National Cancer Institute

CLINICAL PROTEOMIC TECHNOLOGIES FOR CANCER

Clinical Cancer Proteomics: What It Means and What It Means for You

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

National Institutes of Health

Chromosomes are single pieces of DNA that contain many genes

DNA is a molecule that carries genetic information. Genes contain instructions for how to make proteins

Proteins act alone or in groups to perform many functions

Proteins, Biomarkers, and Cancer

A human cell contains between 250,000 and 1 million distinct proteins. Proteins can vary between individuals, between types of cells, and even within one cell under different conditions.

A biomarker is a molecule—such as a protein—in the body's tissues or fluids (e.g., blood, sweat, urine) that can alert doctors to disease. Cancer cells can "leak" proteins into these fluids, which can, with proper tools and methods, be detected with simple blood or urine tests. Protein biomarkers can help doctors detect cancer early, measure responses to treatment, and screen patients after treatment to see if cancer returns.

Certain proteins are already widely used as biomarkers, such as prostate specific antigen (PSA) for prostate cancer and CA-125 for ovarian cancer. While this single-marker approach has proved valuable, some scientists have proposed that measuring protein signatures (groups of cancer proteins) might be even more beneficial.

Understanding Proteins Helps Us to Better Understand Cancer

This year alone, nearly 1.5 million Americans will receive a devastating diagnosis: cancer. Despite the great progress we have made in fighting this disease, it is clear that early detection, diagnosis, and treatment are the best hope for long-term survival.

A major breakthrough in cancer treatment was the discovery that tumors "leak" proteins and other molecules into blood, urine, and other accessible bodily fluids. This insight has led to the possibility of diagnosing cancer at an early stage simply by collecting such fluids and testing them for the presence of cancer-related molecules, also called "cancer biomarkers."

Proteins: A Key Strategy to Early Detection

Within the cells of our body, proteins work like small engines that keep important functions running smoothly, helping to maintain the cell's shape, store and produce energy, and carry messages.

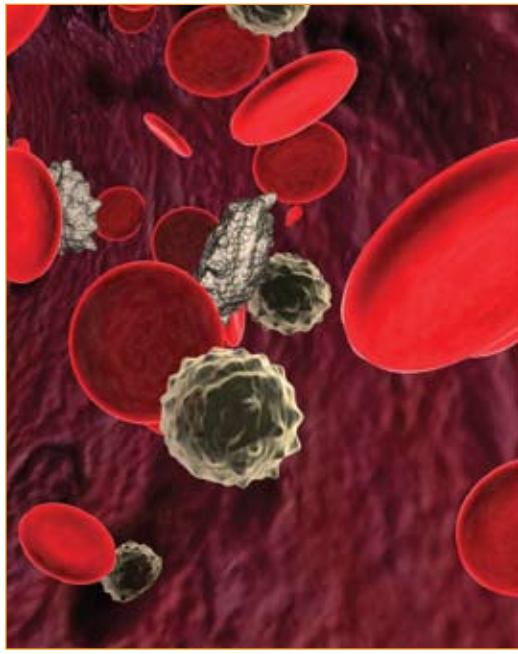
Proteins from cancer cells can have unusual properties that indicate whether someone has a tumor. To detect cancer earlier, scientists are developing tests to find these cancer biomarkers. Biomarkers found in blood and other fluids may also be valuable for monitoring the response to cancer during treatment or detecting the recurrence of tumors after treatment.

