

CARDIAC MARKER DIAGNOSTIC TESTING MARKETS *(SAMPLE COPY, NOT FOR RESALE)*

Trends, Industry Participants, Product Overviews and Market Drivers

TABLE OF CONTENTS

1.	Overview	8
1.1	Statement of Report	8
1.2	Objectives of This Report	8
1.3	Scope of This Report	10
1.4	Methodology	10
1.5	Executive Summary	12
2.	The Basics of Biomarkers	16
3.	Cardiac Marker Testing Markets: Market Segment Analysis: Size, Growth and Share	21
3.1	Global Cardiac Marker Diagnostic Testing Markets	21
3.1.1	Clinical Utility of Cardiac Markers	23
3.1.2	Market Drivers in the Cardiac Marker Diagnostics Testing Sector	24
3.1.3	Market Restraints in Cardiac Marker Testing Segment	24
3.1.4	Principal Market Segments for Cardiac Marker Testing	25
3.1.5	Key Players in the Cardiac Marker Diagnostics Testing Segment	25
3.1.6	Cardiac Marker Testing Sector Analysis	26
3.2	U.S. Cardiac Marker Testing Market	27
3.2.1	Market Overview	27
3.2.2	Cardiac Diagnostic Test Segments	28
3.2.3	U.S. Hospital POC Cardiac Markers	29
3.3	European Cardiac Marker Diagnostic Test Market	31
3.3.1	German Diagnostic Markets	34
3.3.2	U.K. Diagnostic Testing Market	35
3.3.2.1	U.K. Market Statistics	36
3.3.3	Italy	37
3.3.4	France	38
3.3.5	Spain	38
3.3.6	Benelux	39
3.3.7	Scandinavia	39
3.3.8	Switzerland	40
3.3.9	Barriers to Entry to European Market	40
3.4	Japanese Diagnostic Testing Market	41
3.5	Chinese Diagnostic Testing Market	41
3.6	Canadian Diagnostic Market	44
3.7	Cardiac Marker Testing Individual Markets	44
3.7.1	Clinical Overview	44
3.7.2	Cardiac Acute Disease Markers	45
3.7.3	Market Overview	46
3.7.3.1	Troponins	49
3.7.3.2	Market Size and Growth Projections	51
3.7.3.3	Clinical Use of Cardiac Troponins	54
3.7.3.4	TnI and TnT Market Drivers	58
3.7.3.5	TnI and TnT Market Restraints	58
3.7.4	CK-MB and Cardiac Enzymes	59
3.7.4.1	Creatine Kinase (CK) Enzymes	59
3.7.4.2	Market Size and Growth Projections	59
3.7.4.3	CK-MB: Market Drivers	60
3.7.4.4	CK-MB: Market Restraints	61
3.7.5	Myoglobin	61
3.7.5.1	Market Size and Growth Projections	61
3.7.5.2	Clinical Use of Myoglobin	62
3.7.5.3	Myoglobin Market Drivers	63
3.7.5.4	Myoglobin Market Restraints	63

3.7.6	Natriuretic Peptides	63
3.7.6.1	Market Overview	63
3.7.6.2	Market Size and Growth Projections	65
3.7.6.3	Commercial Assays for BNP and NT-proBNP	66
3.7.6.4	Competitive Landscape	68
3.7.6.5	BNP Test Market Share	68
3.7.6.6	Clinical Applications of BNP/NT-proBNP	71
3.7.6.7	BNP NT-proBNP Market Drivers	74
3.7.6.8	BNP NT-proBNP Market Restraints	74
3.7.6.9	Future Projections and Trends of NP Testing	75
3.7.6.10	Future Use of BNP	75
3.7.7	Albumin	75
3.7.7.1	Ischemic Modified Albumin (IMA)	75
3.7.7.2	Microalbuminuria	77
3.7.8	Key Players in Cardiac Markers	78
3.7.9	Evaluation of Cardiac Markers	86
3.7.10	Cardiac Markers Use in Clinical Decisions	87
3.7.11	Status of Cardiac Markers in the ER	87
3.7.12	Cardiac Markers in Renal Failure	88
3.7.13	Troponins in Non-Ischemic Heart Disease	88
3.7.14	Market Restraints	89
3.7.15	Market Drivers	89
3.7.16	Cardiac Panels	89
3.7.17	POC Cardiac Markers	90
3.7.17.1	Market Size and Growth Rate	90
3.7.17.2	Market Restraints	91
3.7.17.3	The Next Wave	93
4.	Cardiovascular Disease Markers	97
4.1	Cholesterol, HDL and LDL	97
4.1.1	Cholesterol Testing Market Forecasts	99
4.1.2	Cholesterol Testing Market Growth Drivers	99
4.1.3	Market Outlook: U.S. Market Analysis	99
4.1.4	Trends and Issues	100
4.1.5	Key Players in the Cholesterol Kit Market	101
4.1.5.1	Review of Cholesterol Kit Company Products	102
4.1.5.1.1	Cholestech (Now Alere)	102
4.1.5.1.2	PTS Diagnostics CardioChek	102
4.1.5.1.3	Miraculins PREVUE POC Skin Cholesterol Test	103
4.1.5.1.4	Abaxis Piccolo Express	103
4.1.5.2	Product Comparison of Leading Suppliers	103
4.2	Homocysteine	105
4.3	Fibrinogen	106
4.4	C-Reactive Protein	106
4.5	Lipoprotein Fractions	108
4.6	Pulmonary Embolism (D-Dimer Test)	109
4.7	Oxidized LDL and HDL	109
4.8	Stroke	110
5.	Cardiac Marker Testing Development Issues	111
5.1	Genetic Testing and Personalized Medicine	111
5.2	Preventive Medicine	111
5.3	Patient Safety and Quality Measures	111
5.4	Reimbursement	112
5.5	Cardiovascular Screening Codes	113
5.6	Screening for Diabetes	114

