

Innovations

Knowledge Translation Versus Knowledge Integration: A “Funder’s” Perspective

Jon F. Kerner, PhD

Abstract

Each year, billions of US tax dollars are spent on basic discovery, intervention development, and efficacy research, while hundreds of billions of US tax dollars are also spent on health service delivery programs. However, little is spent on or known about how best to ensure that the lessons learned from science inform and improve the quality of health services and the availability of evidence-based approaches. To close this discovery-delivery gap, researchers and their funding agencies not only must recognize the gap between basic discovery and intervention development, addressed in part through translational research investments, but they must also work together with practitioners and their funding agencies to recognize the growing gap between innovative interventions developed through research and what is actually delivered to reduce the burden of chronic disease within the United States. From a funding-agency perspective, the complexity of the challenges of translating lessons learned from science to public health, primary care, or disease specialty service settings requires a multifaceted partnership approach to accelerate the translation of research into practice. This essay reviews the background and challenges of closing the development-to-delivery gap and some exemplar strategies that have been used by funding agencies to address these challenges to date.

Key Words: Knowledge translation, knowledge integration, funding-agency perspective, continuing education, evidence, dissemination, diffusion

Introduction

Enormous investments have been made in the discovery and development of efficacious and effective public health and clinical approaches, as well as intervention programs, to prevent, detect, and treat the major chronic diseases burdening the American public. However, comparatively little has been invested in the United States to study efficacious and effective approaches to disseminate and implement evidence-based public health and medical interventions developed and tested through research.^{1,2} Limited investments to study how best to promote the adoption of evidence-based interventions perhaps explain the generally slow process of the diffusion of innovations³ and the slow uptake of evidence-based medicine in primary care practices.⁴ In addition, it raises the question of what would happen if we devoted as many resources to ensuring the delivery of what we know has an impact on disease as we do to developing new intervention approaches to incrementally improve public health and clinical intervention efficacy.⁵

Because little is invested in studying how best to ensure that the lessons learned from science inform and improve the quality of health services⁶ and the availability of evidence-based approaches, relatively little is known. In June 2002, Andrew von Eschenbach, MD, Director of the National Cancer Institute (NCI), challenged

Dr. Kerner: Deputy Director for Research Dissemination and Diffusion, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, MD.

The findings and conclusions in this report are those of the author and do not necessarily represent the views of the National Cancer Institute, the National Institutes of Health, and the U.S. Department of Health and Human Services.

Reprint requests: Jon F. Kerner, PhD, Deputy Director for Research Dissemination and Diffusion, Division of Cancer Control and Population Sciences, National Cancer Institute, 6130 Executive Blvd, EPN 6144, Bethesda, MD 20892.

the cancer community to recognize the gaps between basic discovery and intervention development, addressed in part by translational research investments. He also challenged the research and practice communities to recognize the growing gap between innovative interventions developed through research and what is actually delivered to address the cancer burden within the United States.⁷ In September of that same year, the NCI cosponsored a meeting with the Center for the Advancement of Health and the Robert Wood Johnson Foundation entitled “Designing for Dissemination,”⁸ where 50 researchers, 50 public health, primary care and oncology specialty care practitioners, and 50 intermediary organizations (including public and nongovernmental organization funding agencies) came together to review the challenges and propose solutions to closing the development-to-delivery gap articulated by Dr. von Eschenbach in June. In this essay, I review the background and challenges of closing the development-to-delivery gap and the strategies that have been used by some funding agencies to address these challenges to date.

Background and Challenges

What Are We Talking About, and What Is the Return on Investment?

The first historical challenge is one of language and meaning. The terms *translational and translation research, knowledge translation and transfer, dissemination, diffusion, and implementation* (to name but a few) are used interchangeably to mean sometimes similar and sometimes different things in the literature.^{9,10} Even within a single funding agency like the NCI, there are some who hold that translational research applies not only to basic discovery-to-intervention development types of research but also extends to development-to-delivery research. Others, this author included, argue that it is important to distinguish translational

research from dissemination and implementation research because, in part, the context of the former is so different from the context of the latter. Thus, the context of translational research is relatively homogeneous (e.g., academic medical centers, large pharmaceutical corporations) and relatively resource rich. Conversely, the contexts for translating intervention innovations are more heterogeneous both in implementation resources and infrastructure to support dissemination and implementation of innovations. At a recent implementation science meeting sponsored by the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Drug Abuse (NIDA), and the Center for Substance Abuse Treatment (CSAT), the terms *translation 1* and *translation 2* were used to clarify this distinction.¹¹ The adoption of these terms may prove helpful in future efforts to achieve a consensus on terminology.

