
REVIEW

Innovative strategic Canadian research training from TomorrOw's Research Cardiovascular Health Care Professionals (TORCH)

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Abstract

Cardiovascular research training is experiential, and “skills” are traditionally acquired through a master-apprentice paradigm. The complexity of contemporary clinical research requires a new model for research training. Facilitated through a Strategic Training Program Initiative, the Canadian Institutes of Health Research (CIHR), with its partners the Alberta Heritage Foundation for Medical Research and the Heart and Stroke Foundation, supported the Universities of Alberta and Calgary to create a new and innovative training model. Tomorrow's Research Cardiovascular Health Professionals (TORCH) is an integrated 2-year program for health care professionals from diverse disciplines to be mentored toward careers as leaders in translational cardiovascular research, applying discovery to human health.

This report describes the vision, mission, core values, objectives, design and curriculum of the program. Our vision is the development of a new generation of cardiovascular research clinician-scientists, with particular emphasis on thought, leadership and collaboration. The program incorporates 4 core values: innovation and discovery, a translational and transdisciplinary focus, an emphasis on collaboration and integration of research concepts, and the teaching of a core body of research knowledge coupled with real-world “survival” skills. The core curriculum, organized according to a cluster concept, traverses the 4 pillars of the CIHR. Through the medium of 1-hour weekly videoconferences, the curriculum cycles through case studies, seminars and a journal

club in focused areas of cardiovascular research. Mentors in the TORCH program have diverse backgrounds that epitomize the transdisciplinary translational aspects of the program and are chosen for their proven record of research accomplishment and prior history of successful mentoring.

The program has recruited 19 trainees from a broad cross-section of disciplines, integrating 2 University of Alberta campuses. The preliminary experience has been both favourable and gratifying.

Résumé

La formation en recherche cardiovasculaire est expé-riencielle et les «compétences techniques» sont habituellement acquises dans un cadre maître-apprenti. La complexité de la recherche clinique moderne exige un nouveau modèle de formation en recherche. Grâce à l'Initiative stratégique sur les programmes de formation, les Instituts de recherche en santé du Canada (IRSC) et leurs partenaires, soit l'Alberta Heritage Foundation for Medical Research et la Fondation des maladies du cœur du Canada, ont permis aux universités de l'Alberta et de Calgary de créer un modèle de formation innovateur. Programme intégré d'une durée de deux ans, Tomorrow's Research Cardiovascular Health Professionals (TORCH) s'adresse aux professionnels de la santé de diverses disciplines que des mentors guideront vers une carrière de chefs de file en recherche cardiovasculaire translationnelle et application des découvertes à la santé humaine.

Ce rapport décrit la vision, la mission, les valeurs

fondamentales, les objectifs, la conception et le contenu du programme. Notre vision consiste à créer une nouvelle génération de scientifiques cliniciens en recherche cardiovasculaire qui mettent particulièrement l'accent sur la réflexion, le leadership et la collaboration. Le programme comporte quatre valeurs fondamentales : innovation et découverte, une orientation translationnelle et transdisciplinaire, l'importance accordée à la collaboration et à l'intégration des concepts de recherche, et l'enseignement d'un corpus fondamental de connaissances en recherche conjugué à des techniques de «survie» dans le monde réel. Le programme d'études de base, structuré en fonction d'un concept de grappe, s'appuie sur les

quatre piliers des IRSC. Au moyen de vidéoconférences hebdomadaires d'une heure, le programme aborde un cycle d'études de cas, de séminaires et un club de journal dans des domaines précis de la recherche cardiovasculaire. Les mentors du programme TORCH ont des antécédents divers qui incarnent les aspects translationnels et transdisciplinaires du programme et sont choisis pour leurs réalisations démontrées en recherche et en mentorat fructueux.

Le programme a recruté 19 stagiaires d'un vaste éventail de disciplines représentant deux campus universitaires de l'Alberta. L'expérience préliminaire est à la fois favorable et satisfaisante.

Research training in Canada has long operated within a traditional master-apprentice paradigm. In this model, the recruitment and training of young, potential research scientists is often delayed for a year or more because of the need to await the results of individual award-funding decisions from external agencies, notwithstanding an agreed-upon research plan and career direction. Moreover, this funding has tended to be insecure and the research training experience itself unstructured as it relates to core knowledge and skill sets. Uncertainty concerns about protected research time, and the lack of external oversight over mentoring quality and career development planning, coupled with an inability to make a firm early commitment to excellent prospective trainees within a competitive external environment, undermines optimal research matchmaking.

