Biomarkers - Technologies, Markets and Companies

Description: This report follows the broad definition of a biomarker as a characteristic that can be objectively measured and evaluated as an indicator of normal biological or pathogenic processes as well as pharmacological responses to a therapeutic intervention. Tests based on biomarkers have been around for more than half a century, but interest in their application for diagnostics and drug discovery as well as development has increased remarkably since the beginning of the 21st century. This report describes different types of biomarkers and their discovery using various “-omics” technologies such as proteomics and metabolomics. Molecular diagnostics technologies are used for the discovery of biomarkers and new tests are also based on biomarker.

Currently the most important applications of biomarkers are in drug discovery and development. The role of biomarkers in various therapeutic areas particularly cancer, cardiovascular diseases and disorders of the central nervous system, is described. Biomarkers are useful not only for diagnosis of some of these diseases but also for understanding the pathomechanism as well as a basis for development of therapeutics.

Biomarkers will facilitate the combination of therapeutics with diagnostics and will thus play an important role in the development of personalized medicine. Biomarkers play a role in use of pharmacogenetics, pharmacogenomics and pharmacoproteomics for development of personalized medicine.

Many of the regulatory issues concerning biomarkers are related to genomics, proteomics, molecular diagnostics and pharmacogenomics/pharmacogenetics. Validation of biomarkers and their role in clinical trials is discussed.

Biomarker markets are estimated from 2015 to 2025 according to share of markets for various technologies and applications: proteomics, metabolomics, molecular diagnostics, drug discovery, clinical trials, and bioinformatics. Market values are further split according to therapeutic applications and major geographical areas. Unfulfilled needs in biomarkers are identified as well as the drivers for biomarker markets. Challenges facing the biomarker industry and strategies for developing biomarker markets are discussed.

A large number of companies with varying technical backgrounds are involved in biomarkers and 301 of these are profiled in part 2 of the report with classification into various categories. These also include major pharmaceutical companies. There is tabulation of 461 collaborations between companies and additional academic collaborations are mentioned in the individual profiles of companies. The report is supplemented by 1,200 references, 76 tables and 18 figures.

Contents: Part 1: Technologies & Markets

0. Executive Summary

1. Introduction
Definitions
Historical aspects of biomarkers
Classification of biomarkers
Biological marker as response to therapeutic intervention
Pharmacokinetic/pharmacodynamics biomarkers
Predictive biomarkers
Valid biomarkers
Types of biomarkers
Genes as biomarkers
Silent gene mutations
Epigenetic biomarkers
Proteins as biomarkers
Proteomics
DNA biomarkers
Mitochondrial DNA
Mitochondrial mutations
RNA biomarkers
Transcriptomics
MicroRNAs
Metabolomics
Glycomics
Single nucleotide polymorphisms
Haplotyping
Cell biomarkers of disease
Stem cell biomarkers
Association of stem cell biomarkers with disease
Cancer stem cell biomarkers
Endoglin as a functional biomarker of stem cells
p75NTR as a biomarker to isolate adipose tissue-derived stem cells
Protein expression profile as biomarker of stem cells
STEMPRO® EZChek® for analysis of biomarkers of hESCs
SSEA-4 as biomarker of MSCs
Gaseous mediators as biomarkers of disease
Autoantibodies as biomarkers of autoimmune diseases
Comparison of various types of biomarkers
Biomarkers and systems biology
Systems biology approach to biomarker identification
Relation of biomarkers to other technologies and healthcare
Biomarkers and translational medicine
Role of biomarkers in monitoring of diseases
Limitations of use of biomarkers in healthcare

2. Technologies for Discovery of Biomarkers
Introduction
The ideal biomarker
Genomic technologies
Gene expression
Whole genome expression array
Gene expression profiling on whole blood samples
Profiling gene expression patterns of white blood cells
Tissue microarrays for study of biomarkers
Technologies for detection of miRNAs as biomarkers
Microarrays for analysis of miRNA gene expression
Microarrays vs quantitative PCR for measuring miRNAs
Point-of-care detection of circulating miRNAs as biomarkers
Epigenomic technologies
Discovery of methylation biomarkers
Proteomic technologies
2D GE
ProteoCarta® integrated proteomics discovery platform
Isotope-coded affinity tags
Liquid chromatography-MS/MS
Lucid Proteomics System
Magnetics beads for protein biomarker discovery
MASStermind™
Combined analysis of protein and nucleic-acid biomarkers
Mass spectrometry
2D PAGE and mass spectrometry
Imaging mass spectrometry
MALDI mass spectrometry for biomarker discovery
Quantitative tandem MS
Single-molecule mass spectrometry using a nanopore
Requirements for MS-based proteomic biomarker development
Nucleic Acid Programmable Protein Array
Protein tomography
Protein biochips/microarrays and biomarkers
Antibody array/affinity proteomics-based biomarker discovery
Detection of biomarkers using peptide array technology
ProtoArray®
Protein nanobiochip
Gene expression microarray data as a source of protein biomarkers
Quantification of protein biomarkers
Multiple reaction monitoring assays
Real-time PCR for quantification of protein biomarkers
CyTOF for quantification of biomarkers
Search for biomarkers in body fluids
Challenges and strategies for discovery of protein biomarkers in plasma
Technologies for removal of highly abundant proteins in blood
3D structure of CD38 as a biomarker
BD™ Free Flow Electrophoresis System
Isotope tags for relative and absolute quantification
Plasma protein microparticles as biomarkers
Proteome partitioning
Stable isotope tagging methods
Technology to measure both the identity and size of the biomarker
Selected reaction monitoring MS
Targeted MS for verification of biomarkers
Biomarkers in the urinary proteome
Peptides as biomarkers of disease
Analysis of peptides in bodily fluids
Antibody biomarker discovery via evolution of peptides
Serum peptidome patterns
SISCAPA method for quantitating proteins and peptides in plasma
Comparison of proteomic profiling technologies for discovery of biomarkers
Verification for interlaboratory reproducibility of protein biomarkers
Significance of similar protein biomarkers in different tissues
Glycomic technologies
Cellular glycomics for discovery of cellular biomarkers
Metabolomic technologies
Genome-wide association studies for identification of metabolic biomarkers
Genetic influences on human blood metabolites
Lipid profiling
Mass spectrometry for discovery of metabolic biomarkers in plasma
Role of metabolomics in biomarker identification and pattern recognition
Urinary profiling by capillary electrophoresis
Validation of biomarkers in large-scale human metabolomics studies
Lipidomics
Disease biomarkers in breath
Portable breath test for volatile organic compounds
Detection of breath biomarkers by sensation technology
Detection of breath biomarkers by nanosensors
Detection of breath biomarkers optical frequency comb spectroscopy
Detection of breath biomarkers by infrared absorption spectroscopy
Detection of biomarkers by electronic nose
Fluorescent indicators for biomarkers
Molecular imaging technologies
Computer tomography
Magnetic resonance imaging
Positron emission tomography
Advantages of imaging biomarkers
Monitoring in vivo gene expression by molecular imaging
Molecular imaging in vivo as a biomarker
Challenges and future prospects of molecular imaging
Basic research in molecular imaging
Imaging intracellular NADH as a biomarker of disease
Devices for molecular imaging
Imaging biomarkers in clinical trials
Molecular imaging in clinical practice
Nuclear magnetic resonance
Chemical derivatization to enhance biomarker detection by NMR
Fluxomics by using NMR
Nanobiotechnology
Dip Pen Nanolithography
Nanomaterials for biolabeling
Quantum dot molecular labels
Bioconjugated QDs for multiplexed profiling of biomarkers
Magnetic nanotags for multiplex detection of biomarkers
Nanoparticles for molecular imaging
Nanoparticles for discovering biomarkers
Nanoproteomics and biomarkers
High-field asymmetric waveform ion mobility mass spectrometry
Nanosensors for measuring biomarkers in blood
Nanobiochip sensor technique for analysis of oral cancer biomarkers
Nucleoprotein nanodevices for detection of cancer biomarkers
Future prospects of application of nanobiotechnology for biomarkers
Bioinformatics
Biomarker Workflow Guide
Analysis of microarray data for selecting useful biomarkers
Role of bioinformatics in discovery of protein biomarkers
Role of bioinformatics in detection of cancer biomarkers
Biomarker databases
Gene networks as biomarkers
Role of bioinformatics in integrating various data and biomarker discovery
Evaluation of biomarker studies

