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The background of the cover is a microscopic view of a blood vessel. It features several red blood cells, which are biconcave discs, and several spherical antibody molecules. The antibodies are depicted as complex, multi-lobed structures with numerous small protrusions on their surface, resembling a fuzzy or spiky texture. The overall color palette is dominated by shades of red and pink, with some darker, almost black, areas representing the interior of the vessel.

Therapeutic Monoclonal Antibodies Markets *(SAMPLE COPY, NOT FOR RESALE)*

Trends, Industry Participants, Product Overviews and Market Drivers

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1. Introduction

1.1 Statement of Report

Antibodies are proteins in the immune system that help the body defend against foreign invasion, particularly from pathogens and toxins. As such, a human-engineered therapeutic monoclonal antibody (mAb) is protein derived from the immune system through recombinant DNA technology that has the ability to combine specifically with a target protein that plays a role in a disease process. With this unique ability to specifically target diseased cells while leaving healthy cells unaffected, monoclonal antibodies can serve to diagnose and treat a wide range of medical conditions. Areas such as breast cancer therapy have benefited greatly since the advent of drugs like Herceptin (trastuzumab) that interferes with the HER2/neu receptor. Indeed, the field of therapeutic monoclonal antibodies potentially has far-reaching and paradigm-shifting implications for biology, drug discovery, and medical treatment of disease. The discipline has already yielded discoveries that have been used for drug delivery and diagnostic purposes, and other exciting new therapeutic applications.

1.2 Objectives of this Report

The principal objectives of this report are to:

- Identify viable technology drivers through a comprehensive look at various platform technologies for the therapeutic monoclonal antibodies markets.
- Obtain a complete understanding of the important therapeutic antibodies platforms, and the application of these unique capabilities to the successful development of therapeutic products to diagnose and treat disease.
- Discover feasible market opportunities via an identification of high-growth applications in different therapeutic antibodies markets areas, with a focus on the biggest and expanding markets for drug delivery.
- Focus on global therapeutic antibodies industry development through an in-depth analysis of the major world markets for these modalities, including forecasts for growth.
- Present market figures regarding the current potential value of the therapeutic antibodies markets, projections and growth rates.
- To examine in depth the use of therapeutic antibodies product and market development, and show specific examples of their use in commercial development and the repositioning of therapeutic agents and products.

By purchasing this report, you will have:

- An improved understanding of the current state and future of the most important therapeutic antibodies market segments.
- The latest information on the leading companies engaged in R&D and product development in the most promising therapeutic antibodies product pipelines, including products for diagnostics, imaging and drug delivery.
- A comprehensive perspective of the exciting recent therapeutic antibodies market developments and revelations and how this technology is already having an impact, and the many products that are now on the market and in the pipeline.
- Knowledge of how therapeutic antibodies are addressing unmet needs in the pharmaceutical industry, including the reformulation of drugs to improve their bioavailability or toxicity profiles.

The following areas of the therapeutic antibodies market have been addressed:

- New and emerging products.
- Global market for therapeutic antibody products.
- Role of therapeutic antibodies in driving market changes.
- Therapeutic antibody patent issues.

Categories of therapeutic antibodies products discussed are:

- Therapeutic antibodies in drug delivery.
- Therapeutic antibodies in diagnostics and sensors.
- Therapeutic antibodies in imaging.
- Key technology for medical uses of antibodies.
- Important technology trends in therapeutic antibodies.
- Therapeutic antibodies market regulation and reimbursement.

General discussions of current issues in this report are:

- Assess the market drivers and bottlenecks, from the perspective of the medical, technology and scientific communities.
- Discuss the potential benefits the therapeutic antibodies for various sectors of the medical and scientific community.
- Establish the current total market size and future growth of the therapeutic antibodies markets and analyze the current size and growth of individual segments.
- Provide strategic recommendations for near-term business opportunities.
- Assess current commercial uses of the therapeutic antibodies markets.

We answer the following questions in this report:

- What are the near-term business opportunities in the therapeutic antibodies markets?
- What are the current and forecasted sizes of the therapeutic antibodies markets?
- What are the business models currently used by companies in the therapeutic antibodies markets?
- How will manufacturers, researchers, physicians, patients and payers influence the therapeutic antibodies markets?
- Who holds the proprietary rights to the therapeutic antibodies markets?
- What are current applications of these technologies?
- How will new or emerging therapeutic antibodies change treatment and payment paradigms?
- How will therapeutic antibodies reduce healthcare expenditures?
- How will therapeutic antibodies impact diagnostic testing?
- What is the role of therapeutic antibodies in drug development?
- Which therapeutic antibodies product categories are driving the growth?

