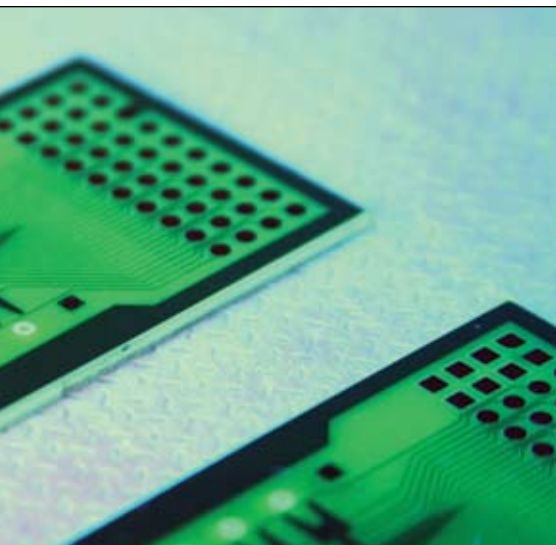


BIOTECHNOLOGY WORKS IN NORTH CAROLINA

North Carolina's Strategic Plan for Advanced Medical Technologies



October 2007

**The North Carolina Biotechnology Center
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The North Carolina Biosciences Organization (NCBIO)**

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I. Introduction

Biotechnology and the Life Science Sector

Twenty years ago leaders in North Carolina saw the potential of the then-emerging biotechnology sector. Based on this vision, the State established a new North Carolina Biotechnology Center to strategically coordinate its base assets and investments in the new technology. The strategy paid off. Today North Carolina proudly claims its position as the third leading state in the competitive national environment of biotechnology.

Biotechnology, however, is now on the radar screen of economic development programs in many more cities, states and countries. Competition is increasing rapidly, and North Carolina is again thinking proactively about how to maintain its lead.

As part of its ongoing evaluation of strategic alternatives in biotechnology, the North Carolina Biotechnology Center has been studying emerging biotechnology trends and opportunities. In particular, the Center has focused on the reality that biotechnology is a technology that supports many different markets. One of the most important of these is the market for health care products and services.

The World of Advanced Medical Technologies

Perhaps the most important market dynamic impacting health care today is the rapid growth in the number of older adults in the United States and around the world. Both business and academic communities are responding to this reality with unparalleled focus on development and commercialization of diagnostic, treatment, monitoring and rehabilitation technologies that will allow older adults to continue to enjoy a meaningful quality of life.

With so many emerging technologies now coming together in support of medical solutions, biotechnology is being viewed as only one component of a much broader base of advanced medical technologies that will change medical care and life expectancies. Conversely, because of its strong base in biotechnology, North Carolina has a major opportunity to be a world leader in this new, exciting era of advanced medical technologies.

The keystone of this opportunity lies in the future merging of biotechnology with other health-related disciplines. Already, the North Carolina Biotechnology Center has received, and continues to receive, inquiries from companies that are not strictly biotechnology companies. Many of these companies are instead developing what are often called “convergent medical technologies” that are based on two or more existing technology platforms.

Indeed, in the last five years, there has emerged in North Carolina a variety of exciting medical technology companies, as well as growing advanced medical technology communities in various parts of the state, where companies and researchers are working to harness the potential of convergent medical technologies. Key supporting technologies in these efforts include not only biotechnology, but also medical diagnostics, therapeutic and surgical devices, informatics, wireless monitoring devices, nanotechnologies and microfluidics, tissue regeneration, and specialized materials and coatings. Figure 1 depicts the world of convergent medical technologies.

North Carolina’s existing medical technology companies and communities demonstrate the state’s strong potential

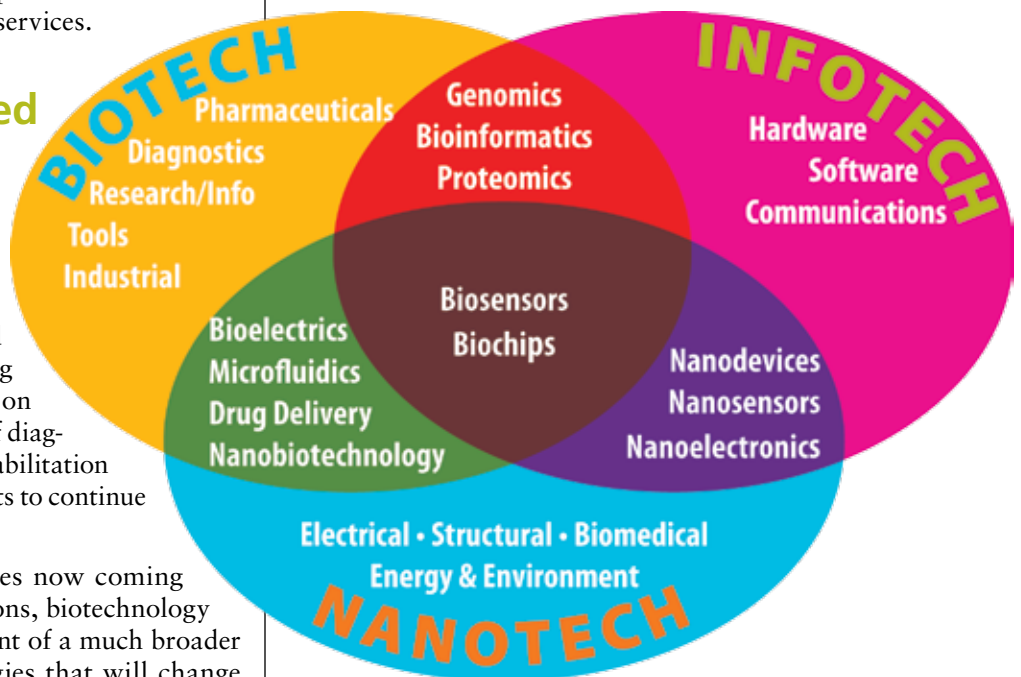


Figure 1. Convergent Medical Technologies [Adapted from: *Biology, Bioconvergence, Information and Enterprise: Taking the Broad View*, May 20, 2004, Alan Barrel]

as a hub for convergent medical technology research, development and commercialization. Moreover, these endeavors are likely to be only the harbingers of future technology-driven economic growth. Future advances in these medical technologies will likely arise from still nascent cross-fertilizations among scientists, engineers and clinicians in

disciplines including biology, materials science, chemistry, optics, physics, medicine, informatics and robotics. With successful collaboration across these various disciplines, new advanced medical technologies will revolutionize the world of health care and lifestyle.

