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BIOMARKER TECHNOLOGY  
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*(SAMPLE COPY, NOT FOR RESALE)*

Trends, Industry Participants, Product Overviews and Market Drivers

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## 1. Overview

### 1.1 Statement of Report

Cancer is a generic term for a large group of diseases that can affect any part of the body, characterized by uncontrolled growth and spread (metastasis) of abnormal cells. The accurate diagnosis of cancer before the appearance of symptoms could predict more successful treatments and often depends on the identification of reliable biomarkers, indicators of normal biologic or pathogenic processes. These biomarkers reflect the progression of cancers and suggest the etiology of the disease. There is an urgent need for diagnostic tests to detect cancer earlier, allowing physicians to make more informed therapeutic decisions. Recently, the growth in this field has been extremely rapid with a large number of tumor biomarkers being identified with an emphasis on platforms to perform elaborate and rapid tumor marker tests.

Cancer is characterized by massive genomic instability, ranging from single point mutations to major chromosomal re-arrangements and duplications. Neither conventional genotyping nor sequencing can provide the amount and type of data that is necessary for complex molecular diagnostics. There are just too many genes and too many mutations to use an approach that detects hot-spot mutations. There are several very large genes that are important in cancer, which—when mutated—activate a whole “cancer pathway.” Such genes are too large to be analyzed using a point mutation assay. Performing conventional sequencing on 1,000 to 2,000 exons, which is necessary for complex, multi-gene diseases, would be extremely inefficient, expensive and an engineering feat. Next-generation sequencing allows researchers to develop fully comprehensive genotype profiles associated with cancer and develop better diagnostic tests for this disease.

The purpose of this report is to describe the specific segment of the cancer diagnostics market that develops new biomarker technology platforms. Such platforms include: robotic and automated sample nucleotide extraction and real-time PCR machines, next-generation sequencers, comparative genomic hybridization (CGH) arrays, proteomics and SELDI-TOF-MS technology for cancer biomarker profiling and cancer diagnosis and treatment. Biomarkers are useful in following the course of cancer and evaluating which therapeutic regimes are most effective for a particular type of cancer, as well as determining long-term susceptibility to cancer or recurrence. This study examines those clinical measurement devices and their reagents and supplies that are meant to be used in hospitals, clinics, commercial laboratories and doctor’s offices to diagnose and monitor cancer. The examination also provides an in-depth discussion of the application of biomarkers in developing novel targeted cancer therapeutics, their predication response and efficacy, as well as their use in the diagnosis of cancer.

### 1.2 About This Report

The report describes new technology platforms developed for the analyses of constituents of blood, plasma, serum or tissue that are connected to the growth and progression of cancer. The emphasis is on those companies and products that are actively developing and marketing new clinical laboratory instrumentation, reagents and supplies for performing tumor marker tests, as opposed to the more routine and clinically-accepted tumor markers that are manufactured and marketed by large diagnostic companies. This study focuses on smaller biotech companies that have new products and procedures in this sector. Research companies in the process of developing new ideas are not reviewed in any detail here.

The main objectives of this analysis are:

- Identifying viable technology drivers for cancer biomarkers and related companion diagnostics through a comprehensive examination of platform technologies, including: probe-based nucleic acid assays, microarrays and sequencing, and mass spectroscopy.
- Obtaining a complete understanding of the new cancer biomarker diagnostic tests—*i.e.*, predictive, screening, prognostic, monitoring, pharmacogenomic and theranostic—from their basic principles to their applications.

- Discovering growing market opportunities by identifying high-growth applications in different cancer diagnostic areas, focusing on the biggest and expanding markets in oncology (e.g., biomarkers for breast cancer and predictive biomarkers).
- Focusing on global industry development through an in-depth analysis of the major world markets for cancer diagnostics, including growth forecasts.

