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*Buffalo Branch, Federal Reserve Bank of New York
160 Delaware Avenue
Buffalo, NY 14202
Tel: (716)849-5023
Fax: (716) 849-5218
www.newyorkfed.org/buffalo*

*Barbara Walter
Senior Vice President and
Branch Manager*

*Reggie Melson
Community Affairs
Representative
reggie.melson@ny.frb.org*

*Richard Deitz, Ph.D.
Regional Economist
richard.deitz@ny.frb.org*

*Ramon Garcia
Assistant Economist
ramon.garcia@ny.frb.org*



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THE REGIONAL ECONOMY

OF UPSTATE NEW YORK

Vitality in Upstate Medical Manufacturing

In 2006, Baby Boomers will begin entering their sixties. This change in the population will dramatically boost the demand for medical products and services—a health care trend that had already been rising steadily since World War II.¹ Along with this increasing demand have come a host of medical and biological breakthroughs that have spawned the development of a broad range of diagnostic and therapeutic treatments.

These factors have helped fuel a robust expansion of the medical manufacturing industry. Medical manufacturing, which includes the production of medical devices and pharmaceuticals, is currently one of the few U.S. manufacturing industries adding workers. Although the pharmaceutical industry and, to a lesser extent, the medical device industry have experienced consolidation in recent years, the demand for their products has continued to expand. And while the nascent biotechnology industry is not yet a major employer, many view it as the future of pharmaceuticals, destined to create jobs as well as lead to extraordinary cures and treatments. The overall economic impact of medical manufacturing is limited by the industry's small size, but its relative returns are enhanced because it pays good wages and employs an above average proportion of high-skilled workers.

The promise of medical manufacturing has not gone unnoticed by those concerned about the vitality of their local economies, and many communities are looking to become the next medical manufacturing hub. In this issue of *The Regional Economy of Upstate New York*, we describe the medical manufacturing industry generally and examine the industry's presence in upstate New York and its metropolitan areas.² We show that upstate has a considerable employment concentration in the manufacture of both medical devices and pharmaceuticals. This activity is distributed widely among the region's metropolitan areas, with Buffalo, Glens Falls, Rochester, Syracuse, and Utica specializing in the

industry overall and Albany showing strength in two subindustries.

What is Medical Manufacturing?

The medical manufacturing industry includes firms that research, develop, and manufacture products for the prevention, diagnosis, treatment, and cure of disease. It is divided into two broad categories: medical devices and pharmaceuticals. The medical device sector includes businesses that produce a vast array of instruments, supplies, machines, and other medical equipment intended for diagnostic and therapeutic purposes. Medical device firms range from producers of commodities such as disposable hospital supplies to high-tech manufacturers of medical implants and imaging machines.

The pharmaceutical sector comprises companies involved in the production of drugs and related products such as vitamins, herbs, blood derivatives, and antiseptics. Included in this sector are firms engaged in biological and medical research (also known as life sciences research). Many such firms focus on biotechnology: the application of biological knowledge and techniques to the development of products and services. Biotechnology has applications in a wide range of industries (such as agriculture, food processing, and chemical engineering), yet it is used most in health and medicine. Most biotechnology firms are involved primarily in research and development and do not manufacture drugs themselves; they typically sell or license their technology to pharmaceutical firms capable of large-scale production and distribution. Although not technically manufacturers, research biotechnology companies and other types of biomedical research firms are an integral part of drug development, and so are considered in our study to be a component of the medical manufacturing industry.

Despite being distinct industries with few direct linkages, medical devices and pharmaceuticals have a great deal in common. They often serve the same markets and have similar concerns about Food and

Table 1
**Selected Economic Characteristics of the United States
 Medical Manufacturing Industry, 1997**

Category	Job Growth, 1987-96 (Percent)	Average Annual Wage (Dollars)	Value Added per Production Worker Hour (Dollars)	Nonproduction Workers as Percentage of Workforce
Medical equipment & supplies	31.4	34,331	88	36
Pharmaceuticals	24.0	49,729	313	50
All manufacturing	-1.5	33,907	75	28

Source: U.S. Bureau of the Census, *Census of Manufactures*.