Above and beyond confusion in terminology, the high level of public and private investment in health research, in combination with the current emphasis on translational research studies that are primarily designed to move basic (e.g., laboratory) science discoveries into clinical trials, creates an interesting paradox. On the one hand, an enormous amount of information is being generated through research, published in thousands of discipline-specific journals, and presented in hundreds of discipline-specific professional meeting venues. On the other hand, so much information is being pushed out through this passive process of information diffusion that a “signal-to-noise” ratio problem exists with respect to translating research into practice. Recently, computerized approaches to manage the mass of clinical research literature have become widespread. With over 10,000 randomized clinical trials indexed in MEDLINE in 1999 alone, computerization, while necessary, is not sufficient to ensure that such a large mass of information can easily be translated into practice.¹²

This massive and largely passive diffusion approach may also raise unrealistic expectations.

Many individual research reports, while suggesting exciting new innovations that may lie ahead in the future, have little or no immediate application in public health and/or clinical practice. Thus, it may be difficult for the practice community to distinguish the signal about what is currently important to practice from the noise of what may or may not become important in the future.¹ It has even been suggested that scientists who are effective translators should stop generating new scientific knowledge and focus more effort on translating existing knowledge into products more suitable for practice decision makers.¹³

Context Counts

The service delivery contexts of public health, primary care, and disease specialty care vary widely with respect to the best means to disseminate research knowledge into practice, the extent of demand for evidence-based interventions, and the level of resources and infrastructure for integrating the lessons learned from science with the knowledge gained from the practical experience of service delivery.¹⁴ Ellis et al.,⁹ in reviewing 30 original reports of dissemination research focused on cancer control interventions, found studies grouped into health care provider contexts (both primary and specialty care), media contexts, and worksite contexts to reach the public. The extent to which context counts, with respect to translating research into practice, may help to explain, in part, the challenge of finding generalized dissemination and implementation principles across contexts.

For example, in a recent narrative literature review of implementation science,¹⁵ the authors conclude that the “best evidence” is for what *does not* work. They argue that the few carefully designed experimental studies confirm their overall conclusions that information dissemination alone (research literature, mailings, promulgation of practice guidelines) is an ineffective implementation method, as is training alone, no matter how well it is done. That information dis-

semination efforts were judged to be ineffective in terms of implementation should be no more surprising than the well-accepted maxim that changing awareness, while necessary, is rarely if ever sufficient to change behavior.¹⁶ The conclusion about the ineffectiveness of training alone raises critical questions about the value of health care professions’ continuing education versus other knowledge-translation approaches.¹⁷

With respect to clinical care of chronic diseases, many barriers to the application of research evidence in clinical practice have been enumerated in the literature. In cardiovascular disease, barriers include the quality, scope, and relevance of the evidence; factors affecting the clinicians’ ability to apply the evidence at the point of patient care; patient characteristics (e.g., preferences, adherence); and setting or system factors (e.g., lack of time, limited incentives).¹⁸ Similarly, in diabetes management, physician (e.g., forgetfulness, inadequate knowledge), patient (e.g., lack of resources, limited motivation), and health care system factors (e.g., practice organization better suited to deliver acute versus chronic care, inadequate information systems) have also been identified as barriers.¹⁰

Whose Evidence Anyway?

Different perspectives regarding the nature and quality of evidence and a lack of agreement on what constitutes “best” evidence¹⁹ suggest that for patients and practitioners alike, evidence, like beauty, may be in the eye of the beholder. It has been suggested that we need to accept that changing practitioners’ behavior has less to do with expanding practitioners’ knowledge of the evidence and more to do with their being convinced that applying specific evidence will benefit a particular patient when the opportunity arises in a particular office or clinic visit.¹⁸ Such a patient-specific and context-specific perspective suggests that new models and strategies for integrating explicit knowledge from research with tacit and contextual knowledge from clini-

cal and patient experience (*knowledge integration*)²⁰ may hold some promise over and above the relatively unidirectional approach of framing the translation challenge as always emphasizing the value of objective evidence gained from research over subjective “evidence” gained from practitioner and patient experience (*knowledge transfer*).