1.3 Scope of the Report

This report reviews the market for medical products based on emerging therapeutic monoclonal antibodies. It defines the dollar volume of sales in the U.S. and worldwide, and it analyzes the factors that influence the size and the growth of the market segments. The study goes on to discuss in detail the trends that have developed which have stimulated this market and surveys many of the companies marketing, manufacturing or developing monoclonal antibodies therapies. Monoclonal antibodies for non-therapeutic purposes—used primarily in life science and research applications—are not discussed in this review. Moreover, antibody process technology is not covered. Special effort was made to include mention of smaller companies that are or potentially could have an impact on their industry far in excess of their current size. Each company is discussed in depth with a section on the history of the company, the product line, business and marketing analysis, and a subjective commentary of the position of the company in its market.

1.4 Methodology

The author of this analysis holds a Ph.D. in genetics from the University of Washington and has worked in academia as a professor in departments of biology, cell biology and biochemistry. He has worked in the private sector in product R&D and published over 200 peer-reviewed papers, market reports, books, chapters in books and articles in the biotech trade press. His writings include such diverse areas as antibody technology, bioprocessing, drug development, evolutionary biology and biofuel technology. The senior editor is a Ph.D. in physiology with a focus on computational physiology from the University of Toronto in Canada, with postdoctoral training and experience in cell and systems biology from the University of Toronto.

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. Additionally, sources of information include the non-governmental organizations (NGOs) such as the World Health Organization (WHO) and governmental entities like the U.S. Department of Health and Human Services (HHS) and U.S. federal agencies such as the National Institutes of Health (NIH), the Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC). Where possible and practicable, 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 we publish annually. We extract relevant data and analytics from TriMark's 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.

Market Forecasts and Modeling

The numerical data on market size, growth rates and sales forecasts are obtained from a well-examined model based upon quantitative market information obtained from the leading global companies in the sector, private seminar presentations by company experts and public SEC filings. Many industry experts are also consulted to confirm these market estimates. The numbers used are washed of discounts and returns, and represent the final sale numbers. In addition, global numbers are assessed by region components as well, taking into account differences in market conditions between the U.S., Europe and Asian markets in particular.

TriMark Publications Report, Research and Data Acquisition Structure

The general sequence of research and analysis activity prior to the publication of every report in TriMark Publications 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 data and proprietary databases.
- Formulating a study outline with the assigned writer, including important items, as follows:
 - 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.
- Completing a confirmatory primary research assessment of the report's findings with the assistance of expert panel partners from the industry being analyzed.

1.5 Executive Summary

Antibodies and antibody fragments have long been essential tools for biological research and are now rapidly gaining importance as therapeutic agents. They are a powerful class of reagents, but their development is a costly and time-consuming process. Revenues of publicly traded biotech companies worldwide crossed the \$ [REDACTED] threshold for the first time in [REDACTED]. In fact, among the blockbuster drugs marketed by the biotech industry (over \$ [REDACTED] in sales), drugs like Biogen Idec's monoclonal antibody Rituxan (rituximab) stood out as fast growers. Next generation antibodies are forecast to drive the market over the \$ [REDACTED] mark by [REDACTED], although at a slower pace estimated to be a compounded annual growth rate (CAGR) of [REDACTED] %.

In comparison, the pharmaceutical industry is a worldwide enterprise of extraordinary size, generating total global revenues of \$ [REDACTED] in [REDACTED]. This sector is projected to grow to over \$ [REDACTED] by [REDACTED]. Despite the many advances in molecular immunology, approvals have lagged substantially behind predictions in recent years. At present, there are [REDACTED] antibodies on the market, and only one new offering gained FDA approval in [REDACTED]. Problems in moving antibodies through the pipeline include increasing costs and complexities of clinical trials, questions concerning long-term safety and efficacy, the high cost of therapies, restriction on government healthcare spending and, finally, difficulties working through the layers of patents on various antibody technologies. A number of antibodies are in various stages of clinical evaluation.

Oncology products will continue to dominate the therapeutic monoclonal antibody market. However, sales of arthritis, immune and inflammatory disorders (AIID) products are growing dramatically and will account for approximately [REDACTED] % of the market by [REDACTED]. With the predicted launch of two pipeline antibodies in the next five years, the infectious disease area is set to grow in importance. Therapeutic antibodies are also being developed for respiratory, cardiovascular and ophthalmology indications. Analysis of early and late stage therapeutic antibody pipelines show development focus is shifting away from murine and chimeric monoclonal antibodies to humanized and fully-human antibodies.