Drug Administration regulation, health care industry trends, and product quality control. Moreover, both industries are technology-intensive, sharing a dependence on research, innovation, venture capital, and scientific talent.

**Economic Characteristics of the United States
 Medical Manufacturing Industry**

Overall, medical manufacturing is a fast-growing, moderate-to high-wage industry with a workforce boasting a large proportion of skilled occupations. Needless to say, industries with such attributes are especially important to regional economies. Table 1 compares these characteristics for the two largest medical manufacturing subindustries—medical equipment & supplies and pharmaceuticals—with those for all manufacturing at the national level.³ Employment in both industries grew significantly between 1987 and 1996, while manufacturing declined 1.5 percent overall. With an average annual wage of almost \$50,000, the pharmaceutical industry is one of the highest-paying industries in the manufacturing sector. Pharmaceuticals is able to pay workers well because it is a high-value-added industry, that is to say, an hour of production worker labor adds \$313 of value, four times the manufacturing average and well above the average for most other industries. By comparison, medical device manufacturing is a moderate-wage, moderate-value-added industry. The table also reveals that the medical manufacturing industry, particularly pharmaceuticals, has a relatively high percentage of nonproduction workers. Many of these employees occupy managerial, professional, technical, and marketing positions that require specialized skills and advanced education and training.

Nevertheless, while medical manufacturing provides a high proportion of quality jobs, the industry’s overall effect on the U.S. economy is limited by its relatively small size. In 2000, for example, the industry employed only about 750,000 nationwide, approximately 0.7 percent of all private-sector jobs. Moreover, medical equipment & supplies and pharmaceuticals each accounted for less than 2 percent of U.S. manufacturing employment.⁴

The Location of Medical Manufacturing Firms

Like many industries, medical manufacturing is typically clustered in certain regions. However, pharmaceuticals tend to be more highly concentrated than medical devices. The geographic characteristics of these industries are evident from Table 2, which presents the top states for medical equipment & supply and pharmaceutical manufacturing ranked by employment. Also depicted is each industry’s employment concentration and growth rate from 1988 to 1997. Employment concentration is measured using a common gauge known as a location quotient. A location quotient of 1.0 means that a region’s concentration of employment in an industry is identical to that of the nation. Location quotients above 1.2 suggest specialization in a particular industry.⁵ Because we are examining upstate New York, we separate the region from downstate and treat each as a separate “state.”

The pharmaceutical industry tends to be highly concentrated in only a few parts of the country. Its historic hub encompasses a region that stretches from Connecticut, through downstate New York and northern New Jersey, to Philadelphia. Of the world’s fifty largest pharmaceutical firms, nineteen have either their world or their U.S. headquarters in New York or New Jersey.⁶ This strength in drug manufacturing is apparent from Table 2, which indicates that the region’s respective states have substantial employment as well as high location quotients. Other, smaller centers of pharmaceutical production can be found in southern California, the Chicago area, and North Carolina.

By comparison, medical equipment & supply manufacturing is more evenly dispersed throughout the United States. Some regions of strength exist, such as southern California, Minnesota’s “Medical Alley,” and upstate New York, but these areas do not exhibit the magnitude and concentration of employment found in centers of pharmaceutical production.

