

CHAPTER ONE: INTRODUCTION.....	1
STUDY GOALS AND OBJECTIVES.....	1
REASONS FOR DOING THE STUDY	1
INTENDED AUDIENCE.....	2
SCOPE OF REPORT	2
METHODOLOGY	2
INFORMATION SOURCES.....	3
RELATED BCC REPORTS	3
BCC ONLINE SERVICES.....	3
DISCLAIMER	4
 CHAPTER TWO: SUMMARY.....	 5
SUMMARY.....	5
<i>SUMMARY TABLE GLOBAL VALUE OF EPIGENOMIC PRODUCTS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS)</i>	6
<i>SUMMARY FIGURE GLOBAL VALUE OF EPIGENOMIC PRODUCTS, BY APPLICATION, 2008-2014 (\$ MILLIONS)</i>	6
SUMMARY (CONTINUED)	7
 CHAPTER THREE: OVERVIEW	 8
INTRODUCTION	8
THE NEW PARADIGM OF EPIGENOMICS.....	8
<i>FIGURE 1 EPIGENOMICS: A NEW PARADIGM</i>	9
HOW EPIGENOMICS FITS WITHIN GENOMICS	10
<i>TABLE 1 GENOMICS PLATFORMS</i>	10
HOW EPIGENOMICS FITS WITHIN ... (CONTINUED).....	11
TECHNICAL SCOPE OF THIS REPORT	12
<i>TABLE 2 TECHNOLOGY SCOPE OF THIS REPORT</i>	12
MARKET POTENTIAL OF EPIGENOMICS	13
<i>TABLE 3 GLOBAL VALUE OF EPIGENOMIC PRODUCTS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS)</i>	13
EPIGENOMICS PRODUCTS.....	14
RESEARCH TOOLS AND REAGENTS	14
DIAGNOSTICS	15
DRUGS	15
<i>FIGURE 2 ACTIVE CANCER EPIGENETIC DRUG CLINICAL TRIALS, BY PHASE AND INDICATION, JANUARY 2010</i>	16
GROWTH DRIVING FORCES.....	17
GROWTH IN LIFE SCIENCE FUNDING	17
CREATION OF EPIGENOMIC MAPS	17
AGING POPULATION IN DEVELOPED COUNTRIES	17
NEED FOR BETTER CANCER THERAPIES	17
GROWTH IN PERSONALIZED MEDICINE	18
WHY EPIGENETIC TECHNOLOGY IS IMPORTANT.....	18

<i>FIGURE 3 EPIGENETIC PROCESSES CAN GENERATE ABNORMAL CELLS DURING CELL DEVELOPMENT</i>	18
LIFE CYCLE STATUS OF EPIGENOMICS TECHNOLOGIES.....	19
HISTORICAL BACKGROUND.....	20
<i>TABLE 4 HISTORICAL OVERVIEW OF EPIGENOMICS</i>	20
HISTORICAL BACKGROUND (CONTINUED)	21
THE EPIGENOMICS INDUSTRY.....	22
<i>TABLE 5 EPIGENOMICS INDUSTRY KEY COMPANIES</i>	23
THE EPIGENOMICS INDUSTRY (CONTINUED)	24
CHAPTER FOUR: EPIGENETIC TECHNOLOGIES	25
INTRODUCTION	25
EPIGENETIC ANALYSIS TECHNOLOGIES	25
<i>TABLE 6 EPIGENETIC ANALYSIS TECHNOLOGIES</i>	26
STATUS OF DNA AND HISTONE ANALYSIS TECHNOLOGIES	26
<i>TABLE 7 STATUS OF DNA METHYLATION AND HISTONE ANALYSIS TECHNOLOGIES</i>	26
<i>TABLE 7 (CONTINUED)</i>	27
DNA AND HISTONE ANALYSIS WORKFLOW	28
<i>FIGURE 4 UPSTREAM AND DOWNSTREAM STEPS IN EPIGENETIC ANALYSIS WORKFLOW</i>	29
DNA METHYLATION.....	29
METHYLATED CYTOSINE—A FIFTH BASE.....	29
<i>FIGURE 5 EPIGENETIC CHANGES TO DNA AFFECT GENE EXPRESSION</i>	30
BIOLOGICAL ROLE OF DNA METHYLATION	30
<i>TABLE 8 BIOLOGICAL ROLES OF DNA METHYLATION</i>	31
DNA METHYLTRANSFERASE ENZYMES	32
CPG ISLANDS	33
<i>TABLE 9 DESCRIPTION OF CPG ISLANDS</i>	34
HISTONE METHYLATION AND ACETYLATION	35
HISTONES	35
HISTONE MODIFICATIONS	36
<i>FIGURE 6 ACETYLATION OF HISTONE TAIL REGIONS</i>	36
HISTONE ACETYLATION AND METHYLATION ENZYMES	37
<i>FIGURE 7 HISTONE ACETYLATION AND METHYLATION ENZYMES</i>	38
Histone Acetyl Transferases (HAT)	38
Histone Deacetylases (HDAC)	39
<i>TABLE 10 HDAC ENZYMES CLASSES</i>	39
Histone Methyltransferases and Demethylases	39
INAPPROPRIATE METHYLATION AND ACETYLATION	40
<i>TABLE 11 MECHANISMS FOR INAPPROPRIATE METHYLATION AND ACETYLATION</i>	40