5.7	Other Reimbursement Concerns	114
5.7.1	Reimbursement for Routine Venipuncture	114
5.7.2	Japanese Reimbursements for Medical Devices	115
5.8	CPT Test Codes and Payment Amounts	115
5.9	Rapid Near-Patient Testing in Hospitals	116
5.10	Satellite Facilities	116
5.11	Regionalization of Laboratory Care	117
5.12	POCT: Current Market Trends and Drivers	118
5.12.1	Effectiveness of POCT	119
5.12.2	New Growth Areas for POCT	119
5.12.3	Advantages of POCT in a Clinical Setting	120
5.12.4	Shifts from Central Lab Testing to POCT	120
5.12.5	Turnaround Time for POCT	121
5.13	Clinical Laboratory Improvement Amendments (CLIA)	121
5.14	Regulatory Requirements	124
5.15	Record-Keeping and Data Management	124
5.15.1	Effectiveness of Clinical Outcomes	124
6.	Business Trends in the Industry	125
6.1	Sector Consolidation	125
6.2	Diagnostic Testing Growth Trends	125
6.3	Acquisition, License Agreements, Internal Development and Partnerships	127
6.4	Product Testing Depth in Cardiac Marker Testing	129
6.5	Government Regulation	129
6.5.1	U.S. Regulation	129
6.5.2	CLIA Regulations	129
6.5.3	Clinical Laboratory Improvement Act	130
6.5.4	State Licensing for Service Laboratories	131
6.5.5	IVDMIA	132
6.5.6	FDA Draft Guidance on <i>In Vitro</i> Companion Diagnostic Devices	133
6.5.7	510(k) Clearance	133
6.5.8	Pre-Market Approval	134
6.5.8.1	Pre-Market Approval Application	134
6.5.8.2	Importing Medical Devices into the U.S.	135
6.5.8.3	Exporting Medical Devices from the U.S.	136
6.5.9	E.U. Regulations	136
6.5.10	Japanese Regulations	141
6.5.11	Chinese Regulations	144
6.6	Barriers to Growth	149
6.7	Drivers of Growth	151
7.	Important Technology Trends	153
7.1	Trends in Cardiac Marker Diagnostic Testing	153
7.1.1	Free Fatty Acids and Fatty Acid Binding Proteins	154
7.1.2	Glycogen Phosphorylase Isoenzyme BB	154
7.1.3	S-100 Protein	155
7.1.4	Cobalt-Binding Albumin	155
7.1.5	Myosin Light Chains	155
7.1.6	Emerging POCT Cardiac Marker Testing	156
7.2	Cardiac Biomarker Research	156
7.2.1	Myeloperoxidase	156
7.2.2	Glutathione Peroxidase	156
7.2.3	Antioxidant Biomarkers	156
7.2.4	Oxidative Biomarkers	156
7.2.5	Inflammatory Biomarkers	157
7.2.6	Nitrosative Biomarkers	158

