TRAINEE SECTION

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The KRESCENT Program: An initiative to match supply and demand for kidney research in Canada

Abstract

Background: The prevalence of kidney disease is rising in Canada, and new approaches to prevention, diagnosis, and treatment are required. A kidney research training strategy, which enhances capacity while fostering collaboration and knowledge translation, may help to address this health care problem.

Purpose: This manuscript describes the Kidney Research Scientist Core Education and National Training (KRESCENT) Program that was launched in 2004 with a major goal to enhance kidney research capacity in Canada.

Features: KRESCENT is an innovative training program, which recruits from a variety of research disciplines, and emphasizes multi-disciplinary research approaches, team-based collaboration and knowledge translation. The program provides salary support for post-doctoral fellows, new investigators and allied health doctoral trainees, and also offers core curriculum and mentorship support. The curriculum involves knowledge acquisition, application and integration and uses workshops and web-based problem modules to enhance research skills. Training in methodological approaches and career development is also included. Initial evaluation of KRESCENT suggests that kidney research capacity in Canada has increased, and trainees have a high success rate in obtaining academic positions (~88%) and peer-review grant support (~50%).

Summary: KRESCENT represents a novel collaborative approach to kidney research training in Canada that may serve as a suitable model for training in other countries, or in other medical disciplines.

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The problem of chronic kidney disease and the need to enhance research capacity

Chronic Kidney Disease (CKD) is estimated to affect between 0.65 and 1.2 million Canadians [1]. At the end of 2008, there were more than 36,600 people with end-stage renal disease (ESRD) in Canada; an increase of 57% since 1999 [2]. Much of this growth has been attributed to the rising prevalence of type 2 diabetes and to the aging population. Approximately 40% of all patients in Canada requiring renal replacement therapy (dialysis or kidney transplantation) also have diabetes, and most patients are older than 60 years. ESRD is associated with significant morbidity, mortality and resource utilization, and thus has a major impact on an already burdened health care system. Indeed, individuals with established CKD have higher health care resource utilization prior to dialysis than those with either diabetes or cardiovascular disease alone [3].

Targeted research into the causes, prevention, and treatment of all forms of kidney disease represents an important strategy to address this problem. To date, substantial research efforts in Canada have led to important discoveries affecting people living with kidney disease, including advances in ambulatory peritoneal dialysis [4], nocturnal hemodialysis [5,6] and insights into the etiology of inherited kidney diseases [7], amongst others. Despite these important breakthroughs, the increasing recognition of CKD as a public health problem provides support for training increased numbers of kidney research scientists in Canada. Indeed, the Horizons Conference in 1999, which addressed the state of kidney research in Canada, was followed by a National Research Coalition Task Force Report, prepared jointly by the Canadian Society of Nephrology (CSN) and the Kidney Foundation of Canada (KFOC), which called for enhanced kidney research capacity as a first priority [8].

Several barriers exist to the enhancement of kidney research training, including the increasing demands on clinician specialists who might otherwise be involved in research to provide improved clinical care. In addition, trainees may perceive that careers in research are less rewarding financially than those focused on clinical care, and are accompanied by significant challenges related to obtaining grants, developing collaborations, and securing adequate time protection, in comparison with other pursuits such as clinical teaching or administration. In its Strategic Plan for 2009-2014, the Canadian Institutes of Health Research (CIHR) has noted the importance of knowledge translation, in addition to knowledge creation, and the need to build networks of researchers with multi-disciplinary team-based research approaches [9]. This strategy, while innovative, may be challenging for those on traditional training

tracks that emphasize excellence in single disciplines with commitment to specific methodologies or topic areas. For young investigators, the research environment may therefore seem confusing, and traditional training methods may be suboptimal. For the next generation of kidney research scientists in Canada, novel approaches to training are required that address the current barriers to choosing a research career, and that foster the development of multi-disciplinary approaches and knowledge transfer.

KRESCENT: A response to the need and changing environment

The Kidney Research Scientist Core Education and National Training (KRESCENT) Program was developed as a national strategy to ensure the sustainability of innovative kidney-related research in Canada. KRESCENT is a unique joint collaboration between a national professional specialty society (CSN), a major national charitable organization (KFOC) and the CIHR (Institute of Nutrition, Metabolism, and Diabetes, and Institute of Circulatory and Respiratory Health).