A cardinal feature of Bill C113 in the Canadian Institutes of Health Research (CIHR) Act passed by the House Of Commons in 1999 was for CIHR to “excel, according to internationally accepted standards of scientific excellence, in the creation of new knowledge and its translation into improved health for Canadians, more effective services and products and a strength in Canadian Health Care System.” One priority identified in this Act was that of enhancing the capacity of the health research community by developing and sustaining scientific careers. In the spring of 2001, CIHR issued a request for proposals about strategic training initiatives in health research representing a first Canadian opportunity for institutions to develop an externally funded research-training program. The requirements and expectations of this initiative are depicted in Box 1.

This initiative was especially welcomed by those of us working in the cardiovascular arena, for several reasons. First, the past decade has seen a growing—indeed excessive—workload shouldered by academic health-care professionals, with clear, concomitant evidence that clinical demands have attenuated the time ordinarily devoted to research and other scholarly pursuits.¹ Second, with the emergence of a more aging population there has likewise been a shift in the demographics of cardiovascular health-care professionals; for example, the average age of health care workers rose from 39.1 years in 1994 to 40.8 years in 2000.² The Canadian Medical Association estimates that approximately 1 in 4 cardiologists were over the age of 55 years in 2003.³ It is projected that this percentage will rise to over 34% by 2021. Third, the nefarious combination of increased emigration of health sciences professionals, coupled with a sharp decline in applications for clinical-

Box 1: Requirements and expectations of research training programs as defined in the request for proposal (RFP) by CIHR.

RFP requirements for CIHR training programs

- Excellent mentors with record of success in training
- Transdisciplinary outlook
- Innovative and effective approaches that would be advantageous to trainees entering health-research enterprises

Program expectations: TORCH would

- Have a defined format and content
- Have a collaborative framework
- Build capacity in the four pillars of research

CIHR = the Canadian Institutes of Health Research
TORCH = Tomorrow's Research Cardiovascular Health Care program

research training and the anticipated diminished pool of clinician investigators and other cardiovascular researchers, has generated real concern about future Canadian research and development.

The explosion of new knowledge, complexity of contemporary health care and research, and the increasing need for clinical scientists to fulfill multiple and more diverse roles in order to adapt to contemporary realities is a daunting framework in which to develop a research career. Somewhat paradoxically, core research training in the fundamental precepts of the scientific method, research design, ethics and the socioeconomic implications of human health are rarely addressed in a systematic way during conventional research training. The need for a greater commitment to understanding the research process has recently been embraced by the core cardiology training statement of the American College of Cardiology.⁴

Concomitantly, several American national, professional and research-oriented organizations have expressed concern about the health of the physician–scientist career path.⁵ The paucity of such individuals, juxtaposed against the ever-increasing demand for their talents, has long been a major concern.⁶ That clinician–scientists make the strongest case for the societal relevance of fundamental discovery to health agencies, legislators and the public at large is well recognized.⁷ Although the surgical-scientist postgraduate program at the University of Toronto and the emergence of MD/PhD programs in selected Canadian medical schools have provided new and welcome seeding-grounds for research careers to develop, their impact has been quantitatively modest.⁸

Recently, to address the “uneven balance of experts,” i.e., the much larger cohort of basic versus clinical researchers, Gray and Bonventre⁹ suggested a new approach to this issue: training PhD researchers to translate science to clinical medicine in order to “close the gap from the other side.”

Taking into account the history of cardiovascular research training in Canada, the contemporary external environment, the austere outlook for the future on the one hand and the new opportunity provided by CIHR on the other, we undertook extensive discussions with selected and accomplished cardiovascular researchers at the University of Alberta and subsequently at the University of Calgary. Shortly

thereafter, we jointly submitted a formal CIHR Training Grant Application in December 2001 and were fortunate to receive funding commencing in March 2002 for a 6-year period.

It is the purpose of this report to describe the genesis of our training program as it relates to its vision, mission, core values, objectives, design and curriculum. We also reflect on our initial experience after completing the first year of program operation, with the hope that it would be of both interest and assistance to others.

