

ANTIBODY DRUG CONJUGATES: TECHNOLOGIES AND GLOBAL MARKETS



PHM161A
February 2014

Kim Lawson
Project Analyst

ISBN: 1-56965-691-6

bcc | Research
Market Forecasting

BCC Research
49 Walnut Park, Building 2
Wellesley, MA 02481 USA
866-285-7215 (toll-free within the USA),
or (+1) 781-489-7301
www.bccresearch.com
information@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
STUDY BACKGROUND	2
STUDY GOAL AND OBJECTIVES	2
SCOPE OF REPORT	3
METHODOLOGY AND INFORMATION SOURCES	3
COMMERCIAL DRUGS	3
DEVELOPMENTAL DRUGS	4
<i>TABLE A FDA* APPROVAL PROCESS FOR NEW DRUGS</i>	4
ANALYST CREDENTIALS	5
RELATED BCC RESEARCH REPORTS	5
BCC RESEARCH ONLINE SERVICES	5
DISCLAIMER	5
CHAPTER 2 SUMMARY	7
<i>SUMMARY TABLE GLOBAL FORECAST FOR ADC DRUGS* THROUGH 2018 (\$ MILLIONS)</i>	8
<i>SUMMARY FIGURE GLOBAL FORECAST FOR ADC DRUGS* 2011-2018 (\$ MILLIONS)</i>	8
CHAPTER 3 OVERVIEW OF ADCS WITHIN ANTIBODY DRUG CLASS	13
<i>FIGURE 1 ADC ILLUSTRATED</i>	14
APPROVED ADCS	15
MYLOTARG (GEMTUZUMAB OZOGAMICIN)	15
ADCETRIS (BRENTUXIMAB VEDOTIN)	16
KADCYLA (TRASTUZUMAB-DM1)	17
THE ROOTS OF ADCS: ANTIBODIES AS DRUG CLASS	18
HISTORY OF ANTIBODY DEVELOPMENT	20
<i>TABLE 1 KEY DATES IN ANTIBODY DEVELOPMENT</i>	21
THE MOVE TO HUMANIZATION	21
<i>TABLE 2 CLASSES OF BIOPHARMACEUTICALS</i>	23
ADCS AS A NEW CATEGORY	23
<i>TABLE 3 DOMINANT ADC TECHNOLOGY</i>	24
COMPONENTS OF ADCS	25
Antibodies	25
Linkers	25
Cytotoxins	26
<i>TABLE 4 ADC CYTOTOXINS USED AND THEIR MODES OF ACTION</i>	26
Calicheamicin	27
Maytansinoid	27
Auristatins (MMAE, MMAF)	27
PBDs	27
The Antigen Target	28
KEY ANTIGEN TARGETS FOR ADCS	28
HER2 (Human Epidermal Growth Factor Receptor)	28
Nectin-4	28
Mesothelin	29
GPNMB	29

TOPIC	PAGE NO.
PSMA	29
EGFR (Epidermal Growth Factor Receptor, also Called ErbB1)	29
VEGF (Vascular Endothelial Growth Factor)	30
CD19	30
CD20	30
CD22	30
CD25	31
CD30	31
CD33	31
CD40	31
CD56	32
CD74	32
CD79a and CD79b	33
CD138 (Syndecan 1)	33
CEACAM (also called CEA)	33
SLITRK6	34
LIV-1	34
EGP-1 (Epithelial Glycoprotein-1 Antigen, also known as TROP-2)	34
Mesothelin	34
NOVEL FORMS OF ANTIBODY THERAPIES	35
NANOBODIES AND OTHER NOVEL FORMS OF ANTIBODIES	36
NANOBODIES	36
ANTIBODY FRAGMENTS	36
BISPECIFIC ANTIBODIES (BSABS)	36
Intrabody	36
INNOVATIONS IN ANTIBODIES	37
<i>TABLE 5 NOVEL ADC-RELATED TECHNOLOGIES</i>	38
DIFFENTIATING ASPECTS OF ADCS	39
Novel Cytotoxic Technology	39
Novel Conjugation Technology	40
<i>TABLE 6 NOVEL ADC TECHNOLOGIES</i>	41
PRODUCTION	44
<i>TABLE 7 MANUFACTURERS IN THE ADC SPACE AND THEIR FOCUS</i>	47
CHAPTER 4 MARKET FORECAST FOR ADCS	51
PHARMACEUTICAL LANDSCAPE	51
<i>TABLE 8 LEADING PHARMACEUTICAL COMPANY IN TERMS OF SALES, 2012 (\$ BILLIONS)</i>	51
<i>FIGURE 2 REVENUES BY REGION IN THE PHARMACEUTICAL SECTOR, 2012</i>	52
THE ADC MARKET LANDSCAPE	53
KEY DRIVERS	53
KEY CHALLENGES	54
ADC GROWTH AND ITS DISTRIBUTION	55
<i>FIGURE 3 FORECAST FOR NUMBER OF U.S. FDA-APPROVED ADC DRUGS, 2011-2018 THROUGH 2018</i>	55
<i>FIGURE 4 ADC REVENUES BY REGION, 2013 AND 2018 (% OF TOTAL REVENUES)</i>	56
<i>FIGURE 5 REVENUES BY ADC TARGET ANTIGEN, 2013 AND 2018 (\$ MILLIONS)</i>	57
<i>FIGURE 6 REVENUES BY ADC SPECIFIC CYTOTOXIN, 2013 AND 2018 (\$ MILLIONS)</i>	58