CHAPTER FIVE: EPIGENOMIC ANALYSIS TECHNOLOGIES.....	41
IMPORTANCE OF EPIGENOMIC RESEARCH TOOLS.....	41
DNA METHYLATION RESEARCH TOOLS.....	42
<i>TABLE 12 DNA METHYLATION ANALYSIS ASSAYS</i>	42
DNA METHYLATION RESEARCH TOOLS (CONTINUED)	43
<i>TABLE 13 EMERGING DNA METHYLATION TECHNOLOGIES</i>	44
<i>TABLE 14 ACROYNMS FOR DNA METHYLATION TECHNOLOGIES</i>	45
DNA METHYLATION ANALYSIS WORKFLOW	46
<i>FIGURE 8 METHYLATED DNA ANALYSIS WORKFLOW</i>	47
DNA METHYLATION ANALYSIS METHODS BY COVERAGE AND THROUGHPUT	47
<i>TABLE 15 DNA METHYLATION TECHNOLOGIES BY COVERAGE AND THROUGHPUT</i>	48
DNA METHYLATION ANALYSIS TYPES BY WORKFLOW	49
<i>TABLE 16 EXAMPLES OF DNA METHYLATION ASSAYS</i>	49
DNA METHYLATION ANALYSIS: UPSTREAM TECHNOLOGIES	50
<i>TABLE 17 METHYLATION RECOGNITION TECHNOLOGIES</i>	50
RESTRICTION ENZYME-BASED METHODS.....	51
<i>FIGURE 9 ANALYSIS OF DNA METHYLATION BY RESTRICTION ENZYMES</i>	52
BISULFITE-BASED METHODS	52
Bisulfite-based Methods (Continued)	53
<i>FIGURE 10 BISULFITE CONVERSION OF DNA</i>	54
Analysis of Low Complexity DNA.....	55
AFFINITY-BASED METHODS.....	56
CHALLENGE OF HIGH BACKGROUND METHYLATED DNA.....	57
GENOME WIDE DNA METHYLATION ANALYSIS.....	57
<i>TABLE 18 DNA METHYLATION ANALYSIS TECHNIQUES BY GENOME RESOLUTION</i>	58
HISTONE EPIGENETIC ANALYSIS TECHNOLOGIES	59
<i>TABLE 19 CHIP ASSAYS</i>	60
CHIP-CHIP AND CHIP-SEQ	61
<i>FIGURE 11 WORKFLOW SCHEMATIC FOR CHIP PLATFORMS</i>	61
<i>TABLE 20 TECHNOLOGIES FOR MAPPING GENOMIC LOCATION OF CHROMATIN PROTEINS AND ENZYMES</i>	62
EMERGING DOWNSTREAM EPIGENETIC ANALYSIS PLATFORMS	63
MICROARRAYS.....	63
<i>TABLE 21 MICROARRAY TYPES</i>	63
<i>TABLE 22 COMPARISON OF DNA AND PROTEIN MICROARRAY TECHNOLOGIES</i>	64
DNA Microarray Technologies	65
<i>FIGURE 12 MICROARRAY FEATURE DENSITY</i>	66
<i>FIGURE 13 MICROARRAY RESOLUTION</i>	66

<i>TABLE 23 MICROARRAY GENOME CONTENT</i>	67
<i>TABLE 24 DNA MICROARRAY PLATFORM FEATURES</i>	68
<i>TABLE 25 DNA MICROARRAY PLATFORM COMPARISON FOR MAJOR MANUFACTURERS</i>	69
DNA Microarray ... (Continued)	70
Microarrays for Epigenetics Analysis.....	71
<i>FIGURE 14 MICROARRAYS ENHANCE MULTIPLEX CAPABILITIES OF EPIGENETICS ASSAYS</i>	71
Microarrays for ... (Continued)	72
NEXT GENERATION DNA SEQUENCING.....	73
<i>FIGURE 15 DNA SEQUENCING PLATFORMS</i>	73
Next Generation DNA ... (Continued).....	74
Next Generation DNA ... (Continued).....	75
<i>FIGURE 16 NEXT GENERATION SEQUENCING TECHNOLOGIES WORKFLOW OVERVIEW</i>	76
SERIAL ANALYSIS OF GENE EXPRESSION.....	77
ANTIBODIES.....	78
ALTERNATIVES TO ANTIBODIES IN UPSTREAM ANALYSIS STEP	79
ALTERNATIVES TO ANTIBODIES IN ... (CONTINUED).....	80
CHAPTER SIX: EPIGENETICS DIAGNOSTICS TECHNOLOGIES	81
WHAT IS A BIOMARKER?.....	81
<i>TABLE 26 ROLE OF BIOMARKERS IN CLINICAL TRIAL DESIGN</i>	81
DNA METHYLATION AS A CANCER BIOMARKER	82
DNA METHYLATION IN CANCER ETIOLOGY	82
<i>TABLE 27 BIOLOGICAL RATIONALE FOR DNA METHYLATION CANCER BIOMARKERS</i>	83
<i>TABLE 28 CANCER-RELATED CELL PATHWAYS AND GENES AFFECTED BY HYPER-METHYLATION</i>	84
Cell Cycle Control.....	84
Cell Invasion and Adhesion	84
DNA Damage Repair	84
Growth Factor Response	85
Regulation of Apoptosis.....	85
Hormonal Response.....	85
Cytokine Signaling	85
<i>TABLE 29 CANCER-RELATED EPIGENETIC CHANGES</i>	86
COMPARISON OF MOLECULAR BIOMARKER PLATFORMS	87
<i>TABLE 30 COMPARISON OF KEY CANCER BIOMARKER TECHNOLOGY PLATFORMS</i>	87
Comparison of Molecular ... (Continued)	88
Comparison of Molecular ... (Continued)	89
ASSESSMENT OF DNA METHYLATION BIOMARKER COMPETITIVE POSITION	90