3. Biomarkers and Molecular Diagnostics
Introduction
Molecular diagnostic technologies
Polymerase chain reaction
Amplification
Target selection
Detection of amplified DNA
Limitations of PCR
Real-time PCR systems
Limitations of real-time PCR
Future applications of real-time qPCR
Real-time qPCR for quantification of circulating mtDNA
Combined PCR-ELISA
Non-PCR methods
Linked Linear Amplification
Transcription mediated amplification
Rapid analysis of gene expression
WAVE nucleic acid fragment analysis system
DNA probes with conjugated minor groove binder
Rolling circle amplification technology
Gene-based diagnostics through RCAT
RCAT-immunodiagnostics
RCAT-biochips
RCAT-pharmacogenomics
Circle-to-circle amplification
Biochips and microarrays
Applications of biochips/microarrays
Role of biochip/microarrays in discovery of biomarkers
Biomarkers and high throughput molecular screening
Detection and expression profiling of miRNA
Real-time PCR for expression profiling of miRNAs
Use of LNA to explore miRNA
Microarrays for analysis of miRNA gene expression

4. Biomarkers for Drug Discovery & Development
Introduction
Biomarker technologies for drug discovery
Proteomics-based biomarkers for drug discovery
Chemoproteomics
Activity-based chemical proteomics
Transcriptomics for drug discovery
AvalonRx® drug discovery platform
Metabolomics for drug discovery
Biomarkers and drug safety
Biomarkers of adverse drug reactions
Applications of biomarkers in drug safety studies
Genomic technologies for toxicology biomarkers
Proteomic technologies for toxicology biomarkers
Metabonomic technologies for toxicology biomarkers
Integration of genomic and metabonomic data to develop toxicity biomarkers
Toxicology studies based on biomarkers
Biomarkers of hepatotoxicity
Biomarkers of nephrotoxicity
Cardiotoxicity
Neurotoxicity
Applications of biomarkers for drug development
Application of metabolomics/metabolomics for drug development
Role of pharmacokinetic/pharmacodynamic biomarkers in drug development
Molecular imaging as a biomarker in drug development
Molecular imaging in preclinical studies
Molecular imaging in clinical trials
Prospects of molecular imaging in drug discovery and development
Biomarkers in clinical trials
NIH recommendations on the use of biomarkers in clinical trials
Advantages of biomarkers for drug development
Limitations and problems with use of biomarkers in clinical trials
Application of biomarkers by the pharmaceutical companies
Role of biomarkers in vaccine development
Use of biomarkers in relation to stage of drug discovery and development
Drug development in cardiovascular disorders
Drug development in neurological disorders
Future prospects of biomarker-based drug development
The Biomarker Alliance
Biomarkers Consortium
Molecular Libraries and Imaging Roadmap of NIH
Pharmacogenomic biomarker information in drug labels
Rare Diseases Clinical Research Consortia
Systems Approach to Biomarker Research in Cardiovascular Disease
Concluding remarks on the future trends in biomarker development