The KRESCENT program originated directly from the National Research Coalition Task Force Report [8]. In addition to identifying the need to build kidney research capacity in Canada, the report recommended the development of productive partnerships and leveraging of resources to ensure a sustainable kidney research environment. After a series of consultative workshops and collaborations, KRESCENT was officially launched with the first call for applications in December 2004, and enrolment of the first seven trainees in July 2005. As of June 2010, there have been 41 KRESCENT trainees, and of these, 20 have successfully completed a 3-year cycle of the program.

KRESCENT: Administrative structure and funding strategy

The administrative structure for KRESCENT consists of a Governing Council (with representation from the three founding partners: CSN, KFOC and CIHR), to provide strategic leadership and governance for successful implementation of the program and to oversee the functions of a Program Steering Committee, a Peer Review Committee, a Curriculum Task Force and a Mentors Group. Each of the three founding partners of KRESCENT has made substantial financial contributions to the program, which total ~50% of the annual funding requirements. The membership of the CSN supported KRESCENT by adopting a 40% increase in annual membership dues (an additional \$100/person-year). To our knowledge, this is

the first initiative of its kind to be supported by a national physicians' group in this manner. Financial commitments were also obtained from the Fonds de recherche en santé du Québec (FRSQ), the Canadian Association of Nephrology Social Workers (CANSW), and the private sector, with major contributions from Shire BioChem Inc., Ortho Biotech Inc., Amgen Canada, Roche Ltd., Merck-Frosst Canada Ltd., Maple Leaf Foods of Canada and Baxter Corp.

Objectives and features of the KRESCENT Program

The major goals of KRESCENT are to enhance kidney research capacity in Canada by training the next generation of research leaders, and to foster collaborative research and knowledge translation across the four thematic streams of research, as identified by the CIHR: 1) Biomedical, 2) Clinical, 3) Health systems and services, and 4) Social, cultural, environmental, and population health. KRESCENT has several unique features: a) a national scope, with training opportunities open to applicants from all academic centers in Canada, b) recruitment of trainees from multiple research disciplines, c) a core curriculum, focused on themes pertinent to kidney research, and d) provision of mentorship support.

Given the perceptions of financial disincentives to research and uncertainty in the funding environment, KRESCENT provides competitive salary support for up to three years to individuals in one of three categories of research training: Allied Health Doctoral Scholarships (\$40,000/year), Fellowships (\$55,000-\$65,000/year) and New Investigator Awards (\$60,000-\$70,000/year).

1. Allied Health Doctoral Scholarships: In Canada, there is a perceived relative paucity of PhD scientists in these areas (e.g. nursing, dietetics, social sciences, pharmacy, etc.). The program, therefore, supports allied health professionals who are involved in kidney research and who are enrolled in postgraduate PhD programs at institutions within Canada. These individuals must be research-focused (at least 80% of time protected for research), and demonstrate commitment to a future career in kidney research in Canada.
2. Fellowships: This category includes the post-doctoral trainee, with an MD and/or PhD degree, destined for a career as a research scientist. KRESCENT fellowships may be undertaken at institutions outside of Canada, as long as the trainee's application demonstrates an intention to return to Canada once training is completed to establish a career in kidney research.

TABLE 1. KRESCENT Curriculum: The Principles of Adult Learning

Adults are motivated by learning that:

- ▶ Is perceived to be relevant
- ▶ Is based upon and builds upon previous experiences
- ▶ Is participatory and actively involves them
- ▶ Is focused on problems
- ▶ Is designed so that they can take responsibility for their own learning
- ▶ Can be applied to practice immediately
- ▶ Involves cycles of action and reflection
- ▶ Is based on mutual trust and respect

3. New Investigator Awards: This category includes Faculty staff, with an MD and/or PhD degree, at academic centers in Canada, and within three years of the first academic appointment (Assistant Professor or equivalent). It is during this period that investigators are likely to benefit from adequate time protection, salary support, and mentorship to build their research programs and acquire sufficient peer review funding. To be eligible for KRESCENT funding, the institution must guarantee that 80% of the awardee's time will be protected for research. In addition to salary support, New Investigators receive one-time infrastructure funding, matched by their institution.

