical, or mathematical sciences. Ten of the K99 awardees have Ph.D.s in chemistry, physics, or engineering. One K99 awardee applied for both a CASI award and a CABS award. Another candidate applied for both a K99 and the CABS award, was successful with both applications, and chose the CABS award.

Awardees from both programs tend to change institutions for the independent investigator portion of the award. Of the 50 K99 awardees that transitioned, 14 did not change institutions. For the CABS awardees that transitioned 16 percent did not change institutions. For the CABS awardees who are now independent, the time from their last doctorate to independence averaged 5.5 years (median = 5 years; range 2 to 10 years). This could not be determined for the K99 awardees.

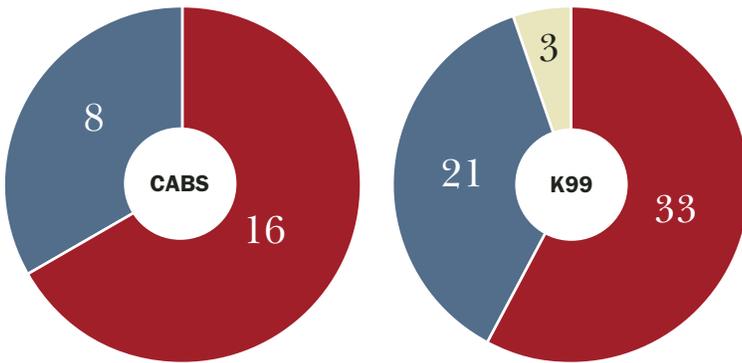
Both the Bridges to Independence program and the CABS program appear to have met their goal of moving young scientists to independence, however, the goal (tenure for the CABS awardee) for demonstrating the success of the programs cannot be determined until mid-career when we see where these awardees are and what they are doing.

Awardee Demographics

CABS = 24 awardees, K99 = 57 awardees

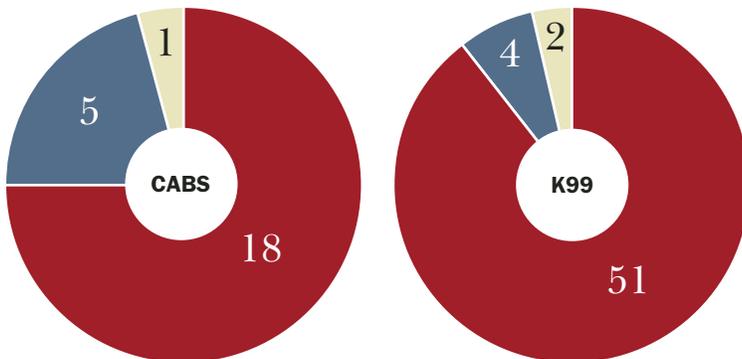
Gender

Female Male Unknown

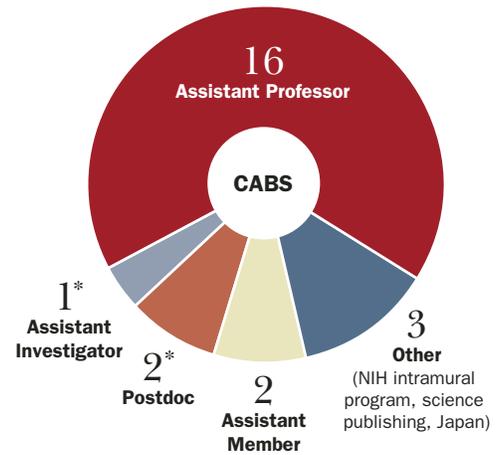


Degree

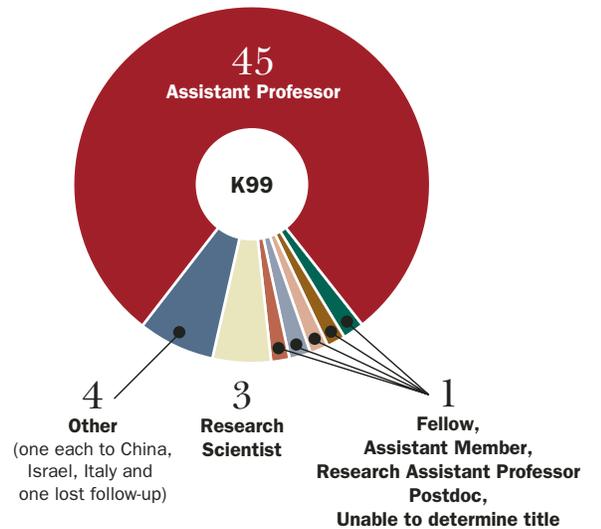
M.D. M.D., Ph.D. Ph.D.



Current Title



* BWF awardees whose primary appointment is at research a research institute have a secondary appointment at a degree granting institution.



Career Awards for Medical Scientists (CAMS)

Because of NIH's Bridges to Independence program (K99/R00 award), introduced in 2006, the CABS program was reformulated to a physician scientist only program and renamed Career Awards for Medical Scientists (CAMS). The focus of the CAMS program is the physician scientist who is making the transition from a mentored position to that of an academic independent investigator. The program provides \$700,000 in support over five years.

The CAMS program has gone through three award cycles (2007, 2008, and 2009) and a total of 42 awards have been made. The program was suspended for the 2009-2010 award cycle but is scheduled to resume for the 2010-2011 cycle.

CAMS Outcomes

For the three award cycles, 395 eligible proposals were received and 42 awards were made. Thirty of the awardees are M.D., Ph.D.s, 11 are M.D.s, and one is a D.D.S., Ph.D. Thirty-five currently have tenure-track faculty appointments. One of the faculty appointments is at McGill. Of the 35 awardees who accepted faculty appointments, nine changed institutions.

For the U.S. appointments the average salary is \$155,642 (range \$80,000 to \$350,000). The average start-up, less salary, is \$712,786 (range \$120,000 to \$2,200,000). In addition to start-up money and salary, many received additional support in the form of signing bonuses, childcare help, money for shared equipment, cost-of-living supplements, and meeting expenses. Also, many received housing and relocation allowances.

Only 14 of the 42 awardees have active K awards (K08 = 11, K23 = 2, K21 = 1). Six of the 35 assistant professors have ROIs. One 2007 awardee has active NIH grants totaling \$5,359,871.

Where does BWF go from here?

In some instances using sophisticated analyses and methods to evaluate programs may cloud the evaluation picture to such an extent that the reported outcomes may bear little resemblance to reality. With this in mind the CABS program will continue with the evaluation strategy that has been in place for a number of years. This includes:

- Annual scientific advisory committee and program staff review of the awardees' progress through written progress reports. Progress reports and start-up packages are also used to identify specific outcomes.
- Board members serving as liaisons to the program. This provides consistency across programs and assures that each program meets the goals set by the Board.
- Convening activities which provide opportunities for the Board, advisory committee, and staff to monitor progress.

For the CAMS program we will continue a similar strategy to that used for the CABS program, but we will look more closely at the awardee's publication record, funding, and time to tenure.

Summary

BWF is committed to the continued career development of young biomedical and physician scientists. By identifying and measuring outcomes and providing opportunities for candid feed-back from our awardees, BWF is able to identify areas where adjustments to its' career development portfolio should be made. These adjustments, hopefully, will have a positive impact on the research environment that BWF supports.

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