EPIGENETIC BIOMARKER GENES	91
<i>TABLE 31 PUBLISHED DNA METHYLATION BIOMARKER GENES</i>	
<i>FOR CANCERS</i>	92
<i>TABLE 32 DIFFERENTIALLY METHYLATED GENES IN</i>	
<i>NEUROLOGIC AND CARDIOVASCULAR DISORDERS</i>	93
BIOMARKER DISCOVERY PROCESS.....	93
METHYLATION BIOMARKER DISCOVERY TECHNOLOGIES	94
<i>TABLE 33 DNA METHYLATION ANALYSIS TECHNOLOGIES IN</i>	
<i>BIOMARKER DISCOVERY</i>	94
GENOME-WIDE SCANNING FOR BIOMARKER DISCOVERY.....	95
CASE STUDY: FROM RESEARCH TOOLS TO BIOMARKERS.....	96
<i>IN-VITRO</i> DIAGNOSTIC DEVELOPMENT PROCESS	97
PHASE 1: BIOMARKER DISCOVERY.....	97
PHASE 2: BIOMARKER VALIDATION.....	97
PHASE 3: FORMAL KIT DEVELOPMENT	98
PHASE 4: CLINICAL VALIDATION.....	99
PHASE 5: REGULATORY REVIEW AND APPROVAL.....	99
FUTURE STATUS OF DNA METHYLATION BIOMARKERS.....	100
<i>TABLE 34 TECHNICAL HURDLES FOR DEVELOPMENT OF</i>	
<i>METHYLATION EPIGENETIC CANCER BIOMARKERS</i>	100
FUTURE STATUS OF DNA ... (CONTINUED).....	101
CHAPTER SEVEN: EPIGENETIC CANCER DRUG TECHNOLOGIES	102
INTRODUCTION	102
EPIGENETICS IN TUMORIGENESIS.....	102
EPIGENETIC GENES IN HUMAN CANCER.....	102
<i>TABLE 35 EPIGENETIC GENES ALTERED IN HUMAN CANCERS</i>	103
<i>TABLE 35 (CONTINUED)</i>	104
EPIGENETIC ENZYME DRUG TARGETS	105
<i>FIGURE 17 HISTONE DEACETYLASE REACTION</i>	105
<i>TABLE 36 STATUS OF INHIBITORS OF EPIGENETIC ENZYMES</i>	
<i>TARGETING HISTONES</i>	106
HISTONE DEACETYLASE INHIBITORS	107
BENEFITS OF HDAC INHIBITORS.....	108
HDAC INHIBITOR DRUG CLASSES	109
<i>TABLE 37 HDAC INHIBITOR CLASSES AND RELATIVE POTENCY</i>	109
Hydroxamates.....	110
<i>FIGURE 18 CHEMICAL STRUCTURE OF TRICHOSTATIN A, A</i>	
<i>HYDROXAMATE CLASS HDAC INHIBITOR</i>	110
Aliphatic Acids.....	110
<i>FIGURE 19 PHENYLBUTYRIC ACID, AN ALIPHATIC ACID CLASS</i>	
<i>HDAC INHIBITOR</i>	111
Cyclic Tetrapeptides	111
<i>FIGURE 20 APICIDIN A, A CYCLIC TETRAPEPTIDE CLASS HDAC</i>	
<i>INHIBITOR</i>	111

Benzamides	112
<i>FIGURE 21 ENTINOSTAT, A BENZAMIDE CLASS HDAC INHIBITOR</i>	112
HDAC INHIBITOR TECHNOLOGY TRENDS	113
<i>TABLE 38 HDAC INHIBITOR DRUG TECHNOLOGY TRENDS</i>	113
Enzyme Selectivity	113
Enzyme Selectivity (Continued).....	114
<i>TABLE 39 HDAC INHIBITOR CLASS I AND II SELECTIVITY</i>	115
Potency	115
Improvements in Drug-like Properties.....	116
SELECTIVE HDAC COMPOUNDS CAN PROVIDE COMPETITIVE ADVANTAGE.....	116
<i>FIGURE 22 DISEASE HDAC ISOFORM GENE EXPRESSION PROFILE</i>	117
CHEMICAL DESIGN IS THE KEY TO HDAC INHIBITOR SELECTIVITY	118
<i>FIGURE 23 COMMON STRUCTURAL COMPONENT MOTIFS OF VORINOSTAT</i>	118
Chemical Design ... (Continued).....	119
HDAC INHIBITORS IN COMBINATION THERAPIES	120
<i>TABLE 40 DRUG CLASSES THAT CAN BE USED IN COMBINATION WITH HDAC INHIBITORS</i>	121
HDAC INHIBITORS AS THERAPIES OUTSIDE CANCER	122
DERMATOLOGICAL DISORDERS.....	123
PARASITIC DISEASES.....	123
NEURODEGENERATIVE DISEASES.....	124
DIABETES	125
INFLAMMATORY DISEASES.....	125
IMMUNE DISORDERS	125
DNA METHYLTRANSFERASE INHIBITORS	126
<i>FIGURE 24 LEAD DNMT INHIBITOR COMPOUNDS</i>	126
TECHNICAL CHALLENGES FOR EPIGENETIC DRUG DEVELOPMENT.....	127
<i>TABLE 41 FUTURE CHALLENGES FOR EPIGENETIC DRUG DEVELOPMENT</i>	127
TECHNICAL CHALLENGES FOR ... (CONTINUED)	128
 CHAPTER EIGHT: EPIGENETICS CLONING AND CELLULAR THERAPIES TECHNOLOGIES.....	129
SOMATIC CELL NUCLEAR TRANSFER	129
<i>FIGURE 25 SOMATIC CELL NUCLEAR TRANSFER</i>	129
<i>TABLE 42 TECHNOLOGY OPPORTUNITIES IN SOMATIC CELL NUCLEAR TRANSFER</i>	130
APPLICATIONS	130
REPROGRAMMING FACTORS	131
<i>FIGURE 26 EPIGENETIC PROGRAMMING OF STEM CELLS</i>	132
QUALITY CONTROL ASSAYS IN CELLULAR THERAPIES	132