5. Role of Biomarkers in Healthcare
Introduction
Biomarkers of inflammation
ESR and CRP as biomarkers of inflammation
Metabolic biomarkers of inflammation
YKL-40 as a biomarker inflammation and predictor of mortality
Biomarkers of allergic disorders
Biomarkers of oxidative stress
1,4-dihydroxyxnonane-mercapturic acid
Oxidized phospholipids
Oxidative DNA damage
Proteins as biomarkers of oxidative stress in diseases
Testing for oxidative stress
Biomarkers in metabolic disorders
Biomarkers of acute intermittent porphyria
Liver X receptors
Biomarkers of diabetes mellitus
β-cell function as biomarker of diabetes
Biomarkers of hyperglycemia
Biomarkers of diabetes-associated oxidative stress
Biomarkers of inflammation associated with diabetes
Biomarkers of renal complications in diabetes mellitus type 2
Biomarkers of diabesity
Biomarkers of prediabetes
Biomarkers of insulin resistance
Glycosylated hemoglobin in diabetes mellitus
Glycated albumin as a biomarker of diabetes mellitus
Lack of C-peptide as biomarker of complications of diabetes type 1
Personalized management of diabetes mellitus based on biomarkers
Biomarkers of metabolic syndrome
Adiponectin
Cystatin C
Human plasma lipidome
Biomarkers in immune disorders
Biomarkers relevant to organ transplantation
Biomarkers of graft versus host disease
Biomarkers of renal allograft failure
Biomarkers of renal transplant tolerance
Biomarkers of lung transplant rejection
Biomarkers of GVHD following transplantation of hematopoietic cells
Plasma biomarkers of response to therapy of GVHD
Systemic lupus erythematosus
Adiponectin
Current management and need for biomarkers
Role of collaborative efforts and databases of SLE biomarkers
C4d-bearing reticulocytes
CB-CAPS
Epigenetic biomarkers of SLE
Genetic loci of SLE
HMGB1
Biomarkers of systemic sclerosis
Biomarkers of musculoskeletal disorders
Muscle disorders
Biomarkers of muscle fatigue during exercise
Biomarkers of mitochondrial content in skeletal muscle
Idiopathic inflammatory myopathies
Rheumatoid arthritis
Assays for biomarkers of RA
Biomarkers for personalizing therapy of rheumatoid arthritis
Circulating cytokines in RA
Epigenetic biomarkers of rheumatoid arthritis
miRNA biomarkers in RA
Serum CRP in RA
Biomarkers of spondylarthritis
Osteoarthritis
Molecular pathophysiology of OA
Assays for biomarkers of OA
Biomarkers of OA
Concluding remarks and future prospects of biomarkers of OA
Biomarkers of osteoporosis
Dual x-ray absorptiometry
Bone imaging with quantitative CT and MRI
Assays for detection of biomarkers of osteoporosis
Biomarkers of osteonecrosis
Osteonecrosis in Gaucher's disease
Biomarkers of infectious diseases
Introduction
Sepsis
Application of proteomics for discovering biomarkers of infections
Biomarkers of sepsis
Circulating CPS-1 as biomarkers of organ damage in sepsis
CoQ10 level reduction in septic shock
Multibiomarker-based outcome risk stratification of septic shock
Nitric oxide as a biomarker of sepsis
SuPAR as a biomarker of sepsis
Chemokines as biomarkers of infection
Endotoxin as biomarker of infection
Procalcitonin as a guide to antibiotic therapy in infections
Soluble urokinase plasminogen activator receptor
Systemic inflammatory response syndrome
Tuberculosis
Conventional diagnosis of tuberculosis
Molecular diagnostics for tuberculosis
Biomarkers for tuberculosis
Biomarkers of pulmonary tuberculosis in the breath
Biomarkers of viral infections
Viral hepatitis
Biomarkers of SARS
Biomarkers of HIV
Biomarkers in parasitic infections
Role of biomarkers in malaria
Identification of biomarkers in Schistosomiasis infections
Biomarkers of liver disease
Breath biomarkers of liver disease
Biomarkers of viral hepatitis B and C
Biomarkers of liver injury
Biomarkers of liver fibrosis and cirrhosis
Biomarkers of hepatic encephalopathy
FibroMax
Biomarkers of pancreatitis
Biomarkers of renal disease
Biomarkers of lupus nephritis
Biomarkers of diabetic nephropathy
Cystatin C as biomarker of glomerular filtration rate (GFR)
Estimated GFR and albuminuria as biomarkers of chronic kidney disease
Proteomic biomarkers of acute kidney injury
Troponin-T as a biomarker for predicting end-stage renal disease
Biomarkers of pulmonary diseases
Association of biomarkers of inflammation with lung function in the elderly
Biomarkers of oxidative stress in lung diseases
Biomarkers of community-acquired pneumonia
Biomarkers of acute lung injury and respiratory distress syndrome
Cytokine/chemokine biomarkers of SARS
Plasma biomarkers related to inflammation
Urinary NO as biomarker
Biomarkers of interstitial lung disease
Pulmonary surfactant proteins as biomarkers for lung diseases
Serum KL-6 as biomarker of interstitial lung disease
Biomarkers of chronic obstructive pulmonary disease
Alpha1-antitrypsin gene polymorphisms predisposing to emphysema
Biomarkers of lung failure in COPD
BNP as a biomarker of chronic pulmonary disease
Chromagranin A (CgA) as biomarker of airway obstruction in smokers
Gene expression profile in peripheral blood of patients with COPD
Increased expression of PIGF as a biomarker of COPD
Biomarkers of asthma
Biomarker for rhinovirus-induced asthma exacerbation
Biomarkers for predicting response to corticosteroid therapy
Comparison of biomarkers of asthma and COPD
Cytokines as biomarkers of asthma severity
Exhaled NO as a biomarker of asthma
Endothelin-1 in exhaled breath as biomarker of asthma
IgE as guide to dosing of omalizumab for asthma
Periostin as a biomarker for treatment of asthma with lebrikizumab
Biomarkers for cystic fibrosis
Biomarkers of thrombotic disorders
Biomarkers of arterial thromboembolism
Nanoparticles as synthetic biomarkers of thrombus formation
Biomarkers of venous thromboembolism
BNP and cTnT as biomarkers of outcome in pulmonary embolism
D-dimer as biomarker of venous thromboembolism
Molecular biomarkers of venous thromboembolism
Biomarkers in gynecology and obstetrics
Biomarkers of menopause
Biomarkers of premenstrual dysphoric disorder
Biomarkers of endometriosis
Biomarkers for preclampsia
Protein biomarker of preclampsia in urine
Protein biomarkers of preclampsia in CSF
Protein HtrA1 as a biomarker for preclampsia
Placental growth factor as a biomarker for preclampsia
sFlt1 and soluble endoglin as biomarkers of preclampsia
RNA biomarkers
Genes associated with preclampsia
Biomarkers of premature birth
Proteomic biomarkers of premature birth
Biomarkers of oxidative stress in complicated pregnancies
Fetal biomarkers in maternal blood
Metabolic biomarkers of prenatal disorders in maternal urine and blood
Biomarkers for genetic disorders
Biomarkers for Down's syndrome
Biomarkers for muscular dystrophy
Biomarkers of phenylketonuria
Genetic biomarkers for psoriasis
Biomarkers of lysosomal storage disorders
Biomarkers of aging
Effect of calorie restriction on biomarkers of longevity
Genetic biomarkers of aging
Genetic signatures of longevity
Mitochondrial mutations as biomarkers of aging
Telomere attrition as aging biomarker
Gene variants as determinants of biological age
Gene expression profiles for calculating transcriptomic age
Low serum thyroid hormone level as biomarker of longevity
Metabolomic biomarkers of aging
Protein biomarkers of aging
Carbamylated proteins as biomarkers of aging
Proteomic biomarkers of muscle aging
Role of humanin in age-related diseases
Role of bioinformatics in search for biomarkers of aging
Study of biomarkers of aging in a genetically homogeneous population
Biomarkers in pediatrics
Pediatric critical care
Biomarkers of acute kidney injury in children
Biomarkers of miscellaneous disorders
Biomarkers of carbon monoxide poisoning
Biomarkers of erectile dysfunction
Biomarkers of fever
Biomarkers of heat stroke
Biomarkers of hyponatremia
Biomarkers of inflammatory bowel disease
Biomarkers of radiation injury
Biomarkers for prediction of all-cause mortality
Biomarkers common to multiple diseases
Nasal nitric oxide as a biomarker of response to rhinosinusitis therapy
Biomarkers and nutrition
Biomarkers in nutritional epidemiology
Biomarkers of nutritional status
Biomarkers of branched chain amino acid status
Biomarkers of caloric restriction
Biomarkers of malnutrition
Maternal nutrition during early pregnancy causes epigenetic changes
Proteomic biomarkers and nutrition
Vitamin deficiency as biomarker of disease
Vitamin D as a biomarker of disease
Vitamin B12 deficiency
Biomarkers of gene-environmental interactions in human disease
Application of biomarkers in animal health