Study Structure and Support

This study was undertaken by the North Carolina Biotechnology Center for the purpose of analyzing North Carolina's existing medical device and convergent medical technology assets and their economic potential.

The study was launched in October 2006. Teri Loudon, President of The Loudon Network and a long-time medical technology marketing executive and strategy consultant, was engaged to conduct the study. A 19-member advisory board was appointed to participate in the study and to review and comment on its findings. The North Carolina Biosciences Organization (NCBIO), and the North Carolina Medical Device organization (NCMD) [a project of NCBIO], agreed to collaborate with the Biotechnology Center in the design and conduct of the study. Sam Taylor,

President of NCBIO, was designated to serve as the group's lead contact for the study. Project direction and oversight were provided by Dr. Ken Tindall of the Biotechnology Center.

A major component of the study was to conduct personal interviews with medical device and combination products executives, related vendors, researchers, engineers and scientists, and investors across the state. Regional offices of the Biotechnology Center provided assistance in identifying appropriate contacts and setting up meetings. In addition, market intelligence was gained through attendance at major national medical device and technology conferences and through phone interviews with industry executives outside of North Carolina. Further information was garnered from materials of other states and cities that

target the medical device sector for economic development. In total, over 170 interviews were conducted throughout the course of the study.

In addition, statistical information and news reports concerning the medical device and combination products industries were gathered and compiled by the Biotechnology Center's library staff. This information was used to develop benchmark data on employment and business establishments.

This report is designed to highlight the key trends identified from the research and to recommend strategic initiatives that can be expected to advance the growth and economic-development potential of North Carolina's advanced medical technology assets.

II. The Advanced Medical Technologies Market and Key Trends

Defining the Advanced Medical Technologies Market

Historically, the advanced medical technologies market has been defined and segmented based on guidelines and regulations established by the U.S. Food and Drug Administration (FDA). Generally, FDA's regulatory paradigm identifies the following three categories of medical products that are subject to FDA regulation.

- Pharmaceutical/Drug
 - Manufactured by a chemical process
 - Regulated by Center for Drug Evaluation and Research (CDER)
- Bio-pharmaceutical/Biologic
 - Manufactured by a biological process (biotechnology)
 - Regulated by Center for Biologics Evaluation and Research (CBER)
- Medical Device
 - Neither chemical nor biological; e.g., mechanical, electrical, information technology, etc.
 - Regulated by Center for Devices and Radiological Health (CDRH)
 - Segmented into three classes: I, II, and III (with III being the most invasive and technically complex)

In recent years, however, the lines separating these three areas of medical products have begun to blur because medical technologies increasingly consist of a combination of technologies. The trend is expected to continue, and in fact, has been acknowledged by the FDA through the establishment of a new category of products known as Combination Medical Products, or Convergent Medical Products. The FDA defines these products as comprising two or more of the three FDA-regulated components: drug, biologic, device. In response to the growth of this category and its special characteristics, the FDA created an Office of Combination Products.

Examples of combination products include products with components or elements that are:

- Physically/chemically combined
 - Drug-eluting stent (drug/device)

- Orthopedic implant with growth factors (device/biologic)
- Co-packaged or kit
 - Pre-filled syringe
 - Metered-dose inhalers
- Cross-labeled
 - PET imaging (diagnostic with a radiopharmaceutical)
 - Hyperthermia device with chemotherapeutic drug

Combination medical products are gaining market share in the United States as well as internationally. Further, it is expected that much of the advanced medical products sector's future growth will be based on convergence of existing technologies.

The most critical convergences are expected to cluster around biotechnology, biomedical engineering, information technology, materials and coatings, and nanotechnology. The significance of this potential is reflected in the increasing number of medical conferences that focus on combining multiple technologies. A representative sampling of these conferences includes:

BioDevice Partnering (June 2007), hosted in part by Eucomed, the European trade association for medical device manufacturers and distributors

BioMedDevice (October 2007), hosted in part by BayBio, Northern California's regional life science industry association

PharmaMedDevice (April 2007), hosted in part by the Medical Device Manufacturers Association, the trade association for the American medical device industry

Convergent Medical Technologies (CMT) (November 2005), hosted in part by MEDEC, the Canadian medical device industry's trade association

Synergies with Consumer-Driven Health Care Technologies

Rapid convergence of medical technologies is also occurring in the unregulated market for consumer health products. This trend is particularly important for companies serving the large and growing aging population of baby boomers

and their parents. Consumer needs targeted in this market include cosmetic improvements, as well as aids to diet, health information, and lifestyle.

Products already under development in the consumer health care sector include Web-based information and data capture; wireless health monitoring; home diagnostics and monitoring; specialized physical fitness products; wellness and prevention tools; consumer Web-based health education and medical compliance tools; cosmetic-focused technologies; and an emerging category of “medical foods.” Demand for these products is strengthened by the significant discretionary income and spending propensity of targeted consumer sectors. Finally, increasing emphasis on disease management by employers and health care payers is expected to contribute to rapid expansion of markets for these products.

Relation to Informatics/Electronic Medical Records

In addition to consumer demand for innovative health care products, health care providers in the United States are—after an early period of painfully slow adoption—moving more rapidly to implement information technology solutions in the provision of health services. Use of personal data assistance technologies for prescription delivery (reducing errors in the delivery and administration of drugs), and growing acceptance of electronic medical records (improving communication of patient information between physicians and other health care providers) are examples of this trend. Information technology is also playing a growing role in clinical trials for both drugs and medical devices.

Government policies encouraging use and standardization of health care information technologies will continue to support and accelerate the use of information technology in the American health care system. With its strong base of information technology firms and infrastructure, North Carolina is well positioned to take advantage of the growing role of information technology in health care.

Attention from Investors and Existing Health Care Businesses

The convergence of medical technologies and growing consumer demand for health care products and services, especially those offering early diagnosis and alternative treatment modalities, are reshaping the world health products marketplace. Investors and existing health products companies are rapidly responding to these market forces.

Venture capital investors, in particular, are attracted by the relatively short company start-up and product-commercialization time frames for medical devices. For example, investments in medical device companies were up 20 per-

cent to \$2.63 billion in 2006—a record year in the number of deals and amounts invested. Between 2004 and 2006, more than 44 medical device companies made initial public offerings (IPOs) of stock, and most had high post-IPO performance. Additionally, another 92 venture-backed device companies were acquired by existing health care products companies.