7.2.7	Hemostatic Biomarkers	158
7.3	Potential Stroke Markers	159
7.3.1	Pharmacogenomics: Cardiovascular Drugs and Proteomic Markers	159
7.3.2	Cardiac Proteomics	159
7.3.3	Drivers for Cardiovascular Proteomic Markers	160
7.3.4	Barriers to Cardiovascular Proteomic Markers	160
7.4	Future Developments for Cardiovascular Markers	160
7.5	Research Questions	161
7.5.1	Biomarker Development Strategies	163
7.5.2	Biomarkers for Unstable Angina	164
7.6	Lp-PLA2	165
7.7	Urotensin	166
8.	Company Profiles	167
8.1	Abbott Laboratories and SWOT Analysis	167
8.2	Alere and SWOT Analysis	170
8.3	Beckman Coulter (now part of Danaher)	175
8.4	bioMérieux	177
8.5	Biosite, Inc. (now a brand of Alere)	179
8.6	CardioGenics	180
8.7	Chek Diagnostics	180
8.8	diaDexus and SWOT Analysis	181
8.9	Health-Chem Diagnostics (HCD)	183
8.10	Ortho-Clinical Diagnostics, Inc. and SWOT Analysis	183
8.11	LifeSign, LLC	185
8.12	PreMD, Inc.	185
8.13	PTS Diagnostics	185
8.14	Randox Laboratories Ltd.	186
8.15	Response Biomedical	186
8.16	Radiometer Medical	187
8.17	Roche Diagnostics	190
8.18	Sanyo Chemical Industries Ltd.	192
8.19	Siemens Healthcare Diagnostics	193
8.20	Sierra Resources International	194
8.21	Spectral Diagnostics, Inc.	195
8.22	Shionogi & Co., Ltd.	195

INDEX OF FIGURES

Figure 3.1: Market Share of Cardiac Marker Segment	27
Figure 3.2: U.S. Cardiac Marker Diagnostic Testing Market Segments, 2014	29
Figure 3.3: U.S. POC Cardiac Marker Sales, 2010-2020	30
Figure 3.4: Cardiac Marker Market for Diagnostic Testing in Europe, 2010-2020	32
Figure 3.5: Cardiac Marker POCT Troponin Market Share by Product Type	91
Figure 3.6: Cardiac Marker POCT BNP Market Share by Product Type	91
Figure 4.1: Age-Adjusted Prevalence of High LDL Cholesterol Among Adults Aged 40-74, by Sex and Age in the U.S., 1976-2010	98
Figure 4.2: Age-Adjusted Trends in Prevalence of High LDL Cholesterol, Use of Cholesterol-Lowering Medications, and Low Saturated-Fat Intake Among Adults Aged 40-74 in the U.S., 1976-2010	99
Figure 5.1: CLIA Laboratories by Certificate Types	122
Figure 6.1: Current Conformity Assessment Route, Annexes and Quality System Standards by IVD Device Category	138
Figure 6.2: The Chinese Healthcare System	146