Tissue Engineering.....	133
Stem Cell Therapies	133
Non-stem Cell Therapies.....	134
CHAPTER NINE: LARGE SCALE REGIONAL EPIGENOMICS PROJECTS	135
LARGE SCALE REGIONAL EPIGENOMICS PROJECTS	135
<i>TABLE 43 REGIONAL EPIGENOMICS INITIATIVES</i>	136
<i>TABLE 43 (CONTINUED)</i>	137
EUROPE.....	137
UNITED STATES	138
ASIA.....	139
Asia (Continued).....	140
CHAPTER TEN: CANCER DIAGNOSTICS APPLICATIONS	141
ATTRACTIVE CANCER INDICATIONS FOR SCREENING	
MARKETS	141
<i>FIGURE 27 CANCER SCREENING OPPORTUNITY MATRIX FOR</i>	
<i>MOLECULAR DIAGNOSTICS</i>	142
EPIGENETICS AS A SCREENING PLATFORM.....	143
<i>FIGURE 28 NEW EPIGENETIC SCREENING PARADIGM</i>	144
DIAGNOSTIC SENSITIVITY AND SPECIFICITY	144
<i>FIGURE 29 SENSITIVITY AND SPECIFICITY</i>	145
STATUS OF DIAGNOSTICS TESTS FOR SELECTED CANCER	
INDICATIONS	146
BLADDER CANCER.....	146
CARCINOMA OF UNKNOWN PRIMARY (CUP).....	147
<i>TABLE 44 COMMERCIAL MOLECULAR DIAGNOSTIC PLATFORMS</i>	
<i>FOR TISSUE OF ORIGIN TESTS</i>	148
CERVICAL CANCER.....	149
<i>TABLE 45 COMMERCIAL LANDSCAPE FOR HPV TESTS</i>	150
Cervical Cancer (Continued)	151
COLORECTAL CANCER	152
Colorectal Cancer Existing Screening Tests	152
<i>TABLE 46 CURRENT SCREENING AND DIAGNOSTICS TESTS FOR</i>	
<i>COLORECTAL CANCER</i>	153
<i>TABLE 47 ACCURACY OF EXISTING COLORECTAL SCREENING</i>	
<i>TESTS</i>	154
Molecular Colorectal Cancer Diagnostics Tests.....	155
<i>TABLE 48 COMMERCIAL LANDSCAPE FOR COLORECTAL</i>	
<i>MOLECULAR TESTS</i>	155
Molecular ... (Continued)	156
<i>TABLE 49 COMPETITIVE SITUATION FOR CONVENTIONAL AND</i>	
<i>MOLECULAR COLON CANCER SCREENING TESTS</i>	157
Colorectal Cancer Diagnostics Tests	158
GASTRIC CANCER	158

LUNG CANCER	159
Lung Cancer (Continued)	160
OVARIAN CANCER	161
<i>TABLE 50 OVARIAN CANCER SCREENING TESTS</i>	161
<i>TABLE 51 OVARIAN CANCER DIAGNOSTIC TEST STATUS</i>	162
PANCREATIC CANCER	163
PEDIATRIC CANCERS	163
PROSTATE CANCER	164
Prostate Cancer (Continued)	165
PERSONALIZED TREATMENT EPIGENETIC-BASED TESTS	166
KEY CLINICAL REQUIREMENTS FOR AN EPIGENETIC-BASED DIAGNOSTICS TEST	166
<i>TABLE 52 REQUIREMENTS FOR AN EPIGENETICS BISULFITE DIAGNOSTIC ASSAY</i>	167
DNA METHYLATION DIAGNOSTICS PIPELINE	168
<i>TABLE 53 EPIGENETIC DIAGNOSTICS DEVELOPMENT PIPELINE</i>	168
<i>TABLE 53 (CONTINUED)</i>	169
DNA METHYLATION DIAGNOSTICS ... (CONTINUED)	170
CHAPTER ELEVEN: THERAPEUTIC APPLICATIONS	171
EPIGENETIC DRUG CLINICAL TRIALS	171
<i>TABLE 54 APPROVED EPIGENETIC DRUGS</i>	171
<i>TABLE 55 NEXT GENERATION EPIGENETIC DRUGS</i>	171
<i>FIGURE 30 ACTIVE CANCER EPIGENETIC DRUG CLINICAL TRIALS, BY DRUG CLASS AND CANCER TYPE, JANUARY 2010</i>	172
<i>FIGURE 30 (CONTINUED)</i>	173
<i>FIGURE 31 ACTIVE CANCER EPIGENETIC DRUG CLINICAL TRIALS, BY PHASE AND INDICATION, JANUARY 2010</i>	174
<i>FIGURE 32 CURRENT EPIGENETIC CANCER DRUG CLINICAL TRIALS, BY DRUG AND TRIAL TYPE, JANUARY 2010</i>	175
<i>FIGURE 33 ACTIVE EPIGENETIC CANCER DRUG CLINICAL TRIALS, BY CLINICAL PHASE AND TRIAL TYPE, JANUARY 2010</i>	176
EPIGENETIC DRUG NOMENCLATURE	177
<i>TABLE 56 EPIGENETIC DRUG NOMENCLATURE TABLE</i>	177
<i>TABLE 56 (CONTINUED)</i>	178
HDAC INHIBITOR CLINICAL TRIALS	178
<i>TABLE 57 HDAC INHIBITOR CLINICAL TRIALS SUMMARY</i>	178
<i>TABLE 57 (CONTINUED)</i>	179
HDAC INHIBITOR CLINICAL TRIALS (CONTINUED)	179
HDAC INHIBITOR CLINICAL TRIALS (CONTINUED)	180
<i>TABLE 58 MBCD0103 INHIBITS SELECTED HDAC ENZYMES</i>	181
HDAC INHIBITOR CLINICAL TRIALS (CONTINUED)	182
DNMT INHIBITORS CLINICAL TRIALS	183
<i>TABLE 59 DNMT INHIBITOR CLINICAL TRIALS SUMMARY</i>	183
DNMT INHIBITORS CLINICAL TRIALS (CONTINUED)	184