Program development

Our vision for TORCH was to develop a new generation of cardiovascular research–clinician scientists, with particular emphasis on the promotion of thought leadership and collaboration. We believed that this vision could be accomplished by developing a dynamic and innovative research program to foster a novel cadre of transdisciplinary cardiovascular researchers. The program has 4 core values:

1. innovation and discovery during the conduct of research
2. embracing a double focus that is translational (i.e., applying discovery to human health) and transdisciplinary (traversing barriers conventionally erected between fundamental clinical health-care outcomes and population-based research)
3. underscoring collaboration and integration of research concepts (expected to inculcate the initial 2 core values)
4. teaching a body of core research knowledge and real-world “survival skills” so critical to successful research career

We placed particular emphasis on mentoring trainees, recognizing that a single mentor per trainee may be inadequate to achieve the program’s goals.

Program objectives

Our specific objectives include:

- developing the next generation of cardiovascular health care researchers
- recruiting outstanding trainees with demonstrated academic distinction, ambition to succeed and the determination to undertake a research career. Ex-

posure to an exciting menu of innovative research opportunities would be undertaken aligned with 4 major themes: myocardial ischemia/reperfusion; vascular biology and medicine, to include stroke; cardiac function/metabolism; and cardiac electrophysiology and disturbances of cardiac rhythm.

- developing these opportunities in a translational research environment that spans fundamental, clinical, applied and health outcomes population research. Our expectation was to congregate transdisciplinary research trainees with differing backgrounds, preparatory training and career aspirations, yet all would share the requisite qualifications and disposition to be successful in a cardiovascular research career. We specifically

intended to include an eclectic mix of physicians, surgeons, nurses, pharmacists, rehabilitation medicine trainees, nutritionists, health promotion and population health specialists, and qualified interested others.

- equipping trainees with the necessary tools and skills for lifelong success in a research career
- providing participants throughout their research training with strong and accomplished mentors committed to their career development

Program design

The design of the training program is depicted in Fig. 1. The main components of the program include