Market opportunities for advanced medical technologies are expected to continue to grow well into the future. Areas of particular potential include technologies with applications in orthopedics, cardiology, obesity, diabetes and cosmetic procedures. In addition, wireless monitoring and technologies supporting non-invasive or less-invasive procedures will experience strong demand.

Strategic Challenges for Advanced Medical Technologies Companies

While these new emerging combination products offer exciting prospects, there are also near- and long-term challenges for companies in the advanced medical technologies sector.

One crucial challenge will be the development of efficient mechanisms for bridging professional barriers and facilitating interdisciplinary exchanges of knowledge. In particular, development of convergent medical technologies will require participation by physicians and other clinicians; engineers; biologists; material scientists; experts in nanotechnology, optical sciences, and information technology; and professionals in genomics, data mining, statistics and biotechnology. Interaction of these disciplines will be required not only in the research and development phases of product development, but in the structuring of new manufacturing techniques and processes as well.

A second key challenge, especially for convergent technologies, will be the development and mastery of new regulatory regimes. As already indicated, the FDA has established a new office for regulating combination products, but the contours of the new paradigm are far from settled. In addition, recent safety problems with both drugs and devices have caused regulators to redouble regulatory scrutiny of new and existing products. Most recently, the FDA introduced stricter post-market surveillance guidelines that will need to be understood and adhered to by advanced medical technology companies. These regulations will increase company launch and operating costs.

Finally, advanced medical technology companies will have to grapple with reimbursement issues similar to, but in some cases more complex than, those already applicable to existing health care technologies. Rising health care costs, particularly in publicly supported programs such as Medicare and Medicaid, have forced payers to adopt ever more rigorous

protocols for validating the efficacy and cost advantages of new products. These trends will continue, placing ever more stringent requirements for entry into key publicly supported health care product markets.

Thus, in many ways the future world of advanced medical technologies and convergence looks much like the world faced by biotechnology years ago, when North Carolina saw the potential and the need for supporting that new technology. Just as in the 1980s, states that aid new companies in the navigation of uncharted waters can expect to achieve substantial economic benefits as emerging medical technologies create new jobs and economic opportunity.

Global Markets and Related Challenges

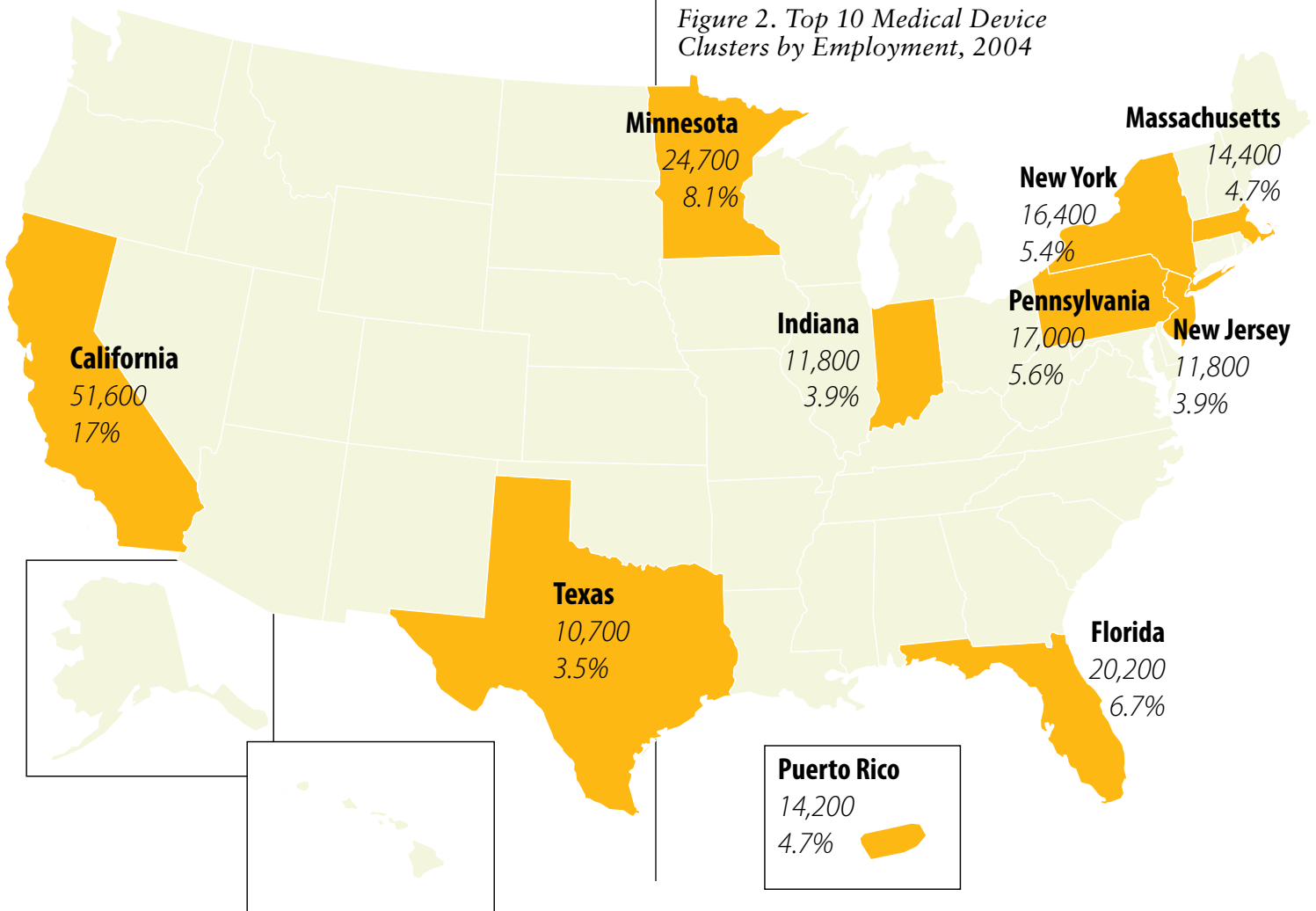
In addition to technical and regulatory barriers, global market forces, as with most all industries, are expected to dramatically impact the advanced medical technologies sector. These impacts will be particularly important to start-up companies in the United States, forcing executives

of these firms to think, act and network globally. Global market considerations will include:

- Continued off-shoring of manufacturing, especially for less technical Class I and II medical devices
- International clinical trials and initial product launches that take advantage of less restrictive regulatory and reimbursement regimes outside the United States
- Competition in the development of advanced medical technologies from countries such as India, Singapore and China, which provide substantial government incentives as well as lower labor and other operating costs
- The opening of enormous new medical technology markets in new world economies such as those of India, China, Singapore and Vietnam

Many of these factors already have contributed to substantial consolidation in the U.S. medical device industry. In particular, companies have become larger and more diverse, with multi-billion dollar players operating multiple business

Figure 2. Top 10 Medical Device Clusters by Employment, 2004



units targeting a wide range of technologies and diseases. Industry consolidation continues to drive acquisition of attractive technologies and the emerging companies that pioneer them.