EPIGENETIC DRUGS FOR NON-CANCER INDICATIONS.....	185
TABLE 60 EPIGENETIC NON-CANCER DRUG LANDSCAPE.....	186
EPIGENETIC DRUGS FOR NON-CANCER ... (CONTINUED)	187
CHAPTER TWELVE: MARKET GROWTH DRIVING FORCES	188
EPIGENETICS SCIENTIFIC PUBLICATIONS.....	188
FIGURE 34 GROWTH IN SCIENTIFIC PUBLICATIONS RELATED TO EPIGENETICS (NUMBER OF PUBLICATIONS).....	188
GROWTH DRIVING FORCES.....	189
TABLE 61 FORCES DRIVING EPIGENOMICS INDUSTRY GROWTH	189
GROWTH IN FUNDING FOR LIFE-SCIENCE RESEARCH.....	189
TABLE 62 STIMULUS FUNDING ALLOCATED TO UNITED STATES SCIENCE SPENDING	190
FIGURE 35 ANNUAL NIH FUNDING BUDGET, 2000-2009 (\$ MILIONS).....	190
FIGURE 35 (CONTINUED)	191
CREATION OF EPIGENETIC MAPS	191
RANGE OF OCCURRENCE OF EPIGENETIC CHANGES	192
AGING POPULATIONS IN DEVELOPED COUNTRIES.....	192
NEED FOR BETTER CANCER THERAPIES	193
GROWTH IN PERSONALIZED MEDICINE	193
UNDERSTANDING OF EPIGENETIC PROCESSES BEYOND CANCER	194
CHAPTER THIRTEEN: MARKET ANALYSIS	195
MARKET SUMMARY.....	195
TABLE 63 GLOBAL VALUE OF EPIGENOMIC PRODUCTS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS).....	195
MARKET SUMMARY (CONTINUED)	196
TABLE 64 GLOBAL VALUE OF EPIGENOMIC PRODUCTS, BY GEOGRAPHY, THROUGH 2014 (\$ MILLIONS).....	197
RESEARCH TOOLS MARKETS.....	197
GLOBAL SALES BY PRODUCT.....	197
TABLE 65 GLOBAL VALUE OF EPIGENOMIC ANALYSIS RESEARCH TOOLS, BY PRODUCT TYPE, THROUGH 2014 (\$ MILLIONS)	198
Kits	198
Reagents.....	198
Microarrays and Next Gen Sequencing	198
Microarrays and ... (Continued).....	199
EPIGENOMIC KIT SALES BY TECHNOLOGY	200
TABLE 66 GLOBAL VALUE OF EPIGENOMICS RESEARCH TOOLS KITS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLION)	200
Epigenomic Kit ... (Continued)	201
TABLE 67 GLOBAL VALUE OF EPIGENOMIC ANALYSIS KITS, BY FORMAT, THROUGH 2014 (\$ MILLIONS)	202

