JOURNAL OF WOMEN'S HEALTH
Volume 16, Number 2, 2007

DOI: 10.1089/jwh.2006.0129

Opportunities and Challenges of Interdisciplinary Research Career Development: Implementation of a Women's Health Research Training Program

STEVEN E. DOMINO, M.D., Ph.D., YOLANDA R. SMITH, M.D., M.S., and TIMOTHY R.B. JOHNSON, M.D.

ABSTRACT

Background: **A key component of the National Institutes of Health (NIH) Roadmap for Medical Research is the development of interdisciplinary research teams. How best to teach and foster interdisciplinary research skills has not been determined. An effort at promoting interdisciplinary research was initiated by the Office of Research on Women's Health (ORWH) at NIH in 1999. The following year, 12 academic centers were funded to support 56 scholar positions for 2–5 years under Building Interdisciplinary Research Careers in Women's Health (BIRCWH). A second cohort of 12 centers, called BIRCWH II, was funded in 2002.**

Methods: **In this paper, we present the experience of the University of Michigan BIRCWH program, including a practical approach to dealing with the challenges and opportunities of interdisciplinary research training. Scholars are mentored not only by their primary research advisor but also by a three-person mentor team as well as by their peers. All scholars and a core of supportive faculty meet regularly to discuss interdisciplinary research career development and approaches to apply knowledge in new ways.**

Results: **Of the original cohort of 10 scholars at the University of Michigan, 7 have achieved independent research funding.**

Conclusions: **Challenges include arranging times to meet, developing a common language and knowledge base, dealing proactively with expectations and misunderstandings, focusing on a conceptual model, and providing timely feedback.**

INTRODUCTION

The Office of Research on Women's Health (ORWH) at the National Institutes of Health (NIH) challenged academic medical centers to develop training programs in interdisciplinary research targeted to women's health under the 1999 Request for Applications titled, Building Interdisciplinary Research Careers in Women's Health (BIRCWH).[1] From a funding point of view, important areas of health sometimes fall between the missions of individual NIH institutes and centers. The ORWH has used its overarching position to bridge these gaps in interdisciplinary research in women's health for over 10 years.[2,3] Many scientific organizations agree on the im-

Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, Michigan.
This work was supported in part by grants from the National Institute of Child Health and Human Development (K12HD001438) and the National Center for Research Resources (K23RR017043).

portance of interdisciplinary research.[4] In the NIH Roadmap, the NIH Office of the Director emphasized that traditional divisions may impede the pace of scientific discovery and called for the training of interdisciplinary research teams of the future as one of its three major pillars.[5] How best to promote interdisciplinary research is not well known, however, and the concept is frequently reduced to mere buzz words.[6] Disparate academic cultures still present barriers to interdisciplinary research among medical and social sciences, public health, and engineering.

In 2004, the National Academy of Sciences Committee on Facilitating Interdisciplinary Research defined interdisciplinary research as:

> . . . a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.[7]

This comprehensive definition builds on the more commonly used concept of multidisciplinary research teams. To illustrate the difference in terms: multidisciplinary teams work on the same problem but with different approaches and tools; transdisciplinary research crosses boundaries, expanding the variety of research that can be accomplished; interdisciplinary teams extend the two by encouraging researchers to use each other's disparate skills to reframe research questions, to build new areas of research, and to quicken the pace of clinically useful discoveries.

INTERDISCIPLINARY RESEARCH TRAINING

Challenges

If interdisciplinary research is so important, why doesn't everybody do it? The barriers are both practical and institutional.[7–9] Academic tradition organizes research by disciplinary departments, creating barriers to promotion for those who have interdisciplinary careers by disagreement over what constitutes high-quality research, significant teaching effort, and appropriate service. Medical promotion committees often recognize only the first and last authors in publications. Even the NIH maintains the tradition of one principal investigator (PI), with the exception of program project grants. In response to this identified barrier, NIH is piloting the use of multiple PIs on a selected set of grant programs beginning in September 2006.[10] Despite the desire to see a paradigm shift in the organization of research, independent investigator grant projects remain the best path to research career success in academic institutions.

Practical barriers to interdisciplinary research include the difficulties of organizing meetings, developing a common language and knowledge, and understanding the task at hand. The causes of critical health problems are many and varied, complicating the essential task of deciding on the focus of the group. As the group progresses, social dynamics and communication can get in the way. Expectations and misunderstandings must be dealt with proactively.

