ORIGINAL ARTICLE

Canadian research fellowship training programs in digestive sciences: achievements and challenges

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Abstract

Background: The Canadian Association of Gastroenterology (CAG) is committed to fostering the development of future Canadian investigators. Up to 1986, research fellowship support was obtained from the Medical Research Council (MRC) of Canada. Since that time, several peer-reviewed, industry-sponsored, CAG-supported research fellowships and a variety of independently funded awards have augmented this effort. In the same period, several peer-reviewed operating grants (OGs) from the MRC and other agencies have been constrained. The aim of this study was to determine the success of CAG, MRC or any other Canadian research fellowships in the development of career investigators in digestive sciences and to identify factors influencing the outcomes of such training.

Methods: MRC records and the minutes of CAG annual meetings were reviewed to identify research fellowship support. Canadian program directors were requested to list research fellows affiliated with their groups between 1986 and 1997. Only fellowships providing at least 1 year of training were included. A 7-page questionnaire detailing biographic characteristics, the site and duration, and specific issues related to the quality of research training was sent to identified trainees. Significant associations between success in achieving an academic appointment or OG support and several variables of training were identified.

Results: Eighty-six research fellows were trained. Responses were obtained from 43 of them. The demographic characteristics of the whole group and the respondents were similar. Of the respondents, 81% of trainees obtained academic appointments. Fellowships longer than 1 year were associated with higher rates of academic posting, and MRC-funded fellows had greater success rates of academic appointments. Of eligible trainees 63% have obtained OG support. None of the other variables examined predicted success. Of the trainees responding, 85% valued the fellowship very highly.

Conclusions: The establishment of the additional research fellowships has fostered the development of career investigators in digestive sciences. The high success rate of former trainees in obtaining academic appointments and OG support suggests that the fellowship programs are effective and appropriately oriented. The
structure of the current programs does not require substantial revision. OG support for new investigators appears now to lag substantially.

Résumé

Contexte : L’Association canadienne de gastroentérologie (ACG) est vouée à favoriser la formation de futurs chercheurs au Canada. Jusqu’en 1986, les bourses de recherche provenaient du Conseil de recherches médicales (CRM) du Canada. Depuis, plusieurs bourses de recherche soumises à l’examen des pairs, commanditée par l’industrie et appuyées par l’ACG, ainsi que diverses bourses provenant d’intervenants indépendants, sont venues s’ajouter au programme. Au cours de la même période, on a limité les subventions de fonctionnement soumises à l’examen des pairs, provenant du CRM et d’autres organismes. Cette étude visait à déterminer les taux de succès des bourses de recherche de l’ACG, du CRM ou de toute autre bourse canadienne dans la formation de chercheurs professionnels en sciences de la digestion et à définir les facteurs qui jouent sur les résultats de cette formation.

Méthodes : On a examiné les archives du CRM et les procès-verbaux des assemblées annuelles de l’ACG pour circonscrire l’appui donné sous forme de bourses de recherche. On a demandé aux directeurs de programme du Canada de dresser la liste des boursiers chercheurs affiliés à leur groupe entre 1986 et 1997. La liste ne comprenait que les bourses donnant au moins un an de formation. Les boursiers ont reçu un questionnaire de sept pages portant sur les détails des caractéristiques biographiques, l’établissement et la durée de la formation, et comportant des questions précises liées à la qualité de la recherche. On a établi des liens importants entre la réussite représentée par la nomination à un poste universitaire ou une subvention de fonctionnement et plusieurs variables de la formation.

Résultats : Sur les 86 boursiers de recherche, 43 ont répondu. Les caractéristiques démographiques du groupe dans son ensemble et des répondants se ressemblaient. Parmi les répondants, 81 % ont obtenu un poste au niveau universitaire. On a établi un lien entre les bourses de plus d’un an et des taux plus élevés d’affectation à des postes universitaires. Les titulaires d’une bourse du CRM ont obtenu plus de succès à cet égard. Parmi les boursiers admissibles, 63 % avaient obtenu une subvention de fonctionnement. Aucune des autres variables analysées n’était un prédicteur de réussite. Parmi les répondants, 85 % attachaient une très grande valeur à la bourse d’étude.