### 1.3 Scope of the Report

This analysis emphasizes companies that are actively developing and marketing new reagents and supplies for performing cancer biomarker diagnostics tests. It discusses the various market trends and opportunities using new biomarkers, while providing an in-depth analysis of market share, revenue forecasts, and market drivers and restraints. Specialty cancer diagnostics testing, such as pathology screening methods and special tissue stains to examine cancer cells *in situ* are mentioned here, since they are often part of the overall analytical focus of companies that market cancer technology platforms. However, no effort is made to quantify this older and broader market. The reader should consult other TriMark Publications reports at <http://www.trimarkpublications.com> for detailed discussions of important individual market segments related to cancer diagnostics and therapeutics markets, such as *Cancer Diagnostic Testing World Markets*, *Cancer Cell Therapy Markets* and *Cancer Therapeutics Markets*.

### 1.4 Objectives

The goal of this report is to review the market for new cancer biomarker testing equipment and supplies using reagents and instruments for analysis of individual components in blood, serum or plasma, which depend on the breaking developments in the genomic and proteomic spaces. The study defines the dollar volume of sales, both worldwide and in the U.S., and analyzes the factors that influence the size and the growth of the market segments. Also examined are the subsections of each market segment, including: the physician office labs, hospital labs and commercial laboratories. Additionally, the numbers of institutions using this type of testing and the factors that influence purchases are discussed. The analysis examines:

- Opportunities and barriers for new cancer biomarkers using proteomics.
- Secreted proteins as biomarkers.
- Adaptive design using biomarkers.
- Pharmacodynamic biomarkers identified with broad-based phenotyping as companion diagnostics.
- Tools for improving measurement, safety and validation of biomarkers.
- Filling the gap between discovery and clinically validated biomarkers.
- Enabling technologies for oncology biomarker discovery.

This study answers the following questions:

- Which companies are utilizing cutting-edge technologies to develop, validate and implement cancer biomarkers for clinical use?
- What impediments still exist to incorporating promising research into clinical practice?
- Which cancer biomarkers show the most promise for approval?
- What are the economic challenges to approval?
- How can regulatory oversight drive approval and adoption of new technologies?
- Which alliances show the greatest synergy in bringing valid biomarkers to market?
- Which shared technologies are driving the most encouraging development?

### 1.5 Methodology

The author of this report holds a Ph.D. in biochemistry from the University of Minnesota and has had post-doctoral experience at the University of Connecticut School of Medicine. He has taught at Quinnipiac University and the Tufts School of Medicine, and has been a senior scientist at Pfizer Pharmaceutical Laboratories in drug development. He also has many decades of experience in science writing and as a medical industry analyst. He has

over thirty years of experience in laboratory testing and instrument and reagent development technology as a licensed clinical laboratory director, as well as extensive experience in senior level management positions in biotech and medical service companies. The editor of the report has a Ph.D. in biochemistry from the University of Toronto and has over 15 years of experience in the fields of molecular biology, immunology and oncology. She has worked as a research assistant professor and scientist at the University of Pittsburgh's Cancer Institute.

Company-specific information is obtained mainly from industry trade publications, academic journals, news and research articles, press releases and corporate websites, as well as annual reports for publicly-held firms. Additional sources of information include non-governmental organizations (NGOs) such as the World Health Organization (WHO) and governmental entities such as the U.S. Department of Health and Human Services (HHS), the National Institutes of Health (NIH), the Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC). Where possible and practical, the most recent data available have been used.

Some of the statistical information was taken from Biotechnology Associates' databases and from TriMark's private data stores. The information in this study was obtained from sources that we believe to be reliable, but we do not guarantee the accuracy, adequacy or completeness of any information or omission or for the results obtained by the use of such information. Key information from the business literature was used as a basis to conduct dialogue with and obtain expert opinion from market professionals regarding commercial potential and market sizes. Senior managers from major company players were interviewed for part of the information in this report.

### ***Primary Sources***

TriMark collects information from hundreds of Database Tables and many comprehensive multi-client research projects, as well as Sector Snapshots that it publishes annually. TriMark extracts relevant data and analytics from its research as part of this data collection.

### ***Secondary Sources***

TriMark uses research publications, journals, magazines, newspapers, newsletters, industry reports, investment research reports, trade and industry association reports, government-affiliated trade releases and other published information as part of its secondary research materials. The information is then analyzed and translated by the Industry Research Group into a TriMark study. The Editorial Group reviews the complete package with product and market forecasts, critical industry trends, threats and opportunities, competitive strategies and market share determinations.