The geographic differences between these industries may be due in part to two factors. First, a higher proportion of medical equipment & supply firms rely on local markets (such as hospitals and doctor’s offices) than do pharmaceutical firms. As a result, most states have at least a moderate level of medical equipment & supply manufacturing. Second, while both industries depend on innovation and technology, this is especially true for pharmaceuticals. Evidence suggests that technology-intensive industries are more likely to cluster because their firms often locate in regions with the specialized knowledge and workforce skills they require.⁷ This pattern has been quite obvious in the development of the U.S. biotechnology industry: much of the industry’s activity is centered in only nine metropolitan areas.⁸

Bucking the Trend in Northeast Manufacturing

Overall, manufacturing has been migrating from the Northeast to the South and West. Evidence suggests that this trend reflects both the population shift to a warmer climate and the Northeast’s labor market disadvantages.⁹ Despite this pattern, medical manufacturing has tended to remain—and even grow—in the Northeast. While total manufacturing employment there declined 21 percent over the 1988-97 period,

Table 2

Top-Ranked States for Medical Manufacturing Employment

Medical Equipment & Supplies and Pharmaceuticals, 2000

Medical Equipment & Supplies					Pharmaceuticals				
Rank	State	Employees	LQ ¹	Employment Growth (Percent), 1988-97 ²	Rank	State	Employees	LQ ¹	Employment Growth (Percent), 1988-97 ²
1	California	56,593	1.6	18	1	New Jersey	30,552	4.3	13
2	Florida	19,909	1.2	74	2	California	30,324	1.2	25
3	Pennsylvania	17,545	1.3	10	3	Illinois	21,239	1.9	44
4	Texas	16,958	0.8	50	4	North Carolina	13,952	2.1	25
5	Minnesota	15,098	2.4	137	5	Downstate New York	13,691	1.3	10
6	Massachusetts	12,722	1.5	38	6	Pennsylvania	12,622	1.2	-30
7	Indiana	12,701	1.8	83	7	Indiana	11,006	2.1	-49
8	Upstate New York³	12,483	2.0	4	8	Connecticut	10,297	3.3	74
9	New Jersey	12,478	1.3	0	9	Michigan	8,867	1.1	8
10	Ohio	11,227	0.8	28	10	Texas	7,312	0.5	28
21	Downstate New York⁴	5,175	1.3	-30	11	Upstate New York	6,530	1.4	16
-	United States	304,555	1.0	27	-	United States	227,461	1.0	22

Sources: U.S. Bureau of the Census, *County Business Patterns*; authors' calculations.

Notes: In some cases, employment was estimated from ranges of values.

¹ Location quotients (LQs) are a common measure of industry employment concentration. A quotient of 1.0 means that a region's concentration of employment in an industry is identical to that of the nation. LQs above 1.2 suggest specialization in a particular industry.

² Standard Industrial Classification definitions were used to allow for the tracking of industries over time. The subindustries included as part of medical equipment & supplies changed in 1997 under the new North American Industry Classification System.

³ Upstate New York refers to a fifty-county region of New York State that is distinct from downstate.

⁴ Downstate New York refers to the New York State portion of the New York/Northern New Jersey/Long Island consolidated metropolitan statistical area, which includes the following New York State counties: Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, and Westchester.

pharmaceutical jobs grew 21 percent and medical equipment & supply employment rose 9 percent.¹⁰ Medical manufacturing tended to grow faster in the South and West, but the Northeast still maintained its relative strength in the industry. The growth of medical manufacturing in the face of a general manufacturing decline suggests some unique characteristics of this industry: for instance, the Northeast may have competitive advantages in medical manufacturing that are absent, say, from metals-related manufacturing.

Upstate New York Shows Strength

Upstate New York holds a strong position in U.S. medical manufacturing. If the region were a separate state, it would rank eighth nationally in medical equipment & supply employment and eleventh in pharmaceutical jobs (Table 2). Even more notable are upstate's comparatively high location quotients, which suggest that both industries are fields of specialization there. With a location quotient of 2.0 and employment approaching 12,500, medical equipment & supply manufacturing is a particularly solid industry in the region.

Moreover, as is the case with the Northeast generally, medical manufacturing in Upstate New York is bucking the overall trend in manufacturing employment. Between 1988 and 1997, upstate's total manufacturing employment declined 15 percent, while jobs in medical equipment & supplies increased 4 percent and those in pharmaceuticals rose 16 percent. These growth rates lagged the national rate, but they are significant in light of the general downward trend in upstate manufacturing.