The KRESCENT Core Curriculum

Overview

The core curriculum of KRESCENT is designed to expose all trainees, irrespective of focus (basic or clinical science), to the entire spectrum of kidney research, and enhance the ability to understand key research questions, approaches and methodologies relevant to each of the four streams of health research. The curriculum has been constructed using the principles of adult learning (Table 1) [10]. Importantly, the curriculum provides training focused on kidney research issues that are not likely to be addressed within any one institution. As such, it complements formal course work in which trainees are engaged, and is distinct from the trainees' specific research projects or programs.

The curriculum is implemented by a Task Force consisting of established Canadian kidney research investigators, trainee representatives, and administrative staff. The Task Force meets by monthly teleconference to evaluate the content of the program and to plan workshops and other aspects of the curriculum. Completion of the KRESCENT curriculum is mandatory for all trainees, and includes level-specific requirements. Adhering to a philosophy of iterative processes and responsive-

TABLE 2. Components of the KRESCENT Core Curriculum

- ▶ Career Development sessions
- ▶ Core lectures (Knowledge Acquisition Modules, KAcMs)
- ▶ Problem-based modules (Web-based)
 - ▶ Knowledge Application Modules (KAMs)
 - ▶ Knowledge Integration Modules (KIMs)
- ▶ Transdisciplinary Research Challenge (first year trainees)
- ▶ Trainee Research Program presentations
- ▶ Trainee Summary Presentations
- ▶ Research Tools Seminars
- ▶ The Industry/Academic interface: Seminars from industry funders

ness, the curriculum has undergone progressive changes based on the feedback provided by trainees since 2004. Specifically, the program has recognized that the priority for all trainees is the successful completion of their individual research projects. Thus the curriculum is constructed to be supplementary and enabling, rather than time-consuming or burdensome. Evaluation of all assignments is a requisite part of the curriculum, and invited content experts provide written and verbal feedback on a regular basis. Canadian scientists have been recruited to the KRESCENT curriculum committee, deliver training modules and lectures, and act as role models and content experts as well.

Critical elements of the curriculum

The KRESCENT curriculum has several components (Table 2), which are largely delivered at 2-day workshops held twice yearly. The Fall workshop is typically held in Montreal or Toronto, and the Spring workshop is held in the Canadian city hosting the annual meeting of the CSN, and immediately precedes that meeting. Attendance at the workshops is a mandatory component of training, and is supported financially by the KRESCENT program. Workshops are constructed to ensure focused interaction amongst KRESCENT trainees, who come from a diverse range of disciplines of kidney research. Thus the interactions include individuals either involved in basic science, clinical or translational research, epidemiology, or other research streams, at various stages of their training. For each of the workshop exercises, the trainees are separated into teams, ensuring a multiplicity of interests and skill sets.

In the periods between workshops, assignments are completed either individually or in teams (with periodic teleconferences supported by the program). This encourages interaction amongst the trainees as they address and complete the problem-based tasks or specific modules that are posted on the KRESCENT website.

TABLE 3. KRESCENT Core Curriculum Topics*

- ▶ Diabetic Nephropathy
- ▶ Chronic Kidney Disease and its Complications
- ▶ End-Stage Renal Disease and Dialysis Research
- ▶ Nephron Transport
- ▶ Hypertension and Kidney Disease
- ▶ Kidney Development and Genetic Disorders
- ▶ Glomerular Disease
- ▶ Acute Kidney Injury
- ▶ Renal Transplantation/Immunology

* Each topic is covered at least once at a workshop during a 3-year cycle

KRESCENT workshops: overview

The formats for the KRESCENT workshops place emphasis on both content and process themes. Career Development Sessions focus on key issues pertinent to academic advancement. These are generally informal interactive sessions, led by one or two Canadian kidney research scientists with particular expertise or interest in that area. To date, a number of topics have been addressed, including progression along the academic pathway, grant-writing skills, time protection, and gender-specific issues in career development.