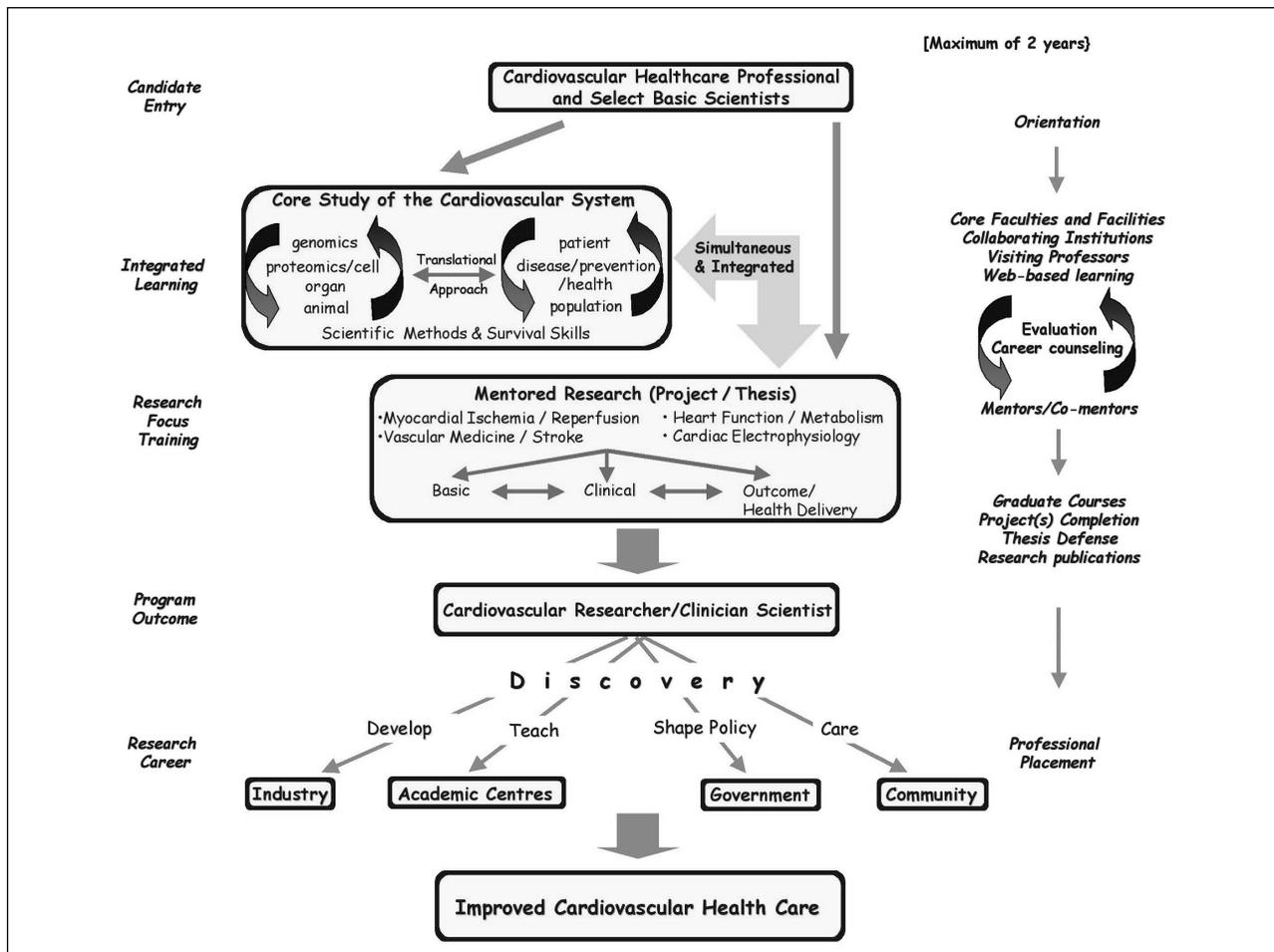


Fig. 1: Structure of the TORCH Training Program. The centre panel develops the content of the core curriculum as a simultaneous and integrated process with the mentored research project and the notion that the emerging researcher would be prepared for a career in a variety of environments.

acquisition of a graduate degree or post-doctoral training, mentored research and a specialized core curriculum that unfolds over a 2-year period. It is anticipated that trainees would acquire a Masters or Doctoral degree for those who are graduate students or physicians in training, whereas others would pursue post-doctoral training.

After an orientation phase, the trainees are exposed to a core curriculum that emphasizes transdisciplinary skill acquisitions and research methodology, data acquisition, statistical analysis, scientific integrity and bioethics. Particular emphasis is placed on acquiring “real world” training including scientific writing and presentation, grant preparation and teaching/communication skills. The curriculum features outstanding national and international cardiovascular visitors to both universities, and both trainees and faculty are expected to present and discuss selected aspects of their research regularly.

The core curriculum was organized according to a cluster concept whereby 1-hour sessions on alternate weeks consist of a case study, a seminar or journal club, which by design crosses all 4 pillars of the

CIHR (Table 1). A representative case of a patient with congestive cardiac failure illustrates the transdisciplinary elements for the curriculum. In this instance, a clinical case representing a patient with advanced congestive heart failure engaged 7 separate research trainees around the various facets of this key clinical problem. These included epidemiology, pathophysiology, non-pharmacological management (including exercise and dietary modulation), pharmacological therapy, surgical options, quality of life indicators and ethical and socioeconomic implications.

A cornerstone of the TORCH program crucial to all steps of the trainee’s career development is careful, credible, comprehensive and coherent mentoring. As required by CIHR, 10 key mentors were originally selected from both participating universities’ highly qualified academic staff at the level of associate or full professor. Their backgrounds epitomize the eclectic nature of the program and include classic clinician–scientists, fundamental researchers, population health investigators and a nurse clinician–scientist. Their areas of investigative interest span

Table 1: TORCH trainees at a glance—the first cohort

Discipline	Degree program	Program stream	CIHR pillar
Neuroscientist	MSc	Neuroscience	1 Biomedical research
Physician (cardiac surgery resident)	MSc	Surgery	
Physiologist [entering for 2003/04]	MD/PhD	Physiology	
Physician (cardiac surgery resident)	MSc/PhD	Experimental surgery	
Physician	PhD	Pediatrics	
Physician	PhD	Physiology	
Physician (cardiology resident) [entering for 2003/04]	PDF	Medicine (cardiology)	
Physician	MSc	Clinical epidemiology	2 Clinical science and research
Physician (cardiology resident)	MSc	Experimental medicine	
Nurse	PhD	Cardiovascular nursing	
Exercise physiologist	PhD	Exercise physiology	
Exercise physiologist [entering for 2003/04]	PDF	Medicine (physiology)	
Nurse	PDF	Nursing	
Nurse [entering for 2003/04]	PDF	Medicine (cardiology)	
Nurse	MSc	Clinical epidemiology	3 Research on health systems and services
Economist [entering for 2003/04]	PhD	Economics	
Nurse	PhD	Nutrition and metabolism	
Nurse	PhD	Ethics	4 Research on population health and how it is influenced
Human ecologist	PhD	Human ecology	