6. Biomarkers of Cancer
Introduction
The ideal biomarker for cancer
Biomarkers and hallmarks of cancer
Single vs multiple biomarkers of cancer
Types of cancer biomarkers
Biomarkers of epigenetic gene silencing in cancer
Carcinoembryonic antigen
Circulating tumor cells as cancer biomarkers
Circulating nucleic acids as potential biomarkers of cancer
DNA repair biomarkers
HER3 as biomarker of cancer
Immunologic and inflammation biomarkers of cancer
Metastatic cancer biomarkers
miRNAs as biomarkers in cancer
circulating miRNAs for cancer detection
Diagnostic value of miRNA in cancer
Tumor microvesicles or exosomes
Molecular diagnostic techniques for cancer
Technologies for detection of cancer biomarkers
Genomic technologies for cancer biomarkers
Biomarkers of PTEN tumor suppressor gene status
Cold-PCR
ddPCR for detection of cancer biomarkers in cell free plasma DNA
Digital karyotyping for cancer biomarkers
Early detection of tumor suppressor gene mutations
Genome analysis at the molecular level
KRAS as a biomarker of cancer
LigAmp for detection of gene mutations in cancer
Mitochondrial DNA as a cancer biomarker
Sequencing-based approaches for detection of cancer biomarkers
Telomerase as a biomarker of cancer
Tissue microarrays for study of cancer biomarkers
Molecular fingerprinting of cancer
Proteomic technologies for detecting biomarkers of cancer
2D PAGE
Antibody-based detection of protein biomarkers
Aptamer-based molecular probes for cancer biomarker discovery
Biomarkers of protein-drug interactions in cancer
Cancer immunomics to identify autoantibody signatures
Desorption electrospray ionization for detection of cancer biomarkers
Detection of circulating nucleosomes in serum of cancer patients
Detection of tumor biomarkers with ProteinChip technology
eTag assay system for cancer biomarkers
Glycoprotein biomarkers of cancer
HER-2/neu oncoprotein as biomarkers for cancer
Humoral proteomics
Laser capture microdissection
Membrane-type serine protease-1
Phage display technology
Proteomic analysis of cancer cell mitochondria
Proteomic technologies for detection of autoimmune biomarkers
SELDI-TOF MS
Serum proteome analysis for early detection of cancer
Synthetic biomarker-based POC diagnostic for cancer
Triple-quadrupole MS for detection of mutant proteins
Targeted MS for validation of cancer biomarkers in plasma
Tissue proteomics for discovery of cancer biomarkers
Metabolomic biomarkers of cancer
Magnetic resonance for detecting metabolomics biomarkers of cancer
Choline phospholipid biomarkers of cancer
Hypoxia-inducible factor-1
Detection of drug resistance in cancer by metabolic profiling
Plasma free amino acids profiling in cancer
Urinary metabolomic biomarkers of cancer
Epitomics for the early detection of cancer
Epigenetic biomarkers of cancer
Combined use of tissue-specific genetic and epigenetic biomarkers
Detection of biomarkers of DNA methylation
Epigenomics Marker Machine for DNA methylation biomarkers
Histone deacetylase
MDScan® microarray technology
Mucins as epigenetic biomarkers in epithelial cancers
PCR with bisulfite for detecting DNA methylation biomarkers in cancer
Rubicon MethylPlex technology
Agena's integrated platform for genetic and epigenetic analysis
Nanobiotechnology for early detection of cancer to improve treatment
Aptasensor for electrochemical detection of exosomes
Nanowire biosensors for detection of cancer biomarkers
NP-peptide complexes for detection of cancer biomarkers in urine
Selective expression of biomarkers by cancer compared with normal tissues
Ultrasound radiation to enhance release of a tumor biomarker
In vivo imaging of cancer biomarkers
Computer tomography
Optical systems for in vivo molecular imaging of cancer
Positron emission tomography
Imaging of tumor oxygenation and microvascular permeability by MRI
Xenon-enhanced MRI
Kallikrein gene family and cancer biomarkers
Detection of CTCs as biomarkers of cancer
Applications of cancer biomarkers
Use of biomarkers for cancer classification
Cancer classification using microarrays
Proteomic classification of cancer
Use of biomarkers for early detection of cancer
Applications of biomarkers for cancer diagnosis
Methylated DNA sequences as cancer biomarkers
MicroRNA expression profiling for diagnosis of human cancers
MUC4 as a diagnostic biomarker in cancer
Applications of biomarkers for cancer diagnosis and therapy
ARTS as a biomarker as well as a basis of anticancer drugs
Asparagine synthetase as biomarker for therapy with L-asparaginase
Peptide-based agents for targeting cancer biomarkers
PI3K mutations as a biomarker for use as a companion diagnostic
Biomarkers for assessing efficacy of cancer therapy
ERCC1-XPF expression as a biomarker of response to chemotherapy
P53 expression level as biomarker of efficacy of cancer gene therapy
Biomarkers of angiogenesis for developing antiangiogenic therapy
Biomarkers of response to antiangiogenic agents
Circulating endothelial cells as targets for antiangiogenic drugs
Imaging biomarkers for evaluation of antiangiogenic agents
Tumor endothelial markers
VEGF signaling inhibitors as biomarkers
VEGF-PET imaging for analysis of angiogenic changes within a tumor
Biomarkers of prognosis in cancer treatment
Biomarkers for monitoring cancer therapy
Biomarkers of drug resistance in cancer
A systems approach to biomarkers of innate drug resistance
Epithelial membrane protein-1 as a biomarker of gefitinib resistance
Methylation biomarkers of drug resistance in cancer
STAT3 and resistance to cisplatin
Biomarkers of radiation therapy for cancer
Role of biomarkers in drug development in oncology
Molecular imaging of tumor as a guide to drug development
Use of PET to assess response to anticancer drugs
Use of MRI to assess response to anticancer drugs
Biomarkers in plucked hair for assessing cancer therapy
Molecular targets of anticancer drugs as biomarkers
Safety biomarkers in oncology studies
Role of biomarkers in phase I clinical trials of anticancer drugs
Met receptors as targets for anticancer drugs
Biomarkers according to organ/type of cancer
Bladder cancer biomarkers
Detection of FGFR3 mutations in urine for diagnosis of bladder cancer
NMP22 BladderChek
Urinary telomerase as biomarker for detection of bladder cancer
Concluding remarks about biomarkers of urinary cancer
Brain tumor biomarkers
14-3-3zeta positive expression as a prognostic biomarker for GBM
Biomarkers to predict response to EGFR inhibitors
Biomarkers for predicting recurrence of meningiomas
CD133 as biomarker of resistance to radiotherapy
Circulating microvesicles as biomarkers
CSF protein profiling
CSF attractin as a biomarker of malignant astrocytoma
ELTD1 as a biomarker of gliomas
Methylation profiling of brain tumors
Metabolite biomarkers of brain tumors
miRNAs as biomarkers of brain tumors
MRI biomarker for response of brain tumor to therapy
Multigene predictor of outcome in GBM
Neuroimaging biomarkers combined with DNA microarray analysis
Receptor protein tyrosine phosphatase \( ? \) as biomarker of gliomas
Serum protein fingerprinting
VEGF-R2 as biomarker of angiogenesis in brain tumors
Future prospects of biomarkers of malignant gliomas
Bone tumor biomarkers
Cytogenetics for the study of bone and soft tissue tumors
Biomarkers of Ewing’s tumors
Role of biomarkers in the diagnosis of bone tumors
Breast cancer biomarkers
Autoantibody biomarkers of breast cancer
Biomarkers of breast cancer in breath
Biomarkers for breast cancer in nipple aspiration fluid
Circulating tumor DNA as biomarker of breast cancer
Flow cytometry for quantification of biomarker expression patterns
Plasma proteomics for biomarkers of breast cancer
Quantitative realtime PCR assays for biomarker validation
Cdk6 as a biomarker of breast cancer
Centromere protein-F
Carbonic anhydrase IX
COX-2 as a biomarker of breast cancer
G88 as a biomarker of progression of ER+ breast cancer
Glycomic biomarkers of breast cancer
HER-2/neu oncoprotein
High mobility group protein A2
Hypermethylated genes as biomarkers of metastatic breast cancer
Lipocalin 2 as biomarker of breast cancer progression
Long intervening non-coding RNAs
Mammaglobin
miRNA biomarkers of breast cancer
p27 expression as biomarker for survival after chemotherapy
Podocalyxin
Proneurotensin and Proenkephalin
Progranulin as a biomarker of breast cancer
Proliferating cell nuclear antigen
Protein kinase C as a predictive biomarker of metastatic breast cancer
Retinoblastoma tumor suppressor gene as a biomarker
Riboflavin carrier protein
Risk of invasive cancer after diagnosis of ductal carcinoma in situ
Serum CA 15-3 as biomarker of prognosis in advanced breast cancer
Stage-specific embryonic antigen-3
Suppressor of deltax protein
Tumor microenvironment as biomarker of metastasis in breast cancer
Type III TGF-β receptor as regulator of cancer progression
Diagnostic tests based on breast cancer genes
Prognostic role of breast cancer genes
Protein biomarkers for breast cancer prevention
Biomarkers to evaluate efficacy of chemoprevention
Biomarkers of response to chemotherapy of breast cancer
Concluding remarks and future prospects of breast cancer biomarkers
Cervical cancer biomarkers
Gastrointestinal cancer biomarkers
Esophageal cancer biomarkers
Gastric cancer biomarkers
Colorectal cancer biomarkers
Head and neck cancer
Leukemia biomarkers
Chromosomal translocations in leukemias
DNA methylation biomarkers in leukemia
Gene mutations as biomarkers in leukemia
Molecular diagnostic techniques for leukemia
Proteomic technologies for discovering biomarkers of leukemia
Biomarkers of chronic lymphocytic leukemia
Biomarkers of chronic myeloid leukemia
Biomarkers of drug resistance in leukemia
Biomarkers of myelodysplastic syndromes
Lymphoma biomarkers
Liver cancer biomarkers
Biomarkers indicating lower risk of HCC in coffee drinkers
Metabonomics profiles discriminate HCC from liver cirrhosis
Urinary biomarkers of HCC
Lung cancer biomarkers
Autoantibodies as biomarkers in lung cancer
Biomarkers associated with neuroendocrine differentiation in NSCLC
Biomarkers of chronic inflammation in lung cancer
Biomarkers for predicting sensitivity to chemotherapy in lung cancer
Biomarkers for prediction of sensitivity to EGFR inhibitors
CTCs as biomarkers of lung cancer
Gene expression profiling for biomarkers of lung cancer
Methylation biomarkers of lung cancer
miRNA biomarkers in lung cancer
Noninvasive detection of lung cancer using exhaled breath
Serum protein biomarkers of lung cancer
tNOX as biomarker of lung cancer
Tumor-derived DNA and RNA markers in blood
Volatile organic compounds in the exhaled breath
Malignant pleural mesothelioma
Melanoma biomarkers
Nasopharyngeal carcinoma biomarkers
miRNA biomarkers of nasopharyngeal carcinoma
Oral cancer biomarkers
Ovarian cancer biomarkers
3D microfluidic platform to assess multiple ovarian cancer biomarkers
CA125 as biomarker of ovarian cancer
Epitomics approach for ovarian cancer biomarkers in serum
FGF18 as a biomarker in ovarian cancer
Gene expression studies in ovarian cancer
HE4 protein in urine as a biomarker for ovarian cancer
Hematogenous metastasis of ovarian cancer
HtrA1 as a biomarker of response to chemotherapy in ovarian cancer
Mutation of genes in ovarian cancer
Serum biomarkers of ovarian cancer prognosis
Serum albumin-associated peptides and proteins
TIM-3 as a biomarker of ovarian cancer
Multiplex assays for biomarkers of ovarian cancer
Concluding remarks on biomarker-based tests of ovarian cancer
Pancreatic cancer biomarkers
Discovery and validation of pancreatic cancer biomarkers
Cancer stem cells as biomarkers of pancreatic cancer
Circulating exosomes as biomarkers of cancer
Histone modifications used as biomarkers in pancreatic cancer
miRNA biomarkers of pancreatic cancer
Macrophage inhibitory cytokine-1 as biomarker of pancreatic cancer
Proteomic biomarkers of pancreatic cancer
Parathyroid cancer biomarkers
Peripheral nerve tumors
Biomarkers of neurofibromatosis
Prostate cancer
Adipose tissue-derived biomarkers of obesity-related prostate cancer
B7-H3 as biomarker of prostate cancer
Cancer genetics-guided biomarker signatures of prostate cancer
Detection of prostate cancer biomarkers in urine
Detection of prostatic intraepithelial neoplasia
Epigenetic biomarkers of prostate cancer
Exosomes as biomarkers of prostate cancer
Gene expression analysis of prostate cancer
Genetic biomarkers of prostate cancer
Huntingtin Interacting Protein 1 overexpression in prostate cancer
Id proteins expression in prostate cancer
Identification of prostate cancer mRNA biomarkers
Integrative genomic and proteomic profiling of prostate cancer
Kallikreins as biomarkers of prostate cancer
LCM for diagnosis of prostate cancer
Loss of p27 as predictor of recurrence of prostate cancer
Microarray for diagnosis of prostate cancer
miRNA biomarkers of prostate cancer
Prostate cancer biomarkers in semen
PSA as biomarker of prostate cancer
ProPSA as biomarker of prostate cancer
Prostate Health Index
Prostasomes in blood as biomarker of prostate cancer
PSMA as biomarker of prostate cancer
Sarcosine as a metabolic biomarker of prostate cancer
Silenced CDH13 gene as a biomarker of cancer
Serum-protein fingerprinting
Tests for prostate cancer based on genetic dislocations
Concluding remarks on biomarkers of prostate cancer
Renal cancer biomarkers
Gene expression profile of RCC for biomarkers
miRNA biomarkers of renal cancer
Use of proteomics for detection of RCC biomarkers
Use of RCC biomarkers for prognosis and therapy
Thyroid cancer biomarkers
Detection of BRAF mutation
Gene expression biomarkers of thyroid cancer
Multiple endocrine neoplasia type 2B as risk factor for thyroid cancer
miRNA biomarkers of thyroid cancer
Biochemical biomarkers of thyroid cancer
Role of the NCI in molecular diagnosis of cancer
The Cancer Genome Anatomy Project
Molecular profiling of cancer
Cancer Genome Atlas
Cancer Genetic Markers of Susceptibility Project
Oncology Biomarker Qualification Initiative
Role of NCI in cancer biomarker development and validation
Projects for cancer biomarker research in Europe
COBRED project
COLtheres consortium
PREDICT Consortium
Future prospects for cancer biomarkers
Cancer biomarker research at academic institutions
Future prospects and challenges in the discovery of cancer biomarkers