INDEX OF TABLES

Table 2.1: Cardiac Biomarkers of Inflammation and Atherogenesis	17
Table 2.2: Cardiac Biomarkers of Endothelial Function	18
Table 2.3: Cardiac Biomarkers of Thrombosis	18
Table 2.4: Cardiac Biomarkers of Ischemia/Necrosis	18
Table 2.5: Cardiac Biomarkers of Hemodynamic Stress	19
Table 2.6: Cardiac Biomarkers of Heart Failure Mortality	19
Table 2.7: Cardiac Biomarkers of Renal Dysfunction	19
Table 2.8: Cardiac Biomarkers of Metabolic/Lipid Dysregulation	20
Table 2.9: Cardiac Biomarkers of Brain Damage	20
Table 3.1: Cardiac Marker Markets by Country and Region, 2010-2020	22
Table 3.2: Cardiac Marker Markets by Country and Region, 2010-2020	22
Table 3.3: Total Global Cardiac Marker Market, 2010-2020	22
Table 3.4: Most Clinically Used Cardiac Markers	23
Table 3.5: Market Share of Cardiac Marker Segment	26
Table 3.6: U.S. Cardiac Marker Market, 2010-2020	28
Table 3.7: U.S. Cardiac Marker Diagnostic Testing Market Segments, 2014	28
Table 3.8: U.S. POC Cardiac Marker Sales, 2010-2020	29
Table 3.9: Cardiac Marker Market for Diagnostic Testing in Europe, 2010-2020	31
Table 3.10: Regional Comparison of Healthcare and IVD Expenditures	33
Table 3.11: German IVD Diagnostics Products Market Sales, 2010-2020	34
Table 3.12: German Cardiac Marker Test Market, 2010-2020	35
Table 3.13: U.K. IVD Diagnostics Products Market Sales, 2010-2020	36
Table 3.14: U.K. Cardiac Marker Market, 2010-2020	37
Table 3.15: Italian Cardiac Marker Market, 2010-2020	37
Table 3.16: French Cardiac Marker Market, 2010-2020	38
Table 3.17: Spanish Cardiac Marker Market, 2010-2020	39
Table 3.18: Benelux Cardiac Marker Market, 2010-2020	39
Table 3.19: Scandinavian Cardiac Marker Market, 2010-2020	40
Table 3.20: Swiss Cardiac Marker Market, 2010-2020	40
Table 3.21: Japanese Cardiac Marker Diagnostic Testing Market, 2010-2020	41
Table 3.22: Chinese Cardiac Marker Market, 2010-2020	42
Table 3.23: Canadian Cardiac Marker Market, 2010-2020	44
Table 3.24: Actual Reported Number of ER Visits in U.S. Hospitals, 1997-2014	47
Table 3.25: Common Causes of Chest Pain	48
Table 3.26: Rate of Inappropriate Discharge from the ER for Patients with AMI, 1984-2014	48
Table 3.27: Continuing Analytical Issues for Implementation of Cardiac Troponin	51
Table 3.28: Global Cardiac Troponin Marker Market, 2010-2020	52
Table 3.29: U.S. Cardiac Troponin Marker Market, 2010-2020	52
Table 3.30: Selected POC Cardiac Biomarkers, 2014	53
Table 3.31: Projections in U.S. Sales of POC Cardiac Marker Tests, 2010-2020	54
Table 3.32: Causes of Troponin Elevations	57
Table 3.33: World Revenue from CK-MB Markets, 2010-2020	60
Table 3.34: U.S. Revenue from CK-MB Markets, 2010-2020	60
Table 3.35: World Myoglobin Market Revenues, 2010-2020	61
Table 3.36: U.S. Myoglobin Market Revenues, 2010-2020	62
Table 3.37: BNP Clinical Characteristics	64
Table 3.38: Global Sales of BNP and NT-proBNP assays, 2010-2020	65
Table 3.39: U.S. Sales of BNP and NT-proBNP assays, 2010-2020	65
Table 3.40: FDA Approved BNP Assays	67
Table 3.41: FDA Approved NT-proBNP Assays	67
Table 3.42: Analytical Characteristics of Commercial BNP Assays per Manufacturer	69
Table 3.43: Analytical Characteristics of Commercial NT-proBNP Assays per Manufacturer	69
Table 3.44: Market Share of BNP Assays in the U.S. by Instrument	70
Table 3.45: Market Share of NT-proBNP Assays in the U.S. by Instrument	70

Table 3.46: U.S. Hospital Share Estimates of NP Usage	71
Table 3.47: CHF National Hospital Discharge Survey, 2000-2010	71
Table 3.48: BNP NT-pro BNP Market Drivers	74
Table 3.49: BNP NT-pro BNP Market Restraints	74
Table 3.50: Trends in Cardiovascular Testing in Primary Care, U.S. and Globally	75
Table 3.51: The Clinical Advantages of Ischemia Modified Albumin	76
Table 3.52: Analytical Advantages of IMA	77
Table 3.53: Analytical Disadvantages of IMA	77
Table 4.1: HDL Levels in Adults	97
Table 4.2: LDL Levels in Adults	98
Table 4.3: Number of U.S. Cholesterol Tests, 2000-2014	100
Table 4.4: Selected POC Cholesterol Testing Devices, 2014	101
Table 4.5: World CRP Market Revenue, 2010-2020	107
Table 4.6: U.S. CRP Market Revenue, 2010-2020	108
Table 4.7: Clinical Characteristics of CRP	108
Table 4.8: Clinical Characteristics of D-Dimer	109
Table 5.1: CPT Codes Lipid Profile and Cholesterol Testing	114
Table 5.2: Financial Comparison for Moderate and Waived CLIA Labs	122
Table 5.3: POCT Clinical Outcomes in AMI	124
Table 6.1: Regulatory Rules that Affect the Ability of a Diagnostic Testing Reagent Company to Conduct Business	129
Table 6.2: Strengths of the 510k Process	133
Table 6.3: Drawbacks of the 510k Process	133
Table 6.4: Number of Healthcare Institutions According to Ownership China, 2010	147
Table 6.5: Total Number of Hospitals by Ranking China, 2010	148
Table 6.6: POC Cardiac Marker Testing Market: Market Restraints Ranked in Order of Impact	150
Table 6.7: Cardiac Marker Testing Market: Market Drivers Ranked in Order of Impact	152
Table 7.1: Oxidative Biomarker Research Assay Market Size	157
Table 7.2: Potential New Stroke Markers	159
Table 7.3: Non-Lipid Markers of CVD	161
Table 8.1: Alere Professional Diagnostics	172
Table 8.2: Alere, Inc. Financial Figures—Net Sales by Business Sector, 2011-2013	173
Table 8.3: Alere, Inc. Financial Figures—Net Sales by Geographic Region, 2011-2013	174
Table 8.4: Roche Group Financial Figures—Net Sales by Business Sector, 2009-2013	191
Table 8.5: Roche Group Financial Figures—Net Sales by Geographic Region, 2012 and 2013 for the Diagnostics Division	192
Table 8.6: Roche Group Financial Figures—Net Sales by Sub-Division, 2011-2013	192