Conclusions : L’établissement de bourses de recherche supplémentaires a favorisé la formation de chercheurs professionnels en sciences de la digestion. Le taux élevé de réussite des anciens boursiers qui ont obtenu des postes au niveau universitaire et des subventions de fonctionnement indique que les programmes de bourses d’études sont efficaces et bien orientés. Il n’est pas nécessaire de revoir à fond la structure des programmes actuels. Les subventions de fonctionnement pour les nouveaux chercheurs semblent avoir pris beaucoup de retard.

Introduction

The need to encourage the development of career investigators in the biomedical sciences has been clearly stated by the Medical Research Council of Canada.¹ The recent establishment of the Clinician Investigator Program by the Royal College of Physicians and Surgeons of Canada² is testimony to the importance of stimulating interest in research as a career among subspecialty clinical trainees. A major goal of subspecialty training is the development of future investigators. Since its inception, mindful of its responsibility to facilitate this objective, the Canadian Association of Gastroenterology (CAG) has undertaken to promote research by trainees in several ways. Among these initiatives, the establishment of specific research fellowships that enable both the extension of training beyond the regular adult or pediatric clinical subspecialty training programs and the incorporation of trainees from other clinical (surgery) and non-clinical disciplines, highlights this commitment.³ Until 1986, research training fellowships were available primarily from the Medical Research Council (MRC) of Canada. Since 1986, research fellowship support has been progressively augmented by the establishment of several peer-reviewed, industry-supported, CAG-sponsored research training fellowships. These have been further supplemented by a variety of local faculty/department- or division-funded fellowships and the emergence of strong funding support from selected national organizations (Crohn’s and Colitis Foundation of Canada, Canadian Liver Foundation, Canadian Association for the Study of the Liver). Accordingly, there is now considerable capacity for the training of a critical mass of potential new investigators in the broad areas of the digestive sciences (luminal gastrointestinal, hepatobiliary and pancreatic). Although research trainees entering these funded fellowships have been highly selected, there
has been no systematic review of either their successes in obtaining academic positions or their records of achieving research grant funding afterward. Moreover, during the same period, financial resources for peer-reviewed MRC operating grants (OGs) in these areas have been constrained.\textsuperscript{1,4–15} There has been concern that the output of qualified new investigators might quickly outdistance the national system’s ability to provide sufficient operating capital for these highly skilled individuals. The availability of academic positions and the relative ease of obtaining funding in other countries are factors that could influence the placement of some of these trainees. Although most trainees have been Canadian, a significant minority are foreign graduates. The ultimate geographic disposition of this cadre of new investigators has never been carefully examined.

The present study was designed to determine, for the period from 1986 to 1997, the success of CAG, MRC or any other Canadian research fellowship training awards in the development of career investigators in gastroenterology and hepatology and to identify any factors that predicted the outcomes. The population examined included only trainees who were appointed as Research Fellows and who were fully committed to at least 1 year of research. Research conducted by clinical trainees in gastroenterology during their clinical years (PGY 4 and 5) was not considered in this analysis.

Methods

The specific objectives of the study were: (a) to identify recipients of CAG, MRC or other Canadian research fellowship training awards in the development of career investigators in gastroenterology and hepatology and to identify any factors that predicted the outcomes. The population examined included only trainees who were appointed as Research Fellows and who were fully committed to at least 1 year of research. Research conducted by clinical trainees in gastroenterology during their clinical years (PGY 4 and 5) was not considered in this analysis.

Characterization of research trainees and their experiences

Identified fellows were sent a 7-page questionnaire designed specifically to identify several academic and biographic characteristics, the site and duration of fellowship training, the career path following completion of training and success in obtaining OG support. The questionnaire elicited demographic data (age, marital status, number of children, citizenship during training and currently), training before entering the research fellowship (MD, PhD and MD plus PhD), clinical training (internal medicine, pediatrics,
surgery or other) and subspecialty training that could influence decision-making regarding a choice of career. These data were obtained, where applicable, for the time of training and at the time of the response.