Expanding Economic Development Activities

Figure 2 shows the top ten states by employment for medical device companies. Most all of the large medical device conglomerates are headquartered in these states and have research, development, and often, manufacturing operations there as well. Among the large companies populating these communities are Boston Scientific, Johnson & Johnson, Medtronic, Baxter, Abbott, General Electric Medical, Bard, Stryker Medical, Beckman Coulter and Becton Dickinson.

Over the years, medical technology communities have developed around large companies as the companies have spun off both business and scientific/clinical/engineering talent who then launch more medical technology companies. These communities have significant advantages in not only having the local networking and talent pool, but also the investment backing and related vendor support.

The largest medical technology cluster communities in the United States are Boston, Minneapolis, and several regions of California including San Jose/Silicon Valley, Orange County and San Diego. On a smaller scale, cities including Memphis, Tennessee, and Warsaw, Indiana, have developed focused medical technology cluster communities around a single medical technology, such as orthopedics.

With the attractive future projections for medical technology industry growth, there are also now more new state and city initiatives targeting this sector. At the state level, recent activity has focused on growing medical technology clusters in Florida, Wisconsin, Ohio and Michigan. Unlike the historically strong medical technology cluster communities, these new emerging clusters do not have large corporate headquarters or facilities. Instead, they are focused on supporting the launch of companies with leading-edge technologies that will seek larger corporate partners for licensing or acquisition.

The success of such leading-edge technology companies, and the communities that support them, will therefore be based on a number of factors important to emerging company growth. These include access to intellectual property counseling necessary to adequately protect pioneering technology, assistance with regulatory and reimbursement hurdles, support in proving market demand and size through effective market research, and access to business development executives of potential partners and acquirers. Also critical to these companies is access to the seed capital that is so necessary to overcoming early technical and business hurdles.

III. North Carolina's Advanced Medical Technologies Market and Position

North Carolina's Advanced Medical Technologies Industry Today

North Carolina has an emerging advanced medical technologies industry, although it has not yet reached a cluster level of development in any geographic area.

It is difficult to document statistics for the broader definition of advanced medical technology because there is no database that tracks companies and employees across all the component sectors. However, some information regarding advanced medical technology companies does exist. Using data from the North Carolina Employment and Security Commission, this report identifies seven specific NAICS codes that comprise the advanced medical technologies industry.¹ These codes include:

- Laboratory apparatus products and furniture
- Surgical and medical instruments
- Surgical appliances and supplies
- Ophthalmic products
- Dental equipment and supplies (excluding laboratories manufacturing dentures, crowns, etc., in this study)
- Electromedical apparatus (e.g. MRI's, ultrasound, pacemakers, hearing aids)
- Irradiation apparatus (e.g. use of beta-rays, gamma-rays, X-rays, or other ionizing radiation for both human health and research)

Based on these NAICS codes, North Carolina's 2006 advanced medical technologies industry consisted of:

- 142 companies (up from 86 in 1990 and 105 in 1996)
- 7,222 workers (up from 5,277 in 1990 and 6,179 in 1996)
- An average annual wage of \$40,648

Industry growth has been particularly strong among start-up device companies in the last five years, with the total number of companies increasing by 31 establishments and 1,331 employees.

As of 2006, companies in North Carolina manufactured or distributed an estimated 781 different FDA-approved

devices. The vast majority of these (435), were Class I products; 304 were Class II products; and nine products were categorized as Class III.

At a broader level, North Carolina's medical device industry can be divided into the four segments described below. Each of these company groups has its own unique set of challenges and needs. However, at the present time, there are no targeted economic development programs addressing the needs of any of these companies.

- Established manufacturing operations of larger corporations: BD Technologies (Durham/RTP), Teleflex (RTP), Baxter (Marion), Wilson-Cook Medical (Winston-Salem), Arrow International (Asheboro), bioMérieux (Durham), Closure Medical (Raleigh), Coeur Medical (Washington)
- Small manufacturers and contract/outsource manufacturers
- Incubators/accelerators with medical technologies focus: Synecor (RTP), Southeast TechInventures (RTP), QuarTek Corporation (Greensboro), and SpringMed Group (Winston-Salem)
- Start-up companies: InnerPulse (RTP), Transl (Wilmington), Alveolus (Charlotte), Encelle (Greenville), Affinergy (RTP), Sichel Technologies (Morrisville), nContact Surgical (Morrisville), Tengion (Winston-Salem), and Advanced Liquid Logic (RTP)

In addition, North Carolina is home to a number of advanced university and non-profit research institutions with strong medical device-related programs.

A Broad Array of Pioneering Start-up Companies

The most exciting opportunities for future growth of the medical technologies sector in North Carolina are represented by the many existing early stage companies and those yet to be formed based on innovations at regional research centers.

This potential is illustrated by the high level of company-launch activities in North Carolina's advanced medical technologies sector. These include start-ups and launches using many different types of advanced medical technologies, focused on various diseases and conditions, with corresponding large amounts of investment funding. These start-ups are appearing in all areas of the state, including

¹ NAICS codes 339111 thru 339115, 334510, and 334517. See Appendix for detailed descriptions of each of these codes.

the Research Triangle area, Charlotte, Wilmington, the Triad and Greenville. Technology applications driving these start-ups include:

- Percutaneous cardiac defibrillation
- Minimally invasive low back pain treatment
- Site-specific biological delivery technology
- New tissue coagulation devices for surgeries
- Implantable wireless sensors
- Non-vascular stent technology for both pulmonary and gastroenterological purposes
- Point-of care diagnostics, including microfluidics “lab-on-a-chip” technologies
- Biopolymers for tissue repair
- Wireless handheld units for diabetes testing

Since 1999, medical device and advanced medical technology companies in North Carolina have collectively raised more than \$545 million in private and public equity from investors. Among these investments were \$370 million for medical device companies, \$99 million for diagnostics firms, and \$76 million in investments in medical information technology businesses. Advanced medical technology companies represented the second largest category of life science investments during the period, exceeded only by investments in drug-based therapeutic technology companies.

