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Training in the conduct of population-based multi-site and multi-disciplinary studies: the Cancer Research Network's Scholars program

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Abstract

Background—Expanding the research capacity of large research networks within health care delivery systems such as the Cancer Research Network (CRN) requires strategically training both embedded and external investigators in necessary skills for this purpose.

Methods—We describe the goals and components of the CRN Scholars Program, a training program developed to increase the capacity for cancer research conducted within the network's participating sites.

Results—The CRN Scholars training program was launched in 2007 as a 22-month training activity to assist junior investigators from member sites to develop independent and sustainable research programs within the CRN environment. As a result of an increased emphasis within the CRN on promoting collaborations with external research institutions, the 2013 Scholars' program began recruiting junior investigators from institutions outside the CRN. Based on involvement of this broader population and feedback from the prior Scholar cohorts, the program has honed its focus on specific opportunities and issues encountered in conducting cancer research within networks of health care delivery systems.

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Conclusions—Research within large multi-site networks affords collaborative research opportunities. Efficiency and effectiveness of working within networks is accelerated by strategic and mentored navigation. Investment in training programs specific to these settings provides the opportunity to improve multi-disciplinary and multi-institutional collaboration, particularly for junior investigators.

Keywords

Cancer research; training; health care delivery systems; multi-disciplinary research; Cancer Research Network; health services research

Introduction

The Cancer Research Network (CRN)¹ is a National Cancer Institute (NCI)-funded consortium of research centers set in mixed-model and integrated health care delivery organizations. Its purpose is to support and foster collaborative cancer research conducted among the participating sites. Key characteristics include researchers who are embedded in these health care organizations; access to standardized electronic databases capturing clinical and administrative data for millions of members, and the capability of following defined populations over a long period of time in a "real world" community setting. CRN-based research can be conducted across the cancer spectrum, from primary prevention and early detection to active treatment, surveillance and follow-up, and palliative care. Our close ties to clinical and operational partners facilitate translation of research findings into clinical practice.

To address the full scope of cancer research using the CRN's extensive data resources on large defined populations within health care systems, enhanced investigator capacity is needed. Strategically expanding research capacity within the CRN requires training investigators based at CRN member sites as well as investigators from institutions outside of the CRN to develop the skills necessary for conducting research within health care delivery systems.

Working within the health care settings of the CRN requires skills and specialized knowledge not typically acquired in most current training programs, particularly those skills conducive to multi-site and multi-disciplinary research set in delivery systems. Research within such systems requires: an understanding of the strengths of a complex array of clinical and claims data while appreciating the limitations and potential for misuse or misinterpretation; the ability to engage clinical and operational leadership in developing and executing research proposals; sensitivity to stakeholder needs and perspectives; leadership skills for collaborative research across institutional and disciplinary divisions; and constant diligence to ensure research does not impede or adversely influence clinical efficiency and safety. For investigators external to the member health systems, it is critical that they learn how to identify and engage internal investigators to collaborate on feasible research proposals.

Since 2007, the CRN Scholars Program has established a solid track record of targeted training, mentoring, and professional development support for early career investigators.

Despite growing interest in real-world platforms for health research, few programs are specifically designed to train junior investigators in best practices for research within integrated and mixed-model health care delivery systems. This manuscript describes the goals and components of the CRN Scholars Program, the progression of the program from training internal investigators to a mix of internal and external investigators, and the evolution of the content of the training program. Aspects of the CRN Scholars Program may help inform institutions considering the development of similar programs to expand research in health care systems or within large, collaborative, multi-disciplinary research networks.

Overview of the program

To date, there have been four cohorts of CRN Scholars: Cohort I (2007–2009); Cohort II (2009–2011), Cohort III (2012–2015) and Cohort IV (2015–2017). Over this time, the Scholars program has evolved in several ways (Table 1). The CRN Scholars training program was launched in 2007 as a 22-month training activity aimed to help junior investigators from CRN member sites develop research independence within the CRN environment and make use of CRN research resources. In the first two cycles, 28 junior investigators from 14 CRN sites or closely affiliated academic centers completed the program, progressing toward independent research careers (Table 1). The program created a forum for exposing Scholars to a broad range of expertise and resources in the CRN, as well as to external experts in cancer research.