DNA METHYLATION ANALYSIS KIT MARKET	202
DNA Methylation ... (Continued)	203
TABLE 68 GLOBAL VALUE OF DNA METHYLATION RESEARCH TOOLS KITS, BY ANALYSIS OBJECTIVE, THROUGH 2014 (\$ MILLIONS).....	204
TABLE 69 GLOBAL VALUE OF DNA METHYLATION RESEARCH TOOLS KITS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS).....	205
TABLE 70 GLOBAL VALUE OF DNA METHYLATION SINGLE LOCI RESEARCH TOOLS KITS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS).....	206
TABLE 71 GLOBAL VALUE OF DNA METHYLATION GENOME-WIDE RESEARCH TOOLS KITS BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS).....	207
HISTONE ANALYSIS KIT MARKET.....	208
TABLE 72 GLOBAL VALUE OF HISTONE ANALYSIS KITS, BY TECHNOLOGY FORMAT, THROUGH 2014 (\$ MILLIONS).....	208
EPIGENETICS MICROARRAY MARKETS	208
MICROARRAYS AND NEXT GEN SEQUENCING AS DOWNSTREAM TOOLS	209
MICROARRAY MARKET	209
TABLE 73 GLOBAL VALUE OF EPIGENOMIC MICROARRAYS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS).....	210
RESEARCH TOOLS REAGENTS MARKET	211
TABLE 74 GLOBAL VALUE OF RESEARCH TOOLS EPIGENOMIC REAGENTS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS).....	211
CHAPTER FOURTEEN: EPIGENOMIC DIAGNOSTICS MARKET.....	212
OVERVIEW OF CANCER DIAGNOSTICS MARKET	212
TABLE 75 VALUE OF GLOBAL MOLECULAR DIAGNOSTICS PRODUCTS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS).....	212
CANCER MOLECULAR DIAGNOSTICS GROWTH DRIVERS.....	213
EPIGENETICS-BASED DIAGNOSTICS MARKETS	213
TABLE 76 PROJECTED CHANGE IN AGE 65-PLUS POPULATION BY REGION (%).....	214
Epigenetics-based ... (Continued).....	215
TABLE 77 U.S. CANCER INCIDENCE AND ESTIMATED TREATMENT DECISIONS, 2009	216
TABLE 78 GLOBAL VALUE OF EPIGENETIC DIAGNOSTIC ASSAYS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS).....	217
TABLE 79 GLOBAL VALUE OF EPIGENETIC DIAGNOSTIC ASSAYS, BY CANCER INDICATION, THROUGH 2014 (\$ MILLIONS)	218
Epigenetics-based ... (Continued).....	219
CHAPTER FIFTEEN: EPIGENETIC DRUGS MARKETS.....	220
OVERVIEW.....	220

CANCER DRUG MARKET GROWTH DRIVING FORCES.....	220
CANCER DRUG MARKET ... (CONTINUED)	221
CLINICAL PROOF OF PRINCIPLE OF EPIGENETIC DRUGS IS ESTABLISHED	222
EPIGENETIC THERAPIES BEYOND CANCER	223
EPIGENETIC DRUG MARKET SUMMARY	223
<i>TABLE 80 GLOBAL VALUE OF EPIGENETIC DRUGS, BY CANCER INDICATION, THROUGH 2014 (\$ MILLIONS)</i>	224
Hematological	224
Hematological (Continued).....	225
Solid Tumors.....	226
Solid Tumors (Continued)	227
Solid Tumors (Continued)	228
EPIGENETIC DRUG MARKET BY DRUG CLASS.....	229
<i>TABLE 81 GLOBAL VALUE OF EPIGENETIC DRUGS, BY DRUG CLASS, THROUGH 2014 (\$ MILLIONS)</i>	229
HDAC INHIBITORS MARKETS	229
Strategic Opportunities in HDAC Inhibitors	230
<i>TABLE 82 SUMMARY OF HDAC INHIBITOR STRATEGIC OPPORTUNITIES FOR CANCER TREATMENT</i>	230
HDAC Inhibitor Drug Market Size by Indication.....	231
<i>TABLE 83 GLOBAL VALUE OF HDAC INHIBITOR DRUGS, BY INDICATION, THROUGH 2014 (\$ MILLIONS)</i>	232
HDAC Inhibitor Market Size by Technology.....	233
<i>TABLE 84 GLOBAL VALUE OF HDAC INHIBITOR DRUGS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS)</i>	233
DNMT INHIBITORS MARKET	234
<i>TABLE 85 GLOBAL VALUE OF DNMT INHIBITOR DRUGS, BY INDICATION, THROUGH 2014 (\$ MILLIONS)</i>	235
<i>TABLE 86 GLOBAL VALUE OF DNMT INHIBITOR DRUGS, BY TECHNOLOGY, THROUGH 2014 (\$ MILLIONS)</i>	236
HEMATOLOGICAL CANCER EPIGENETIC DRUG MARKET	236
OVERVIEW OF HEMATOLOGICAL CANCERS	236
<i>TABLE 87 OVERVIEW OF MAJOR HEMATOLOGICAL MALIGNANCIES</i>	237
Overview of Hematological Cancers (Continued).....	238
<i>TABLE 88 MDS DRUG COMPARISON</i>	239
HEMATOLOGICAL DRUG MARKET BY INDICATION	240
<i>TABLE 89 HEMATOLOGICAL CANCER EPIGENETIC DRUGS, BY INDICATION, THROUGH 2014 (\$ MILLIONS)</i>	240
HDAC Hematological Drug Market.....	241
<i>TABLE 90 HDAC HEMATOLOGICAL CANCER EPIGENETIC DRUGS, BY INDICATION, THROUGH 2014 (\$ MILLIONS)</i>	241
HDAC Hematological ... (Continued)	242