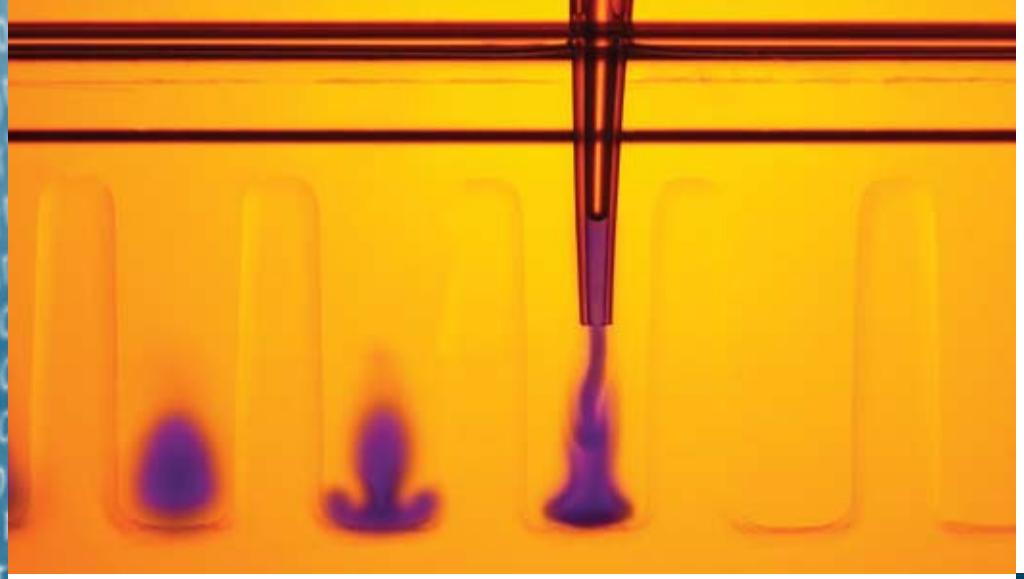
The Challenge of Studying Cancer Proteins & Biomarkers

Proteomics (the study of proteins) holds great promise in our fight against cancer, but there is a significant challenge that must be overcome. Laboratories across the country collect, store, and study proteins in different ways. This lack of standardization makes it difficult to accurately compare results from one laboratory to another, and limits the number of cancer protein or biomarker tests that are available to the public.

What is the National Cancer Institute (NCI) Doing to Standardize the Study of Proteins?

The NCI is working to standardize proteomics at laboratories across the country. In 2006, the NCI launched the **Clinical Proteomic Technologies for Cancer (CPTC)** initiative to coordinate the uniform collection, storage, and analysis of proteins. The goal of this five-year initiative is to help laboratories achieve comparable, reliable, and reproducible results so we can find and treat cancer earlier.





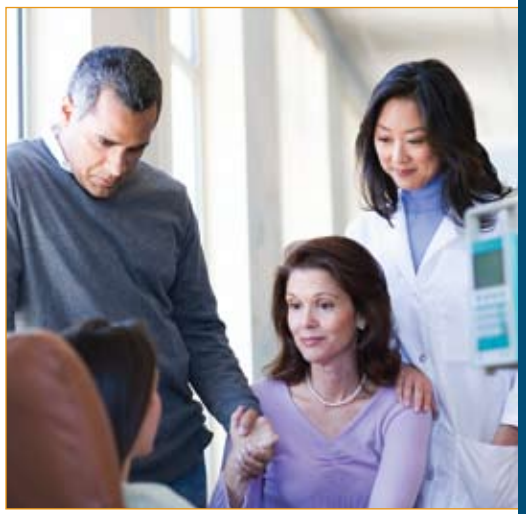
Using a Team Approach to Advance Cancer Proteomics

The Clinical Proteomic Technologies for Cancer (CPTC) initiative is creating a national protein research infrastructure by working in partnership with scientists from nearly 50 federal, academic, and private sector organizations. The members of this network have joined together to use the science of cancer proteomics to develop life-saving biomarker tests and other resources for patients.

The CPTC is expected to improve the discovery and development of protein biomarkers by ***establishing standards and rigorous quality control measures***. This initiative will also support the development of an information system capable of merging and comparing results across laboratories.

The integrated CPTC team is organized to:

- Build a framework that links multiple laboratories and permits large-scale, real-time exchange of protein technologies and information.
- Enhance materials, methods, and analysis to ensure that proteins are systematically collected, separated, identified, and measured, and that results are consistent across the country.
- Evaluate new approaches for understanding how proteins affect cancer development.



How is NCI Building on Existing Resources to Make a Difference?