TORCH = TomorrOw’s Research Cardiovascular Health Care program; CIHR = Canadian Institutes of Health Research; PDF = postdoctoral fellowship.

molecular biology of channels, electrophysiology, myocardial protection, physiologically based clinical investigation, clinical trials and health care outcomes. Each was chosen for a proven record of accomplishment as measured by peer-reviewed publications, research funding and successful mentoring, as well as their ability to provide training in a particular area of cardiovascular health and/or disease. In addition, they were required to demonstrate willingness and capability to participate in a collaborative interdisciplinary research-training program. Several additional associate mentors were selected because of their expertise, qualifications and commitment to research, as well as their genuine interest in participating. We intend that this effort will be associated with the development of long-term committed mentors.

The program has taken special care to define the expectations of mentors, and a formal training session on mentoring was undertaken in September 2002 shortly after the first intake of research trainees. It is expected that mentors be able to provide constructive criticism and promote the optimal performance of the trainee and be willing to supply the necessary time. Mentors must provide practical knowledge of departmental and faculty organizational structures, academic procedures and how to access to external funding. The essential qualities of the mentor include being approachable, empathetic and supportive. They are expected to encourage original spontaneous inquiry, acquisition of knowledge in appropriate areas of research (research design, ethics, methodology, grant writing and the ability to obtain funding) and public speaking. Mentors are also engaged in supervising the writing of abstracts and papers. Since it is often impossible for a single mentor to effect all of these aspects, we have found that the appointment of a second mentor or co-mentor has been a valuable strategy.

Integration

Synergy and integration of the research personnel and resources available at both the University of Alberta and the University of Calgary has been facilitated by regular weekly 1-hour videoconferences, which allow for dynamic interaction between trainees and mentors from both geographic sites.

This is a central feature of the core curriculum, which is planned to have a life cycle of 2 years. One of the most novel aspects of TORCH has been the acquisition of information technology tools and Web-based learning by one of us (R.H.), who has been at the forefront of the appraisal, dissemination and implementation of knowledge in clinical practice guidelines.^{10,11} A unique platform desktop has been created for TORCH that gathers the best electronic resources for trainees and mentors with trustworthy information and resources from the libraries of the 2 campuses. Through the desktop portal, “1-stop shopping” is provided for a rich array of journal texts and Web sites relevant to the TORCH mission. This inventory of resources, carefully selected by the program advisory group with input from its mentors and trainees, is continually enhanced and evaluated through the monitoring of usage data. While participants are connected to the desktop, their use of information resources is monitored, including which applications are opened, where, when and for how long. The desktop also serves as the presentation platform for the weekly videoconferences, supporting peer evaluation of the sessions, follow-up discussions and conversations.

Organizational structure

The organizational and administrative structure of TORCH is shown in Fig. 2. In the start-up phase of the program, the Advisory Committee met face-to-face 5 times in a 12-month period and held regular interim conference calls to discuss issues arising from the operation of the program, planning of the core curriculum and workshops, evaluation of the trainees and mentors and, importantly, a rigorous peer-review system for the admission of new trainees.

An important component of TORCH's function has been collaboration and partnering with the institutional parents at both universities, not only for appropriate faculties but also with respect to the regional health authorities. Selected industrial partnerships of the TORCH program have been developed and are evolving. Based on the expected output of TORCH trainees and the notion that their career destinations will involve the full spectrum of vocational opportunities that require research skills

and knowledge, we anticipate that our trainees will constitute a desirable and successful cohort of young investigators well prepared for the challenges of contemporary cardiovascular research.

Evaluation

To assure the success of each participant, multiple qualitative and quantitative methods are used to analyze the program’s effectiveness. From curriculum-based surveys we learned that the most successful sessions involved robust interaction between faculty preceptors and trainees. Didactic presentations have therefore been restricted to 30 minutes to promote the general discussion of a variety of issues.