For instance, at the KRESCENT workshop in May 2009, the Career Development Session involved a mock peer review grant panel, consisting of KRESCENT trainees, who also served in the positions of panel Chair and Scientific Officer. The experience was intended to mimic an actual peer review process, and trainees were asked to submit early drafts of their actual intended grant proposals, using the guidelines specified for operating grants at the KFOC. The proposals were distributed in advance amongst members of the panel, with two internal reviewers per grant and a grant “reader”, represented by an established kidney research scientist. The grants were reviewed in sequence by the panel according to the usual procedures for peer review, with attention to ethics consideration, and conflict of interest, in addition to overall scientific merit. Through this specific exercise, the trainees gained valuable feedback regarding their proposed research plans, and the importance of conveying information clearly and concisely. Most importantly, the exercise was instrumental in fostering an appreciation for all aspects of peer review process, including the merits of exhibiting fairness and constructive criticism, to which most of the trainees had never been exposed.

The KRESCENT workshops also ensure acquisition of core knowledge within each of nine identified key topics pertinent to kidney research (Table 3). A major objective of the curriculum is to introduce trainees to research questions, ap-

FIGURE 1. Hierarchical learning process involved in the KRESCENT curriculum. Topics are presented to the trainees in sequence, beginning with a core lecture (Knowledge Acquisition Module, KACM), followed by problem-based modules that require knowledge application (Knowledge Application Module, KAM), and then analysis, synthesis, and evaluation (Knowledge Integration Module, KIM).

proaches and advances that cross two or more of the themes of health research relevant to the specific core topic, and to foster a critical approach to methodology, integrative approaches to problem resolution and applied science.

Furthermore, a goal is for the trainee to progress through increasingly complex stages of learning around the topic (Figure 1). The first component involves acquiring and understanding information, via “Knowledge Acquisition Modules” (KACMs). These consist of at least two core lectures on the topic (by content experts), with one typically involving basic science and one directed at a clinical, health systems or social, cultural, environmental or population health issue pertinent to the topic. KACMs are meant to be interactive (20-25 min presentation, followed by 15-20 min of questions/discussion).

The lectures form the basis for the next component of learning, consisting of a ‘problem-based task’ that is executed in teams, with each team assigned a problem that requires application of the acquired information to a research question that typically involves a single stream of research (Knowledge Application Modules, or KAMs). Team members work together on these problems on site, and then present their proposals orally at the workshop. The problems are subsequently posted as modules on the KRESCENT website (www.krescent.ca), and individual trainees must provide written responses on-line. The KRESCENT website is password-protected and specifically intended for program trainees. Upon completion of the web-based problem modules, trainees receive written feedback from the content experts, forming a component of their evaluation.

Building on the hierarchy of adult learning, the third component of learning requires trainees to complete a “Knowledge Integration Module” (KIM), which involves analyzing, synthesizing and evaluating information and often requires teamwork, since the problem crosses two or more research streams. KIMs are typically posted on the KRESCENT website for completion, but may also be compulsory exercises at the workshops. As with KAMs, the KIMs are evaluated by content experts and scientists who are directly involved in the KRESCENT program, and feedback is provided within six weeks of submission. An example of a KAM and its accompanying KIM, from the November, 2009 workshop, is provided in the supplementary materials.

Fostering transdisciplinary problem solving

The “Transdisciplinary Research Challenge”, offered to all first-year trainees at their first KRESCENT workshop, aims to develop skills in communication across disciplines involved in kidney research, to gain an appreciation for discipline-specific methodologies, and to enhance skills that will facilitate involvement in translational research opportunities and research teams. During this exercise the trainees address complex research questions that might require expertise in several disciplines. They are introduced to a kidney research-relevant topic, and working in teams (typically six or seven trainees per team), develop a research proposal addressing some aspect of the topic, which includes at least three of the four health research streams.

Skills in presentation and synthesis are enhanced and evaluated in that the trainees present their proposals to their peers and scientist members of the KRESCENT program, followed by real-time discussion and feedback. To synthesize the experience, and ensure some degree of retention of key con-

cepts, the trainee teams must prepare written summaries of their proposals, which are posted on the KRESCENT website and formally evaluated by content experts.