TABLE 91 COMPARISON OF THE PTCL DRUGS, FOLYTYN AND ISTODAX.....	243
DNMT Hematological Drug Market	243
TABLE 92 DNMT HEMATOLOGICAL CANCER EPIGENETIC DRUGS, BY INDICATION, THROUGH 2014 (\$ MILLIONS)	244
CHAPTER SIXTEEN: CELL THERAPY ASSAYS MARKETS.....	245
TABLE 93 EPIGENETIC CELL THERAPIES MARKETS, BY APPLICATION, THROUGH 2014 (\$ MILLIONS).....	245
CELL THERAPY ASSAYS MARKETS (CONTINUED)	246
CHAPTER SEVENTEEN: GEOGRAPHICAL MARKETS.....	247
TABLE 94 EPIGENOMIC RESEARCH TOOLS MARKETS, BY GEOGRAPHY, THROUGH 2014 (\$ MILLIONS).....	247
TABLE 95 EPIGENOMIC DIAGNOSTICS MARKETS, BY GEOGRAPHY, THROUGH 2014 (\$ MILLIONS).....	248
TABLE 96 NUMBER OF HOSPITALS AND CLINICS, BY GEOGRAPHICAL REGION.....	248
TABLE 97 EPIGENOMIC PHARMACEUTICALS MARKETS, BY GEOGRAPHY, THROUGH 2014 (\$ MILLIONS).....	249
TABLE 98 EPIGENOMIC CELL THERAPIES MARKETS, BY GEOGRAPHY, THROUGH 2014 (\$ MILLIONS).....	250
CHAPTER EIGHTEEN: COMPETITOR AND INDUSTRY DYNAMICS.....	251
RESEARCH TOOLS	251
TABLE 99 SCOPE OF EPIGENOMIC RESEARCH TOOLS SUPPLIERS.....	252
FIGURE 36 CHIP-GRADE ANTIBODY SUPPLIER MARKET SHARES, 2009 (%).....	253
FIGURE 36 (CONTINUED)	254
DIAGNOSTICS	254
SKILL SET FOR BIOTECHNOLOGY DIAGNOSTICS COMPANIES	254
SHIFTING PARADIGM IN DIAGNOSTICS	255
IN-VITRO DIAGNOSTICS COMPETITORS.....	256
TABLE 100 IN-VITRO DIAGNOSTICS COMPETITORS.....	256
In-Vitro Diagnostics ... (Continued)	257
TABLE 101 STRATEGIC ALLIANCE STATUS FOR BIOTECHNOLOGY EPIGENETICS DIAGNOSTICS FIRMS.....	258
TABLE 102 COMPETITIVE LANDSCAPE FOR MOLECULAR DIAGNOSTICS TECHNOLOGIES	259
EPIGENETIC DRUGS INDUSTRY.....	259
TABLE 103 RELATIVE STRATEGIC POSITION FOR EPIGENOMIC DRUG COMPANIES	260
FIGURE 37 EPIGENOMIC DRUG COMPANY MARKET SHARES, 2009.....	261
EPIGENOMIC INDUSTRY STRATEGIC ALLIANCES	262

TABLE 104 EPIGENOMICS STRATEGIC ALLIANCES: 2007-2010	263
TABLE 104 (CONTINUED).....	264
EPIGENOMIC INDUSTRY ... (CONTINUED).....	265
EPIGENOMIC INDUSTRY ... (CONTINUED).....	266
EPIGENOMICS INDUSTRY ACQUISITIONS.....	267
TABLE 105 EPIGENOMICS INDUSTRY ACQUISITIONS, 2007–2010	268
EPIGENOMICS INDUSTRY ... (CONTINUED).....	269
CHAPTER NINETEEN: PATENTS	270
EPIGENOMICS PATENT ACTIVITY	270
FIGURE 38 NUMBER OF EPIGENOMICS PATENTS, BY YEAR, 2000- 2009	270
FIGURE 39 NUMBER OF EPIGENOMICS PATENTS, BY GEOGRAPHY, 2000–2009.....	271
FIGURE 39 (CONTINUED)	272
RESEARCH TOOLS AND DIAGNOSTICS PATENT ACTIVITY.....	272
TABLE 106 EPIGENOMICS AG RESEARCH TOOLS PATENT COVERAGE	272
RESEARCH TOOLS AND ... (CONTINUED).....	273
FIGURE 40 BIOTECHNOLOGY DIAGNOSTICS PATENTS, BY COMPANY (%).....	274
TABLE 107 PATENT STATUS FOR BIOTECHNOLOGY DIAGNOSTICS COMPANIES	275
PHARMACEUTICALS PATENTS ACTIVITY	276
TABLE 108 HDAC INHIBITOR PATENT CLAIMS, 2004–2006	276
TABLE 108 (CONTINUED).....	277
FIGURE 41 NUMBER OF EPIGENOMICS DRUG PATENTS, BY TECHNOLOGY CLASS AND GEOGRAPHY.....	278
PHARMACEUTICALS PATENTS ACTIVITY (CONTINUED)	279
FIGURE 42 NUMBER OF HDAC INHIBITOR PATENTS, BY COMPANY AND GEOGRAPHY	280
FIGURE 43 NUMBER OF DNMT INHIBITOR PATENTS, BY COMPANY AND GEOGRAPHY	281
PATENT CASE STUDIES.....	282
CHAPTER TWENTY: COMPANY PROFILES	283
ABBOTT LABORATORIES.....	283
ABCAM PLC.	284
ACCESS PHARMACEUTICALS	285
ACETYLON PHARMACEUTICALS.....	286
ACTIVE MOTIF.....	286
AFFYMETRIX, INC.....	287
AFFYMETRIX, INC. (CONTINUED)	288
TABLE 109 AFFYMETRIX STRATEGIC ALLIANCES	289
TABLE 109 (CONTINUED).....	290