The details of the training milieu requested included sources of funding (MRC, CAG or other), locations and departments of training sites, training structure (toward a degree), the degree of supervision and the extent of first-hand experience in experimental design, execution and data analysis. Separate sections of the questionnaire dealt with matters related to instruction and experience in manuscript preparation and grant writing. This information was supplemented with a publication list including abstracts and full papers produced during or since the completion of the research training. The nature (bench or bedside) and specific fields of the research undertaken were defined.

The questionnaire also attempted to explore the broad issue of mentoring. Trainees were asked to indicate the extent to which their supervisors guided them in the process of securing an academic post and preparing them for life as an independent investigator. Finally trainees were asked to rate their overall satisfaction with the training fellowships.

Responses to the questionnaire were received from February to August 1999. Delinquent responses were tracked by telephone, fax and email.

Classification and analysis

Trainees securing an academic (university) appointment were classified as “academic”; all others were classified as “private practice.” The training population was characterized across all variables using simple descriptive statistics. Significant associations were sought between success in achieving an academic appointment or OG support and other variables, including biographic and academic characteristics and the nature and content of the research fellowship training experience. Significant associations ($p < 0.05$) were identified by univariate analysis using a $\chi^2$ or Fisher’s exact test or by analysis of variance. Associations so identified were employed in a multiple logistic regression analysis (SPSS version 10.1; SPSS, Chicago) to identify independent predictors of success.

Results

Between 1986 and 1997, 86 research fellows were identified. They received a total of 141 person-years of training. Their support was obtained from the MRC, CAG-industry awards and “non-MRC, non-CAG” awards (i.e., support by universities, provincial grants, charitable organizations or private funding). Fig. 1 depicts the sources and time frames of fellowship funding. MRC fellowship support remained stable at 2.9 fellowships per year (range 1 to 4 fellows). There was a substantial increase in non-MRC-, non-CAG-supported fellowships from 3 per year (1986) to 9 per year (1993). This declined to 6 by 1997. The CAG-sponsored grants also increased rapidly from 3 to 9 between 1989 and 1992, due to the recruitment of pharmaceutical industry support. Further expansion of CAG-industry partnerships resulted in the establishment of 12 fellowships per year by 1996. The total number of research fellowships increased dramatically from 5 to 7 between 1986 and 1987 to over 18 fellows per year in 1996 (Fig. 1). Of the 141 person-years completed, 66% were completed by male trainees. Sixty-three (73%)
of the 86 fellows were Canadians and 23 were foreign.

The sources of industry-supported funding are depicted in Fig. 2. There were major shifts in industry support over the short term, triggered by changing corporate priorities and new drug discoveries by different industrial partners. For example, during the late 1980s and early 1990s when histamine receptor antagonist therapy was standard treatment for acid suppression, companies manufacturing these agents (Glaxo Canada, now Glaxo–Wellcome) were eager to get involved. In the mid 1990s, with the emergence of proton pump inhibitors, research focused on this class of agents and new companies (Astra, now AstraZeneca) assumed proportionately greater roles.

Valid current addresses were obtained for 59 (69%) of the 86 fellows. Program directors and supervisors had no traceable addresses for 27. Of the 59 fellows contacted, 43 (73%) responded. Six of these were still in training (Fig. 3). Demographic data were analyzed for all 43 respondents, but the outcomes related to success in academic positions and grant acquisition were analyzed only for the 37 who had completed their fellowship. The general demographic characteristics (age, sex, nationality) of the whole group, the non-respondents and the respondents were similar. Of the 43 respondents, 16 (37%) were women and 27 were men. Twenty-seven (63%) were Canadian and 16 were foreign. Before entering research training, 29 had MDs, 10 had PhDs and 4 had both MDs and PhDs.