7. Biomarkers of Disorders of the Nervous System
Introduction
Discovery of biomarkers for neurological disorders
Biomarker identification in the CSF using proteomics
Biomarker identification in the CSF using lipidomics
Cerebral microdialysis for the study of biomarkers of cerebral metabolism
Detection of protein biomarkers of CNS disorders in the blood
Genomic technologies for study of biomarkers of neurological disorders
Brain imaging for detection of biomarkers
Biomarkers of the aging brain
Cellular biomarker of aging of the brain
CSF F2-isoprostanes as biomarker of aging brain
IL-6 as a biomarker of cognitive impairment with aging
Protein aggregation as a biomarker of aging brain
Telomere shortening as a biomarker of aging brain and dementia
Data mining for biomarkers of neurological disorders
Antibodies as biomarkers in disorders of the nervous system
Biomarkers of neural regeneration
Biomarkers of disruption of blood-brain barrier
Biomarkers of neurotoxicity
Glial fibrillary acidic protein as biomarker of neurotoxicity
Single-stranded DNA as a biomarker of neuronal apoptosis
Biomarkers of neurogenetic disorders
Charcot-Marie Tooth disease
Duchenne and Becker muscular dystrophy
Early-onset torsion dystonia
Fragile X syndrome
Hereditary neuropathy with liability to pressure palsies
Hereditary metabolic storage disorders with neurologic manifestations
Gaucher disease
Pompe's disease
Mitochondrial disorders affecting the nervous system
Spinal muscular atrophy
Biomarkers of SMA
Biomarkers of neurodegenerative disorders
Biomarkers of Alzheimer's disease
The ideal biomarker for AD
Methods for determining biomarkers of AD
Gene expression patterns in AD
Magnetic resonance spectroscopy in AD
MicroRNAs as biomarkers of neurodegenerative disorders
MRI for biomarkers of AD
Nanotechnology to measure Aβ-derived diffusible ligands
PET scanning for biomarkers of AD
Radioiodinated clioquinol as a biomarker for Aβ
Simultaneous measurement of several biomarkers for AD
Targeting of chemokine receptor as biomarker for brain imaging
Biomarkers of AD in CSF
CSF sulfatide as a biomarker for AD
CSF Reelin as biomarker of AD
Glycerophosphocholine as CSF biomarker in AD
Monitoring of synthesis and clearance rates of Aβ in the CSF
Protein biomarkers of AD in CSF
Tau proteins in CSF
Tests for the detection of Aβ in CSF
Tests combining CSF tau and Aβ
Blood biomarkers of AD
A serum protein-based algorithm for the detection of AD
Amyloid precursor protein
Detection of aggregated misfolded proteins in the blood
Lipid biomarkers for preclinical detection of AD
Lymphocyte Proliferation Test
Metabolomic biomarker profiling
Plasma protein biomarkers of AD
Protein kinase C in red blood cells
Urine tests for AD
A biomarker-based skin test for AD
Salivary biomarkers of AD
Applications of biomarkers of AD
Biomarker changes in autosomal dominantly inherited AD
Correlation of imaging biomarkers with CSF biomarkers of AD
Genetic tests for AD
Humanin as a biomarker as well as neuroprotective in AD
Plasma biomarkers of drug response in AD
PredictAD project
TOMM40 gene and risk of AD
Use of biomarkers to predict AD in patients with MCI
Concluding remarks about biomarkers for AD and future prospects
Biomarkers of Parkinson's disease
Autoantibodies as biomarkers of PD
Biomarkers of PD based on gene expression in blood
Cardiac denervation as a biomarker of PD
Genetic biomarkers of PD
Imaging biomarkers of PD
Metabolic brain networks as biomarkers
Metabolomic biomarker profile for diagnosis and monitoring of PD
Protein biomarkers of PD
Serum vitamin D as a biomarker of PD
Future prospects for biomarkers of PD
Biomarkers of Huntington's disease
Quantitative MRI measurement of brain atrophy as biomarker of HD
Metabolic networks as biomarkers of preclinical Huntington disease
Biomarkers of Wilson's disease
Biomarkers of amyotrophic lateral sclerosis
Biomarkers of neuroinflammation in ALS
Detection of ALS biomarkers in blood vs CSF
Ideal biomarker of ALS
Imaging biomarkers of ALS
Metabolomic biomarkers of ALS
Proteomic biomarkers of ALS
Future prospects of biomarkers of ALS
Biomarkers of dementia in HIV-1-infected patients
Biomarkers of autoimmune encephalitis
Biomarkers of prion diseases
14-3-3 protein and tTau/P-Tau ratio
Bioluminescence imaging as a surrogate biomarker of prion infectivity
miRNAs as biomarkers of prion-induced neurodegeneration
Prion protein detection by real-time quaking-induced conversion
Prions in the urine of patients with variant CJD
Biomarkers of multiple sclerosis
Antibodies in multiple sclerosis
Antibodies to galactocerebroside
Antibodies to myelin oligodendrocyte glycoprotein
Brain N-acetylaspartylglutamate as a biomarker of cognitive function
Brain imaging biomarkers of multiple sclerosis
MRI biomarkers of multiple sclerosis
Myelin imaging by PET
Biomarkers of response to therapy of multiple sclerosis
DNA motifs in the blood as biomarkers of response to treatment
CSF biomarkers in multiple sclerosis
CSF Cystatin C as a biomarker of multiple sclerosis
Detecting autoantibodies in multiple sclerosis
Switch-associated protein 70 antibodies in multiple sclerosis
Gelsolin as a biomarker of multiple sclerosis
Gene expression profiling of biomarkers in multiple sclerosis
Matrix metalloproteinases as biomarkers in multiple sclerosis
Serum proteomic pattern analysis in multiple sclerosis
T cells as biomarkers of multiple sclerosis
Concluding remarks and future perspective for biomarkers of multiple sclerosis
Biomarkers of cerebrovascular disorders
Biomarkers of stroke
Etiological biomarkers of ischemic stroke
Brain natriuretic peptide as a biomarker for cardioembolic stroke
Brain lactate and N-acetylaspartate as biomarkers of stroke
CRP as biomarker of risk of stroke
CSF biomarkers in acute stroke
Gene expression in blood following ischemic stroke
Glutathione S-Transferase-p
Intercellular adhesion molecule 1 as biomarker of ischemic stroke
Lp-PLA2 and CRP as biomarkers for stroke
Matrix metalloproteinase-9
miRNAs as biomarkers of stroke
Neuroserpin polymorphisms as a biomarker of stroke
NMDA receptors as biomarkers of excitotoxicity in stroke
Nucleosomes as biomarkers of stroke
PARK7 and nucleoside diphosphate kinase A as biomarkers of stroke
Visinen-like protein 1
Biomarker panels for stroke
Future prospects for biomarkers of stroke
Biomarkers of cerebral vasospasm
Biomarkers of intracerebral hemorrhage
Biomarkers of hypoxic brain damage
D-dimer as a biomarker of cerebral venous thrombosis
Biomarkers of traumatic brain injury
Technologies for identification of biomarkers of TBI
Cerebral microdialysis for study of biomarkers of TBI
Proteomic technologies for biomarkers of TBI
Systemy biology approach for discovery of biomarkers of TBI
Biomarkers of TBI
Aß as a biomarker of TBI
C-tau as biomarker of TBI
Diffusion tensor imaging in TBI
Gial fibrillary acidic protein as biomarker of TBI
Hyperphosphorylated axonal neurofilament protein
IL-6 and nerve growth factor as biomarkers of TBI
Myelin basic protein
Neurofilament heavy chain
Serum S100ß as biomarker of TBI
SNTF as a biomarker for predicting cognitive decline after mild TBI
Ubiquitin C-terminal Hydrolase-L1
Biomarkers of inflicted TBI in infants
Biomarkers of concussion
Clinical applications of biomarkers of TBI
Biomarkers of CNS infections
Biomarkers of bacterial meningitis
Biomarkers of viral infections of CNS
Biomarkers of CNS HIV infection
CSF kynurenic acid level as a biomarker of tick-borne encephalitis
Biomarkers of epilepsy
Biochemical markers of epilepsy
Biomarkers of temporal lobe epilepsy
Genetic epilepsies
Electrophysiological biomarkers of epilepsy
Imaging biomarkers of epilepsy
Protein biomarkers of inflammation in epilepsy
Biomarkers of normal pressure hydrocephalus
Biomarkers of pseudotumor cerebri
Biomarkers of retinal disorders
Biomarkers of age-related macular degeneration
Biomarkers of sleep disorders
Biomarker of excessive daytime sleepiness
Biomarkers of obstructive sleep apnea
Biomarkers of restless legs syndrome
Biomarkers of pain
Biomarkers of disorders with musculoskeletal pain
Biomarkers of neuropathic pain
Brain insular glutamate as biomarker of fibromyalgia
Biomarkers of visceral pain
Biomarkers of migraine
Biomarkers of myalgic encephalomyelitis/chronic fatigue syndrome
Biomarkers of psychiatric disorders
Anorexia nervosa
Attention-deficit hyperactivity disorder
Biomarkers of autism
Gastrointestinal microbiota disturbances and ASD
Genetic factors in ASD
Immune biomarkers of ASD
Metabolic disturbances in autism
Neurophysiological biomarkers
Role of oxidative stress in autism
Test for ASD based on a 55-gene expression panel
Trophoblastic abnormalities in placenta
Umbilical cord biomarkers
Biomarkers of bipolar disorder
Biomarkers of depression
Biochemical biomarkers of depression
Cingulate cortex activity and response to antidepressants
Gene polymorphisms and response to antidepressants
Inflammatory biomarkers of depression and psychosis
Panel of blood transcriptomic biomarkers for diagnosis of MDD
Plasma metabonomics for diagnosis of MDD
Post-partum depression
Biomarkers of psychosis
Biomarkers of schizophrenia
Biomarkers of abnormalities of visual information processing
Genetic biomarkers of schizophrenia
Gene expression analysis of blood for biomarkers of schizophrenia
Metabolic biomarkers of schizophrenia
Proteomic studies for biomarkers of schizophrenia
Biomarkers of suicide