At the University of Michigan BIRCWH, we enlisted the cooperation of multiple departments under one banner of women's health to maximize the visibility of interdisciplinary research training. Linkages with the appropriate department chairs helped assure a financial commitment to bridging the transition to research independence for recently trained faculty. We maintain the involvement of senior faculty leaders by keeping the number of faculty to a manageable size so that each is more likely to feel a commitment to the program's success. Division directors are generally supportive of scholars, assuring time to attend meetings without clinical conflicts. When conflicts do occur, the PI makes personal contact with supervisors to discuss the issues and the requirement for a 75% research effort.

The goal of the Michigan BIRCWH is to develop a cadre of new junior faculty scholars through a mentored scholarly research experience that will lead to independent scientific careers that address interdisciplinary women's health concerns. We have recruited scholars from areas of special interest in pelvic floor issues related to childbirth and aging, health services research, and reproductive science and women's medicine. In addition to the problems familiar to all fellowship training directors—issues of recruitment, scholar and mentor evaluation, research responsibility training, preventing trainee isolation, and development toward scientific independence—the BIRCWH program must also promote interdisciplinary research. The single

greatest barrier we face is creating interdisciplinary collaborations among established researchers.

Cultivating a research community

The scholars mentored in the University of Michigan BIRCWH program represent four schools: Medicine, Nursing, Public Health, and the College of Literature, Science, and the Arts. To create an interdisciplinary environment and cultivate a sense of being part of the larger community in women's health research, we developed interdepartmental monthly half-day meetings. The meetings, called First Tuesday Women's Health, begin with a catered lunch at a central campus location in the home of the University's Institute for Research on Women and Gender (IRWG). This neutral location, away from the hospital, reduces the tendency to be pulled to clinical activities and is the central didactic activity all scholars attend.

The initial hour focuses around a didactic lecture on a relevant career development topic, followed by informal presentations of ongoing research by a scholar or mentor. This format serves to stimulate discussion and provide interaction and feedback from other mentors and peers both before and during presentations. Attendance is required for scholars and encouraged for mentors. Because the number of mentors outnumbers the available number of trainees, a feature of many training programs, most mentors do not have a current scholar, and consequently their attendance is infrequent. The members of the advisory committee attend regularly, assuring faculty presence at every meeting. As the year progresses and familiarity with each other increases, the forum becomes less formal and more interactive. In meetings that scholars find most useful, ideas come from participants with multiple perspectives, broadening the research and suggesting new directions.

We aim to teach interdisciplinary research and collaboration by example. The wide range of expertise represented in these meetings generates new perspectives on old problems. Discussions here are different from those stimulated by a presentation within a focused research group because the interdisciplinary environment provides interactions with a supportive audience whose members do not have an extensive knowledge (or biases) of the individual's field. Members of the group are forced to present their specialized knowledge clearly, in terms that outsiders can understand, and they must attend to challenges to their way of thinking coming from colleagues in other fields. Examples of projects discussed include gender differences in adolescent health, workplace stressors, birth experience, elder care, multiculturalism in health care, use of health services, pelvic organ prolapse, and preterm labor.

Over the last few years, the success of these meetings has attracted regular attendance by other women's health junior faculty members in both basic science and clinical career development awards outside the BIRCWH program, including clinical scholars and postdoctoral Ph.D.s, increasing the interdisciplinary atmosphere (5 BIRCWH scholars, 10–15 additional advanced trainees, 5 BIRCWH faculty).

Although the same day is chosen for each monthly meeting, keeping the topics varied helps maintain interest. The following is a typical academic year schedule:

Meeting 1: Didactic presentation of best practices in interdisciplinary research career development, followed by roundtable introductions of all scholars and mentors.
Meeting 2: Presentation of institutional resources to promote interdisciplinary research, followed by group workshop of a scholar's grant ideas.
Meeting 3: Demonstration of online grant resources at the NIH and foundation sponsors. Workshop of study section comments on a senior scholar's grant application.
Meeting 4: Research ethics discussion, including case studies of human subject protection, scientific fraud, authorship dispute, mentor conflicts. Workshop of a scholar poster or oral presentation for a national meeting.
Meeting 5: Discussion of a successful interdisciplinary research program by an established faculty member, followed by workshop of a scholar draft manuscript.
Meeting 6: Visiting speaker, who is a successful interdisciplinary researcher, relating ups and downs of an interdisciplined career.
Meeting 7: Book club on an interdisciplinary topic of current priority by the ORWH.