It is also important to note some specific key events and companies that reflect the advancement of North Carolina's advanced medical technologies industry in recent years.

Synecor—A Nationally Recognized Medical Technologies Incubator

One entity particularly important to North Carolina's medical technologies start-up track record is Synecor, a medical technologies incubator founded and operated by device industry pioneers with deep roots in North Carolina. With operations in both the Research Triangle area and northern California, Synecor has been recognized in national medical technology publications as one of the most innovative medical technology incubators.

Synecor is praised for its comprehensive approach to providing the full breadth of financing and service support that is needed to launch new medical technologies successfully. Since 2000, Synecor and its start-up companies have raised a total of more than \$123 million and created 61 new jobs in North Carolina, with salaries averaging \$106,000. One Synecor start-up in RTP, InnerPulse, Inc., has raised nearly \$100 million and hired more than 40 employees.

In 2007, Synecor's founders launched a companion venture fund, Synergy Life Science Partners, with more than \$150 million to support future Synecor medical technology launches and other advanced medical technology start-ups. In 2006, both Synecor and InnerPulse were featured as the cover story headline in *IN VIVO*, one of the leading biotech/medical technology magazines read by medical executives and investors.

Successful Exits and Acquisitions

In addition to company formations and financings, a number of more mature advanced medical technology start-up companies in North Carolina have recently received attractive financial evaluations and exits. These include:

- Closure Medical, Raleigh
 - Wound closure technology
 - Acquired by Johnson & Johnson for \$426 million (2005)
- Quill Medical, Durham
 - Barbed suture technology
 - Acquired by Angiotech for \$40 million (2006)
- TriPath Imaging, Burlington
 - Cervical cancer diagnostic test
 - Acquired by Becton Dickinson for \$350 million (2006)

North Carolina Resources and Strengths to Leverage for the Growth of Advanced Medical Technologies

North Carolina has a variety of significant assets to support advanced medical technology companies. These include strong university biomedical engineering programs, a cluster of existing medical device and device component manufacturing and prototyping companies, a cadre of emerging medical device companies with strong venture backing and product pipelines, several early stage incubators with medical device focus, and a supportive medical device vendor community including expertise in regulatory, reimbursement, marketing, legal and research services. In addition, the state is well positioned to support the future convergence of other technologies of potential importance to health care, including materials science, nanotechnology, engineering and information technologies.

In recent years, a support group was formed to provide networking and educational events for growing the advanced medical technologies community across the state. The North

Carolina Medical Device Organization (NCMD) is a membership forum of the North Carolina Biosciences Organization (NCBIO). NCMD continues to support networking events for medical technology company executives and engineers, and operates a Web site that includes a database of members and a medical technologies job board. Together, these assets provide modest support for North Carolina advanced medical technologies companies.

These companies represent North Carolina's opportunity to leverage its existing strengths in biotechnology, medical device technologies, engineering, information technology, nanotechnology and material sciences to stimulate economic growth based on technology convergence and new company creation.

Challenges and Needs for North Carolina's Advanced Medical Technologies Industry

Interviews for this study indicate that, despite early successes, North Carolina must address significant challenges and needs if the state is to accelerate the growth of its advanced medical technologies industry. These challenges and needs are in many ways unique, or at least involve nuances dissimilar to other technologies.

More important, these interviews reveal that the challenges and needs of the advanced medical technologies industry extend well beyond the technology itself. To meaningfully accelerate the sector's growth, attention must be given to the development of talent pools surrounding market intelligence, reimbursement and payment, manufacturing and regulatory compliance, capitalization and commercialization. The interdependent nature of these needs is illustrated in Figure 3.

Although NCMD has been an initial catalyst to bring medical technology company executives and technology experts together, funding as well as administrative and logistics support have been minimal. Most activities have been limited to the Research Triangle area, although medical technology executives and technical experts interviewed across the state indicated the need for networking and support in their local community.

Interviews with medical technology executives also reflected the overall belief that North Carolina currently lacks a robust support base or "community" for advanced medical technology companies, and without this, launching successful companies is definitely more challenging than in other locations where there are supportive advanced medical



It's not just about the technology!

Figure 3. Essential Expertise Required for Advanced Medical Technologies Growth

technology clusters. Finally, most interviews indicated that there is a critical need to bring more experts, vendors and advanced medical technology educational opportunities from outside North Carolina. Companies and their executives need to have access to resources and talent beyond those found in North Carolina.

Overall, the demands for talent and expertise in unique or critical subjects identified by this study are summarized in Figure 4.

A Need for Specialized Resources

Specific needs and requirements identified for advanced medical technology companies are detailed below, using the seven categories outlined above.

- **Technologies/Product Development**

Advanced medical technology development requires close collaboration between physicians/medical clinicians and the technical design experts, including engineers, scientists and information technology experts. The more these connections are made, the more innovative solutions result. North Carolina has not had focused efforts to continuously bring together its many talented clinicians and provider



Figure 4. Professional Disciplines and Services Required for Advanced Medical Technologies Growth

many North Carolina medical device companies seek testing outside of the state.

- **Customer/Market Intelligence**

To develop effective business plans and gain initial funding, medical technology companies must have credible and sound market and competitive research and analysis. There are many different purchase influences for medical technologies, and all of these can impact the size of the market and the speed of a launch.

North Carolina presently lacks the depth of talented and experienced medical technology marketing and product management experts available in more established advanced medical

technologies communities. As a result, many startups rely on students at the local business schools and MBA programs. While these students can be helpful, they lack the essential on-the-job learning of experienced medical technologies marketers and executives.

Fortunately, there are opportunities for North Carolina to build these resources. Development of solid advanced medical technology clusters across the state will attract seasoned marketing and executive talent. In the meantime, programs featuring presentations by medical technology marketing experts, networking platforms that attract national experts and events that present case examples can help address marketing challenges. In addition, marketing issues can often be at least partially addressed through greater collaboration between local and regional payers, providers, clinicians and medical technology companies.