### ***TriMark Publications Report Research and Data Acquisition Structure***

The general sequence of research and analysis activity prior to the publication of every report includes the following items:

- Completing an extensive secondary research effort on an important market sector, including gathering all relevant information from corporate reporting, publicly available databases, proprietary databases, direct meetings and personal interviews with key personnel.
- Formulating a study outline with the assigned writer, including important items:
  - Market and product segment grouping and evaluating their relative significance.
  - Key competitors' evaluations including their relative positions in the business and other relevant facts to prioritize diligence levels and assist in designing a primary research strategy.
  - End-user research to evaluate analytical significance in market estimation.
  - Supply chain research and analysis to identify any factors affecting the market.
  - New technology platforms and cutting-edge applications.

- Identifying the key technology and market trends that drive or affect these markets. Assessing the regional significance for each product and market segment for proper emphasis of further regional/national primary and secondary research.
- Launching a combination of primary research activities including two levels of questionnaires, executive-direct focused, company-specific, and region-specific communications to qualified and experienced senior executives worldwide.
- Completing a confirmatory primary research assessment of the report's findings with the assistance of Expert Panel Partners from the industry being analyzed.

## 1.6 Executive Summary

Until superior therapeutic treatments are developed to prevent, treat and cure cancer, the best means of reducing mortality and morbidity in a disease this complex is early detection and diagnosis. In the major solid cancer types such as lung, breast, colon and prostate, long-term survival rates drop precipitously once metastasis has occurred. The case is clear for development of biomarkers for early detection and screening tests for diseases such as breast, colon, ovarian and lung cancer. In addition, diagnostic measurement of cancer disease progression is essential to successful disease management. For these reasons, development of new and effective biomarkers for cancer detection and diagnosis is central to the cancer problem. The use of both nucleic acid and protein biomarker diagnostics has begun to answer these questions.

As the pharmaceutical and diagnostic industries increase the availability of biomarkers, their importance and influence in all aspects of drug discovery and the development process will continue to grow. Co-development of molecular diagnostics and targeted therapeutics has already been proven to be a successful strategy in the development of novel anti-cancer drugs such as Gleevec<sup>®</sup>. With the global biomarker industry projected to become a nearly \$ [REDACTED] industry by the end of [REDACTED], an increased number of pharmaceutical companies have entered the market.

Unmet patient need is the major driver of innovation in both cancer diagnostics and therapeutics. There is significant need for high-sensitivity diagnostic methods to detect the presence of early-stage disease. Competitive pressures and reimbursement issues will increase the demand for better diagnostic testing information in order to satisfy the need for a diagnostic component to the clinical decision-making process.

The enormous developments in analytical instrumentation in the last [REDACTED] years fueled the \$ [REDACTED] worldwide biotechnology instrumentation market in [REDACTED], of which the U.S. biotechnology instrumentation market was estimated to be \$ [REDACTED]. Of course, the deoxyribonucleic acid (DNA) revolution has brought an entire new class of analytical instruments on board in the last [REDACTED] years. DNA structure and function has lead to new classes of cancer markers.

The IMS Global Oncology Forecast estimates that between now and [REDACTED], the oncology market will grow at a compound annual rate of [REDACTED]% to [REDACTED]% to reach \$ [REDACTED] to \$ [REDACTED] in global sales—nearly double the forecasted growth rate of the overall pharmaceutical market. In North America and the European Union (E.U.), approximately [REDACTED]% of all sales of anti-cancer agents are therapeutic agents introduced in the past ten years, driven largely by innovations derived from biotechnology. Over [REDACTED]% of sales are from launches in the past five years. These innovations have improved quality of life, delayed disease progression, and helped prolong survival for patients battling different types of cancer—including breast, colon, lymphoma, leukemia and kidney.

Targeted therapies have revolutionized the way cancer is being treated, opening up the possibility that many forms of the disease can be fought through long-term maintenance therapy. These therapies are helping to win individual battles against cancer, enabling us to think of it as a chronic illness, rather than a life-ending one. With the industry's innovation and ongoing scientific advances, growth in targeted therapies will continue to be very strong and the outcomes even more impressive, and this will drive the development of companion diagnostic tests. Cancer testing is one of the most important growth opportunities in the diagnostics segment for the next three to five years.