Overall, the trainees’ experience has been positive; they perceive the exposure to areas of cardiovascular research outside their individual expertise as valuable for “raising their consciousness,” broadening their knowledge and forming the basis for new, potentially valuable collaborative relationships. Over the course of a year, the program leaders have responded to trainee feedback, emphasizing research more strongly in the core curriculum and increasing the number of sessions dedicated to research methodology and experimental design as well as to the presentation of their own work.

A major challenge for program development is addressing the diversity of trainee backgrounds—their prior education, knowledge base and experience with cardiovascular disease. To address this, essential literature readings are provided before sessions and a coordinated list of key references containing the most relevant insights into research methodology and cardiovascular disease is being compiled.

Evaluation has been formative, initially emphasizing individual feedback, interviews, surveys and direct observation. These tools have helped in program planning and enhancing the learning experiences of TORCH trainees, providing valuable feedback for in-progress program modification and recalibration to further its effectiveness and efficiency. Individual semi-annual interviews conducted by the Program Director provide insight into trainee progress and the status of trainee–mentor relationships, including the need for remedial action. Ongoing evaluative activities include:

- creating a database of indicator data relevant to each trainees’ profile and projects
- quantified information measured at the outset and at preset times
- expanding on the current evaluation survey for exiting trainees, to track the longitudinal progress of past participants

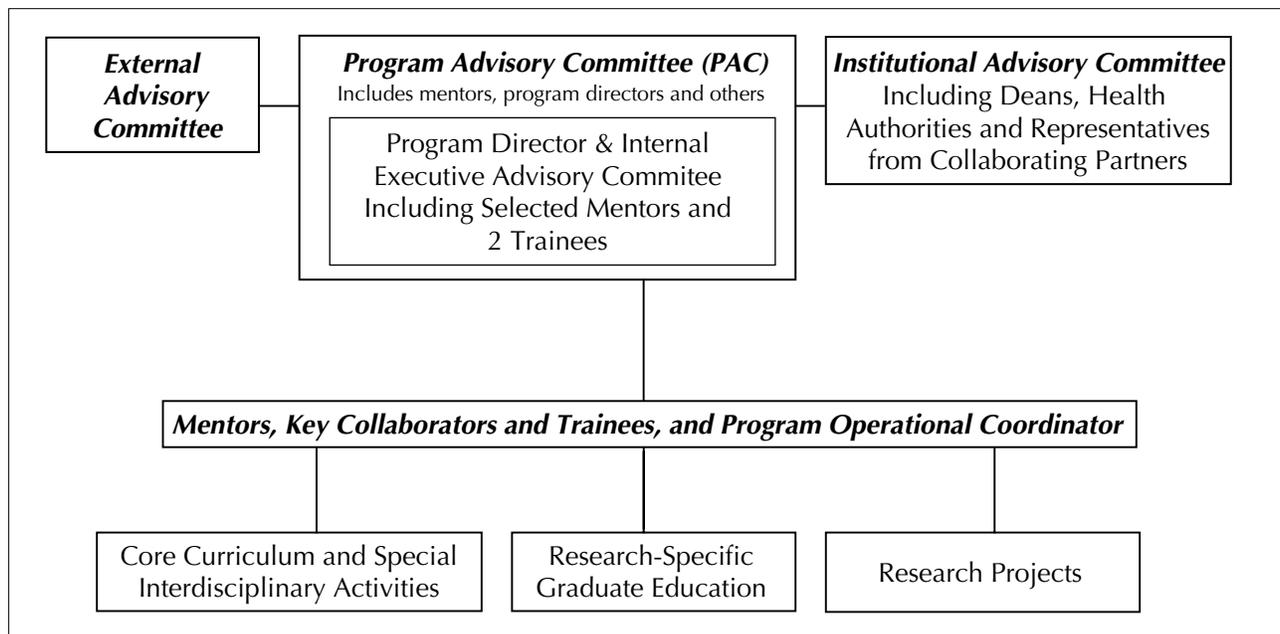


Fig. 2: Tomorrow’s Research Cardiovascular Health Care Professionals (TORCH) organization chart.