In Fall 2012, the NCI re-funded the CRN as a U24 Resource-Related Research Cooperative Agreement, with an expanded primary focus to develop and support collaborative health system research linking cancer investigators from outside the CRN delivery systems with internal researchers. To complement this expansion, the CRN Scholars program now includes a broadened recruitment of junior investigators from academic and other cancer research institutions. The length of the program has been expanded to 26 months in order to allow sufficient time to collect and translate preliminary data into a successfully funded research proposal. Additionally, an earlier emphasis on manuscript submission goals has shifted toward development of fundable research proposals.

The broadened CRN Scholars program expanded its design to: 1) train junior investigators in the methods, culture, and research opportunities available through the CRN; 2) enable Scholars to establish research collaborations with CRN-affiliated researchers and access CRN resources; 3) support and mentor Scholars to achieve two critical career landmarks of independent investigators (becoming PI on a successful R01 or equivalent grant and/or becoming first author on an original peer-reviewed research paper derived from research conducted within one or more CRN sites); and 4) foster and facilitate research career development focusing on using integrated and mixed-model health care systems as a means for answering critical questions on improving the quality, outcomes, and value of medical care and population health. The core features of the Scholars program leverage the CRN's unique strengths (e.g., the HMO Research Network Virtual Data Warehouse (VDW)² and clinical and administrative data integration) and focus on collaborating with stakeholders from the network's sites (e.g., clinical/operational leaders), developing and using complex multisite data, and conducting research within learning health care systems.^{3,4}

Another important change to the program, implemented with Cohort III in 2013, is that Scholars are required to have 20% protected time (10% provided by the CRN and 10% matched by the Scholar's institution) to participate in program activities, pursue their proposed projects and develop grant applications and manuscripts. The CRN does not provide additional funds to conduct projects; thus, Scholars must seek out funding to support their projects, either from their own institutions, competitive application for CRN pilot funds, or other sources. The CRN provides support for preparatory-to-research queries and data acquisition to support research proposals.⁵

Eligibility and Selection

CRN Scholars are selected through a competitive process from among doctoral-level (MD/PhD or equivalent) applicants who meet the NIH criteria for New and Early Stage Investigator status⁶ and demonstrate a strong commitment to a research career in population-based, clinical or translational cancer research set within health care delivery systems that are aligned with pre-specified research priority areas.⁷ Senior internal and external investigators are identified to review applications using criteria adapted from NIH review criteria for K awards.

Our review process was designed to ensure that the research interests and career goals of prospective Scholars complement the overall research priorities of the CRN and to provide representation across scientific disciplines and organizations. Research disciplines (and cancer sites of interest among the Scholars have varied widely. Professional backgrounds of Scholars in the first two cohorts included 21 PhDs with training in economics, epidemiology, health services research, biostatistics, psychology, nutrition, anthropology, sociology, clinical pharmacy, pharmacology and genetics, and 7 MDs trained in dermatology, gastroenterology, oncology, family practice, pediatrics, internal medicine, surgery, and infectious disease. The diversity of research backgrounds and cancer-related research topics promotes development of a cross-disciplinary perspective when discussing collaborative proposals. We do not have a pre-specified ratio of MDs to PhDs, internal to external Scholars, or specific cancer sites. However, there is consensus among the Cohort III participants that having a mix of each of these elements is important to the success of the group, fosters important peer-mentorship, and reduces the sense of peer competition.

Program structure

Figure 1 provides an overview of the goals, curriculum and program components for the Scholars program.