While the transdisciplinary research challenge represents a mock exercise, it encourages trainees to develop novel strategies and approaches to research questions, involving input from different disciplines, but still founded on established scientific principles. Transdisciplinary research training using these principles has been described in other research areas [12-14]. A variety of research topics has been addressed by these workshop exercises, including the relevance of animal models of diabetic nephropathy to human disease, research strategies to address kidney development, reducing cardiovascular risk in renal transplantation, and the role of stem cells in treatment of kidney disease. The transdisciplinary research challenge fosters relationships, which may be continued after the trainees leave the program, enhances critical thinking skills, and encourages open-mindedness. These skills will hopefully be propagated after the awardee leaves the program.

Broadening the horizons: Sharing of research projects

In addition to these specific exercises, the KRESCENT workshops feature seminars focused on research tools (e.g. data management, qualitative research methods, randomized controlled clinical trials in nephrology and proteomics), as well as presentations by representatives from the private sector on topics related to the interface between academia and industry.

In the first year of the program, the trainee is required to present an overview of his/her research program to the other trainees and KRESCENT staff, focusing on its overall objectives, approaches and methodologies, and its broad relevance to the care of people affected by kidney disease. The purpose of this presentation is to enhance skills in oral presentation related to research. Feedback is provided on site, and via written communication from the Curriculum Task Force. In the final year of KRESCENT training (typically during the third year) the trainee is asked to deliver an informal summary presentation outlining his/her research experience and its milestones, as well as career and future research plans.

KRESCENT Mentorship Program

Trainees in the "New Investigator" category of KRESCENT are provided with mentorship support during the three year cycle of funding, since it is recognized that not all institutions have formal mentorship arrangements for new faculty members. This early career period is one of transition to research independence, and stands to benefit from the support and

counsel of a seasoned investigator. The KRESCENT Mentorship Group recommends a mentor for each New Investigator, based on research interests that align with the trainee, as well as level of experience, stature in the research community, and willingness to assume this role. Importantly, the research mentor is not required to be located at the same institution as the trainee. The mentor liaises with the trainee on a quarterly basis and addresses a variety of topics, including barriers and opportunities for research progress, time protection, infrastructure requirements, funding opportunities, career planning, and other issues that might impact on the trainee's research experience. An important role of the mentor is to advocate on behalf of the trainee in situations where deficiencies in the local institutional environment could have a negative impact on research progress and career development.

Informal mentorship is provided to all trainees, via face-to-face meetings between Program scientists and individual trainees, and is held once yearly - during the workshops. All trainees are required to document their research progress in a "KRESCENT Passport" document, which resembles an abbreviated curriculum vitae and which contains information about publications (pending, submitted, and accepted), grants, meetings attended, memberships, and evaluations of workshop problem modules. At these meetings, the passport is reviewed with the trainee, and advice is provided about career planning and research productivity. This is especially pertinent as fellowship trainees enter their third year, when it is expected that they will be considering research appointment opportunities at academic centres and writing their first peer review grants.

Evaluation of KRESCENT

Assessment by trainees

In 2010, KRESCENT entered its sixth year of operation. Since its inception, all trainees have been asked to submit anonymous written evaluations following each of the KRESCENT workshops. The evaluation forms ask the trainee to rate their degree of agreement with statements regarding each component of the workshop on a scale from 1-5, where 1 represents strong disagreement and 5 indicates strong agreement (Table 4A, B). The forms also include sections for the trainees to offer additional comments on each workshop session, the workshop as a whole, and to elaborate on the items that they liked best and least. Examples of written comments from the trainees are provided in Table 4. Objective review of the submitted comments supports the notion that the core curriculum component has been a major success. Trainees have expressed enthusiasm for all components of the curriculum, and have embraced the empha-

TABLE 4A. KRESCENT Lecture Evaluation Form

	Average Scores				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
This was an effective format suitable for the topic	4.4				
The content of this session was relevant to the type of research that I am involved in	4.2				
The objectives for this session were clearly outlined	4.6				
The instructor for this session had good knowledge of the topic	4.8				
The instructor for this session was enthusiastic about the topic	4.8				
The key points for this session were clearly outlined	4.4				
This session covered too much content	1.8				
This session covered too little content	1.9				
This session was poorly organized	1.8				
This session flowed smoothly	4.2				
I felt engaged during this session	4.2				
I was an active participant during this session	3.9				
My attention was maintained during this session	4.4				
The objectives for this session were fully met	4.4				
Overall, this session met my learning needs	4.4				