- **Reimbursement/Payment**

Market sizing, launch speed and potential revenue for advanced medical technology companies are all closely tied to how these firms will get paid, as well as what the economics will be for their customers. Payment challenges and impact on revenue projections vary depending on the type of technology and targeted markets. For example, medical technology

The Solution: Collaboration and Support

experts with its equally talented technical experts. A successful effort of this type might be modeled after the Boston-based Center for Integration of Medicine and Innovative Technology (CIMIT).

In addition, advanced medical technology is innovation-intensive and requires strong support in protection of intellectual property. While North Carolina has many law practices, it lacks the kinds of highly specialized and comprehensive medical device-focused law firms found in larger advanced medical technology cluster markets. As the advanced medical technology base here develops, existing law firms will have opportunities for specialization. Growth will also offer opportunities to introduce outside medical technology-focused law practices to North Carolina by soliciting their sponsorship of industry networking and education events.

Finally, a major first step in medical technology development is the process of pre-clinical testing. This requires access to testing labs that have a specific device focus. Interviews confirmed that Synecor, the earlier-described medical technology incubator, has an excellent lab. However, the Synecor lab is not easily accessible to companies outside of Synecor's investment portfolio. North Carolina State University has been exploring development of a device-focused animal testing laboratory, but has taken no definitive action to date. For this reason,

companies launching to the consumer market, clinical trials market, or research laboratory market can avoid the reimbursement challenges of those selling more traditional products to health care providers and clinicians.

For most advanced medical technology company launches, understanding and navigating through the complex world of third-party medical reimbursement is imperative, and investors are increasingly placing reimbursement on the top of their due-diligence list. This includes understanding how each of the various payers will view technology from a payment perspective. Most all advanced medical technology companies must therefore engage talented reimbursement advisors to navigate through the reimbursement maze, and the earlier in their launch process, the better.

Because of the state's historical pharmaceutical and biotechnology focus, most of North Carolina's resources in reimbursement analysis are focused on these markets. An excellent example is the Lash Group (Charlotte), which is nationally recognized as a pharmaceutical and biotechnology reimbursement consulting firm. Reimbursement issues for medical devices and combination products are quite different. North Carolina should encourage collaboration and networking among the advanced medical technology companies and firms with reimbursement expertise. In addition, with so much of the reimbursement talent concentrated in Washington, D.C., close linkages should be developed with the Department of Health and Human Services (HHS), AdvaMed (a national trade association representing medical technology companies) and other expert consultants specializing in medical device reimbursement.

Company executives interviewed for this report also suggested that case studies and shared learning would be valuable tools in the development of reimbursement strategies. Within this state, organizations such as Blue Cross Blue Shield of North Carolina and the North Carolina Department of Health and Human Services could be involved in addressing reimbursement issues.

- ***Manufacturing/Regulatory***

As mentioned earlier in this report, the regulatory demands and scrutiny of the FDA for both drugs and medical technologies are ever increasing, and particularly challenging in the new area of combination products. Ongoing communication and connections with the FDA and AdvaMed are important for advanced medical technology companies at all stages of development and launch. While there are some regulatory experts in the state specializing in

medical technology, they are not abundant. In addition, North Carolina law firms do not have the depth of regulatory expertise found in larger advanced medical technology communities.

Closely tied to regulatory requirements is the need for manufacturing capacity that meets FDA and other strict quality assurance requirements. Adherence to good manufacturing practices (GMP) and good laboratory practices (GLP) and knowledge of "design for manufacturing" principles specific to advanced medical technologies are critical. Many medical technology companies will outsource their manufacturing to specialized contract manufacturers. It is therefore important for company executives to know what contract manufacturer resources are in the state, and when they might need to go elsewhere.

Finally, manufacturing and regulatory expertise should be made available to academic-based engineers and scientists who do not have access to business-based commercialization resources. Such efforts will help ensure that North Carolina becomes a leader not only in identifying new medical technologies, but in commercializing new technologies and launching successful advanced medical technology companies.

- ***Access to Capital and Technology Commercialization***

Interviews for this study clearly identified lack of early stage seed capital as a major challenge for commercialization of advanced medical technologies in North Carolina. Grants from the National Institutes of Health have greatly diminished in recent years, and North Carolina has a limited number of angel investors with advanced medical technology expertise.

Furthermore, while advanced medical technology companies typically may have much faster exits than drug companies, they also have different capital needs for product development and product launch. Along the way this capital can come from angel and private investors, venture capitalists, strategic large-company partners, incubators and banks.

It is also important to note that advanced medical technology companies have different funding needs during their various stages of development. These phases include:

- developing, testing and securing intellectual property protection for the technology
- analysis of markets, reimbursement assessment and business plan development
- company creation

- regulatory approval
- market testing and targeted launch strategy development
- product launch

Without a historically strong medical technologies sector, it is not surprising that North Carolina does not have a well-established and large group of medical technology-savvy investors, either at the angel or venture level. Yet, in the face of complexities associated with successful launch of advanced medical technologies, prior experience goes a long way in quickly assessing both the risks and the opportunities.

Fortunately, recent successful advanced medical technology launches in North Carolina have attracted the interest of investors both inside and outside the state. In addition, licensing arrangements involving large medical technology companies have also helped put North Carolina on the radar screen of internationally prominent advanced medical technology companies.

It will be important to continue communicating North Carolina capitalization successes both inside and outside of the state. One means of accomplishing this would be to create networking opportunities to entice national and international investors to North Carolina. Such conferences should highlight activities in the advanced medical technologies sector here and demonstrate the opportunity presented by these developments.

The Need to Attract and Retain Talent

Throughout the study, those interviewed agreed that North Carolina has the major technical and scientific talent necessary to create the next generation of advanced medical technologies. Because of the diversity of this talent, the state is particularly well positioned to support the development of new products based on convergent technologies, especially those based on biotechnology, materials science and information technology.

However, study participants also made it very clear that there is a lack of senior-level expertise across the range of functions and skills required to successfully commercialize advanced medical technologies. Currently, most such talent is recruited from out of state. Recruitment challenges are exacerbated by the absence of existing medical technology firms that candidates can view as reliable “fall-back” opportunities if their initial employment in North Carolina ends. Also, many study participants also expressed concern that potential recruits may be uncomfortable with the absence of a fully developed medical technology support community—and consequently focused educational, networking and professional development opportunities—that exist in larger cluster markets.