Mentorship

The Scholars program is designed to complement, not replace, local mentorship; thus, all participants are required to have active local mentors. Each Scholar creates a mentorship plan that includes: 1) A primary mentor at the Scholar's home institution; 2) a 1:1 mentoring relationship with one of the Program Co-Directors; and 3) linkage with at least one CRN investigator. For external candidates, we have an explicit process of identifying CRN and external content experts for each Scholar. Together, these individuals serve as a mentorship

team that meets twice yearly by conference call to evaluate the Scholar's progress. Each Scholar develops a learning contract (eAppendix) in consultation with their mentorship team; these are considered living documents and are updated at each mentorship team meeting. The learning contract serves as a basis for periodically assessing goals and enables all mentors to serve as facilitators for meeting these goals.

Each Scholar meets with the assigned program mentor through monthly conference calls with additional contact as needed. Conference calls focus on immediate and emerging needs of the Scholar, including career advice and review of specific grant proposals and manuscripts.

Curriculum

Our current curriculum is based on principles of adult learning,^{8,9} in which participants identify their own needs and faculty act as facilitators. Scholars come to the program with varied levels of experience designing studies, working with health care data, publishing in the scientific literature, and preparing research proposals. Individual components of the curriculum are linked directly to the learning objectives of the Scholars. General skills development that have been emphasized across all cohorts include setting career objectives, leading multi-site studies, collaborating within the CRN, understanding strengths and weaknesses of CRN data resources including the HMO Research Network VDW,² developing proposals, and meeting logistical or interpersonal challenges.

In-person meetings

With Scholars being geographically dispersed (Figure 2), face-to-face meetings are a critical component for building a sense of community among the Program participants. Given their importance, we have increased our in-person Scholars Program meetings to twice yearly in conjunction with the annual HMO Research Network conference¹⁰ and CRN Steering Committee meetings to allow program leaders, mentors, and senior investigators from the CRN and NCI to participate. The timing of Scholars in-person meetings strategically overlaps with broader CRN-related activities to support Scholar engagement in richer discussions with CRN stakeholders and provide opportunities to network with potential future collaborators. The Scholars, in collaboration with the program co-Directors, set their meeting goals and agendas.

Videoconferencing Webinars

A central component of the program is bi-monthly 90-minute webinars for the full cohort. These sessions use proven distance-learning and virtual teamwork strategies.¹¹ Based on feedback from the first cohorts, regular contact every 2–3 weeks was viewed as important in building a sense of community. Meeting agenda are set by the Scholars, Co-Directors and the Program Coordinator to focus on topics most relevant to the Scholars as recommended for engaging adults in structured learning activities. Scholars take turns organizing and leading conference calls to gain experience setting an agenda, engaging other colleagues on a conference call, leading open discussions and tracking next steps and action items.

Commitment to continuous improvement

Roughly four times a year, topics are solicited from the Scholars themselves through web surveys, group conference calls and 1:1 meetings with the Program co-Directors. Each Scholar ranks suggested topics according to level of interest, priority, and appropriate meeting format (in person vs. webinar). There are key differences between the learning needs of Cohort III vs. Cohorts I and II (Tables 2 and 3). Some of these may be attributable to the changes in the most recent CRN funding cycle with its greater focus on establishing collaborations with external institutions and investigators, and some may also reflect additional training obtained by junior investigators before starting independent careers. Cohort III Scholars reported having prior training in research protocols and existing support in manuscript development and submission. Thus, the curriculum for Cohort III included a greater focus on understanding and working with CRN data, developing collaborative grant proposals, and understanding federal and foundation research review processes (Table 3).

Other opportunities

Scholars must seek out funding to support their projects, either from their own institutions, competitive application for CRN pilot funds, or other sources such as start-up funds or institutional pilot funds. CRN Pilot grants¹² have provided the opportunity for many Scholars to lead a project with one or more CRN sites and to gather preliminary data for larger external applications.

Scholars are considered full members of the CRN and are encouraged to participate in CRN Scientific Working Groups, contribute to brainstorming sessions for specific funding announcements, and develop and chair symposia for the annual HMORN conference. Scholars are also invited to sit on the publications committee, topic-specific writing committees, and to attend Steering Committee meetings. By participating in these activities, Scholars interact with CRN leaders and investigators from across the network on program-related tasks and learn how large, multi-institutional grants and cooperative agreements are carried out.