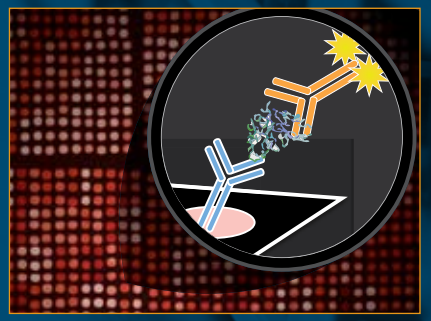
To accomplish its goal, the CPTC is working in partnership with existing NCI programs. NCI-designated Cancer Centers are assisting the CPTC in discovering biomarkers for specific cancer sites (e.g., breast, lung, prostate, or colon). The NCI Early Detection Research Network (EDRN) and Specialized Programs of Research Excellence (SPOREs) are helping to take basic research findings from the laboratory to create clinical applications for patients. In addition, the cancer Biomedical Informatics Grid (caBIG™) is building an information system (also called an informatics grid) that will help scientists share information about proteins related to cancer.

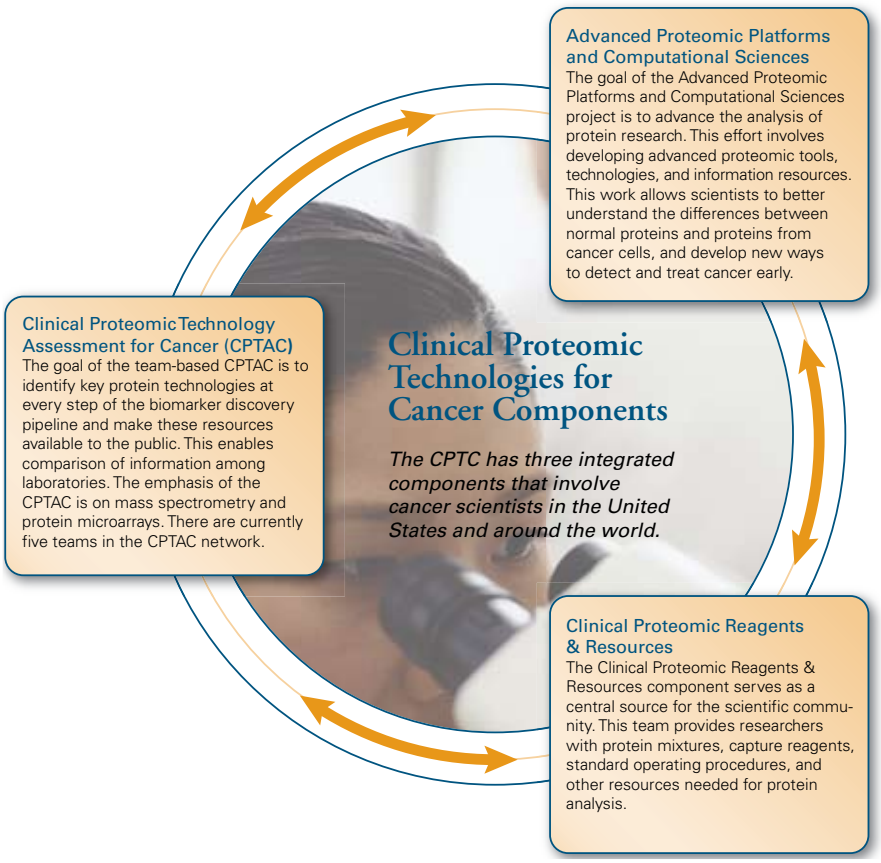
Proteomic Technologies

The CPTC uses many new technologies including mass spectrometry and protein microarrays.

Mass spectrometry (MS) is an evolving technology that allows scientists to detect and identify ever-smaller amounts of proteins. The method is very precise, distinguishing proteins that differ in composition by a single hydrogen atom (the smallest atom). It is also extremely fast. The entire process, from blood collection to data analysis, can take less than one minute.

Protein microarrays are powerful new tools for capturing and measuring proteins from blood and other body fluids and tissues. A protein microarray typically consists of a small piece of glass or plastic that is coated with thousands of "capture reagents" (molecules that can "grab" specific proteins). This technology allows scientists to isolate and study many potential biomarker proteins.





How Can I Find Out More about the Clinical Proteomic Technologies for Cancer (CPTC) Initiative?

For more information about the CTPC, please visit *http://proteomics.cancer.gov*, or contact us at:

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