1. Overview

1.1 Statement of Report

Cardiac marker diagnostic testing measures the concentration of certain proteins, *i.e.*, biomarkers, which indicate the presence or severity of cardiovascular disease (CVD). Among the most prevalent CVDs are sudden cardiac arrest (SCA), acute myocardial infarction (AMI), congestive heart failure (CHF) and atherosclerosis. Every year according to WHO, an estimated [REDACTED] people worldwide die from a CVD. This TriMark Publications report describes the specific market segment of the *in vitro* diagnostics (IVD) market devoted to cardiac marker testing, including size; growth; industry trends; product development and investment; and clinical measurement devices, reagents and supplies. Highly-attractive cardiac marker areas covered in this review include:

- The cardiac rapid assay market, troponins.
- Creatine kinase-myocardial band (CK-MB).
- Brain natriuretic peptide (BNP) testing.
- N-terminal pro-B-type natriuretic peptide (NT-proBNP).
- Myoglobin.
- Homocysteine (Hcy).
- C-reactive protein (CRP).
- D-dimer test.
- Low-density and high-density lipoproteins (LDL and HDL).
- Glial fibrillary acidic protein (GFAP).
- Fatty acid binding protein.
- Ischemia modified albumin.
- Troponin I and Troponin T.

These markers are used in stroke and other cardiac diseases to make; clinical decisions for cardiovascular disease; and also cardiac markers are used in renal failure, cardiac panels and point of care (POC), congestive, hypertensive and peripheral arterial disease.

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 cardiac marker segments of the diagnostic testing market.
- Obtain a complete understanding of the chief cardiac markers and their diagnostic test predictive, screening, prognostic monitoring, pharmacogenomic and theranostic value, while also appreciating these elements from their basic principles to their applications.
- Discover feasible market opportunities via identification of high-growth applications in different cardiac marker diagnostic testing areas, with a focus on the biggest and fastest-expanding markets for diseases.
- Focus on global industry development through an in-depth analysis of the major world markets for cardiac marker diagnostic testing, including forecasts for growth.
- Present market figures regarding the current value of the cardiac marker testing market, projections and growth rates. These are taken from the most recently available data of the global diagnostic industry.

By purchasing this study, the reader will gain:

- An improved understanding of the current state and future of the most exciting cardiac marker diagnostic testing market segments.
- The latest information on the leading companies engaged in R&D and products in the cardiac marker diagnostic reagent pipeline with SWOT analyses.
- The leading perspective of recent diagnostic test developments and revelations as well as how they will influence selected clinical markets.

- Knowledge of the cardiac diagnostic testing market as an area of growth, research and investment.

This analysis will cover the following categories of the cardiac diagnostic testing segments:

- Acute myocardial infarction (AMI).
- Heart failure.
- Brain natriuretic peptide (BNP).
- Myoglobin.
- Homocysteine (Hcy).
- C-reactive protein (CRP).
- Pulmonary embolism (PE) (D-dimer test).
- Low-density lipoproteins (LDL) and high-density lipoproteins (HDL).
- Stroke.
- Creatine kinase-myocardial band (CK-MB) and cardiac enzymes.
- Albumin.
- Cardiac markers used in clinical decisions.
- Cardiac markers in renal failure.
- Troponins in non-ischemic heart disease.
- Cardiac panels.
- Point of care (POC) cardiac markers.

