

Future Directions for Postdoctoral Training in Cancer Prevention: Insights from a Panel of Experts

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Abstract

Cancer prevention postdoctoral fellowships have existed since the 1970s. The National Cancer Institute facilitated a meeting by a panel of experts in April 2013 to consider four important topics for future directions for cancer prevention postdoctoral training programs: (i) future research needs; (ii) underrepresented disciplines; (iii) curriculum; and (iv) career preparation. Panelists proffered several areas needing more research or emphasis, ranging from computational science to culture. Health care providers, along with persons from nontraditional disciplines in scientific training programs such as engineers and lawyers, were among those recognized as being underrepresented in training programs. Curriculum suggestions were that fellows receive training in topics such as leadership and human relations, in addition to learning the principles of epidemiology, cancer biologic mechanisms, and behavioral science. For career preparation, there was a clear recognition of the diversity of employment options available besides academic positions, and that program leaders should do more to help fellows identify and prepare for different career paths. The major topics and strategies covered at this meeting can help form the basis for cancer prevention training program leaders to consider modifications or new directions, and keep them updated with the changing scientific and employment climate for doctoral degree recipients and postdoctoral fellows. *Cancer Epidemiol Biomarkers Prev*; 23(4); 679–83. ©2014 AACR.

Introduction

Formal funding of postdoctoral training programs in cancer prevention by the National Cancer Institute (NCI) in the United States began in the 1970s. As of May 2013, there were 30 postdoctoral cancer prevention and control fellowship programs supported by NCI grants*, as well as fellows supported through other means. Most programs support fellows for 2 to 4 years and are designed to train scientists for research careers in academic institutions. Although no standardized curriculum exists, most cancer prevention postdoctoral fellowships rely primarily on one-to-one mentoring, supple-

mented with lectures and other didactic training experiences.

Given changes occurring in science and technology, such as mapping of the genome and communication technology, and among the general population about economics and demographics (e.g., more limited government funding of science, aging of the U.S. population), this is an opportune time to consider where cancer prevention training fits in the larger picture of health workforce training. The NCI convened a group of 14 experts from academic institutions, government, and the private sector in Bethesda, MD to discuss future directions for postdoctoral training in cancer prevention in April 2013. The major topics addressed were: (i) future research needs; (ii) underrepresented disciplines; (iii) curriculum; and (iv) career preparation. This article summarizes ideas and strategies for cancer prevention training programs generated from group discussions at this meeting.

Future Research Needs

The panel first made suggestions about what they considered to be important cancer prevention research needs in the foreseeable future (1, 2). Panelists proffered several broad and specific areas needing more research or emphasis. These included computational science (e.g., statistics, mathematics, and informatics), behavioral science, communication, economics, and policy. Also suggested were health services research,

*R25 or T32 institutional grants.

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doi: 10.1158/1055-9965.EPI-13-1209

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the gene–environment interaction, genomics and other types of "omics," dissemination and implementation (including innovation, sustainable science, and implementation in low resource settings; refs. 3, 4), transdisciplinary team science (5–7), evaluation, and systems science (7, 8). Finally, there was support for increased prevention research in global health, cancer or health disparities, and lifestyle risk factors (e.g., tobacco, diet, and physical activity).

Several participants stressed the importance of new, or newly adapted, research designs and methodologies. Examples included mathematical modeling (e.g., network analysis of social or behavioral factors, N-of-1 designs, and improved understanding of signal-to-noise ratios) and moving beyond single risk factor studies (9). Other specific ideas included assessing and interpreting scientific evidence, the challenge of reproducibility of scientific findings, refining evaluation of early detection methods (e.g., biomarkers), use and understanding of large and diverse ("big") data sources, conducting more rapid and responsive research studies (10), communicating risk and uncertainty to lay audiences, and examining multi-level influences, such as the role of culture on normative population behaviors (7).

Broadening and Expanding Disciplines Involved in Cancer Prevention Research

Two long-standing challenges to the field are the absence of a widely accepted definition of cancer prevention and clearly defined career paths (1, 11). Cancer prevention covers topics that range from subcellular mechanisms to international health policies. Across the academic, government, and private sectors, there are few officially recognized departments, or other organizational units, devoted solely to cancer prevention.

