

Profile of Biomedical Research and Biotechnology Commercialization

Boston-Worcester-Lawrence Consolidated Metropolitan Statistical Area

Overview and History of Biotechnology in Boston

Along with San Francisco, Boston stands out as a pioneer in the biotechnology industry. The region has produced a number of research breakthroughs that have driven the biotech industry, including five discoveries that have earned Nobel prizes. Boston has a dense concentration of institutions—MIT, Harvard, Massachusetts General Hospital, Beth-Israel Deaconess Medical Center, and the New England Medical Center—all with world class research and teaching.

Two of the nation's first biotech firms, Biogen and Genzyme, were founded in Boston and continue to be pillars of the local biotech economy. Biogen was established in 1978 by researchers from Harvard and MIT who later won Nobel prizes for their work. Genzyme, located in Cambridge, was established in 1981 based on research carried out at Tufts University. There have been dozens of other biotechnology firms started in the area in the past two decades. Many continue to rely on local research; one study reports that 30 Massachusetts biotechnology companies were founded or co-founded by MIT graduates or faculty or have licensed MIT biotechnology patents. Boston is also a center for venture capital investment in biotechnology (as well as in other industries).

The Boston-Worcester-Lawrence Consolidated Metropolitan Statistical Area had a population of 5.8 million in 2000, making it the seventh-largest metropolitan area in the United States. During the 1990s population in the Boston area grew by nearly 7 percent.

Biomedical Research Activity in Boston

Boston has a considerable amount of biomedical research activity. The region has more than 4,900 life scientists. Boston has a well-endowed biomedical research infrastructure, including 13 biological institutions granting life science PhDs, three of which are ranked among the top 20 nationally in life sciences research. Total financial support flowing to the Boston area from the National Institutes of Health (NIH) is almost \$1.5 billion annually.

Table 1. Boston: Indicators of Biomedical Research

Biomedical Research Indicators	Year	Boston-Worcester-Lawrence, MA--NH--ME--CT CMSA
Life Scientists Employed	1998	4,980
Institutions Granting Life Science PhD Degrees	1999	13
Life Science PhDs Granted	1999	355
Universities Ranked among the Top 20 Nationally in Life Sciences Research	1982	3
Total NIH Financial Support	2000	\$1,422,875,474
NIH Funding for Medical Schools	1985	\$185,980
	1990	\$234,956
	1995	\$315,396
	2000	\$499,825
Biotechnology Patents	1975–79	126
	1980–89	592
	1990–99	3,007

Ten research institutions in the Boston area are among the top 100 institutions that receive NIH funding. Harvard University, Massachusetts General Hospital, Brigham and Women's Hospital, and Boston University received more than \$700 million in NIH research support in 2000. Harvard University is the seventh-ranking recipient of NIH support nationally.

Table 2: Boston: Principal NIH-Funded Research Institutions, 2000

Rank	Institution	Research Grants	Grant Amount (in millions)	Total NIH Support (in millions)
7	Harvard University	467	\$227.1	\$250.4
17	Massachusetts General Hospital	483	\$168.4	\$180.5
22	Brigham and Women's Hospital	414	\$152.6	\$162.5
38	Boston University	299	\$100.7	\$108.2
47	Dana-Farber Cancer Institute	187	\$83.3	\$87.2
53	Beth Israel Deaconess Medical Center	255	\$78.3	\$82.1
54	Whitehead Institute for Biomedical Research	35	\$80.6	\$81.3
60	University of Massachusetts Medical School	217	\$69.3	\$73.9
58	Massachusetts Institute of Technology	179	\$68.2	\$75.0
74	Children's Hospital	147	\$49.2	\$52.9

Source: National Institutes of Health

Local public institutions are the most prolific biotechnology patent holders in the Boston area. General Hospital Corporation, the third-oldest hospital in the United States, accounts for the majority of the biotechnology patents in Boston. Harvard College and Massachusetts Institute of Technology are public research institutions that are also active in patenting their biotechnology innovations. These institutions have accounted for a majority of the increase in biotechnology patenting in the region during the 1990s.