Leadership

Successful administration and management of the Scholars Program requires many individuals' involvement and commitment (Table 4). Most training programs have limited to no financial support for the training grant program director, principal investigator or mentors for trainees. Although many CRN sites are affiliated with schools of public health or other academic programs, with many CRN researchers having affiliated faculty appointments, the vast majority of investigators within CRN research institutions do not have supported time to devote to training junior investigators. Therefore, adequate support for individuals who serve as Director(s) and Project Manager of the CRN Scholars has been critical to the success of the program.

Summary

The rapid rise of new technologies and the availability of big data are driving cancer epidemiology and health services research forward, but relevant training may be lagging

behind.¹³ One element that has not been well developed previously is the training of researchers embedded within and working with resources that are increasingly available for research purposes in integrated, mixed-model, and other health care delivery systems. The need for such researchers and opportunities to conduct research in health care settings is expanding secondary to the widespread implementation of electronic medical records, and the growing recognition of the potential these data provide for answering critical questions across the cancer care spectrum. In addition to the CRN and other HMORN-based consortia, other large networks that bring data and researchers together across multiple health systems include the Patient Centered Outcomes Research Institute's (PCORI's) Clinical Data Research Networks (CDRN)¹⁴ and the Food and Drug Administration's Mini-Sentinel/Sentinel network.¹⁵ In the cancer arena, this interest is demonstrated by initiatives such as the American Society of Clinical Oncology's CancerLinQ¹⁶ or Moffitt Cancer Center's Total Cancer Care program,¹⁷ the incorporation of cancer care delivery research into the NCI Community Oncology Research Program (NCORP; NCI's clinical trials enterprise),¹⁸ and interest in technology companies such as Flatiron Health.¹⁹

Training priorities identified by Cohort III include topics that many existing training programs for early-career investigators may not cover (Tables 2 vs. 3). Training programs that emphasize these unique research skills and challenges are poised to develop the next generation of researchers who can contribute directly to realize the promise of learning health systems. Such programs can leverage the breadth of big data through electronic medical records linked to defined populations and can engage in research questions that arise from the health care system. An evaluation of these investments versus those made through K-awards would be valuable for informing the effective use of training funds.

The CRN Scholars training program creates a forum for exposing Scholars to a broad range of expertise and resources within the network—beyond those available at a single CRN site or academic institution—and to experts in cancer research within and outside CRN institutions.^{3,4} Research within the CRN provides opportunities to test, refine, and disseminate research and interventions in community settings; however, this effort will continue to require additional attention to training researchers who are competent working in these types of settings. The CRN Scholars program works to expand the cadre of investigators conducting cancer research within integrated and mixed-model health care delivery systems through mentored career development of the participating Scholars and through linkages formed between the Scholars and researchers at academic institutions and cancer centers across the U.S. The mentored navigation throughout the Scholars Program helps accelerate the efficiency and effectiveness of conducting research within large networks. Future investments in training within these networks will continue to improve multi-disciplinary and multi-institutional collaboration, particularly for early-stage investigators.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

The CRN Scholars Program: Goals, Curriculum and Program Components

★ CRN SITES

GEISINGER HEALTH SYSTEM • GROUP HEALTH COOPERATIVE • HARVARD PILGRIM HEALTH CARE INSTITUTE • HENRY FORD HEALTH SYSTEM/HAP • HEALTHPARTNERS INSTITUTE FOR EDUCATION AND RESEARCH • KP COLORADO • KP GEORGIA • KP HAWAII • KP NORTHERN CALIFORNIA • KP NORTHWEST • KP SOUTHERN CALIFORNIA • LOVELACE HEALTH SYSTEM • MARSHFIELD CLINIC/SECURITY HEALTH PLAN • MEYERS PRIMARY CARE INSTITUTE • NATIONAL CANCER INSTITUTE

● EXTERNAL SITES

COLUMBIA UNIVERSITY • NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES • UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL • UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL • UNIVERSITY OF TEXAS SOUTHWESTERN • UNIVERSITY OF WASHINGTON • YALE SCHOOL OF MEDICINE