Nov. 2009 workshop - shown are averages of responses submitted by 18 trainees

sis on transdisciplinary training and team work, citing in particular the value of gaining skills in transdisciplinary communication, which is not necessarily a feature of traditional research training programs. Career development sessions have been well-received, with particular praise for the sessions devoted to grant-writing and peer review. The curriculum has also been modified to ensure relevance, and appropriate workload requirements in the context of other commitments.

Measures of success

A formal external evaluation of KRESCENT has not yet been performed. Whether the program will achieve its goal to establish a new generation of kidney scientists with increased ability and opportunity to perform transdisciplinary research remains to be determined. However, clear indicators do exist that the program has been successful in certain respects. First, KRESCENT has been national in scope, with a broad distribution of Canadian-based trainees across the provinces (13 in Ontario, eight in Quebec, four in Alberta, one in British Columbia, and one in Prince Edward Island). Second, there is evidence that

TABLE 4B. Overall Workshop Evaluation and Comments: Shown are averages of responses submitted by 18 trainees. Below table 4B are comments submitted by trainees related to the workshop. Title of lecture deleted (---).

	Average Scores				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
Overall, the Workshop met my learning needs	4.5				
The objectives for the Workshop were fully met	4.5				
The Workshop flowed smoothly	4.5				
The pre-meeting literature was relevant to the Workshop	4.0				
There was sufficient time for discussion and networking at the Workshop	3.8				
Pre-meeting general information was satisfactory (i.e. travel information etc.)	4.7				
The Workshop was well organized	4.6				

What did you like most about the meeting?

- Networking
- Multidisciplinary focus of feature (i.e. emphasis on translational aspects)
- I enjoyed it!
- KAM; very applicable and thought provoking
- Talks were excellent
- Always well organized, well run
- Saturday morning session
- Team problem-solving, learning about various kidney diseases
- Career advice session
- Disciplined educational meeting

What did you like least?

- Too much glomerulus
- Need some time halfway through day (e.g. lunch) for break.
- --- lecture.
- Overruns (predictable), The last 20 min. of the --- lecture.
- Dense curriculum

Please offer additional comments on the workshop (e.g. topics, speakers, etc.) including ways in which we could improve it:

- Too much glomerulus, what about the tubule?
- Continues to be excellent

KRESCENT has enhanced kidney research capacity in Canada. In the five year period before KRESCENT (2000-2004), the KFOC provided salary support grants to 42 Canadian trainees in the fellowship or new investigator categories. In the first five years after the launch of KRESCENT, the total number of training awards to the KFOC and KRESCENT programs increased to 61, representing a 45% increase in kidney research training positions. Applications for kidney research support have also risen sharply since the launch of KRESCENT in 2005 (from 117 from 2000-2004 to 251 from 2005-2009, an increase of 214.5%). Of the 17 trainees who have completed the fellowship stage of KRESCENT, 15 have already secured academic research positions at the Assistant Professor level (88%). Importantly, of the nine post-doctoral KRESCENT awardees who completed training outside of Canada, only one has not returned to Canada (11%). Third, approximately 50% of trainees who have completed the program have since secured operating grant support from peer review agencies, which represents a relatively high success rate, considering that funding rates for operating grants since 2008 are 18-23% at CIHR and 33% at KFOC. Finally, although the numbers are small, there has been a trend towards increasing numbers of applications to KRESCENT from trainees in non-biomedical research streams, as well as applications involving more than one stream of research. Of the 18 current trainees, 12 are involved in only one stream of research (nine basic, two clinical, and one health systems research), whereas 6 conduct research in more than one stream (four basic/clinical, one clinical/health systems, and one clinical/health systems/population health). If this trend continues, the training experience is likely to be enhanced for all participants in the program.

One limitation of the program has been a relatively low number of successful applicants from the Allied Health streams since 2004 (three trainees). In 2011, the Steering Committee expects to implement a policy to secure one Allied Health position in KRESCENT on an annual basis.