Table 3. Boston: Top Biotechnology-related-Patent Holders, by Decade, 1975–1999

Rank	Company Name	1970s	1980s	1990s
1	General Hospital Corporation		22	197
2	Individually Owned Patent	14	59	154
3	Harvard College	1	41	139
4	Genetics Institute, Inc.		19	136
5	Massachusetts Institute of Technology	15	98	118
6	Brigham and Women's Hospital		8	93
7	Dana-Farber Cancer Institute, Inc.		13	87
8	New England Biolabs, Inc.			76
9	Genzyme Corporation			58
10	Children's Medical Center Corporation		7	57
11	Boston University		17	55
12	Sepracor, Inc.		2	50
13	Diatide, Inc.			49
14	Biogen, Inc.		3	44
15	Millenium Pharmaceuticals, Inc.			42
16	Vertex Pharmaceuticals, Inc.			41
17	Beth Israel Hospital Association		6	39
18	Creative Biomolecules, Inc.			37
19	Amoco Corporation			35
20	Beth Israel Deaconess Medical Center, Inc.			29
21	Brown University Research Foundation			29

Source: U.S. Patent & Trademark Office, 2001

Biotechnology Commercialization in Boston

Boston is a region with a long biotechnology history. The area has attracted almost \$2 billion in venture capital investment in biopharmaceutical firms since 1995. Investments have been made in 211 new firms. The region has had three initial public offerings by biotech companies since 1998. The region has attracted more than \$3.9 billion in pharmaceutical-biotech research alliances since 1996—the highest amount of research alliance investment among the nine regions studied. Boston has 58 publicly traded biotech companies with an aggregate market capitalization of nearly \$52 billion. The industry includes 33 firms having more than 100 employees each. More than 100 firms are members of the national Biotechnology Industry Association.

Table 4. Boston: Indicators of Biotechnology Commercialization

Indicator	Boston-Worcester-Lawrence, MA--NH--ME--CT CMSA	
Venture Capital Investment, 1995–2001	Number	211
	Amount	\$1,915,654,300
	Share	20%
Venture Capital Firms among the 50 Most Active in Biopharmaceutical Investment	1995–2001	10
Number of Initial Public Offerings by Biotech Companies	1998–2001	3
Value (in millions) of Research Alliances between Pharmaceutical Companies and Local Biotechnology Companies	Prior to 1990	\$254
	1990–1995	\$882
	1996–2001	\$3,924
Number of Publicly Traded Biotechnology Companies	2001	58
Market Capitalization (in millions) of Local Biotechnology Companies, 2001	2001	\$52,756
Local Biotechnology Firms Established	through 1980	15
	1981–1990	57
	1991–2001	65
	Not Available	4
	All Firms	141
Local Biotechnology Firms with More than 100 Employees	2001	33
NAICS 3254: Pharmaceuticals	Establishments	67
	Employment	6,945
NAICS 5413: Life Sciences R&D	Establishments	284
	Employment	11,249
Number of Members of the Biotechnology Industry Organization (BIO)	2001	101

The Boston area's largest biotechnology firms are based in Cambridge—Genzyme General and Biogen, which is the world's oldest independent biotechnology company. Boston's private biotech firms with the most employees are Raytheon (105,300) and TJX (62,000), ranked number one and number two respectively, although none of the region's biotechnology firms ranks among the region's 20 largest private employers

Table 5. Boston: Principal Biotechnology Firms

Firm	City	Employment	Segment
Genzyme General	Cambridge	3,500	Therapeutics; Specialty Chemicals; Clinical Diagnostics; Gene Therapy; Vaccines; Testing/Analytical Services
Biogen Inc.	Cambridge	1,400	Therapeutics; Clinical Diagnostics; Reagents; Vaccines
Genetics Institute Inc.	Cambridge	1,200	Therapeutics; Medical Devices
IT Corporation	Norwood	1,200	Environmental Testing/Treatment
Charles River Laboratories Inc.	Wilmington	1,200	Specialty Chemicals; Animal Agriculture; Immunological Products
ThermoRete Corporation	Concord	1,000	Environmental Treatment/Testing
Millennium Pharmaceuticals Inc.	Cambridge	952	Therapeutics; Clinical Diagnostics
Genzyme Transgenics Corporation	Framingham	683	Therapeutics; Clinical Diagnostics; Vaccines; Animal Agriculture
Primedica Corporation	Worcester	550	Therapeutics
Genzyme Genetics	Framingham	550	Clinical Diagnostics; Animal Agriculture; Toxicology; Therapeutics

Source: Institute for Biotechnology Information, 2001

Table 6. Boston: Venture Capital Investment in Biopharmaceutical Firms, 1995–2001

Year	Venture Capital
1995	\$230,300,000
1996	\$209,415,000
1997	\$254,879,300
1998	\$293,665,000
1999	\$168,255,000
2000	\$601,540,000
2001*	\$157,600,000

Source: PriceWaterhouseCoopers, 2001 (* Six Months)