In addition, most executives who were interviewed questioned the nearly complete absence of marketing aimed at publicizing advanced medical technology assets that are, in fact, already present here. Many respondents further observed that North Carolina’s appeal as an early retirement destination could be profitably marketed. These study participants noted that senior, experienced medical technology experts from Boston, New Jersey, Minneapolis and other locations are retiring to North Carolina. These retirees could play an important support role for local start-up medical technology companies, through involvements such as consulting, board positions and angel investing.

Finally, most senior executives interviewed for this study emphasized the critical need to retain senior talent that is already in North Carolina. Several respondents indicated that likelihood of such retentions would be greatly improved by the creation of a central platform for industry cross-connections. We note that such a platform might also play an important role in helping outsiders learn more about North Carolina’s emerging medical technologies industry.

IV. North Carolina Advanced Medical Technologies Strategic Plan Recommendations

Goals

- To support accelerated growth of the advanced medical technologies industry across North Carolina
- To position the state as a global leader in emerging new medical technologies for the 21st century
- To leverage the existing health care, technology and clinical infrastructure, and other relevant assets across the state

Strategic Areas of Focus

Four strategic areas of focus are recommended. The subsequent pages provide a three-year plan of recommended activities designed to support each of these strategic areas of focus.

- I. Establish a North Carolina Center for Advanced Medical Technologies
 - Complete a business plan for the Center, to include initial years of investment required and a goal of being self-sustaining by year five
 - Identify and seek funding sources from various entities, including:
 - Develop a consortium to apply for the North Carolina Biotechnology Center's *Centers of Innovation* program
 - Other State support
 - Charitable foundations
 - Vendors
 - Health care payers and providers
 - Hire a talented staff and assemble an expert advisory council
- II. Networking and Education
 - Provide seminars, meetings and conferences to support medical technology executives, scientists, engineers, clinicians, investors and vendors
 - Recognize leading technologies, companies and individuals
 - Bring together advanced medical technology "users, buyers and payers" with technical experts and facilitate partnering in the

creation of workable and commercially viable solutions to problems

- III. Branding, Marketing and Business Development for Advanced Medical Technologies
 - Track, document and market on an ongoing basis what is happening in advanced medical technologies across the state
 - Attract medical technology companies to North Carolina from across the United States and internationally
 - Educate legislators and North Carolina businesses, consumers, students, health care providers and payers about North Carolina's advanced medical technology assets and activities
 - Benchmark North Carolina investments and strategic development of advanced medical technologies against those of other states and regions
- IV. Company Commercialization and Technology Transfer
 - Collaborate with universities to accelerate technology transfer and technical assistance
 - Provide tailored support to entrepreneurs and incubators working in advanced medical technologies

Strategies: Year One

- I. Launch the North Carolina Center for Advanced Medical Technologies

After completing a business plan and obtaining launch funding, the recommended activities for the first year of the Center are as follows:

- a. Staff the Center with appropriate experts and advisors, including:
 - i. *Executive Director*. This person should have appropriate medical device/technology expertise, including related FDA, HHS and reimbursement understanding and connections, and must have respect from the current North Carolina medical technology company executives. The search should include candidates from outside of North Carolina.

*ii. Webmaster and Researcher**iii. Administrative Assistant/Education Coordinator*

- b. Establish an advisory board of key leaders and visionaries who can help guide and support the strategies, tactics and priorities of the Center
- c. Create the Center's initial infrastructure
 - i. Database of companies and vendors
 - ii. Web-based job board built on a database of job creators and job seekers
 - iii. Brochure highlighting the facts about North Carolina's medical technology sector and its related resources. The brochure should be appropriate for use in connection with recruitment of businesses and individuals specializing in advanced medical technology.
 - iv. Interactive Web site with links to North Carolina companies, vendors, conferences, job bank and media reports. The site should serve as a focal point for linking medical technology companies and researchers.
 - v. Process for identifying and tracking the needs of advanced medical technology companies
 - vi. Process to measure performance of Center initiatives in accelerating the growth of North Carolina's advanced medical technologies industry
 - vii. Benchmark and report investment outside of North Carolina in support of the development of advanced medical technologies
- d. Study and learn "best practices" from other similar organizations in cities and states. Examples include:
 - Medical LifeScience (Minneapolis)
 - BIOCOM (San Diego)
 - California Health care Institute
 - MassMEDIC (Massachusetts) and CEMIT (Boston)
 - Nashville Health care Council
 - Memphis Bioworks Foundation
 - Indiana Health care Industry Forum
 - Wisconsin Biotechnology and Medical Device Association

II. Networking and Education

- a. Collaborate with NCBIO to begin educating North Carolina government officials about the medical technologies industry. As part of this effort, create a relationship with the Advanced Medical Technology Association (AdvaMed), the trade association and lobbying group representing the medical technology industry nationally
- b. Develop and market a North Carolina Emerging Medical Technologies Conference. Work with AdvaMed to identify and recruit sponsors and speakers (AdvaMed has provided similar assistance in California and Colorado). This program would be oriented primarily to members of North Carolina's advanced medical technologies community, as opposed to conferences with a national or international focus.
- c. Support the provision of education and networking programs for senior medical technology company executives in North Carolina

III. Branding, Marketing and Business Development

- a. Undertake public relations activities to showcase and highlight North Carolina medical technology successes across the state, including companies and individuals
- b. Provide information to local and state economic development organizations to assist them in marketing North Carolina as a competitive location for new and expanding medical technology companies
- c. Begin planning for future North Carolina medical technology conferences. Build contacts with potential speakers and sponsors. Focus on niches addressing leading-edge advances in medical technology and convergent technologies. Examples are the Healthcare Unbound (emerging wireless medical technologies), Windhover Medtech Insight and BioDevice Partnering conferences

IV. Company Commercialization and Technology Transfer

- a. Work with state officials to establish grant and loan programs for medical technologies research and commercialization support
- b. Leverage the strengths of North Carolina's community college system by encouraging collaborations with emerging advanced medical technology companies that seek to anticipate future specialized manufacturing and technical support talent needs

- c. Support the availability of education, information and assistance regarding regulatory and reimbursement requirements and strategies. Work with the state's medical schools, graduate level business schools, area specialty consultants and law firms to support this critical infrastructure

Strategies: Year Two

I. Networking and Education

- a. Plan, market and launch an annual North Carolina Advanced Medical Technologies Conference designed to showcase companies; provide valuable education for executives; help inventors and start-up companies make investor connections; encourage networking; and introduce vendors that provide support products and services for medical technology companies. Attract financial and other resource support from key sponsors both locally and nationally