Dissemination and Implementation

One example that highlights this challenge has been the considerable interest in sorting out how best to disseminate and implement clinical practice guidelines to influence practitioner behavior. Guidelines, it has been suggested, may reduce inappropriate practice variation, support improved quality of care, and serve as a framework to accelerate the translation of research into practice.²¹ Although awareness of guidelines can be enhanced by a variety of dissemination methods, for guidelines to change clinicians’ behavior, the knowledge contained therein must be implemented.²²

With respect to implementation approaches that have been judged to have sufficient evidence to recommend consideration, sustained multilevel approaches are considered by some to have better evidence,¹⁵ including practice-based practitioner selection, skill-based training, practice-based coaching, practitioner performance evaluation, program evaluation, facilitative administrative practices, and methods for system interventions. However, the task of aligning system and organizational structures with evidence-based practices is both complex and ongoing and needs to engage policymakers, state planners, managers of service provider agencies (e.g., health departments, managed care organizations), and the purveyors of programs and practices.¹⁵

In clinical contexts, there are approaches that have been judged ineffective or minimally effective. Many center on passive knowledge-transfer strategies, such as attending traditional continuing medical education lectures that rely largely

on increasing physicians’ knowledge and are unlikely to have a major impact on practice.^{17,23} With respect to guidelines implementation, in a systematic review of 235 studies reporting 309 comparisons, the majority of interventions observed modest to moderate improvements in care.²⁴ For example, the median absolute improvement in performance across interventions was 14.1% in 14 comparisons of reminders, 8.1% in 4 comparisons of the dissemination of educational materials, 7.0% in 5 comparisons of audit and feedback, and 6.0% in 13 comparisons of multifaceted interventions involving educational outreach. No relationship was found between the number of combined component interventions and the effects of these multifaceted interventions. Thus, contrary to the conclusions drawn by the implementation science review by Fixsen et al.,¹⁵ combining more intervention components did not lead to larger intervention effects.

Even in systematic reviews of the diverse literature on how to spread and sustain evidence-based innovations in health service delivery and organization, the complexity of the interventions themselves, combined with the nuances of their implementation in different social, organizational, and environmental contexts, makes it difficult to develop definitive recommendations. Such efforts continue to illustrate the problems and raise areas for further consideration.²⁵ As Grimshaw et al. note,²⁴ given this implementation complexity, decision makers need to use considerable judgment about how best to use the limited resources they have for clinical decision making to maximize benefits. They recommend that further research is required to develop and validate a coherent theoretical framework of practitioner and organizational behavior and behavior change to inform better the selection of interventions in research and service settings; and to estimate the efficiency of dissemination and implementation strategies in the presence of different barriers and effect modifiers.

A “Funder’s” Perspective

It is beyond the scope of this essay to systematically review all of the government and non-government organization funding approaches to addressing the challenge of closing the gap between discovery and delivery. Suffice it to say that there exists a range of levels of appreciation for the magnitude of the problem, the levels of investment in dissemination and implementation research, and the extent to which what is known is applied in organizational efforts toward research dissemination and implementation. Following are some examples of the range and scope of these efforts.

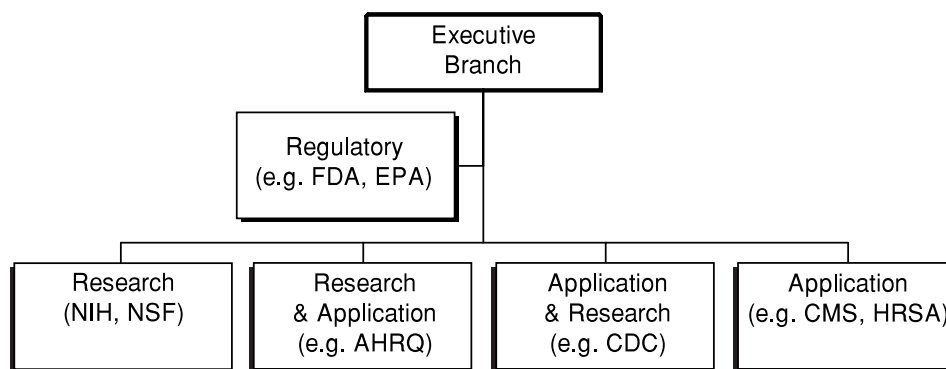
Research-Practice Funding Partnerships?