Cancer prevention is multidisciplinary and many people may not identify or consider themselves cancer prevention scientists, although the intent of their activities may be to prevent or lower the incidence of cancer or other chronic diseases. Another challenge is that potentially interested individuals from some health science disciplines (e.g., physicians), or disciplines outside of science (e.g., engineers), may not learn about career opportunities in cancer prevention, or learn of them during mid-career, when transition to a new field would be more difficult. Thus, it is important to expose students to cancer prevention in their undergraduate and graduate studies through activities such as integrating cancer prevention into curricula, lectures available across universities, and applied training opportunities.

Many panel members thought it feasible and desirable for postdoctoral programs to recruit individuals from selected nontraditional disciplines (e.g., mathematicians, lawyers, etc.) and teach them cancer prevention principles; this would have the added benefit of fostering more diversity of perspectives. The following specific disciplines (in no priority order) were identified as needing

more recruitment efforts to encourage them to become fellows in cancer prevention programs:

- Medicine (e.g., primary care physicians and oncologists)
- Nursing and allied health professions
- Health services
- Engineering (e.g., systems or chemical engineers)
- Mathematics (including statistics)
- Computer science (e.g., simulation modeling)
- Law
- Political science/public policy
- Others (e.g., economics, toxicology, etc.)

Several specific strategies were suggested by panelists to help gain the interest of individuals from underrepresented disciplines and potentially recruiting them into fellowships; these are summarized in Table 1.

Curriculum

Cancer prevention researchers come from different disciplines and pursue divergent academic and nonacademic career paths. Acknowledging these differences, panelists discussed core expectations for cancer prevention scientific knowledge and research skills for trainees regardless of discipline, recognizing that the ultimate goal is reducing population-level cancer incidence and mortality. With this in mind, four core science-related recommendations emerged, each with curriculum implications.

First, cancer prevention fellowship programs should strive to ensure that fellows understand the basic biology of cancer and how interventions can interrupt biologic processes (12, 13). Second, programs should provide essential epidemiologic and biostatistical training to promote in-depth knowledge of study designs, biases, and probability. Epidemiology and biostatistics were emphasized because they form the basis for providing, and interpreting, evidence that can lead to clinical- and population-based recommendations (14, 15).

Third, programs should provide behavioral science instruction so that cancer prevention researchers can better understand the theoretical and evidenced-based approaches to overcome barriers to behavior change (16). Finally, programs should provide training in effective knowledge synthesis and translation (17). This includes identifying, critically assessing, and summarizing the scientific literature on a cancer prevention topic, and being able to translate and communicate syntheses to scientific and lay audiences for purposes such as patient-provider communication or guideline or policy development. Specific strategies to assist fellows with these recommendations are listed in Table 1.

Panelists were aware of the National Postdoctoral Association (NPA) core competencies (discipline-specific conceptual knowledge, research skill development,

Table 1. Suggested strategies for recruiting people from a variety of disciplines, enhancing curricula, and improving career preparation for postdoctoral cancer prevention fellowship programs

Broadening disciplines	Scientific curricula	Career preparation
<ul style="list-style-type: none"> • Offer undergraduate- or graduate-level summer programs in cancer prevention. • Develop specific undergraduate or graduate school cancer prevention tracks or credentialing; this could include experiential learning with cancer prevention scientists. • Attend science career events sponsored by professional societies across the spectrum of disciplines that could contribute to cancer prevention research. • Hold joint cancer prevention professional meetings with organizations that are not traditionally involved in health (e.g., community planners, engineers, etc.). • Directly reach out to professors or students in underrepresented disciplines, and consider creating challenges and asking for ideas/assistance. • Develop closer ties with existing university science, technology, engineering, or medicine (STEM) programs. 	<ul style="list-style-type: none"> • Provide support for coursework or extensive training in selected areas (e.g., epidemiology, biostatistics, cancer biology, behavioral science, etc.). • Provide or authorize fellows to attend comprehensive course(s) on the state of the art in cancer prevention. • Provide lectures on key topics or themes in cancer prevention (e.g., history, disciplines' contributions, biology, or seminal studies). • Provide lectures or other meetings led by established cancer prevention researchers. • Develop collaborative research projects on research questions or topics that involve fellows from different disciplines. • Develop certification or examination criteria in cancer prevention. 	<ul style="list-style-type: none"> • Provide short-term opportunities or assignments to different program areas, projects, or types of positions in cancer prevention and control. • Directly inform fellows about cancer prevention career options through lectures or group meetings, or through sessions sponsored by professional associations, agencies, or institutions (e.g., AACR, ASPO, or NIH). • Convene facilitated individual or small group career planning meetings; consider using preexisting materials (e.g., books not necessarily specific to the sciences). • Provide opportunities to conduct cancer prevention research projects or other activities through national, state, or local governmental or nongovernmental partners. • Create or enhance a network of alumni from cancer prevention postdoctoral programs.