- using an expert external advisory committee to provide insight and assist in the development of future directions

Taking stock

To date, 19 trainees (graduate and post-doctoral fellows) have been recruited into the TORCH program. A condition of entry is application for external personnel funding, which in several instances has been

acquired; TORCH may also provide partial or full stipend support commensurate with CIHR guidelines. The categories of participants in the program are outlined in Table 1. The program has initiated 48 sessions in the first year (Box 2). In addition, workshops on scientific communication, career development, and (planned for 2004) research grant preparation have and will provide in-depth full-day learning opportunities. Teaching mentoring skills to the faculty was undertaken at the inception of the program.

Box 2: Tomorrow's Research Cardiovascular Health Professionals (TORCH) core curriculum, planned and actual	
Proposed curriculum	Actual curriculum, year 1*
Lectures, workshops and seminars developed around case presentations; intended to form a common knowledge base, supplemented by in-depth course-work appropriate to the trainee's career track.	Organized on the basis of disease clusters (listed below) of around 6 sessions apiece, in the form of seminars, journal clubs, case presentations, panel discussions and debates. Effort was made to ensure that topics within each cluster touched on all 4 CIHR pillars.
<p>Pillar 1: Biomedical research</p> <ul style="list-style-type: none"> • Molecular cardiovascular medicine • Response to injury in the cardiovascular system • Evaluation of risk: quantification through modelling • Coagulation in the cardiovascular system • Inflammation in the cardiovascular system 	<ul style="list-style-type: none"> • Heart failure • Electrophysiology and syncope • Stroke • Congenital heart disease • Hypertension • Atherosclerosis: coronary disease (sessions I and II)
<p>Pillar 2: Clinical science and research</p> <ul style="list-style-type: none"> • Genetic counselling • Evidenced-based cardiovascular practise • Primary and secondary prevention • Modulators of risk: — Lipoprotein abnormalities — Exercise and physical conditioning 	<p>Longitudinal themes were not only incorporated into cluster sessions but also presented in stand-alone lectures between topic clusters:</p> <ul style="list-style-type: none"> • Statistics • Research design • Molecular techniques and genetics • Health care policy and administration
<p>Pillar 3: Research on health systems and services</p> <ul style="list-style-type: none"> • Principles of good clinical practice • The Canadian regulatory environment • Health care economics 	<p>"Real world" skills covered in a workshop were also spread throughout the curriculum between or within disease clusters:</p> <ul style="list-style-type: none"> • How to review a scientific paper • Grant writing • Research-in-progress reports • Ethics • Scientific communication: giving presentations
<p>Pillar 4: Research on the health of populations and its influences</p> <ul style="list-style-type: none"> • International and global research perspectives • Measures of quality of life • Modulators of risk: — Behaviour change — Social and economic risk conditions 	
<p>Science methodology and "real world" skills:</p> <ul style="list-style-type: none"> • Ethics of clinical research • Scientific integrity • The industrial-academic interface • Patent protection • Principles of care in animal research • Research design • Quantitative metrics • Biostatistics 	<p>Career development and the building of research careers were addressed, as well:</p> <ul style="list-style-type: none"> • Perspectives from government, community, industry and academia • The art of negotiation • Striking the right balance between personal and professional development • Career planning • Building a curriculum vitae
* 2002/03; consisted of 48 one-hour sessions and 1 workshop.	

Several groups or organizations have featured TORCH in articles in the public domain or in promotional material associated with their own objectives.^{12,13} In addition to CIHR and 2 of its institutes (those of Gender and Health, and Circulatory Respiratory Health), the Heart and Stroke Foundation of Canada and the Alberta Heritage Foundation for Medical Research have entered into partnership to subsidize the program.

Based on the feedback from trainees and mentors after our first year of operation, there appears to be excitement and enthusiasm about and engagement in this new approach to research training. We note a real appreciation that its innovative design, components and faculty commitment, coupled with a unique and heterogeneous group of trainees, provide a hitherto unavailable program that promises to add genuine value to the development of those destined for a career in cardiovascular research.

In conclusion, TORCH is a novel research-training program of a transdisciplinary nature, incorporating an innovative design and approach to the mentoring of trainees. In the course of integrating 2 Alberta university campuses, it transcends the usual boundaries of existing training programs and aims to set a new national standard for cardiovascular research training. Our early experience with this unique approach has been encouraging, and we are looking forward to achieving our longer-term goals.

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