Compared with the nation, upstate New York has a larger share of low-end medical manufacturing. Value added per production worker hour for both pharmaceuticals and medical equipment & supplies is about two-thirds the U.S. average (Table 3). As we have observed, the value added by medical device firms can vary widely, likewise for pharmaceutical firms. (For example, a good portion of Buffalo's pharmaceutical production includes skin care products, which are much less profitable than the latest biotech drug.) Nevertheless, while medical manufacturing in upstate New York tends to add less value, the average wages for both subindustries are similar to the national average, with medical equipment & supply wages almost identical and pharmaceutical wages about 5 percent lower (Table 3).

Several factors may help explain why upstate New York specializes in medical manufacturing. The region most likely benefits from its proximity to the New York/Northern New Jersey/Philadelphia hub of the pharmaceutical industry. Upstate is also home to several medical schools and an array of general medical and specialty hospitals, which act as test sites and markets for medical products. In addition, evidence suggests that medical manufacturing is more likely to flourish in regions strong in biological and medical research.¹¹ New York State can be considered a leader in that regard: a number of biomedical research institutions are located there, and in 2000, New York was ranked third nationally in institutional research grants from the National Institutes of Health.¹²

Table 3

Value Added and Average Annual Wage
 Medical Equipment & Supplies and Pharmaceuticals,
 Upstate New York and the United States, 1997

Category	Value Added per Production Worker Hour (Dollars)	Average Annual Wage (Dollars)
Medical equipment & supplies		
Upstate New York	60	34,461
United States	88	34,331
Pharmaceuticals		
Upstate New York	190	47,026
United States	313	49,729

Sources: U.S. Bureau of the Census, *Census of Manufacturers*; authors' calculations.

Medical Manufacturing Employment in Upstate and Its Metro Areas

We now look more closely at medical manufacturing employment in upstate New York and its metropolitan areas.¹³ We begin by constructing a more complete definition of the industry, one that includes all subindustries involved predominately in the research, development, or production of medical products (Table 4). Next, employment concentration in 2000 is measured in each subindustry for upstate New York and six of the region's metro areas. (Three areas—Binghamton, Elmira, and Jamestown—had very little medical manufacturing employment, so we did not include them in our study.)

To identify medical manufacturing firms, we use the U.S. government's recently introduced North American Industry Classification System (NAICS), which offers a more detailed classification of this rapidly changing industry than

Table 4

The Medical Manufacturing Industry, by NAICS Subindustry

Medical Devices

- Optical instruments & lenses
- Electromedical equipment
 - Electromedical & electrotherapeutic apparatus
 - Analytical laboratory instruments
 - Irradiation apparatus
- Medical equipment & supplies
 - Laboratory apparatus & furniture
 - Surgical & medical instruments
 - Surgical appliances & supplies
 - Dental equipment & supplies
 - Ophthalmic goods
 - Dental laboratories

Pharmaceuticals

- Pharmaceuticals & medicines
 - Medicinals & botanicals
 - Pharmaceutical preparations
 - In vitro diagnostic substances
 - Biological products (except diagnostic)
- Life sciences research & development

Source: Construction by authors using North American Industry Classification System (NAICS) industries.

its predecessor, the Standard Industrial Classification (SIC) system. We should note that, despite its advantages, NAICS is an imperfect measure of medical manufacturing activity. For example, many firms classified as other industries (such as plastics, industrial machinery, or fabricated metals) also produce for medical markets. Accordingly, our study does not capture such activity. Moreover, biotechnology firms are particularly difficult to identify since they may be listed under different NAICS codes; typically, they are classified as either pharmaceuticals & medicines or life sciences research & development.