TOPIC	PAGE NO.
<i>FIGURE 7 ADC BY THERAPEUTIC AREA, 2013 AND 2018 (% OF TOTAL COMMERCIALIZED ADCS)</i>	59
<i>FIGURE 8 ADC REVENUE BY THERAPEUTIC AREA, 2013 AND 2018 (\$ MILLIONS)</i>	60
REGULATORY FACTORS	61
INVESTMENT AND ALLIANCES	62
<i>TABLE 9 MAJOR ADC INVESTMENTS AND ALLIANCES</i>	62
DEVELOPMENT CONSIDERATIONS	65
PATENTING	67
PROMISING THERAPIES	69
CMC-544	69
RG7596	70
RG7593 (pinatuzumab vedotin)	70
CDX-011	70
PSMA ADC	70
SAR3419	71
BT-062	71
<i>TABLE 10 ADC DRUGS IN THE DEVELOPMENT PIPELINE</i>	72
<i>FIGURE 9 ANTIGEN TARGETS FOR ADCS IN LATE DEVELOPMENT (%)</i>	76
<i>FIGURE 10 THERAPEUTIC FOCUS FOR ADCS IN LATE STAGE DEVELOPMENT (%)</i>	77
<i>TABLE 11 USEFUL RESOURCES FOR THE ADC DRUG INDUSTRY</i>	78
CHAPTER 5 COMPANY PROFILES	80
ABBVIE, INC. INC.	80
ABGENOMICS INTERNATIONAL, INC. INC.	80
ADC BIOTECHNOLOGY LTD.	81
ADC THERAPEUTICS	81
AFFINICON APS	82
AGENSYS, INC. INC.	83
ASTELLAS PHARMA US LLC	83
ALBANY MOLECULAR RESEARCH INC.	84
ALGETA ASA	84
ALLOZYNE	85
AMBRX INC.	86
AMGEN INC.	86
AQUITAINE PHARM INTERNATIONAL/PIERRE FABRE	87
AVIDBIOLOGICS, INC.	88
BAXTER HEALTHCARE CORPORATION.	88
BAYER HEALTHCARE PHARMACEUTICALS	89
BIND BIOSCIENCES, INC.	91
BIOGEN IDEC	92
BIOOUTSOURCE LTD.	92
BIOSYN	93
BIOTEST AG	94
BRISTOL MYERS SQUIBB	94
BSP PHARMACEUTICALS SRL	95
CARBOGEN AMCIS	95
CATALENT PHARMA SOLUTIONS	96
CELLEX THERAPEUTICS, INC.	97