communication skills, professionalism, leadership and management skills, and responsible conduct of research; ref. 18). They agreed that NPA competencies in areas besides scientific training were critical aspects of postdoctoral cancer prevention training because they are essential for scientists to function more effectively in the roles they may assume throughout their careers. Specific skills training mentioned by panelists for postdoctoral cancer prevention fellows were:

- Leadership
- Writing
- Oral presentations
- Media relations
- Management
- Human relations (including working as part of a team)
- Budgeting
- Negotiation

Career Preparation

The final topic considered was outplacement or career opportunities for fellows post-training. The two broad

areas discussed were: (i) career options besides those in academic institutions; and (ii) academic career-specific issues, including the relative value of multidisciplinary training. Attendees acknowledged that most scientists with doctoral degrees, or who complete postdoctoral fellowships, will not become tenure-track researchers in academic settings. This is not unique to cancer prevention but extends broadly to the biomedical sciences (19). Many potential career options are available to fellows, such as basic research in private industry, government service, consulting, and working for nonprofit organizations. Most cancer prevention training programs, however, focus on preparing individuals for academic positions. Training program leaders need to recognize the diversity of employment options available and do more to help fellows identify, and prepare for, a variety of career paths.

Regarding academic careers, some panelists reiterated that the multidisciplinary nature of cancer prevention research was considered both a strength and a concern. For example, scientists with multidisciplinary training are not always required or desired for academic positions depending on the goals of the department—

multidisciplinary research requires a team-based approach that some institutions may not promote or support. Other well-recognized concerns included traditional means of recognition, promotion, and tenure of scientists who predominantly engage in team-based research (5, 20). The means of securing recognition, promotion, and tenure in academic institutions has traditionally reinforced individual achievement and highly focused (e.g., more narrow) research topics, rather than applied team science. Moreover, the provision of multidisciplinary training may be more difficult if funding relies on mechanisms that tend to be hosted by a single department or laboratory. Panelists were optimistic, however, that multidisciplinary training should be valued at all levels and different career sectors, and believed cancer prevention research will continue to need contributions from different disciplines and rely upon team-based approaches. Specific strategies to improve fellows' career preparation are listed in Table 1.

Conclusion

Preventing cancer remains a critical goal in the United States and worldwide (21–23). Postdoctoral cancer prevention fellowships can play key roles in training scientists, clinicians, and others in the conduct of high-quality research, and ultimately to develop and implement effective

approaches to prevent or control cancer. For cancer prevention, as for other scientific areas, it is important to periodically revisit the focus, curriculum, and career outcomes of training programs given the new and emerging areas of research, technology, methods, systems, and practice.

The major topics and strategies addressed by experts at the April 2013 meeting can help form the basis for cancer prevention training programs to consider modifications or new directions, and keep them updated with the changing scientific and employment climate for doctoral degree recipients and postdoctoral fellows. The suggestions discussed at this meeting are a valuable first step; implementing them will require concerted efforts by individuals and organizations at many levels.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institutes of Health or the Centers for Disease Control and Prevention.

Acknowledgments

The authors thank Ming Lei of the NCI for his assistance.

Received November 18, 2013; accepted December 5, 2013; published OnlineFirst March 6, 2014.

