Science Leads the NCI

Current Patterns Shaping the Future of Research

Remarkable advances have been made in the fight against cancer since the National Cancer Act became law in 1971, as each success fuels new scientific ideas, discoveries, and the creation of new technologies. We are driven to acquire new knowledge, build upon the findings gained and lessons learned from our past progress, and continue creating the foundations for future advancements.

The Promise of the Future

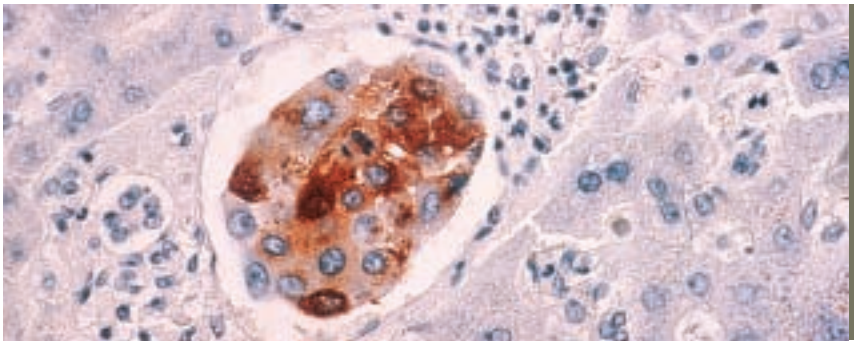
Imagine a time when doctors no longer determine cancer treatments based upon estimates for the entire population and interventions are tailored specifically to meet individual needs—in many cases preventing the disease process before it starts. Current science is ripe with potential for exponential progress against cancer. Our combination of rich scientific ideas and talent, infrastructure, interconnected knowledge, partnerships, and expertise is coupled with an extraordinary array of advanced technologies. NCI leadership has brought to life five key forces that will drive the promise and hope for a better world where cancer is preempted and the best outcomes are assured for all.

Convergence — *where advanced technology and science meet*

It is now understood that cancer is caused by molecular disruptions that can be treated with molecular interventions, yet it is difficult to understand why individual responses to interventions are different even when the pathology is the same. Furthermore, with the ever increasing amount of information available, the human mind can't possibly sort all the possibilities.

The convergence of proteomics, computational biology, and nanotechnology will allow researchers to use this growing knowledge to develop and refine interventions against cancer. Cutting-edge technologies directly enhance proteomics research to speed the systematic identification and characterization of human proteins and their biological functions.

Computational biology will provide computerized models to process and understand the amazing amount of information that will be available, which physicians can then use to inform and improve the care of individual patients. Nanotechnology has enabled us to create instrumentation on a very small scale that will make it possible for us to perform molecular classification of tumors, deliver treatments with precision, and predict therapeutic effectiveness.



Integrative Approaches — *where the understanding of biology and a systems approach meet*

As we learn more about the molecular events that lead to the development of cancer, new approaches to treat cancer as a complex biological system can be modeled to provide predictions of disease behavior, prognosis, and a patient's response to therapy. In the past, as different fields of science were explored in depth, they became highly specialized and isolated. Over the past five years, we have discovered that areas of research that once were thought to be compartmentalized now are beginning to intersect. With the understanding that tumors are collections of interactive parts, it has become apparent that the focus in studying cancer needs to broaden.

This objective can only be accomplished by bringing together individuals with diverse perspectives that address complex information issues, including scale, modeling, simulations, and interpretation of

the information. In addition, we must maintain a keen awareness of how the information is interrelated and connected. NCI is supporting efforts designed to bring together collaborative groups with unique specialties spanning the clinical and basic research spheres. The hope is that their research findings can be linked together to inform new ways of preventing, detecting, and treating cancer.

Connectivity — *where different disciplines and common goals meet*

The talents and solutions needed to address scientific problems no longer rest in the hands of any one investigator or discipline. When researchers join together — and as these partnerships begin to connect to a broader scientific picture — the individual knowledge of each investigator is amplified and leveraged. Multidisciplinary teams composed of physicians, mathematicians, engineers, chemists, computational biologists, epidemiologists, geneticists, sociologists, nanotechnologists, and others hold the collective keys to our future advancements in cancer research.

NCI is forging partnerships with others to build upon the information gained from NIH's human genome project to understand the genetic and molecular basis of cancer. The goal is to create an extensive knowledge base that will enable scientists from all fields of biomedical research to establish new standards of cancer care.

Leveraging Resources and Knowledge — *where collaborative efforts and entities meet*

The partnerships multiplying between the public and private sectors, nonprofit organizations, our national laboratories, and academia are changing the way we work together to address the burden of cancer. Efforts to involve individual state government agencies in these types of partnerships are increasing to better harness the advances made in local universities and regional biotechnology sectors. In addition, such collaborations not only span the United States but also extend globally. Collaborations with national and international universities and commercial firms yield expanded capabilities and resources. Success in cancer research will be predicated by mechanisms and models that encourage such collaborations and consortia to form and grow.

Cooperative relationships also make other scientific resources and tools available. NCI's research

facilities in Frederick, Maryland comprise a unique resource by offering world-class biomedical research and technology support through collaborations within NCI and with other NIH Institutes, Government agencies, and extramural investigators. NCI-Frederick is also home to a fully-integrated, high-performance, scientific supercomputing facility.

The need to find new ways to exploit insights, derived from research data, highlights the need to foster innovation and entrepreneurship, and emphasizes the importance of novel partnerships with the private and philanthropic sectors. Among the challenges that must be addressed for successful public-private partnerships are intellectual property strategies that will not only ensure public availability of discoveries but also preserve incentives for commercialization.

Community — *where scientific advances and community-based cancer care meet*

The dawning of the era of personalized medicine will require new programs that deliver state-of-the-art oncology care to community settings as efficiently as possible. The major problem we will face is one of patient access to science advances and new technologies that are increasingly capable of preventing cancer and providing early diagnosis, novel therapies, and highly-specific treatments when cancer occurs. Innovative programs are in development that will play a major role in communities with the goal of bringing together the many facets needed to improve cancer prevention, screening, and treatment, and reduce health disparities. Furthermore, continued advances in cancer care and prevention are the direct result of participation in clinical trials. Ensuring widespread participation in these studies by more people can be achieved by fostering strong relationships between Comprehensive Cancer Centers, community-based clinical oncology programs, and organizations that reside in and serve local neighborhoods.

***Looking to the future**, as we leverage all five scientific forces through collaboration with key partners, we imagine achieving the goal of a world free from cancer. We envision care that is evidence based, that focuses on prevention and wellness with patient education and navigation, and that includes programs to address health disparities, so that the results of our research reach all segments of our population.*