8. Biomarkers of Cardiovascular Disorders
Introduction
Epidemiology of cardiovascular disease
Biomarkers of cardiovascular diseases
Biomarkers of acute myocardial infarction
Genetic biomarkers of cardiovascular disorders
Methods for identification of cardiovascular biomarkers
Application of proteomics for biomarkers of cardiovascular disease
Targeted MS-based pipeline approach
Cardiovascular disease biomarker panel
Detection of biomarkers of myocardial infarction in saliva by a nanobiochip
Metabolomic technologies for biomarkers of myocardial ischemia
Imaging biomarkers of cardiovascular disease
Annexin A5 as an imaging biomarker of cardiovascular disease
Cardiovascular MRI
Cardiovascular hybrid imaging
Myocardial perfusion imaging
Implantable magnetic biosensors for detecting cardiac biomarkers
Applications of biomarkers of cardiovascular disease
Biomarkers for ischemic heart disease and myocardial infarction
Troponin
Natriuretic peptide
Copeptin
Creatine kinase muscle brain
miRNAs as biomarkers of acute coronary syndrome
Myoglobin
Fatty acid binding protein
Growth Differentiation Factor-15
High density lipoprotein 2
Cripto-1 as a biomarker of myocardial infarction
Cataract as a biomarker of ischemic heart disease
Plasma CD93 as a biomarker for coronary artery disease
Plasma fetuin-A levels and the risk of myocardial infarction
YKL-40 as an inflammatory biomarker in ischemic heart disease
Biomarkers of cardiomyopathy
miRNA biomarkers of peripartum cardiomyopathy
Takotsubo cardiomyopathy
Troponin T levels in hypertrophic cardiomyopathy
Biomarkers of heart failure
Annexin A5 for prognosis of heart failure
Angiogenesis biomarkers
β-2a protein as a biomarker of heart failure
Desmin
Galectin-3 as biomarker of acute heart failure
G protein-coupled receptor kinase-2 as biomarker of CHF
KIF6 gene as biomarker of heart failure
Metabolic biomarkers of heart failure
miRNA biomarkers of heart failure
Natriuretic peptide as biomarker of heart failure
Oxidative stress as biomarker of heart failure
Future prospects for biomarkers of heart failure
Biomarkers for atherosclerosis
9p21-3 locus and coronary atherosclerosis
Adipocyte enhancer-binding protein 1
Gene signatures on leucocytes as biomarkers of atherosclerosis
Ghrelin as a biomarker of atherosclerosis
Imaging biomarkers of hypercholesterolemia/atherosclerosis
Inflammatory biomarkers of atherosclerosis
Lipid-modified proteins as biomarkers of atherosclerosis
Lp-PLA2 as biomarker of atherosclerotic heart disease
Metabolomic profile in hypercholesterolemia
Nitric oxide impairment and atherosclerosis
Oxygen free radicals as biomarkers of atherosclerosis
Proteomic profiles of serum inflammatory markers of atherosclerosis
Biomarkers of coronary heart disease
Antibody to oxidized-LDL
Apolipoproteins as risk factors for coronary heart disease
CRP as biomarker of risk for coronary heart disease
Impairment of EPCs by oxidative stress as a biomarker of disease
Role of TNF in acute coronary syndromes
Serum parathyroid hormone as biomarker of CHD
Serum stem cell factor as a biomarker of chd
VILCAD biomarker score for prediction of long-term mortality in CHD
Biomarkers for pulmonary arterial hypertension
Biomarkers of abdominal aortic aneurysm
Genetic biomarkers for cardiovascular disease
Biomarkers of inherited cardiomyopathies
Gene mutations in pulmonary arterial hypertension
Gene variant as a risk factor for sudden cardiac death
Genetic biomarkers of early onset myocardial infarction
Genetic biomarkers of atherosclerosis
IL-1 gene polymorphism as biomarker of cardiovascular disease
IL-6R signaling pathway and coronary heart disease
Kallikrein gene mutations in cardiovascular disease
Kallikrein gene and essential hypertension
Mutations in the low density lipoprotein receptor gene
Mutations within several genes that code for ion channel
Polymorphisms of the eNOS gene and angina pectoris
Lipoprotein (a) genetics
Polymorphisms in the apolipoprotein C gene
Polymorphisms in the apolipoprotein E gene
Polymorphism in the angiotensinogen gene
Multiple biomarkers for prediction of death from cardiovascular disease
Role of biomarkers in the management of cardiovascular disease
Biomarkers in the diagnosis/prognosis of myocardial infarction
Biomarkers for prevention of cardiovascular disease
C reactive protein as biomarker of response to statin therapy
HSP72 and eNOS as biomarkers of cardioprotective effect of HBO
Multimarker panel for prognosis in chronic heart failure
Molecular signature analysis in management of cardiovascular diseases
Presage ST2 Assay
Role of circulating biomarkers and mediators of cardiovascular dysfunction
Use of protein biomarkers for monitoring acute coronary syndromes
Use of biomarkers for prognosis of recurrent atrial fibrillation
Use of multiple biomarkers for monitoring of cardiovascular disease
Use of biomarkers in the management of peripheral arterial disease
Use of biomarkers in the management of hypertension
Future prospects for cardiovascular biomarkers
Cardiovascular Biomarker Consortium
Systems Approach to Biomarker Research in Cardiovascular Disease

