

Frontiers in Cancer Epidemiology: A Challenge to the Research Community from the Epidemiology and Genomics Research Program at the National Cancer Institute

Muin J. Khoury, Andrew N. Freedman, Elizabeth M. Gillanders, Chinonye E. Harvey, Christie Kaefer, Britt C. Reid, Scott Rogers, Sheri D. Schully, Daniela Seminara, and Mukesh Verma

Abstract

The Epidemiology and Genomics Research Program (EGRP) at the National Cancer Institute (NCI) is developing scientific priorities for cancer epidemiology research in the next decade. We would like to engage the research community and other stakeholders in a planning effort that will include a workshop in December 2012 to help shape new foci for cancer epidemiology research. To facilitate the process of defining the future of cancer epidemiology, we invite the research community to join in an ongoing web-based conversation at <http://blog-epi.grants.cancer.gov/> to develop priorities and the next generation of high-impact studies. *Cancer Epidemiol Biomarkers Prev*; 21(7); 999–1001. ©2012 AACR.

In recognition of the 20th year of publication of *CEBP*, the editor (1) proposed a series of invited commentaries from experts in various disciplines to reflect on major advances and trends in cancer epidemiology over the last two decades and to foresee "what lies ahead." Pieces published in response to this call and some related initiatives have challenged the epidemiology community to extend its boundaries and look to the future. A recent commentary in *CEBP* entitled "bigger, better, sooner: scaling up for success" (2) emphasized the importance and challenges confronting collaborative multidisciplinary research.

The Epidemiology and Genomics Research Program (EGRP) at the National Cancer Institute (NCI; ref. 3) has initiated a strategic planning effort to develop scientific priorities for cancer epidemiology research in the next decade, during a period of great scientific advances and resource constraints. EGRP would like to engage the research community and other stakeholders in a planning effort that will include a workshop in December 2012 to help shape new foci for cancer epidemiology research. To facilitate the process of defining the future of cancer epidemiology, we invite the research community to join in an ongoing web-based conversation at <http://blog-epi.grants.cancer.gov/> to develop priorities and the next generation of high-impact studies.

Authors' Affiliation: Epidemiology and Genomics Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, Maryland

Corresponding Author: Muin J. Khoury, Epidemiology and Genomics Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute. Mailing address: 1600 Clifton Rd., Atlanta, GA 30333. Phone: 404-498-0001; Fax: 404-498-0140; E-mail: muk1@cdc.gov

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EGRP is the largest funder of cancer epidemiology grants in the world. Figure 1 shows trends in the numbers of grants funded in the past decade. During this period, a rapid growth occurred in epidemiologic research on genetic and environmental determinants of cancer occurrence and outcomes. Large-scale epidemiologic studies have been instrumental in assessing risk factors for almost all cancer types, cancer precursors, and response to interventions, as well as survivorship and outcomes. EGRP also focuses on nurturing interdisciplinary consortia (4) that can answer unique questions in cancer occurrence and outcomes by pooling data across a large number of institutions from around the world and facilitating the translation of these findings to clinical and public health applications. In addition, consortia of existing cohort studies have been used to examine risk factors for cancer occurrence and outcomes, common diseases other than cancers, as well as the relationships between cancer and non-cancer health outcomes in diverse populations (5). The growth in cancer epidemiology research has been driven by advances in genomics and related fields and the emergence of genome-wide association studies (GWAS) that have identified an unprecedented number of genetic variants associated with cancer risk (6).

Cancer epidemiology has resulted in many success stories that have led to improved policy and practice (7). These include, among others, the unraveling of cigarette smoking as a cause of lung and many different types of cancer, the role of human papilloma virus (HPV) in cervical and other cancers, and the discovery of hundreds of genetic loci as risk factors for various types of cancer. Despite these successes, observational epidemiology has methodologic limitations that affect the ability to infer causation. To overcome limitations that have perhaps hindered the progress and evolution of epidemiologic

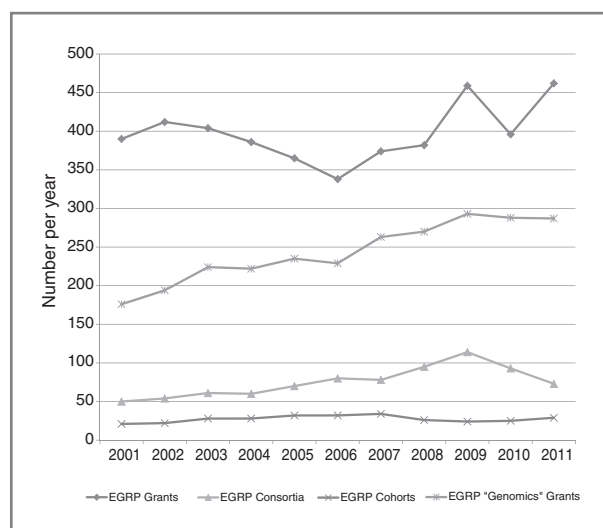


Figure 1. Trends in the number of total funded grants and within selected categories, by the Epidemiology and Genomics Research Program at the National Cancer Institute, 2001–2011. The year on the x-axis reflects the federal fiscal year (i.e., October 1 to September 30). The grants shown include those that were the results of the stimulus funding using the American Recovery and Reinvestment Act (2009–2011). The subcategories of grants (cohorts, consortia, and genomics) are not mutually exclusive.

studies, we need to identify new approaches and apply lessons learned from other fields. Our aim should be to enhance the application of epidemiologic methods along the translational continuum from basic discoveries to population health impact (8).