Figure 1 reflects, within the context of the US government, the types of agencies that may address dissemination and implementation issues in health and health care. Roles vary from regulatory to research and application (i.e., practice). Given the complexity of the challenges described above, one question that arises from Figure 1 is the extent to which the impact of research on practice may depend on the relation-

ship between agencies that fund research (e.g., National Institutes of Health [NIH], National Science Foundation) and agencies that fund application, service, and practice (e.g., Health Resources and Services Administration [HRSA], Center for Medicare and Medicaid Services [CMS]).

Similarly with nongovernmental organizations, many foundations and philanthropic agencies that provide service support funding focus on innovation and novelty in program development, while a small but growing number of these organizations (e.g., the Robert Wood Johnson Foundation) are supporting research-practice partnerships in an effort to expand the utility of research evidence in practice settings.

Historically, research funding agencies have used 3 broad approaches to move science into practice: communication and diffusion of research findings (e.g., conferences, publications, press releases), dissemination campaigns to alter knowledge and behavior, and large-scale demonstration projects.²⁶ All 3 approaches share some characteristics in that the funding is usually time limited (constraining sustainability), funding for these efforts is usually proportionately small compared with the major investments in



FDA- Food & Drug Administration; EPA – Environmental Protection Agency; NIH – National Institutes of Health; NSF – National Science Foundation; AHRQ- Agency for Healthcare Research and Quality; CDC – Centers for Disease Control & Prevention; CMS- Centers for Medicare and Medicaid Services; HRSA – Health Resources & Services Administration

Figure 1 Schematic of the roles of government agencies involved with health research and application (practice).

the primary mission of these agencies (research), and the level of agency support varies from year to year depending on the variation in the annual agency budget. It is noteworthy that many of these efforts have focused as much on agency self-promotion as on health promotion. This is particularly apparent when reviewing agency Web sites, where the most useful information to the practitioner and the public can usually be found only after navigating multiple secondary pages reflecting more agency descriptive information than useful research findings. Similarly, application, practice, and service support agencies (e.g., HRSA, CMS) often use comparable approaches, and given that the bulk of their funding supports service delivery, again the proportion of the budget available to link science with service is relatively small.

Dissemination and Implementation Research

Recently, a number of government research funding agencies have recognized that important research questions could be addressed by an expanded investment in dissemination and implementation science. For example, the National Institute for Mental Health has had several program announcements over the past 6 years that have solicited investigator-initiated implementation research proposals. Several NIH institutes, centers, and offices have partnered together soliciting investigator-initiated dissemination and implementation research proposals, including evidence-based interventions in public health, primary care, and disease specialty care practice settings.²⁷⁻²⁹

In addition, NCI partnered with the Agency for Healthcare Research and Quality (AHRQ) on a program announcement translating research into practice focused on how best to disseminate the lessons learned from primary care practice-based research. NCI has also partnered with the Centers for Disease Control and Prevention (CDC) on co-funding the Cancer Prevention and Control Research Network, in part, to encourage

the dissemination and implementation of evidence-based cancer prevention and early detection interventions through a segment of the CDC’s network of prevention research centers.

Bridging Research and Practice

Agencies that explicitly bridge science and service within their mission have generally done a somewhat better job of developing mechanisms to support tools that help translate research findings into practice recommendations and guidelines. Two examples of these tools are the US Preventive Services Task Force *Guide to Clinical Preventive Services*³⁰ (AHRQ) and the Task Force on Community Preventive Services *Guide to Community Preventive Services*.³¹ Key to the utility of these “synthesis of science” tools is the transparency to the user of the systematic evidence review process. A key challenge is how to keep these tools up to date, given the massive investments research agencies make in funding new research in basic science discovery and intervention development. In addition, these agencies face the same challenges, previously described, of how best to disseminate these tools and to ensure widespread adoption and implementation of evidence-based recommendations.