Of the 43 fellows who responded, 30 (70%) had academic appointments, 7 were in private practice and 6 were still in training (Fig. 4). For the 37 who completed training, 81% held academic positions.

Fig. 2: Variation in corporate support from 1986 to 1997. Industry-funded fellowship support is presented for 6 major partners. MF = Merck–Frosst, HMR = Hoechst Marion Roussel. The total commitment per partner in funded years is noted in parentheses. The changes resulting from industries’ alterations in research and development priorities are reflected in this figure. During the study period several other companies (Axcan, Abbott, Carsen, Solvay, Schering) also contributed to the overall success of the programs.

Fig. 3: Follow-up of 86 identified research fellows. Fifty-nine (68%) of fellows were contacted. Of these, 43 (73%) provided complete responses to the questionnaire. Demographic data are based on 43, outcome data on 37 of the 43 who had completed training.

Fig. 4: Career outcomes of 43 fellows who responded to the questionnaire. Of the 37 who completed research training, 30 (81%) have current academic appointments.
For these “graduates” the following factors did not influence the success in obtaining academic appointments: the trainee’s family situation, sex, nationality, previous degrees (MD or PhD), formal training toward a Masters or Doctorate degree during the research fellowship and the type of research (bench or bedside).

Although some research trainees obtained academic appointments with only 1 year of research training in these programs, the rate of academic success increased with the number of years spent in these research training programs (Fig. 5, left). Two factors limited the interpretation of this observation. Some trainees receiving only 1 year in these programs undertook additional years in other programs, which have not been enumerated, and the number of trainees trained for more than 2 years was too small to permit statistical analysis.

Fellows supported by the MRC had higher rates of academic appointment, but the difference was not significant ($p = 0.16$). All MRC-supported fellows obtained academic positions, and about 40% of fellows supported by other sources pursued private practice (Fig. 6, left).

Of the 30 fellows who had academic appointments, 19 (63%) obtained OGs. None of the variables examined, including the origin of fellowship support and the length of training, appeared to influence this outcome, but the numbers of trainees represented in the groups trained for more than 2 years was too small to exclude a difference. However, only 1 of the 10 MRC-supported fellows failed to obtain a grant (Fig. 6, right) and all trainees with more than 3 years training were successful (Fig. 5, right).

The destinations of fellows after completion of fellowship training in digestive sciences

**Fig. 5:** Effect of duration of research training on obtaining an academic post (left) and securing an operating grant (OG) (right). Left: academic success rates increased with increasing training time. Black bar = academic post, white bar = private practice. Right: of the trainees holding academic appointments 63% obtained an OG. There was no apparent significant correlation with training time. Black bar = successful in obtaining OG, white bar = unsuccessful (no OG).

**Fig. 6:** Effect of source of fellowship funding on academic appointment (left) and operating grant (OG) support (right). Black bar = fellowship supported by the Medical Research Council (MRC) of Canada, white bar = supported by the Canadian Association of Gastroenterology, industry, local or any other agency. Left: trainees funded by the MRC appeared more likely to obtain academic appointments, but the difference was not significant ($p = 0.16$). Right: of the 30 trainees holding academic appointments, trainees who had MRC support for their fellowship were more likely to obtain OG support, but the difference was not significant ($p = 0.20$).
their training (Fig. 7) provide a national balance of the Canadian-based investment in training academic personnel for Canada and abroad. Of the 24 Canadian trainees, the majority (21) remained in Canada and 17 obtained academic posts in Canadian universities. One Canadian was offered and accepted an academic post abroad. This was countered by 2 foreign trainees who accepted academic posts in Canada. Ninety-one percent of foreign research fellows in this survey who subsequently returned home took academic posts.