More than 10 years into the 21st century, we are at a major crossroads in our understanding of cancer. Tools of molecular biology, genomics, and other high-throughput "omic" technologies are increasingly integrated into epidemiologic investigations. In a 2011 NCI Town Hall Meeting, Dr. Harold Varmus, Director of the NCI, said "I expect to see a pretty dramatic revolution in epidemiology... defining cancers by genetic subsets. I expect to see molecular tools brought more forcefully into the realm of cancer diagnosis... talking about ways to discriminate among early lesions and pre-cancerous lesions that may have malignant potential" (9). Along with the emerging tools of genomics come refined social, behavioral, and environmental measurements at the individual, community, and health system levels and the ability to assess gene–gene and gene–environment interactions. There is an increased focus on complex "systems" approaches in understanding the occurrence of cancer and intervening at multiple levels (10). All of this research has been supported by tremendous advances in bioinformatics and information technology (11, 12), allowing us to collect, analyze, and synthesize information from multiple disciplines at an ever-increasing pace. With these opportunities, however, come the major challenge of dealing with the data deluge and uncovering true causal relationships from the millions and millions of observations that are background noise. Thus, in funding cancer

epidemiology studies, we now confront important challenges and must make choices of scientific direction to maximize the use of existing research infrastructures and plan wisely for new ones, as we respond to changing resources.

The process of defining the future of epidemiology is not only occurring in cancer but also in other fields. In a recent commentary published in the *American Journal of Epidemiology* (13), leaders of the epidemiology program at the National Heart, Lung and Blood Institute (NHLBI) have also reflected on the critical questions that confront the cardiovascular epidemiology community in the next decade in the face of constrained resources. NHLBI has invited the community to provide answers to 4 critical questions using their digital forum at <http://nhlbi.epi.wordpress.com/>. How can we avoid wasting resources on studies that provide little or incremental knowledge? How can we assure that we direct our resources as economically as possible toward innovative science? How can we be nimble and responsive to new opportunities? How can we identify prospectively the most meritorious research questions? (13). Obviously, the same questions apply to the future of cancer epidemiology.

EGRP invites the research community to contribute their perspectives on the major questions that cancer epidemiology should address in the next decade to make an impact on public health. In addition, we are interested in input on (i) methods and technologies that should be integrated in cancer epidemiology; (ii) construction, maintenance, and optimization of representative cohorts needed to study determinants of the transition from health to cancer and related outcomes, (iii) use of epidemiology to inform and complement treatment and prevention randomized clinical trials for filling evidentiary gaps, and (iv) epidemiologic approaches, including the use of networks of consortia, for ongoing integration of knowledge emerging from basic, clinical, and population sciences. For more information on the "Cancer Epidemiology Matters Blog," and how you can contribute to the ongoing online dialog, please visit <http://blog-epi.grants.cancer.gov/>

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Authors' Contributions

Conception and design: M.J. Khoury, D.S. Seminara, C.E. Harvey
Development of methodology: M.J. Khoury, A. N. Freedman
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): M.J. Khoury, D.S. Seminara
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): M.J. Khoury, D.S. Seminara, A.N. Freedman, E.M. Gillanders
Writing, review, and/or revision of the manuscript: M.J. Khoury, A.N. Freedman, E.M. Gillanders, C.E. Harvey, C. Kaefler, B.C. Reid, S. Rogers, D.S. Seminara
Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): M.J. Khoury

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References

1. Rebbeck TR. Where were you in November 1991? *Cancer Epidemiol Biomarkers Prev* 2011;20:567–8.
2. Thun MJ, Hoover RN, Hunter DJ. Bigger, better, sooner: scaling up for success. *Cancer Epidemiol Biomarkers Prev* 2012;21:571–5.
3. Epidemiology and Genomics Research Program at the National Cancer Institute. Bethesda, MD: National Cancer Institute. [cited 2012 Apr 24]. Available from: <http://epi.grants.cancer.gov/>.
4. EGRP-Supported Epidemiology Consortia. Bethesda, MD: National Cancer Institute. [cited 2012 Apr 24]. Available from: <http://epi.grants.cancer.gov/Consortia/>.
5. Cancer Epidemiology Cohorts. Bethesda, MD: National Cancer Institute. [cited 2012 Apr 24]. Available from: <http://epi.grants.cancer.gov/cohorts.html>.
6. Hindorf LA, Gillanders EM, Manolio TA. Genetic architecture of cancer and other diseases: lessons learned and future directions. *Carcinogenesis* 2011;32:945–54.
7. Greenwald P, Dunn BK. Landmarks in the history of cancer epidemiology. *Cancer Res* 2009;69:2151–62.
8. Khoury MJ, Gwinn M, Ioannidis JP. The emergence of translational epidemiology. *Am J Epidemiol* 2010;172:517–24.
9. National Cancer Institute, Director's Page. Bethesda, MD: National Cancer Institute; 2011 [cited 2012 Apr 26] Available from: <http://www.cancer.gov/aboutnci/director/speeches/townhall-july2011>.
10. Galea S, Riddle M, Kaplan GA. Causal thinking and complex systems approaches in epidemiology. *Int J Epidemiol* 2010;39:97–106.
11. Forman MR, Greene SM, Avis NE, Tapli SH, Courtney P, Schad PA, et al. Bioinformatics: tools to accelerate population science and disease control research. *Am J Prev Med* 2010;38:646–51.
12. Eysenbach G. Infodemiology and infoveillance: tracking online health information and cyberbehavior for public health. *Am J Prev Med* 2011;40 Suppl 2:S154–8.
13. Sorlie PD, Bild DE, Lauer MS. Cardiovascular epidemiology in a changing world: challenges to investigators and the National Heart, Lung and Blood Institute. *Am J Epidemiol* 2012;175:597–601.