Although the meetings are centered on an instructional program, the informal time before and after presentations allows an opportunity for the

group to develop cohesiveness and share experiences. These meetings encourage informal contact between scholars and advisory committee members to review progress, prevent isolation, and provide two-way communication. Faculty members are asked to promote a sense of connection to the program, with constructive feedback. We have found that the group prevents research burnout by helping scholars to see connections between their individual research projects and the larger world of science.

Career development essentials

As part of continuing evaluation of our program, we organized a meeting among scholars and mentors in order to discuss aspects of career development. From this list, we came up with features that are essential to each career development plan:

1. **Quality mentorship:** This is provided by a diverse group, including the research mentor, PI, advisory committee, and also peers. Mentors are evaluated annually by the advisory committee, with feedback from scholars.
2. **Strong research training:** Education in this area is more than learning technical methods; it means learning how to turn novel research ideas into hypothesis-driven aims. This is provided in the First Tuesday lunch meetings, at weekly scientific seminars within the scholar's research group, and with didactic course work selected by the individual scholar and mentor. Most scholars enrolled in our program have previously completed graduate degree work beyond their initial training. If desired, a masters degree in clinical research is a pathway available and was completed by 1 of our initial 10 scholars during their BIRCWH support.
3. **Research ethics:** Overlapping and reinforcing mechanisms are needed to assure all involved receive training in research ethics, such as PI responsibilities, conflict of interest, human subject protection, and animal research. Compliance is measured by completion of a required web-based set of teaching modules common to all University of Michigan research training programs.
4. **Idea development:** Provide opportunities to interact with others, leading to projects that are interdisciplinary. Encourage attendance at scientific workshops in their area to hear cutting-edge topics. This is measured annually by the number of abstracts and grants submitted.
5. **Interdisciplinary research:** Teach interdisciplinary research and collaboration by example among investigators from different disciplines.
6. **Navigating NIH skills:** At a level appropriate to the trainees, show them how to find grant opportunities and who to talk to before writing a grant.
7. **Grant writing skills:** Provide a committee to review specific aims early in the grant writing process. Require bimonthly meetings with the mentor to review the progress of the grant writing and provide constructive feedback.
8. **Manuscript writing skills:** Initiate a workshop for manuscripts in preparation among the trainees. Help more junior trainees learn from the practical experience of senior trainees by presenting reviewer comments from their manuscripts and grant applications and formulate responses as a group.
9. **Presentation skills:** Scholars present work-in-progress to a group of supportive faculty members and peers committed to providing constructive feedback. Once polished, trainees and mentors begin planning for presentation at national meetings.
10. **National exposure:** Invite at least one guest speaker to give departmental grand rounds who is a leader in the field that each scholar has chosen. Arrange for one-on-one time for scholars to speak with this individual. Arrange for the scholar to meet with leaders in their research field at national meetings. Identify two appropriate societies in which the scholar is interested in getting involved and have mentors assist with finding opportunities within these societies.
11. **Provide a career development mentor:** Encourage the trainee to choose someone who knows the departmental culture for promotion, separate from the research mentor. For clinical trainees, this means providing a career development mentor with appropriate knowledge of what it takes to advance in that field.
12. **Reasonable goals:** R01 funding after only a few years in research is a challenging goal, but individual K awards and smaller R grants

are attainable. Promote a record of success with stepwise increases in capabilities and risk of the proposals.

13. **Evaluation and feedback:** Annual evaluation of both research and career development progress, as measured above, to help detect misalignments of scholar interest and career goals.
14. **Posttraining program plan:** Continued mentorship after the initial 2–3-year program. Target appropriate positions after finishing research training so newly minted investigators can continue their path to independence.

Evaluation and transition to independence

Publications are the currency of academic careers, and we emphasize sustained productivity. For less experienced scholars, publications take time to develop, but at least one research publication is expected each year (range 0–6) with a goal of 3 publications per year. The time scholars have in the program is too short to expect most scholars to achieve funding; therefore, the outcomes we measure are submission of grant applications, abstracts, and publications. In our follow-up of the first 5 years of our program, 7 of the 10 scholars from the original cohorts have achieved external funding (foundations grants, NIH K or R funding, or other Department of Health and Human Services agencies as PI or coinvestigators).