Summary

From a funding-agency perspective, the complexity of the challenges in translating lessons learned from science into public health, primary care, and disease specialty service settings requires a multifaceted approach to accelerating the translation of research into practice. Funding agencies across the discovery-development-delivery continuum must expand existing interagency partnerships and develop new ones. Given the differing missions of research vs. application funding agencies, limited resources are available from all parties. Thus, collaborative development of investment priorities and pooling resources may be the only way to ensure that an adequate investment is made in this critical arena.

Lessons for Practice

- Translating research into practice requires a common language and common understanding among researchers and practitioners about the meaning of knowledge translation, knowledge integration, and the nature of evidence.
- New and expanded investments in dissemination and implementation research are needed to review existing models and develop new conceptual frameworks translating research into practice.
- Research-practice partnerships will be critical in all aspects of future intervention development research; dissemination and implementation research; and diffusion, dissemination, and implementation of research results.
- Setting aside competing agendas will enable science and service funding agencies to integrate research with practice and to work more closely together to develop coordinated translation programs and knowledge management tools.
- When practitioners seek out researchers and are supported by their respective institutions, they can work together to ensure that new interventions being developed and tested through research are informed by the wealth of tacit and contextual knowledge gained from practice experience.
- Continuing education in the health professions should bring researchers and practitioners together to learn how best to integrate the lessons learned from research with the lessons learned from practice.

Government, nongovernment, and private sector agency, organization, and business leaders must clearly articulate their support for these collaborative efforts, make them a higher investment priority, and explicitly recognize and reward those efforts that have proved successful from both the research and the practice perspective. For example, including practitioners on peer-review committees that evaluate intervention development research proposals might increase the consideration of the practical utility of a proposed intervention innovation in the early development stages. By the same token, leaders of research institutions and academic medical centers must reach out to the broad set of clinical service delivery leaders, all of whom compete for and receive resources from funding agencies, to develop new opportunities for research-practice partnerships.

These leaders must also encourage and provide incentives, with their own institutional resources, for research-practice partnership opportunities through training, developmental research support, and protected time for researchers and practitioners to work together to address the challenges of integrating science with service. Finally, the agencies and professional associations by which science is diffused and disseminated, to both the research and the practice communities, should reexamine the extent to which research-practice partnerships can be incorporated into journal article peer review and publication, conference planning, and Web-based tool development (see, for example, the Cancer Control PLANET partnership Web portal).³² In this way, the whole of our investments in research and practice can truly become greater than the sum of its parts.

References

1. Kerner J, Rimer R, Emmons K. Dissemination research and research dissemination: How can we close the gap? *Health Psychol* 2005; 24(5):443–446.