Analysis includes the use of charts and graphs measuring product growth and trends within the marketplace. In addition, a discussion of research into various illnesses provides the reader with a deeper understanding of the possibilities for future treatment and avenues for possible R&D budgets. Company-specific information, including sales figures, product pipeline status and R&D trends, is provided throughout the report. In addition, the study will:

- Assess the cardiac marker diagnostic testing market drivers and bottlenecks, from the perspective of the medical and scientific communities.
- Discuss the potential benefits of the cardiac marker diagnostic testing market for various sectors of the medical and scientific community.
- Establish the current total market size and future growth of the cardiac marker diagnostic testing market and analyze the current size and growth of individual segments.
- Provide current and forecasted market shares by company.
- Discuss profit and business opportunities by diagnostic testing segment.
- Provide strategic recommendations for near-term business opportunities.
- Assess current commercial uses of the cardiac marker diagnostic testing market.

The following questions are answered in this analysis:

- What are the near-term business opportunities in the cardiac marker diagnostic testing market?
- What are the current and forecasted sizes of the cardiac marker diagnostic testing markets in the United States, European Union (E.U.) and Japan, as well as other key country markets?
- What business models are currently used by companies in the cardiac marker diagnostic testing market?
- How will diagnostic manufacturers, researchers, physicians, patients and payers influence this market?
- What are the drivers and bottlenecks influencing the cardiac marker diagnostic testing market?
- What are the technologies used in cardiac marker diagnostic testing?
- Who holds the proprietary rights to the cardiac marker diagnostic testing market technology?
- What are current applications of this technology?
- What regulatory processes must the cardiac marker diagnostic testing technologies undergo in the U.S., Japan and the E.U.?
- How will new cardiac marker diagnostic testing technologies change treatment and payment paradigms?
- How will cardiac marker diagnostic testing technologies reduce adverse clinical reactions and decrease total patient care cost?
- How will cardiac marker diagnostic testing technologies reduce healthcare expenditures?

- What impact is increased testing in developing country markets likely to have on the diagnostic cardiac biomarker testing reagents markets in these countries?
- What are the true drivers for ordering volumes of troponin tests?
- How do the major geographic markets differ in their diagnostic testing protocols for troponin?
- What is the uptake of other biomarker tests, such as creatine kinase-MB (CK-MB) and myoglobin, across the major geographic markets?
- How will troponin, CK-MB, and myoglobin tests fare once the pipeline biomarkers co-peptin and H-FABP gain uptake?
- What are the opinions of interviewed experts regarding the next-generation of high-sensitivity troponin assays?
- However, manufacturers are continuing to develop more sensitive POC troponin tests.
- What are the opinions of interviewed experts regarding POC testing?
- What do they perceive as the advantages of POC testing?
- What are the growth opportunities for POC testing in this market?
- Who are the current and future players in the cardiac marker market?
- What determines the choice of brand for a laboratory?

The examination contains:

- A comprehensive overview of the several categories of diagnostic tests that are, or will be, revolutionizing the treatment of cardiovascular diseases (CVDs).
- A chapter on each of the important cardiac-related categories: AMI, heart failure and stroke, and the diagnostic tests that are used in their treatment.
- Full descriptions of the technologies involved and how these differ from existing and emerging technologies.
- Analysis of the technological approaches undertaken by the various competitors, as well as industry and end-user responses to these products.
- Regulatory issues and legislation affecting use and marketing of products.

1.3 Scope of This Report

The emphasis in this analysis is on those companies that are actively developing and marketing cardiac marker diagnostic testing technologies. The reader should consult other TriMark Publications reports at <http://www.trimarkpublications.com> for a detailed discussion of the important individual market segments that are related to the cardiac marker diagnostic testing technologies market, such as hepatitis testing, clinical chemistry, cancer testing, infectious disease markers, and other new diagnostic methods.

This study reviews the market for cardiac marker diagnostic testing technologies in the clinical hospital market. It defines the dollar volume of sales, both in the U.S. and worldwide, and analyzes the factors that influence the size and the growth of the market segments. The report details market sizes and growth rates, with projections usually—if applicable—for the U.S. and world markets.

The examination discusses activity and trends in the hospital markets. The study goes on to describe in detail the trends that have developed that have stimulated this market. It also comments on the patterns of information processing in cardiac marker diagnostic testing technologies. The report surveys all of the companies known to be marketing, manufacturing, or developing cardiac marker diagnostic testing technologies in the U.S. and worldwide for the selected segments identified. Leading companies are discussed in depth with a section on the history of the company, the product line, business and marketing analysis, as well as a subjective commentary of the position of the company in its market.