9. Biomarkers & Personalized Medicine
Introduction
Pharmacogenetics
Biomarkers and pharmacogenetics
Pharmacogenomics
Pharmacoproteomics
Single cell proteomics for personalized medicine
Role of biomarkers in development of personalized drugs
Use of biomarkers for developing MAb therapy in oncology
Biobanking, biomarkers and personalized medicine in EU
Expression signatures as diagnostic/prognostic tools
Bioinformatics to sort biomarker data for personalized medicine
Biomarkers for monitoring response to therapy
Drug rescue by biomarker-based personalized medicine
Future role of biomarkers in personalized medicine

10. Biomarkers and Regulatory issues
Introduction
Biomarker validation
FDA criteria for a valid biomarker
FDA letter of support for biomarkers
Role of NIST in validation of cancer biomarkers
Quality specifications for BNP and NT-proBNP as cardiac biomarker assays
National Biomarker Development Alliance
FDA perspective of biomarkers in clinical trials
FDA and predictive medicine
Biomarkers and FDA’s Voluntary Genomic Data Submission
Role of imaging biomarkers in approval of drugs
FDA and biomarkers
FDA consortium linking genetic biomarkers to serious adverse events
Oncology Biomarker Qualification Initiative
Critical Path Initiative
Predictive Safety Testing Consortium
The 21st Century Cures Act and biomarkers
From validated biomarker assay to a clinical laboratory diagnostic
Fast Path programs
Need for a single federal agency to oversee biomarker field
FDA requirements of biomarkers and companion diagnostics

11. Markets for Biomarkers
Introduction
Biomarker markets according to technologies/applications
Markets for protein biomarkers
Biomarker market relevant to drug discovery and development
Biomarker market relevant to epigenetics
Biomarker market relevant to bioinformatics
Biomarker markets according to therapeutic areas
Markets for cancer biomarkers
Geographical distribution of biomarker markets
Unfulfilled needs in biomarkers
Drivers for the growth of markets for biomarkers
Challenges facing the biomarker industry
Pitfalls in the discovery and development of biomarkers
Strategies for developing biomarker markets
Utilization of biomarker research in academic laboratories
Biomarker discovery at pharmaceutical companies
Industrial-academic collaborations in biomarkers
Application of biomarkers in medical practice
Future role of biomarkers in healthcare
Applications of biomarkers beyond healthcare
Combating bioterrorism
Biomarkers for monitoring human exposure to environmental toxins
Biomarker patents
Factors that enhance the value of biomarker IP
US policy on patenting relevant to biomarkers
US legal decisions on gene patenting