References

- Weed DL, Greenwald P, Cullen JW. The future of cancer prevention and control. *Semin Oncol* 1990;17:504–09.
- Bode AM, Dong Z. Cancer prevention—then and now. *Nat Rev Cancer* 2009;9:508–16.
- Gaglio B, Shoup JA, Glasgow RE. The RE-AIM framework: a systematic review of use over time. *Am J Public Health [Internet]* 2013 Jun [cited 2013 Dec 12];103:[about 9 p.]. Available from: http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2013.301299?url_ver=Z39.88-2003&rft_id=ori:rid:crossref.org&rft_dat=cr_pub%3dpubmed.
- Stirman SW, Kimberly J, Cook N, Calloway A, Castro F, Charns M. The sustainability of new programs and innovations: a review of the empirical literature and recommendations for future research. *Implement Sci [Internet]*. 2012 Mar [cited 2013 Dec 12];7:[about 19 p.]. Available from: <http://www.implementationscience.com/content/7/1/17>.
- Stokols D, Hall KA, Taylor BK, Moser RP. The science of team science: overview of the field and introduction to the supplement. *Am J Prev Med* 2008;35:S77–89.
- Rimer BK, Abrams DB. Present and future horizons for transdisciplinary research. *Am J Prev Med* 2012;42:200–01.
- Mabry PL, Olster DH, Morgan GD, Abrams DB. Interdisciplinarity and systems science to improve population health: a view from the NIH Office of Behavioral and Social Sciences Research. *Am J Prev Med* 2008;35:S211–24.
- Luke DA, Stamatakis KA. Systems science methods in public health: dynamics, networks, and agents. *Annu Rev Public Health* 2012;33:357–76.
- Collins LM, Murphy SA, Strecher V. The multiphase optimization strategy (MOST) and the sequential multiple assignment randomization trial (SMART): new methods for more potent eHealth interventions. *Am J Prev Med* 2007;32:S112–18.
- Riley WT, Glasgow RE, Etheredge L, Abernethy AP. Rapid, responsive, relevant (R3) research: a call for a rapid learning health research enterprise. *Clin Transl Med* 2013;2:10.
- Chang S, Cameron C. Addressing the future burden of cancer and its impact on the oncology workforce: where is cancer prevention and control? *J Canc Educ* 2012;27:S118–27.
- Hanrahan D, Weinberg RA. Hallmarks of cancer: the next generation. *Cell* 2011;144:646–74.
- Umar A, Dunn BK, Greenwald P. Future directions in cancer prevention. *Nat Rev Cancer* 2012;12:835–48.
- Sterman JD. Learning from evidence in a complex world. *Am J Public Health* 2006;96:505–14.
- Brownson RC, Petitti DB. *Applied epidemiology*. 2nd ed. New York: Oxford; 2007.
- Glanz K, Rimer BK, Viswanath K. *Health behavior and health education: theory, research, and practice*. 4th ed. Hoboken, NJ: John Wiley & Sons; 2008.
- Graham IA. Knowledge synthesis and the Canadian Institutes of Health Research. *Syst Rev [Internet]*. 2012 Feb [cited 2013 Dec 13];1:[about 2 p.]. Available from: <http://www.systematicreviewsjournal.com/content/1/1/6>.
- NPA Core Competencies Committee (2007–2009). *The NPA postdoctoral core competencies toolkit [Internet]*. Washington, DC: National Postdoctoral Association; 2009 [cited 2013 Jun 6]. Available from: <http://www.nationalpostdoc.org/competencies>.
- National Institutes of Health Advisory Committee to the Director Biomedical Workforce Working Group. *Biomedical research workforce working group report [Internet]*. Bethesda, MD: NIH; 2012 [cited 2013 Jun 6]. Available from: http://acd.od.nih.gov/Biomedical_research_wgreport.pdf.

20. Zucker D. Developing your career in an era of team science. *J Invest Sci* 2012;60:779–84.
21. Boyle P, Levin B, editors. *World cancer report 2008* [Internet]. Lyon, France: International Agency for Research on Cancer; 2008 [cited 2013 Dec 13]. Available from: <http://www.iarc.fr/en/publications/pdfs-online/wcr/2008/>.
22. Colditz GA, Wolin KY, Gehlert S. Applying what we know to accelerate cancer prevention. *Sci Transl Med* [Internet]. 2012 Mar [cited 2013 Dec 13];4:[about 9 p.]. Available from: <http://stm.sciencemag.org/content/4/127/127rv4.full>.
23. Horton R. Non-communicable diseases: 2015–2025. *Lancet* 2013; 381:509–10.

Cancer Epidemiology, Biomarkers & Prevention

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Cancer Epidemiol Biomarkers Prev 2014;23:679-683. Published OnlineFirst March 6, 2014.

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