1.4 Methodology

The author of this report holds a Ph.D. in biochemistry from the University of Minnesota, and has had post-doctoral studies at the University of Connecticut School of Medicine. He has taught at Quinnepiac University, the Tufts School of Medicine, and New York Institute of Technology. He has been a senior scientist at DuPont and Pfizer

Pharmaceutical Laboratories in drug development and diagnostic testing. He was a leader in the formation and development of Dianon Laboratories, now part of LabCorp. He also has many decades of experience in science writing and as a medical industry analyst and consultant. He has over 40 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 this report is a Ph.D. in biochemistry from the University of Liverpool and an MBA from Oxford Brookes University with many decades of experience in science writing and as a medical industry analyst.

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 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 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 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

Cardiovascular disease (CVD) comprises conditions that affect the proper functioning of the heart and blood vessels. Among the most prevalent of life-threatening diseases are sudden cardiac arrest (SCA), acute myocardial infarction (AMI), congestive heart failure (CHF) and atherosclerosis. Every year, an estimated [REDACTED] people worldwide die of CVD, particularly from AMIs (heart attacks) and strokes.

CVD remains the leading cause of death in developed countries. In the U.S., one person dies every [REDACTED] from heart disease. This translates to more than [REDACTED] people a day. Each year in the U.S., deaths from CVD represent approximately [REDACTED]% of all deaths, or approximately one million deaths. Heart disease is the leading cause of death for all Americans, age [REDACTED] and older.

There will be a steady increase in demand for point of care (POC) services, along with pressures to improve the quality of healthcare delivered in hospital emergency rooms (ERs) and to lower testing cost. The cardiac marker diagnostic products segment is poised for a major new phase of growth fueled by the availability of new technology coming out of the POC segment. In the chronic cardiac marker segments such as cholesterol, CRP and Hcy testing, there is a higher interest level of individual patients and general healthcare consumers in taking charge of their own health status. Continuous improvements in technology are resulting in a growing number of new IVD tests that combine high levels of accuracy with rapid, easy-to-use product formats. New cardiac drugs are driving more screening programs for chronic heart disease like atherosclerosis and chronic heart failure.

Many acute cardiac marker IVD products and services are specifically targeted at markets outside of the traditional hospital or clinical laboratory, in particular, the hospital ER using POC methodologies. Competition in the development and marketing of cardiac marker diagnostic products is intense, and diagnostic technologies have been subject to rapid change. We estimate that the competitive factors in the cardiac marker diagnostic market include rapid turnaround of test results, immediate availability, data handling techniques, price, reimbursement and product performance as well as the distribution, advertising, promotion and brand name recognition of the marketer.

The market for *in vitro* diagnostic tests for cardiac biomarkers is part of the larger IVD test market. The global IVD market has been estimated to be valued at \$[REDACTED] in [REDACTED]. One of the largest sub-segment of the global IVD market is Central Lab Immunoassays, where much of cardiac marker lab work is done. This sub-segment has been estimated to be valued at \$[REDACTED] in [REDACTED]. The majority of cardiac biomarker tests are included in the Central Lab Immunoassays sub-segment but a growing proportion of cardiac biomarker tests are being carried out as point of care tests and are included in the POC sub-segment.

As a result of the analysis conducted, TriMark has determined that the global market for *in vitro* diagnostic tests for cardiac biomarkers was estimated to be \$[REDACTED] by [REDACTED], and by the end of the forecast period ([REDACTED]), it is predicted that the market will be valued at \$[REDACTED] (CAGR [REDACTED]%).

In vitro diagnostic tests used for the detection of Troponin and BNP and NT-proBNP cardiac biomarkers are the largest single cardiac biomarkers representing revenues of \$[REDACTED] and \$[REDACTED] in [REDACTED], accounting for [REDACTED]% and [REDACTED]% of the global market value, respectively. The *in vitro* diagnostic tests used for the detection of Troponin and BNP and NT-proBNP cardiac biomarkers also represent the biomarkers with the highest growth rates with CAHRs of [REDACTED]% and [REDACTED]%, respectively.

Although there are a wide variety of established products and services with the cardiac marker testing market, the growth and further development of the market is expected to be driven by a host of new biomarkers—high-sensitive C-reactive protein (hs-CRP), homocysteine (Hcy), plasminogen-activator inhibitors (PAIs), S100 protein, p-selectin,

soluble fibrin, glycogen phosphorylase-BB (GPBB), thrombus precursor protein, and recently discovered genetic factors.