12. References

Tables
Table 1-1: Historical landmarks in discovery and development of biomarkers
Table 1-2: Classification of biomarkers
Table 1-3: Terminology of biomarkers of disease relevant to clinical development
Table 1-4: Autoimmune disorders under study for autoantibodies as predictors
Table 1-5: Comparison of various types of biomarkers
Table 1-6: Various "omics" technologies for discovery of biomarkers
Table 1-7: Role of biomarkers in translational medicine
Table 2-1: Classification of methods of gene expression analysis
Table 2-2: Comparison of proteomic profiling technologies for discovery of biomarkers
Table 2-3: Companies involved in developing molecular imaging
Table 3-1: Applications of biochip/microarray technology in relation to biomarkers
Table 4-1: Companies using metabolomics for drug discovery
Table 4-2: Causes of failures in clinical trials and their reduction by use of biomarkers
Table 4-3: Biomarker-based drug development at major pharmaceutical companies
Table 5-1: Metabolic biomarkers of inflammatory diseases
Table 5-2: Oxidized phospholipids as biomarkers of various diseases
Table 5-3: Biomarkers of diabetes mellitus
Table 5-4: miRNAs deregulated in rheumatoid arthritic tissues
Table 5-5: BIPED classification of OA biomarkers
Table 5-6: Biomarkers of sepsis
Table 5-7: Biomarkers of pulmonary diseases
Table 5-8: Biomarkers of aging
Table 5-9: Examples of biomarkers common to multiple diseases
Table 5-10: Examples of use of biomarkers in animal health
Table 6-1: Desirable characteristics of biomarkers for cancer
Table 6-2: Types of cancer biomarkers
Table 6-3: A classification of molecular diagnostic methods in cancer
Table 6-4: Novel biomarkers of prognosis in cancer treatment
Table 6-5: Biomarkers of brain tumors
Table 6-6: Biomarkers of breast cancer
Table 6-7: miRNA associated with breast cancer
Table 6-8: Biomarkers of colorectal cancer
Table 6-9: Biomarkers of lung cancer
Table 6-10: Classification of biomarkers of melanoma
Table 6-11: Biomarkers of nasopharyngeal carcinoma and potential applications
Table 6-12: Biomarkers of ovarian cancer
Table 6-13: Classification of biomarkers of pancreatic cancer
Table 6-14: Biomarkers of prostate cancer
Table 7-1: Biomarkers of cerebral metabolism
Table 7-2: Classification of biomarkers of Alzheimer disease in blood and CSF
Table 7-3: Characteristics of an ideal biomarker for Alzheimer disease
Table 7-4: miRNA expression in neurodegenerative diseases
Table 7-5: Biomarkers of Parkinson's disease
Table 7-6: Biomarkers of Huntington disease
Table 7-7: Classification of biomarkers of sporadic amyotrophic lateral sclerosis
Table 7-8: Biomarkers of multiple sclerosis
Table 7-9: Gene expression as biomarker of response to interferon-β in multiple sclerosis
Table 7-10: Biomarkers of stroke
Table 7-11: Etiological blood biomarkers of ischemic strokes due to large artery atherosclerosis
Table 7-12: Biomarkers of traumatic brain injury
Table 7-13: Biomarkers of epilepsy
Table 7-14: Biomarkers of autism spectrum disorder
Table 8-1: Classification of biomarkers for cardiovascular diseases
Table 8-2: Genes that cause cardiovascular diseases
Table 8-3: Biomarkers of abdominal aortic aneurysm
Table 8-4: Biomarkers for cardiovascular disease risk prediction
Table 9-1: Pharmacogenetic vs. pharmacogenomic studies
Table 9-2: Applications of pharmacoproteomic biomarkers in personalized medicine
Table 10-1: Issued letters of support for biomarkers by the FDA
Table 10-2: Drugs requiring biomarker/companion diagnostic information in the label
Table 11-1: Biomarker markets according to technologies/applications 2015-2025
Table 11-2: Biomarker markets according to therapeutic areas 2015-2025
Table 11-3: Geographical distribution of biomarker markets 2015-2025
Table 11-4: Factors driving the growth of biomarker industry

Figures
Figure 1-1: Relation of biomarkers to other technologies and healthcare
Figure 1-2: Role of biomarkers in monitoring of diseases
Figure 2-1: The central role of spectrometry in proteomics
Figure 2-2: Selected reaction monitoring workflow for verification of biomarkers
Figure 4-1: Role of biomarkers in drug discovery and development process
Figure 5-1: Plasma lipids in metabolic syndrome
Figure 5-2: Diseases associated with myositis autoantibodies
Figure 6-1: Role of proteomics in the discovery of cancer biomarkers
Part II: Companies

13. Companies
Introduction
Top companies in biomarkers
Profiles of companies
Collaborations

Tables
Table 13-1: Companies with focus on biomarkers
Table 13-2: Pharmaceutical and biotechnology companies involved in biomarkers
Table 13-3: Molecular diagnostic companies
Table 13-4: Proteomics metabolomic/metabonomic and systems biology companies
Table 13-5: Pharmacogenomic/ personalized medicine companies
Table 13-6: Companies with biochips, biosensors and imaging technologies
Table 13-7: Nanobiotechnology companies
Table 13-8: Companies involved in drug discovery and development
Table 13-9: Bioinformatic companies involved in biomarkers
Table 13-10: Service, equipment and reagent supply companies
Table 13-11: Top biomarker companies
Table 13-12: Collaborations between companies

Ordering:
Order Online - [http://www.researchandmarkets.com/reports/328357/](http://www.researchandmarkets.com/reports/328357/)
Order by Fax - using the form below
Order by Post - print the order form below and send to

Research and Markets,
Guinness Centre,
Taylors Lane,
Dublin 8,
Ireland.
Fax Order Form
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit http://www.researchandmarkets.com/contact/

Order Information
Please verify that the product information is correct and select the format(s) you require.

Product Name: Biomarkers - Technologies, Markets and Companies
Web Address: http://www.researchandmarkets.com/reports/328357/
Office Code: SCBRJG1I

Product Formats
Please select the product formats and quantity you require:

**Quantity**

- Electronic - Single User: USD 5000
- Hard Copy: USD 5500 + USD 58 Shipping/Handling
- Electronic - Enterprisewide: USD 15000
- Electronic and Hard Copy - Single User: USD 6000 + USD 58 Shipping/Handling

* Shipping/Handling is only charged once per order.

Contact Information
Please enter all the information below in BLOCK CAPITALS

- Title: Mr □ Mrs □ Dr □ Miss □ Ms □ Prof □
- First Name: ____________________________
- Last Name: ____________________________
- Email Address: * ____________________________
- Job Title: ____________________________
- Organisation: ____________________________
- Address: ____________________________
- City: ____________________________
- Postal / Zip Code: ____________________________
- Country: ____________________________
- Phone Number: ____________________________
- Fax Number: ____________________________

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card: You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check: Please post the check, accompanied by this form, to:
Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer: Please transfer funds to:
Account number 833 130 83
Sort code 98-53-30
Swift code ULSBIE2D
IBAN number IE78ULSB98533083313083
Bank Address Ulster Bank,
27-35 Main Street,
Blackrock,
Co. Dublin,
Ireland.

If you have a Marketing Code please enter it below:

Marketing Code:

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:
(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World