Upstate New York

As measured by location quotient—and thus, industry specialization—upstate New York has a high concentration of medical manufacturing employment (Table 5). Moreover, medical manufacturing there is diverse, with specialization evident in each subindustry. According to our study, upstate's medical manufacturing sector employed 26,118 in 2000, or 3.5 percent of the industry nationwide. The pure manufacturing component of the industry (excluding life sciences research) accounted for 23,068 jobs, or about 6 percent of upstate's total manufacturing workforce. Of the five subindustries, optical instruments & lenses and medical equipment & supplies show particular strength upstate. Medical equipment & supplies was by far the largest medical manufacturing subindustry in the region, employing almost 12,500 in 2000.

Upstate Metro Areas

Five of the upstate metropolitan areas—Buffalo, Glens Falls, Rochester, Syracuse, and Utica—showed an above average concentration of medical manufacturing employment overall, while Albany demonstrated an average concentration. Moreover, each metro area specialized in at least two subindustries. As is often the case with technology-intensive industries, these sub-industry specializations tended to vary among upstate's metropolitan areas.

Rochester had the highest level of medical manufacturing employment overall and was especially strong in optical instruments & lenses and medical equipment & supplies. A good portion of Rochester's medical equipment & supply employment is in ophthalmic goods, as Bausch & Lomb, the manufacturer of eye care products, is headquartered and maintains production facilities in the area. Rochester's medical manufacturing specializations are perhaps not surprising; as the birthplace of Kodak and Xerox, it has a long history of developing optics and imaging technology. Medical manufacturing has most likely benefited from this local knowledge.

Buffalo showed particular strength in optical instruments & lenses and life sciences research. The metro is home to two major biomedical research institutions, Roswell Park Cancer Institute and the Woodward Hauptman Medical Research Institute. Pharmaceuticals and medical equipment & supplies were also specializations for Buffalo, which has more than fifty small-to-medium-sized medical equipment & supply manufacturers.

Table 5

Medical Manufacturing Industry Employment Location Quotients¹
Upstate New York and Its Top Metropolitan Areas, 2000

Location	Medical Devices				Pharmaceuticals			Medical Manufacturing	
	Optical Instruments & Lenses	Electro-medical Equipment	Medical Equipment & Supplies	Medical Devices Total	Pharmaceuticals & Medicines	Life Sciences Research ²	Pharmaceuticals Total	Medical Manufacturing Total	Employment
Rochester	4.1	1.0	3.1	2.6	1.6	0.2	1.2	2.0	6,164
Buffalo	4.4	0.9	1.4	1.5	1.4	2.2	1.7	1.6	4,732
Syracuse	0.1	1.8	2.5	2.2	1.8	0.3	1.4	1.9	3,570
Glens Falls	0.0	20.5	23.0	21.3	0.0	0.0	0.0	12.1	3,337
Albany	1.3	0.7	0.3	0.4	0.3	3.9	1.6	0.9	2,074
Utica	10.7	8.5	1.5	3.6	0.0	0.3	0.1	2.1	1,358
Upstate	2.6	1.5	2.0	1.9	1.4	1.4	1.5	1.7	26,118

Sources: U.S. Bureau of the Census, *County Business Patterns* (2000); *Census of Professional, Scientific, and Technical Services* (1997); authors' calculations.

Note: In some cases, employment was estimated from ranges of values.

¹Location quotients are a common measure of industry employment concentration. A quotient of 1.0 means that a region's concentration of employment in an industry is identical to that of the nation. Quotients above 1.2 (in bold) suggest specialization in a particular industry.

²Life sciences research employment values are from the 1997 *Economic Census*—the only government data source that separates the industry from physical and engineering research.

Syracuse also specialized in pharmaceuticals and medical equipment & supplies. Bristol-Myers Squibb, a multinational drug firm headquartered in New York City, has a sizable manufacturing plant there. Welch Allyn, a producer of medical instruments, has a large Syracuse operation as well.

Glens Falls had the highest medical manufacturing location quotients. Despite its small size, the metro has developed a relatively substantial medical device industry. A number of medium-sized medical device manufacturers have located there, including Boston Scientific/NAMIC, C. R. Bard, and Kendall Sheridan.