TriMark has determined that the U.S. market for *in vitro* diagnostic tests for cardiac biomarkers is the largest in the world representing an estimated █% of the global market. The U.S. market for *in vitro* diagnostic tests for cardiac biomarkers was estimated to be valued at \$█ in █. By █, it has been estimated that the U.S. market for *in vitro* diagnostic tests for cardiac biomarkers had increased in value to \$█ (CAGR █%), and by the end of the forecast period (█), it is predicted that the market will be valued at \$█ (CAGR █%).

The approximate number of troponin tests in the U.S. was █, and we estimate perhaps that same number for CK-MB. The difference in market size reflects the considerably lower price per test for the much more mature CK-MB test.

TriMark sees significant opportunities to grow the cardiac marker diagnostic testing business outside the U.S. The European market represents a large established market estimated to be valued at \$█ in █. By █, it has been estimated that the European market for *in vitro* diagnostic tests for cardiac biomarkers had increased in value to \$█, and by the end of the forecast period, it is predicted that the market will be valued at \$█ (CAGR █%). Germany, Italy and France were the top three revenue contributors. For example, we expect that the E.U. will play a critical role in the further commercialization of cardiac marker diagnostic tests like troponin for AMI and BNP for heart failure.

Demand for cardiac marker testing in the E.U. is likely to escalate over the next five years, as its true value becomes more apparent to decision-makers. In terms of revenue, Germany represents the largest market for cardiac risk assessment biomarkers in the E.U., followed by France and Italy. Variations in the cost of troponins across Europe are set to narrow in the next few years. Among key conclusions: point of care testing (POCT) is still at a nascent stage in rapid cardiac marker testing while the two novel natriuretic peptide (NP) biomarkers are poised to make an immediate impact. In addition to the traditional cardiac marker CK-MB, a trio of other useful biomarkers has become available. Troponin T (TnT) became available in the U.S. in █, and was followed by Troponin I (TnI) in the summer of █. Experts praised the superiority of these two biomarkers for their specificity in diagnosing AMI. It has been found that both assays have approximately █% specificity, while TnI had █% sensitivity to AMI.

China is recognized as the country with highest growth rate with a cardiac marker market value estimated at \$█ in █. By █, it has been estimated that the Chinese market for *in vitro* diagnostic tests for cardiac biomarkers had increased in value to \$█, and by the end of the forecast period, it is predicted that the market will be valued at \$█ (CAGR █%).

Whilst the other Asia-Pacific countries are exhibiting dramatic market growth rates the Japanese market has been shown to exhibit relatively slow market growth rates. The Japanese market value has been estimated at \$█ in █. By █, it has been estimated that the Japanese market for *in vitro* diagnostic tests for cardiac biomarkers had increased in value to \$█, and by the end of the forecast period, it is predicted that the market will be valued at \$█ (CAGR █%). The Japanese market is beset with cost constraints and subject to a variety of austerity measures as a method of reducing the overall cost of providing a highly sophisticated healthcare system to an aging population.

The Latin American market is also recognized as being a major opportunity and has market growth rates between █% and █% depending on the individual country and the individual types of cardiac marker being used.

The market penetration of myoglobin is approximately █% in the U.S., but in the E.U. it is much lower, at about █%, and is therefore not as abundant. The total market size was approximately \$█ in █. Following several years of positive growth in myoglobin market, TriMark projects a slight positive growth rate after █, as this biomarker has not been readily accepted by the clinical community.

The world market size for CK-MB as a cardiac marker will grow \$█ in █. Overall, we expect the growth rate of █% per year during the forecast period. We expect the growth rates of the CK-MB market segment to remain steady in pricing, and grow in volume primarily as patient demand grows, since this marker is already very mature and this segment approaches full market penetration. The overall global rate of growth should continue

to be flat for some time, however, as other parts of the world have very high market penetrations, which will allow for modest growth tracking patient demands as admissions for chest pain and AMI continue to rise.

The market for *in vitro* diagnostic test used for the detection of cardiac biomarkers is highly competitive with major multinational diagnostic companies including Siemens, Roche, Abbott Laboratories, Alere, Ortho Clinical Diagnostics, Beckman Coulter (Danaher), etc. present in the market. These companies have the resources to provide extensive sales and marketing coverage in all the major global markets as well as having the ability to provide funding for the development of new and innovative technologies. In addition, however, they are coming under increasing pressure from the smaller and medium sized companies who have developed proprietary technologies which are obtaining market share in niche markets and specific geographic regions.

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