Figure 2.
CRN Scholars

Table 1

Overview of CRN I, II, III and IV cohorts

	Cohort I (2007–2009)	Cohort II (2009–2011)	Cohort III (2012–2015)	Cohort IV (2015–2017)
Total number of scholars	28		9	10
Duration	22 months		26 months	
1:1 mentoring with CRN Scholar Co-Director	1/month			
Full mentorship team meeting	2×/year			
Group phone calls	Twice/month		Twice/month by video meeting	
In person meetings	Once/year		Twice/Year	
Protected FTE	No requirement		20% (10% from CRN grant, 10% match by Scholar’s institution)	
Disciplines	9 PhDs 4 MDs 1 MPH	11 PhDs 3 MDs	3 MDs 3 PhDs 1 ScD 1 EdD 1 PharmD	3 MDs or equivalent 6 PhDs 1 ScD
Training	Epidemiology Health services Nutrition Anthropology Sociology Economics? Dermatology Family practice Internal medicine Infectious disease Biostatistics	Epidemiology Biostatistics Psychology Nutrition Pharmacology Was there a clinical pharmacist in Cohort II? Genetics Dermatology Oncology Pediatrics	Surgery Epidemiology Oncology Clinical Pharmacy Behavioral Science Health Services Gastroenterology Dermatology	Pharmacy Epidemiology Nursing Surgery Health Services Gastroenterology Clinical Genetics Health Communication
Cancer focus	<ul style="list-style-type: none">• CRC• Breast• Skin• Prostate• Cervical• Lymphoma• Multiple (rare cancers, screening, health information technology, risk factors, complementary & alternative medicine, aging, end-of-life care, caregiving)	<ul style="list-style-type: none">• CRC• Skin• Breast• Prostate• Liquid tumors• Multiple (physical activity, obesity, communication, statistical methods, genetics)	<ul style="list-style-type: none">• CRC• Breast• Skin• Hematological• Lung• HCC• Multiple (Sedentary behavior)• Treatment outcomes and adverse events	<ul style="list-style-type: none">• CRC• Breast• DCIS• Bladder• Lung• Prostate
Institution	<ul style="list-style-type: none">• Geisinger Health System	<ul style="list-style-type: none">• Geisinger Health System• Group Health Cooperative	<ul style="list-style-type: none">• NCI• NIEHS• Meyers Primary Care	<ul style="list-style-type: none">• NCI• Indiana University Purdue University

	Cohort I (2007–2009)	Cohort II (2009–2011)	Cohort III (2012–2015)	Cohort IV (2015–2017)
	<ul style="list-style-type: none"> • Harvard Pilgrim Health Care • Health Partners Institute for Education and Research • Henry Ford Health System • Kaiser Permanente (Northern California, Southern California, Hawaii, and Northwest research centers) • Lovelace Clinic Foundation • Marshfield Clinic Research Foundation • Meyers Primary Care Institute/ University of Massachusetts Medical School 	<ul style="list-style-type: none"> • Harvard Pilgrim Health Care Institute • Health Partners Institute for Education and Research • Henry Ford Health System • Kaiser Permanente (Southern California, Hawaii, Northwest, Colorado and Georgia research centers) • Marshfield Clinic Research Foundation • Meyers Primary Care Institute/ University of Massachusetts Medical School 	<ul style="list-style-type: none"> • Institute/ University of Massachusetts Medical School • University of North Carolina Gillings School of Global Public Health • Columbia University Mailman School of Public Health • University of Texas • University of Washington • HealthPartners • Group Health Cooperative • Yale University School of Medicine 	<ul style="list-style-type: none"> • of Indianapolis • University of North Carolina Gillings School of Global Public Health • Kaiser Permanente Northern California • Kaiser Permanente Southern California • University of Washington • Harvard T.H. Chan School of Public Health • University of South Carolina Arnold School of Public Health • North Shore-Long Island Jewish Health Care System • Dana-Farber Cancer Institute, Harvard School of Medicine
Selection	Director from each CRN site was eligible to nominate 1 scholar		Competitive process with review of applications by CRN and external investigators, using iNIH review criteria	