Utica showed a high employment concentration in optical instruments & lenses and electromedical equipment. Conmed Corporation, a producer of medical devices for surgery and critical care, accounted for over half of Utica's medical manufacturing employment.

Albany had an average concentration of medical manufacturing employment overall, but showed specializations in optical instruments & lenses and life sciences research. A large portion of the metro's life sciences employment is attributable to Albany Molecular Research, Inc., a biotechnology company that provides contract research services.

Conclusion

Medical manufacturing is a technology-intensive, well-paying industry with promising long-term prospects. Upstate New York plays a significant and diverse role in the industry, with specializations in the manufacture of both medical devices and pharmaceuticals. The region has demonstrated a particularly strong position in medical devices and is among the top U.S. locations for this industry.

Although the overall economic return of medical manufacturing is limited by its small size relative to the economy as a whole, the industry is growing in upstate New York. And while this growth has lagged that of the nation, the performance is encouraging in view of the general decline in the region's manufacturing sector. Significantly, medical manufacturing activity is widely dispersed upstate, with five metro areas—Buffalo, Glens Falls, Rochester, Syracuse, and Utica—exhibiting overall strength in the industry. Each of these areas, along with Albany, also specialized in at least two medical manufacturing subindustries.

Upstate New York has been struggling to adjust to the post-industrial economy. For the most part, the region has lagged in the development of the high-growth, technology-intensive industries that are creating good jobs and helping to transform local economies. However, this study suggests that medical manufacturing is a bright spot in the upstate New York economy.

Notes:

¹ From 1969 to 1999 alone, the amount spent on health care rose fourfold, to \$1.2 trillion, or more than 13 percent of GDP—up from just 6 percent of GDP three decades earlier (Health Care Financing Administration, National Health Expenditures 1969, 1999; U.S. Department of Commerce, Bureau of Economic Analysis, National Accounts 1969, 1999).

² Upstate New York refers to a fifty-county region of New York State that is distinct from downstate. Downstate is the New York State portion of the New York/Northern New Jersey/Long Island consolidated metropolitan statistical area, which includes the New York State counties of Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, and Westchester.

³ Medical equipment & supply manufacturing represents about 68 percent of the medical device industry. The pure manufacturing component of pharmaceuticals (not including life sciences research & development) represents about 70 percent of the pharmaceutical industry.

⁴ U.S. Bureau of the Census, *County Business Patterns* (2000).

⁵ Location quotients are calculated by dividing the percentage of a region's employment in an industry by the percentage of total U.S. employment in that

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industry. For example, if the manufacturing sector provided 30 percent of all jobs in a region, and the U.S. average was 15 percent of all jobs, the location quotient would be 2.0 (30/15).

⁶ Gardner (2001, p. 9).

⁷ See DeVol (1999) for a general discussion of factors affecting the location of high-tech firms.

⁸ See Cortright and Mayer (2002), who find that the biotechnology industry is largely concentrated within nine of the nation's metropolitan areas: Boston-Worcester-Lawrence, Los Angeles-Riverside-Orange County, New York-No. New Jersey-Long Island, Philadelphia-Wilmington-Atlantic City, Raleigh-Durham-Chapel Hill, San Diego, San Francisco-Oakland-San Jose, Seattle-Tacoma-Bremerton, and Washington-Baltimore. These areas were responsible for three-quarters of the nation's largest biotechnology firms and three-quarters of those formed in the past decade.

⁹ See Crandall (1993) for a discussion of the regional migration of manufacturing.

¹⁰ U.S. Bureau of the Census, *County Business Patterns* (1988, 1997).

¹¹ See Walcott (2002).

¹² National Institutes of Health (2002).

¹³ A metropolitan area consists of a population nucleus of at least 50,000 and its associated county, together with adjacent counties that have a high degree of economic and social integration with that nucleus.

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Richard Deitz and Ramon Garcia

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Federal Reserve Bank of New York
PO Box 961
Buffalo, NY 14240-0961

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