AGILENT TECHNOLOGIES, INC.....	291
ARNO THERAPEUTICS, INC.....	292
ARUP LABORATORIES, INC.....	293
ASTELLAS PHARMA, INC.....	293
BAYER AG.....	294
BIOFIELD CORP.....	295
BIOSERVE BIOTECHNOLOGIES, LTD.	295
BIOVISION.....	295
CELGENE CORPORATION.....	296
CELGENE CORPORATION (CONTINUED).....	297
CELLARTIS AB.....	298
CELLCENTRIC LTD.....	298
CELLERON THERAPEUTICS LTD.	299
CELLZOME AG.....	300
CHIPSCREEN BIOSCIENCES LTD.....	301
CHROMA THERAPEUTICS LTD.	302
CLAVIS PHARMA ASA.....	302
<i>TABLE 110 CLAVIS PHARMA DRUG PIPELINE.....</i>	<i>303</i>
CONSTELLATION PHARMACEUTICALS.....	304
CRYSTAL GENOMICS, INC.	304
CURIS.....	305
EISAI CO. LTD.	305
EPIGENOMICS AG.....	306
EPIGENOMICS AG (CONTINUED).....	307
EPIGENTEK.....	308
EPITHERAPEUTICS.....	309
ELIXIR PHARMACEUTICALS, INC.	309
ENVIVO PHARMACEUTICALS.....	310
EOS SPA.....	311
EPIONTIS GMBH.....	311
EPIZYME, INC.	312
ES CELL INTERNATIONAL PTE LTD.....	313
EXONHIT THERAPEUTICS SA.....	313
F. HOFFMANN-LA ROCHE, LTD.....	314
GENEXTRA S.P.A.....	315
GENPATHWAY, INC.	316
GLAXOSMITHKLINE.....	316
GLAXOSMITHKLINE (CONTINUED).....	317
HUYA BIOSCIENCE INTERNATIONAL.....	318
ILLUMINA, INC.	319
ILLUMINA, INC. (CONTINUED).....	320
<i>TABLE 111 ILLUMINA SEQUENCING TECHNOLOGY SPACE.....</i>	<i>321</i>
IMAGENES GMBH.....	322
INTERNATIONAL DRUG DISCOVERY INSTITUTE.....	323

ITALFARMACO SPA.....	323
JOHNSON & JOHNSON	324
KARUS THERAPEUTICS LTD.	325
LABORATORY CORPORATION OF AMERICA HOLDINGS.....	326
LES LABORATOIRES SERVIER	327
LIFE TECHNOLOGIES INC.	328
LIFE TECHNOLOGIES INC. (CONTINUED).....	329
MERCK KGAA.....	330
MERCK & CO. INC.	331
METHYLGENE	332
<i>TABLE 112 METHYLGENE HDAC INHIBITOR PRODUCT PIPELINE</i>	<i>333</i>
MILLIPORE	334
NATUREWISE BIOTECH & MEDICALS CORP.	335
NOVARTIS.....	336
ONCOLYS BIOPHARMA INC.	337
ONCOMETHYLOME SCIENCES S.A.	338
<i>TABLE 113 ONCOMETHYLOME DNA METHYLATION DIAGNOSTICS PIPELINE</i>	<i>339</i>
ONCOMETHYLOME SCIENCES S.A. (CONTINUED).....	340
ORCHID CHEMICALS & PHARMACEUTICALS LIMITED	341
ORION GENOMICS	342
<i>TABLE 114 ORION STRATEGIC ALLIANCES</i>	<i>343</i>
<i>TABLE 115 ORION EPIGENETIC DIAGNOSTICS PIPELINE</i>	<i>344</i>
ORTHO BIOTECH.....	345
PACIFIC BIOSCIENCES	345
PHARMACYCLICS.....	346
PROGEN PHARMACEUTICALS LTD.....	347
PROGEN PHARMACEUTICALS LTD. (CONTINUED)	348
PROGNOSDX HEALTH, INC.....	349
QUEST DIAGNOSTICS	349
ROCHE LIFE SCIENCES.....	350
ROCHE LIFE SCIENCES (CONTINUED).....	351
ROCHE LIFE SCIENCES (CONTINUED).....	352
QIAGEN GMBH.....	353
RAINDANCE TECHNOLOGIES	354
REACTION BIOLOGY CORP.	354
REPLIGEN CORPORATION	355
RUBICON GENOMICS.....	355
RUBICON GENOMICS (CONTINUED).....	356
S*BIO PTE LTD.....	357
<i>TABLE 116 S*BIO HDAC INHIBITOR DRUG PIPELINE.....</i>	<i>358</i>
SCHERING PLOUGH CORPORATION	358
SCOTTISH BIOMEDICAL LTD.	359
SEQUENOM, INC.	360

SEQUENOM, INC. (CONTINUED).....	361
SEQWRIGHT	362
SUPERGEN, INC.	362
SYNDAX PHARMACEUTICALS, INC.....	363
<i>TABLE 117 ENTINOSTAT CLINICAL TRIALS SUMMARY STATUS.....</i>	<i>363</i>
SYSMEX CORPORATION	364
TAIHO PHARMACEUTICALS	365
TAKEDA PHARMACEUTICAL COMPANY LIMITED	365
TARGECEPT, INC.....	366
THEREPI INC.....	366
TOPOTARGET A/S.....	366
TOPOTARGET A/S (CONTINUED).....	367
TOPOTARGET A/S (CONTINUED).....	368
<i>TABLE 118 TOPOTARGET'S HDAC INHIBITOR PATENT PORTFOLIO.....</i>	<i>369</i>
VALIBIO SA.....	370
VALIRX	371
VERIDEX LLC	371
ZYMO RESEARCH.....	372