Fig. 8 evaluates the quality of the fellowship experiences by the trainees. Of the 43 trainees (those who completed their fellowship and those who were still in training) 85% were satisfied with their experience. They were particularly satisfied with the degrees of overall supervision by their research directors, the experience in learning technical skills and participating in the preparation of manuscripts. A potentially important weakness was a perceived lack of involve supervisor involvement in assisting with the preparation of the first grant submission. Over 50% of the trainees made a strong recommendation to encourage the enlistment of supervisors’ interests in this daunting task.

Discussion

Research in the digestive sciences is well established in Canada. The results of the present survey reflect the Canadian research training efforts in these disciplines. Although trainees in accredited Royal College programs in clinical gastroenterology often carry out research projects as an integral part of the 2-year clinical training exercise, they rarely achieve sufficient experience to enable independent research activity. Accordingly, for potential MD investigators, additional research training must precede or, more commonly, follow clinical training. Non-MD research trainees constitute an equally important national human resource essential to the ultimate success of research in both gastroenterology and hepatology. The research fellowships that are the subject of this study provide the bulk of the funding opportunities available to such trainees. The outcomes of training in this highly selected group are therefore of vital importance to the future stability of Canadian research in these disciplines.

To date there have been no similar systematic studies of the outcomes of research training in digestive sciences. Recent surveys of training experiences in the United States address primarily clinical issues and as such are not comparable to this Canadian experience. Indeed, the American model, in which MDs spend 3 years engaged predominantly in subspecialty clinical training, is quite different from the focus of the present study, which deals only with the development
of career investigators. The data in the present study are more appropriately compared to outcomes of research fellowships distinct from clinical training.20

From 1986 to 1997, Canadian research fellowships enabled the advanced training of 86 highly-qualified young investigators, mostly under the auspices of academic, university-based members of the CAG. Of these, 69% could be contacted and 73% of them provided detailed data for analysis. Because the general demographics of the whole group were similar to those of the respondents, it is reasonable to assume that the data obtained from this analysis are representative. The interval between 1986 and 1997 was selected because research fellowship funding started to increase during this time as a result of new CAG-industry partnerships and other types of non-MRC supported fellowships. The survey stopped at 1997 to optimize data collection and verification and to allow sufficient time for graduates of the fellowships to seek academic positions and apply for OGs.

The goal of these research fellowships is the establishment of a continuing supply of fresh, young, energetic career investigators in the digestive sciences who will compete successfully for OGs. Up to 1986, the main source of fellowship support was the MRC. This was stable, and the number of fellowships supported varied from 1 to 4 per year. Within the last 14 years, the CAG has succeeded in developing partnerships with industry that have dramatically increased the availability of research fellowship funding opportunities (Figs. 1 and 2). This enabled a 300% increase in the annual “graduation” of research trainees during a period (1986 to 1997) when there was a simultaneous gradual 37% decrease (from 76 to 53) in the number of MRC-funded OGs in digestive diseases (Fig. 9).14–15 Support from charitable organizations was unable to buffer this reduction. A major player, the Crohn’s and Colitis Foundation of Canada increased its OGs from 8 in 1986 to 10 in 1997.21 In spite of these constraints, 81% of the eligible research trainees surveyed joined academic departments and 63% of these have been successful in obtaining peer-reviewed OG support (Fig. 5). This is similar to the outcome of the research fellowship program in clinical pharmacology in the US and Canada where two-thirds of program graduates obtained employment in an academic setting.20

Research fellowship funding by the MRC and research training lasting 2 years or more were associated with higher success rates in securing academic positions. Unfortunately the numbers of trainees in the groups of interest were too small to exclude significance. Whether this difference in success rates is an effect of the training paradigm, an effect of trainee commitment and motivation or the selection of the highest calibre trainees by research supervisors for unrestricted multidisciplinary MRC competition remains unknown. Applications for funding adjudicated by the Research Committee of the CAG (CAG-sponsored awards) are restricted to those preparing to work in the field of digestive sciences. The survey does not permit an independent examination of the factors influencing academic success among those in research training for only 1 year. Some may have had previous research experience and some may have been MD-PhDs before their research fellowship year. Although statistically not significant, the same factors that appeared to play roles in determining academic careers also influenced the success rates for OGs. Fellows who spent more than 3 years in research training and 9 of the 10 fellows