Table 2

Priority research training topics

a. Cohorts I and II identified learning topics	
Topic Areas	Topics
General Skills	Setting career objectives
	Collaborating with CRN and external investigators
	Designing multisite, population-based research studies
	Virtual Data Warehouse (VDW) procedures, capabilities and issues
	Dealing with logistical and interpersonal challenges
	Proposal and manuscript review
Communication Skills	Leadership styles
	Scientific writing
	Authorship: who qualifies, order, avoiding troubles
	Presentations at meetings
	Agenda development and leading a meeting or conference call
	Peer feedback
Developing Research Proposals	Choosing a feasible, fundable project
	Writing for a multispecialty study section
	Tailoring application sections appropriately
	Being responsive to funding agencies
	Handling rejection
	Interpreting journal editors' comments and responding to reviewers' suggestions
	Developing budgets
	Interpreting scores and pink sheets
	What to do when not funded the first time

b. Cohort III identified learning topics

CRN data

- Scholars' Prep-to-Research data requests: expert review (recurring topic)
- Specifying enrollment and retention periods: lessons learned from a Scholar project
- Natural language processing
- Health risk assessments
- Health risk assessment and member survey data

Multi-site collaborations

- Examples of successful CRN collaborations: identifying sites and investigators to work with, developing budgets (recurring topic)
- Examples of successful CRN pilot applications
- Multiple IRBs & DUAs
- Scholars' experiences with multi-site collaborations

Project budgets

- Budgeting for multi-site projects

b. Cohort III identified learning topics

Scholars' experiences developing multi-site budgets

Grant review: federal

NIH grant review training and mock study section

AHRQ grant review process

NCI K awards

Grant review: foundation

PCORI review process

ACS review process

Scholar works-in-progress

Presentation and discussion of Scholar works-in-progress (recurring topic)

Mock grant review of Scholar proposals

Programmatic issues

Selecting and prioritizing topics for webinars and in-person meetings (recurring topic)

Developing learning contract template

Grantsmanship

Generalizability of CRN research; representativeness of CRN populations

The tension between the science & administrative elements of grant development

Project management

Managing projects and teams

Navigating troubled waters: discussion of real-life scenarios

Study design

Engaging patients in research

Dissemination and implementation research

Career development

Career-life balance

Strategically seeking funding for junior investigators

Moving beyond the Scholars Program

Communication skills

Presentation skills

Media relations training

Table 4

Individuals involved in running the Scholars program

Program Role	Responsibilities and Activities
Co-Directors	Participate in all activities relevant to the careers of CRN Scholars: research, mentoring students and junior faculty, teaching, editing peer-reviewed medical journals, and serving on guideline panels and study sections
Project Coordinator	Supports Co-Directors in all Program-related activities. Develops and disseminates Scholars' surveys; Oversees recruitment and review of each cohort; liaison with Coordinating Center; Meeting planning and logistics with collaboration from Co-Directors
Local Mentor or Mentoring Team	Provides oversight and local mentoring throughout the duration of the Program.
CRN Mentor or Collaborator	Serves as CRN expert. Helps Scholar navigate the CRN and its data resources. Provides insight for how to conduct multi-site research in an integrated health care system.
Coordinating Center and Administrative Core tie	Fulfills administrative responsibilities including, but not limited to, Initiating and executing subcontracts. Provides support for: the development of internal and external Program materials, processes, and procedures including for the announcement/call for applications, as well as the for the application and review stages; organizing webinars and in-person meetings; identifying collaborators internal to and external to the CRN; facilitating the completion of prep-to-research requests and; responding to ad hoc requests from the co-Directors.
Network of CRN investigators, including SWG Leads collaborating researchers, faculty, and NCI staff	Participate in various Program activities: linking prospective Scholars to CRN investigators, LOI and application review committees, mock Study Section reviewers, presenters on conference calls and webinars, serve as general resources for Scholars.
Scholar to Scholar Interactions and Collaborations	Ongoing interactions fostering shared interests, supporting fellow scholars through peer review and feedback.