Summary

The KRESCENT Program is based on a unique collaboration of multiple stakeholders committed to improving the health of individuals affected by kidney disease in Canada. KRESCENT represents an enriched research training experience that embodies the value and importance of transdisciplinary approaches and team building, and prepares individuals for kidney research careers in Canada. The core curriculum, based on adult learning principles, is an especially innovative feature of the program. Initial data suggest that KRESCENT is meeting its goal to enhance kidney research capacity by training the

next generation of leading scientists in Canada. With the ongoing support of its founding partners, KRESCENT can continue to evolve and serve as a model for other countries involved in the training of kidney research scientists, or indeed for research training in other medical specialties.

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Appendix 1

KRESCENT – November 2009 Workshop

Knowledge Application Module (KAM)

Session: Translational Research Interactive Workshop
Lecture: Proteomics, genomics, and metabolomics in kidney disease populations: principles, pitfalls and promises
Content Expert: Dr. Peter Nickerson

Objectives

By the end of this module, the trainee will be able to:

- Design a translational study to discover novel targets for hypothesis generation
- Understand the key steps in 'omic' study design
- Discuss strategies to control for possible "confounders" in the design and conduct of a study

Assignment

Acute kidney injury (AKI) is a common event associated with CABG surgery in your institution. From your reading, it is clear the mechanisms associated with AKI are poorly understood and you have decided to design a research study to identify the biologic pathways associated with AKI in these patients. Your goals are two fold: [1] to test the hypothesis that biomarker(s) exist pre or intra op that will predict who is going to develop AKI post-op. [2] to test the hypothesis that an "omic" approach can be used to identify novel pathways of injury associated with AKI, which in turn may be targets for blockade to prevent AKI (something for a future study).

Outline the following:

1. What "omic" approach would you propose to use?
2. What are the strengths or weaknesses of your approach vs. alternative "omic" approaches?
3. What biologic material are you going to focus your study on and why?
4. What are the key variables you are going to have to control for in your study design?
5. Assuming you identify a novel biomarker in your studies, what would be your next steps in confirming the usefulness of that biomarker?

References

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- Reeve J, et al. Diagnosing rejection in renal transplants: a comparison of molecular- and histopathology-based approaches. *Am J Transplant* (2009) 9:1-9
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Appendix 2

KRESCENT – November 2009 Workshop

Knowledge Integration Module (KIM)

Session:	Translational Research Interactive Workshop
Lecture:	Proteomics, genomics, and metabolomics in kidney disease populations: principles, pitfalls and promises
Content Expert:	Dr. Peter Nickerson

Objectives

By the end of this module, the trainee will be able to:

- Design a multi-centre clinical study to investigate the validity of a newly discovered surrogate biomarker for acute kidney injury
- Describe the team members required to carry out these studies
- Describe the importance of collaboration between investigators with different skill sets in addressing these questions

Assignment

A request for proposals (RFA) has been issued for a Network Grant co-sponsored by the Kidney Foundation of Canada, the CIHR Institute for Cardiac and Respiratory Health. The purpose of the RFA is to develop novel tools to identify patients at risk for AKI associated with CABG surgery. The goal, once these predictive tools are validated, is to design therapeutic intervention trials to prevent AKI in those patients at high risk for AKI, given that those who do develop AKI following CABG surgery have an extremely high mortality rate.

You have developed in your lab a serum and urine biomarker that in your discovery "omic" cohort studies ($n=25$ patients with AKI vs. 25 patients without AKI) has been found to correlate highly ($R^2=0.90$) with the risk for the development of AKI post-op. You have decided to apply to the RFA and now you must assemble a team of investigators to design and execute your project plan that covers at least 2 pillars of CIHR (population health, biomedical science, clinical sciences or health services).

- A. Describe your team and the rationale for their selection.
- B. Describe in a series of studies (observational or interventional) how you might establish a research program which are able to address the following questions:
 1. What patient variables are associated with risk for AKI?
 2. What are the key elements of the study to control for?
 3. How robust is the biomarker(s) relative to clinical predictors of risk for AKI as tools for guiding therapy?