TOPIC	PAGE NO.
CELLTRION	97
CENTROSE	98
THE CHEMISTRY RESEARCH SOLUTION LLC	99
CYTOMX THERAPEUTICS, INC. INC.	100
DAIICHI SANKYO CO., LTD. (U.S.)	100
DALTON PHARMA SERVICES	101
ELI LILLY AND COMPANY	101
ESPERANCE PHARMACEUTICALS, INC. INC.	102
FABRUS, LLC	102
FIVE PRIME THERAPEUTICS, INC. INC.	104
FUJIFILM DISYNTH BIOTECHNOLOGIES	104
GENENTECH, INC	105
HOFFMANN-LA ROCHE, INC. INC.	105
<i>TABLE 12 GENENTECH'S ADC PIPELINE</i>	106
GENMAB A/S	106
GLAXOSMITHKLINE PLC	107
GOODWIN BIOTECHNOLOGY, INC. INC.	108
HEIDELBERG PHARMA GMBH	109
WILEX	109
IMAGINAB, INC. INC.	110
IMMUNOGEN, INC. INC.	110
IMMUNOMEDICS, INC. INC.	113
INTELLECT NEUROSCIENCES, INC. INC.	115
LAUREATE BIOPHARMACEUTICAL SERVICES, INC. INC.	116
LONZA GROUP LTD.	117
MEDIMMUNE LLC	117
ASTRAZENECA PLC	118
MENARINI BIOTECH	118
MERSANA THERAPEUTICS, INC. INC.	119
MILLENIUM PHARMACEUTICALS, INC	120
TAKEDA PHARMACEUTICAL COMPANY LTD.	120
MORPHOSYS	122
NBE THERAPEUTICS	122
NOVASEP	123
OXFORD BIOTHERAPEUTICS	124
PIRAMAL HEALTHCARE LTD.	125
PFIZER	126
PHILOCHEM	127
PHOTOBIOLOGICS, LTD.	127
POLYTHERICS	128
PROGENICS PHARMACEUTICALS, INC	128
SANOFI	129
SEATTLE GENETICS	130
SIGMA-ALDRICH SAFC	131
SORRENTO THERAPEUTICS, INC	131
SPIROGEN LTD.	132
STELLAR BIOTECHNOLOGIES, INC. INC.	133

TOPIC	PAGE NO.
SUTRO BIOPHARMA, INC. INC.	134
SYNTHON	134
UCB	135
VENTANA MEDICAL SYSTEMS, INC. INC.	136
HOFFMAN-LA ROCHE, INC. INC.	136
VIVENTIA BIOTECHNOLOGIES, INC. INC.	136
ZHEJIANG MEDICINE CO. LTD.	137

LIST OF TABLES

TABLE HEADING	PAGE NO.
TABLE A FDA* APPROVAL PROCESS FOR NEW DRUGS	4
SUMMARY TABLE GLOBAL FORECAST FOR ADC DRUGS* THROUGH 2018 (\$ MILLIONS)	8
TABLE 1 KEY DATES IN ANTIBODY DEVELOPMENT	21
TABLE 2 CLASSES OF BIOPHARMACEUTICALS	23
TABLE 3 DOMINANT ADC TECHNOLOGY	24
TABLE 4 ADC CYTOTOXINS USED AND THEIR MODES OF ACTION	26
TABLE 5 NOVEL ADC-RELATED TECHNOLOGIES	38
TABLE 6 NOVEL ADC TECHNOLOGIES	41
TABLE 7 MANUFACTURERS IN THE ADC SPACE AND THEIR FOCUS	47
TABLE 8 LEADING PHARMACEUTICAL COMPANY IN TERMS OF SALES, 2012 (\$ BILLIONS)	51
TABLE 9 MAJOR ADC INVESTMENTS AND ALLIANCES	62
TABLE 10 ADC DRUGS IN THE DEVELOPMENT PIPELINE	72
TABLE 11 USEFUL RESOURCES FOR THE ADC DRUG INDUSTRY	78
TABLE 12 GENENTECH'S ADC PIPELINE	106

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE GLOBAL FORECAST FOR ADC DRUGS* 2011-2018 (\$ MILLIONS)	8
FIGURE 1 ADC ILLUSTRATED	14
FIGURE 2 REVENUES BY REGION IN THE PHARMACEUTICAL SECTOR, 2012	52
FIGURE 3 FORECAST FOR NUMBER OF U.S. FDA-APPROVED ADC DRUGS, 2011-2018 THROUGH 2018	55
FIGURE 4 ADC REVENUES BY REGION, 2013 AND 2018 (% OF TOTAL REVENUES)	56
FIGURE 5 REVENUES BY ADC TARGET ANTIGEN, 2013 AND 2018 (\$ MILLIONS)	57
FIGURE 6 REVENUES BY ADC SPECIFIC CYTOTOXIN, 2013 AND 2018 (\$ MILLIONS)	58
FIGURE 7 ADC BY THERAPEUTIC AREA, 2013 AND 2018 (% OF TOTAL COMMERCIALIZED ADCS)	59
FIGURE 8 ADC REVENUE BY THERAPEUTIC AREA, 2013 AND 2018 (\$ MILLIONS)	60
FIGURE 9 ANTIGEN TARGETS FOR ADCS IN LATE DEVELOPMENT (%)	76
FIGURE 10 THERAPEUTIC FOCUS FOR ADCS IN LATE STAGE DEVELOPMENT (%)	77