![Fig. 9: Comparison of fellowship output and operating grant (OG) support by the Medical Research Council (MRC) of Canada and the Crohn’s and Colitis Foundation of Canada (CCFC). The output of trainees increased sharply (by 300%) at a time when OG funding was decreasing (37% by MRC and unchanged by CCFC). Squares = fellowship output (those who completed training that year), solid circles = MRC-supported OGs, open circles = CCFC-supported OGs.](image-url)
who had MRC funding were successful in obtaining OGs.

The majority of foreign research fellows trained in Canada returned home to take up academic positions. Thus, the Canadian research training environment has contributed to academic development not only in Canada but also abroad (Fig. 7).

Research fellows were generally satisfied with their training experience. The majority found that they had appropriate supervision, learned sufficient technical skills to set up their own laboratories and were taught to prepare manuscripts (Fig. 8). One of the weaknesses pointed out by over 50% of the research fellows was that supervisors were not always closely involved in the preparation of the trainees’ first research grant applications. The potential importance of this observation should not be underestimated. After completion of research training, new faculty concentrate on setting up their laboratories and preparing their first OG applications. Unsuccessful applicants may have to forego hard-earned research careers. Appropriate guidance in these endeavours by accomplished senior scientists who know the strengths and weaknesses of their trainees better than anyone else is invaluable to these fledgling investigators. Without this final contribution, some of the effort expended in the development of this new generation of scientists may be in vain.

The survey acquired responses from 73% of those fellows who were contacted. Regrettably only 68% of the trainees identified could be contacted. The reasons for this unexpected finding are not completely clear. In some cases trainees, now in foreign locations, could not be traced using the contact information provided by program and research directors. In other instances there was no contact information available from any source. Since considerable effort is expended in these programs it seems appropriate to encourage those directing such research training to establish better methods of documenting the immediate disposition of their fellows. Without this information it will become increasingly difficult to measure the outcomes accurately.

It is reasonable to conclude that the establishment of the additional research fellowships by the CAG, in partnership with industry, has achieved the goal of fostering the development of career investigators in gastroenterology in Canada and abroad. The success rates of former research fellows in obtaining academic appointments and OG support suggest that the fellowship programs in Canada are effective. Although training for 2 years or more and the acquisition of MRC funding are associated with higher success rates, success in obtaining funding is not restricted to these determinants. It would appear that the programs are appropriately oriented and do not require substantial revision.

The success of the CAG in establishing a sound foundation for fellowship funding in partnership with industry has resulted, in part, from the recognition that the funding base requires broad representation among the industry partners. Fig. 2 clearly demonstrates the potential vulnerability of this strategy. There is substantial variability in corporate funding, reflecting changes in management and the priorities for research and development that may occur among the partners in a relatively short time span. Within the last 2 years there has been a further increase in research fellowship support from industry (Axcan, Abbott and Carsen) sponsored by the CAG.22,23 Fellowship grants have been combined with the MRC, and the MRC, industry and the CAG now jointly support some of these fellowships. For the year 2000, in conjunction with its partners, the CAG funded 31 ongoing fellowships, of which 13 were new grants.24

Based on the successes of this national approach to date, it appears that the capacities of the major granting agencies to provide OGs to this new generation of investigators may soon be exceeded. A comparison of the output capacity of new investigators, made possible by an aggressive fellowship funding strategy, with the MRC profile of OGs for digestive sciences during the interval under study illustrates this worrisome development (Fig. 9). Such a funding dichotomy may deter future scientists from pursuing research careers in Canada. The recent decision to reject an application for the establishment of an Institute for Digestive, Nutritional and Dental Sciences within the Canadian Institutes of Health Research may aggravate further this somewhat precarious situation. The evolving imbalance between the future need for enthusiastic,
well-trained researchers and OG availability now mandates a national effort to increase OG funding in the digestive sciences.

References


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