2. Woolf SH, Johnson RE. The break-even point: When medical advances are less important than improving the fidelity with which they are delivered. *Ann Fam Med* 2005; 3(6): 545–552.
3. Rogers EM. Diffusion of innovations. 5th ed. New York: Free Press, 2003.
4. Balas EA, Boren SA. Managing clinical knowledge for health care improvement. In: van Bommel JH, McCray AT, eds. Yearbook of medical informatics 2000: Patient-centered systems. Stuttgart, Germany: Schattauer, 2000:65–70.
5. Kravitz RL. Doing things better vs. doing better things. *Ann Fam Med* 2005; 3(6):483–485.
6. Moses H 3rd, Dorsey ER, Natheson DH, Their SO. Financial anatomy of biomedical research. *JAMA* 2005; 294(11):1333–1342.
7. Von Eschenbach A. Closing the discovery-delivery gap. Presented at the semiannual meeting of the National Dialogue on Cancer, Washington, DC, June 2002.
8. Designing for dissemination conference final report. Available at: http://www.cancercontrol.cancer.gov/d4d/info_d4dconf.html. Accessed Jan 2006.
9. Ellis P, Ciliska D, Sussman J, Robinson P, Armour T, Brouwers M, O’Brien MA, Raina P. A systematic review of studies evaluating diffusion and dissemination of selected cancer control interventions. *Health Psychol* 2005; 24(5):488–500.
10. Venkat Narayan KM, Benjamin E, Gregg EW, Norris SL, Engelgau MM. Diabetes translation research: Where are we and where do we want to be? *Ann Intern Med* 2004; 140:958–963.
11. Mittman B. The “state of the science” of implementation science: A review of recent assessments and recommendations for improvement. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism, National Institute on Drug Abuse, and Center for Substance Abuse Treatment-sponsored meeting on Implementation Science: What Do We Know and Where Do We Go? January 2006.
12. Sim I, Sanders GD, McDonald KM. Evidence-based practice for mere mortals: The role of informatics and health services research. *J Gen Intern Med* 2002; 17:302–308.
13. Choi BCK, McQueen DV, Rootman I. Bridging the gap between scientists and decision makers. *J Epidemiol Community Health* 2003; 57:918.
14. Kerner JF, Guirguis-Blake J, Hennessy KD, Brounstein PJ, Vinson C, Schwartz RH, Myers BA, Briss P. Translating research into improved outcomes in comprehensive cancer control. *Cancer Causes Control* 2005; 16(suppl 1):27–40.
15. Fixsen DL, Naoom SF, Blasé KA, Friedman RM, Wallace F. Implementation research: A synthesis of the literature. Tampa: University of South Florida, Louis de la Parte Mental Health Institute, The National Implementation Research Network (FMHI publication 231), 2005.
16. Green LA, Seifert CM. Translation of research into practice: Why we can’t “just do it.” *J Am Board Fam Pract* 2005; 18:541–545.
17. Davis D, Evans M, Jadad A, Pierre L, Rath D, Sibbald G, et al. The case for knowledge translation: Shortening the journey from evidence to effect. *BMJ* 2003; 327:33–35.
18. Majumdar SR, McAlister FA, Furberg CD. From knowledge to practice in chronic cardiovascular disease: A long and winding road. *J Am Coll Cardiol* 2004; 43(10):1738–1742.
19. Haynes RB. What kind of evidence is it that evidence-based medicine advocates want health care providers and consumers to pay attention to? *BMC Health Serv Res* 2002; 2:3–10.
20. Glasgow R. Disseminating behavioral medicine research: Making the translational leap. SBM 2005, 26th annual SBM meeting, Symposium #22.
21. Institute of Medicine. Crossing the quality chasm: A new health system for the 21st century. Washington, DC: National Academy Press, 2001.
22. Gross PA, Greenfield S, Cretin S, Ferguson J, Grimshaw J, Grol R, et al. Optimal methods for guideline implementation: Conclusions from Leeds Castle meeting. *Med Care* 2001; 39(suppl 2):85–92.

23. Grimshaw JM, Shirran L, Thomas R, et al. Changing provider behavior: An overview of systematic reviews of interventions. *Med Care* 2001; 39(suppl 2): 2–45.
24. Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, et al. Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technol Assess (Rockv)* 2004; 8(6):1–72.
25. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: Systematic review and recommendations. *Milbank Q* 2004; 82(4):581–629.
26. National Cancer Institute. Community-based interventions for smokers: The COMMIT field experience. Smoking and Tobacco Control Monographs #6. NIH publication No. 95–4028, 1995.
27. US Department of Health and Human Services, National Institutes of Health. Dissemination and implementation research in health (R01). Available at: <http://grants1.nih.gov/grants/guide/pa-files/PAR-06-039.html>. Accessed Jan 2006.
28. US Department of Health and Human Services, National Institutes of Health. Dissemination and implementation research in health (R03). Available at: <http://grants2.nih.gov/grants/guide/pa-files/PAR-06-071.html>. Accessed Jan 2006.
29. US Department of Health and Human Services, National Institutes of Health. Dissemination and implementation research in health (R21). Available at: <http://grants2.nih.gov/grants/guide/pa-files/PAR-06-072.html>. Accessed Jan 2006.
30. US Preventive Services Task Force. Guide to clinical preventive services. 3rd ed. Periodic updates. Rockville, MD: Agency for Healthcare Research and Quality, 2004. Available at: <http://www.ahrq.gov/clinic/peiororder.html>. Accessed Jan 2006.
31. Zaza S, Briss, Harris KW, eds. The guide to community preventive services: What works to promote health. New York: Oxford University Press, 2005.
32. Cancer Control PLANET. Available at: <http://cancercontrolplanet.cancer.gov>. Accessed Jan 2006.