Successful humanized and fully-human antibody products which have been approved by the FDA previously include Avastin, Herceptin, Remicade, MabThera/Rituxan, Humira and Erbitux. Growth in sales of almost \$ [REDACTED] was generated by monoclonal antibody products between [REDACTED] and [REDACTED]. Not only are these products

showing strong sales growth for their original indication, but a number of antibodies have received widened approval for other disease states, such as Genentech and Roche's Avastin (bevacizumab). Because this antibody targets angiogenesis (the process by which tumors develop blood vessels for survival), it may be effective against a wide range of cancer types.

Predictions are that antibody revenue growth will slow by [REDACTED]. Competition between rival products will result in cannibalization, such as Humira sales growth at the expense of Remicade, for example, while some second-generation product launches (such as MedImmune's Numax) will eat into first-generation monoclonal antibody products including MedImmune's Synagis.

Because of the difficulties in recreating an exact copy, antibody products have been largely insulated from the threat of generics or "biosimilars". However, this climate is changing as regulatory approval for biosimilars has been streamlined and as many antibodies move toward patent expiration. Nonetheless, antibody products will remain completely insulated from the threat of generic competition through [REDACTED], a trend owed to robust patent protection and a lack of a regulatory pathway suitable to support biosimilar antibody development. In addition to occupying a sector of the market that is insulated from generic competition, antibodies have the advantage of primarily addressing high unmet need therapy areas such as oncology and AIID.

SAMPLE

2. The State of Therapeutic Monoclonal Antibody Technology

Antibodies and antibody fragments have long been essential tools for biological research and are now rapidly gaining importance as therapeutic agents. Monoclonal antibodies—which are highly specific antibodies produced in large quantity by the clones of a single hybrid cell formed in the laboratory by the fusion of a B cell with a tumor cell—are a powerful class of reagents, but their development is a costly and time-consuming process. Conversely, polyclonal antibodies are antibodies that are derived from different B cell lines. They are a mixture of immunoglobulin molecules secreted against a specific antigen, each recognizing a different epitope. The science of immunology underwent a radical transformation with the discovery of hybridoma technology in the mid 1970s, and the effects of this seminal creation continue to dominate the pharmaceutical industry. Although early application of monoclonal antibodies derived from the fusion of a lymphocyte with a tumor cell were fraught with failures and setbacks, the union of new molecular technologies allowed the manipulation of these structures and an escape from the early drawbacks brought about by the introduction of murine antibodies into a human circulatory system. Recombinant DNA technology allowed the redesign of antibody molecules and resolved many of the early problems faced by the industry. Today, the technology has matured—both from the standpoint of the discovery phase as well as from the industrial side—in which antibodies are now produced in kilogram quantities.

Advances in kits for manipulating macromolecules, as well as new hardware, continue to streamline antibody technology, driving the industry with cheaper, faster technologies. The development of therapeutic antibodies involves several stages, including:

- Immunogenicity studies.
- In-process control.
- Product release testing that are under strict regulatory control.

A critical bottleneck in early development of monoclonal antibodies is the screening of hybridoma cell clones, which must be maintained in large numbers until the best candidate monoclonal antibodies are confidently identified. Additionally, during in-process and quality control, validated assays must be able to monitor the biological product through multiple stages of expression and purification.

2.1 State of the Pharmaceutical Industry

The pharmaceutical industry is a worldwide enterprise of extraordinary size, generating total global revenues of \$ [REDACTED] in [REDACTED]. This sector is projected to grow to over \$ [REDACTED] by [REDACTED]. North America is the largest component of this market with [REDACTED]% market share of sales. In terms of return on investment, the pharmaceutical industry is ranked amongst the leaders in the industrial sector. The pharmaceutical industry has over the last [REDACTED] years produced a string of blockbuster drugs, and many of these have had a profound beneficial affect on the health of the American people. Pharmaceutical prices have increased far above the overall rate of inflation, bringing large revenue increases to the drug companies. For instance, the price of Schering-Plough's blockbuster allergy pill, Claritin, was raised [REDACTED] times over [REDACTED] years. Its [REDACTED]% increase over this period was over four times the rate of general inflation.

Less advantageous for the pharmaceutical sector is the fact that \$ [REDACTED] in products going off patent will occur in [REDACTED], challenging the pharmaceutical industry to identify new and innovative ways to fill their pipelines. The change in the shape of the drug market will reflect several factors including the global downturn, patent expiry and flat lining growth rates in mature markets. Growth of the world's largest market, the U.S., is expected to decrease from [REDACTED]% to between [REDACTED]% and [REDACTED]% in [REDACTED], mainly due to an increase in generic products, continued turbulence in the economic markets, and the relatively low number of new drugs in the pipeline. Revenue growth in Europe and Japan is expected to follow suit in [REDACTED]; however, "pharmerging markets" like India, China and Brazil are projected to burgeon to nearly [REDACTED]%, reaching \$ [REDACTED] in [REDACTED], and taking up a good share of the slack in other markets.