Upon completion of BIRCWH K12 support, scholars develop a postaward plan that describes the scholar's desired research, academic, or clinical position either within our university or at other academic centers. In our initial experience, each of the 10 scholars supported has progressed in his or her career by obtaining faculty positions, including 7 in tenure track appointments and 3 as research faculty at our university or elsewhere. The capacity for the field of obstetrics and gynecology is too small to assure jobs for all BIRCWH scholars; therefore, we encourage ties to other disciplines in women's health. The appropriateness of a scholar's eventual position is, of course, a personal decision, but it is our desire to see our scholars contribute to the systematic examination of problems in women's health. Most scholars have achieved permanent positions within their department of clinical interest (pediatrics, public health, women's studies, nursing, medicine, obstetrics and gynecology).

As we noted, interdisciplinary research careers, unfortunately, often face barriers from traditions and policies for promotion and tenure.[11] The University of Michigan Medical School recognizes the interdisciplinary dilemma in its promotion guidelines and requests that reviewers avoid taking a purely numerical view of authorship order and to consider authors other than the first and last as worthy of notice as a significant contributor.[12] It is anticipated that this promotion policy will foster interdisciplinary collaborations and will ultimately benefit future scholars.

LESSONS LEARNED

Interdisciplinary research faces many obstacles and challenges, and these must be addressed within a training program. The 5-year competing renewal of the first set of BIRCWH programs resulted in a turnover of 50% of the centers because of issues of insufficient recruitment, programmatic difficulties, or lack of scholar advancement toward independence. The BIRCWH model at the University of Michigan provides curriculum, mentoring, evaluation, and career planning within an interdisciplinary environment and has been successful in developing a cadre of new junior faculty scholars.

Critical factors in the success of the program include enlisting the cooperation of multiple departments under the single banner of women's health (which maximizes the visibility of interdisciplinary research training), linking with appropriate departments to assure a financial commitment to bridging the transition to research independence following training, and teaching interdisciplinary culture by example. Evaluating the ultimate value of this and similar programs requires following the careers of these junior faculty scholars with an eye toward both their success as faculty leaders in interdisciplinary research programs and the realization of interdisciplinary solutions to otherwise intractable health problems.

ACKNOWLEDGMENTS

We thank our colleagues, mentors, and scholars at the University of Michigan for their support of the goals of the BIRCWH program and Drs. Donna Vogel and Raymond De Vries for discussions on interdisciplinary research.

REFERENCES

1. Building Interdisciplinary Research Careers in Women's Health, RFA-OD-99-008, NIH guide, September 7, 1999. Available at *grants2.nih.gov/grants/guide/rfa-files/RFA-OD-99-008.html*
2. Pinn VW. Research on women's health: Progress and opportunities. JAMA 2005;294:1407.
3. Stone J, Pinn VW, Rudick J, Lawrence M, Carlyn M. Evaluation of the first 10 years of the Office of Research on Women's Health at the National Institutes of Health: Selected finding. J Womens Health 2006;15:234.
4. Gidjunis J. Interdisciplinary research urged. Chronicle Higher Education 2004;51:A.25.
5. NIH Roadmap website, Office of Portfolio Analysis and Strategic Initiatives, Division of Strategic Coordination, U.S. Department of Health and Human Services. Available at *nihroadmap.nih.gov/*
6. Lattiuca LR. Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty. Nashville, TN: Vanderbilt University Press, 2001:296.
7. Committee on Facilitating Interdisciplinary Research. Facilitating interdisciplinary research. Washington, DC: National Academies Press, 2004:306.
8. Frost SH, Jean PM. Bridging the disciplines: Interdisciplinary discourse and faculty scholarship. J Higher Education 2003;74:119.
9. Pfirman SL, Collins JP, Lowes S, Michaels AF. Collaborative efforts: Promoting interdisciplinary scholars. Chronicle Higher Education 2005;51:B.15.
10. Multiple Principal Investigators website, NIH Office of Extramural Research. Available at *grants2.nih.gov/grants/multi_pi/*
11. Smith C. An incomplete picture of me. Chronicle Higher Education: Chronicle Careers online edition, May 26, 2006. Available at *chronicle.com/jobs/news/2006/05/2006052601c/careers.html*
12. University of Michigan Medical School, Faculty Promotion website. The Interdisciplinary Dilemma—Accounting for the critical interdisciplinary scholar in our promotion and tenure process.

Address reprint requests to:
Steven E. Domino, M.D., Ph.D.
Department of Obstetrics and Gynecology
6428 Medical Science I Box 0617
University of Michigan
Ann Arbor, MI 48109-0617

E-mail: sedomino@med.umich.edu