II. Branding, Marketing and Business Development

- a. Launch a North Carolina Advanced Medical Technologies Annual Report to review the status of North Carolina's industry each year
- b. Begin publishing a newsletter
- c. Develop or support an on-demand Internet channel that provides replays of panel discussions featuring leading clinicians, researchers, device executives and device experts
- d. Work with state, regional and local economic development marketing officials to promote North Carolina as a location for medical device industry retirees who could serve as advisors, directors and angel investors
- e. Recruit existing medical technology conferences to locations in North Carolina. Conduct early and on-going promotion to ensure that these conferences are supported by North Carolina's medical technologies community
- f. Begin planning for a national advanced medical technologies conference to be held in North Carolina and marketed nationally and internationally

III. Company Commercialization and Technology Transfer

- a. Create one or more programs that support a 21st century model for development and commercialization of convergent medical technologies. This should include collaborative efforts across numerous sectors, including universities,

medical centers, medical technology industries, information technology and other technical industry sectors, the financial community and the public sector. Consider the Boston-based Center for Integration of Medicine and Innovative Technology (CIMIT) as a possible model

- b. Begin a "library" of relevant medical technologies industry reports and databases that can be shared by North Carolina medical technology companies and researchers
- c. Establish an advanced medical technologies "coaching" program to assist early stage and start-up companies in finding appropriate senior industry executives in North Carolina and elsewhere who can provide coaching assistance to help ensure more successful launches. (Note that this is also a way to develop relationships with key medical technology executives who might want to relocate to North Carolina.)

Strategies: Year Three and Beyond

I. Branding, Marketing and Business Development

- a. Hold the first of a series of annual conferences focused on issues related to the emerging world of convergent and other new advanced medical technologies. Market this conference nationally and internationally. Obtain appropriate sponsor support and use the conference as a platform to generate papers, media reports, etc. The goals of this effort should be to position North Carolina as a state leading the way in emerging technologies for medical advancement and to attract large medical technology company executives, investors and support professionals to North Carolina.
- b. Participate visibly in selected medical technology conferences and events outside of North Carolina. Consider the following:
 - i. Windhover's Annual Medtech Insight Conferences. Windhover hosts three domestic conferences and one in Europe, each highlighting early stage medical technology companies and attracting related investors from large medical companies and venture firms. Sponsorship of these conferences would support attendance by more North Carolina companies and valuable networking opportunities.

- ii. BioDevice Partnering Conference: Building Convergent Medical Technologies. This conference is held each year in Europe. Plans for a North American venue are under consideration.
- iii. Also consider participation in selected medical technology conferences in the international arena, particularly in Europe and the emerging markets of China, Singapore, India and Dubai.
- c. Work with other Southeastern health care and medical technology groups to promote the region as a leader in developing advanced medical technologies for the future. The goal of such collaborations should be to bring more investors and also major medical company business development executives to the region. California, Minneapolis and Boston have employed similar strategies.

II. Company Commercialization and Technology Transfer

- a. Launch a state-supported “seed fund” to provide focused investment to support research and commercialization of convergent medical technologies. (An example of this type of activity is Pennsylvania’s \$20 million BioAdvance seed fund for life science investment, which was funded through proceeds from the state’s Medicaid tobacco settlement.)
- b. Develop international relationships in the advanced medical technologies sector, including Europe and the emerging markets in India, China and the Middle East. The goal of these efforts would be to improve recognition of North Carolina as a place for launching new advanced medical technology companies targeting the U.S. market and to provide a platform for North Carolina scientists and medical technology companies to make international connections for clinical research and marketing in overseas markets.

Appendix

NAICS Code Descriptions for Medical Device Sector Analysis:

339111: Laboratory Apparatus and Furniture

Consists of establishments primarily engaged in manufacturing laboratory apparatus and laboratory and hospital furniture (except dental). Examples of products made by these establishments are hospital beds, operating room tables, laboratory balances and scales, furnaces, ovens, centrifuges, cabinets, cases, benches, tables and stools.

339112: Surgical and Medical Instrument Manufacturing

Consists of establishments primarily engaged in manufacturing medical, surgical, ophthalmic and veterinary instruments and apparatus (except electrotherapeutic, electromedical and irradiation apparatus). Examples of products made by these establishments are syringes, hypodermic needles, anesthesia apparatus, blood transfusion equipment, catheters, surgical clamps and medical thermometers.

339113: Surgical Appliance and Supplies Manufacturing

Consists of establishments primarily engaged in manufacturing surgical appliances and supplies. Examples of products made by these establishments are orthopedic devices, prosthetic appliances, surgical dressings, crutches, surgical sutures and personal industrial safety devices (except protective eyewear).

339114: Dental Equipment and Supplies Manufacturing

Consists of establishments primarily engaged in manufacturing dental equipment and supplies used by dental laboratories and offices of dentists, such as dental chairs, dental instrument delivery systems, dental hand instruments, and dental impression material.

(Although this NAICS code includes manufacturers of dentures, crowns and dental prosthetics, such businesses were excluded from the scope of this study.)

339115: Ophthalmic Goods Manufacturing

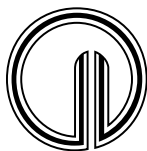
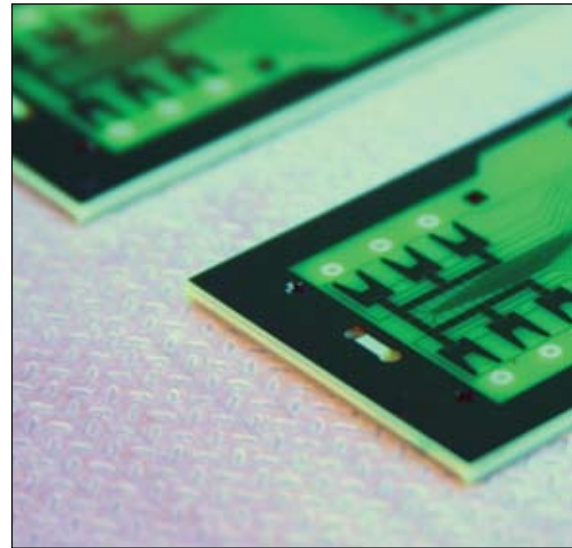
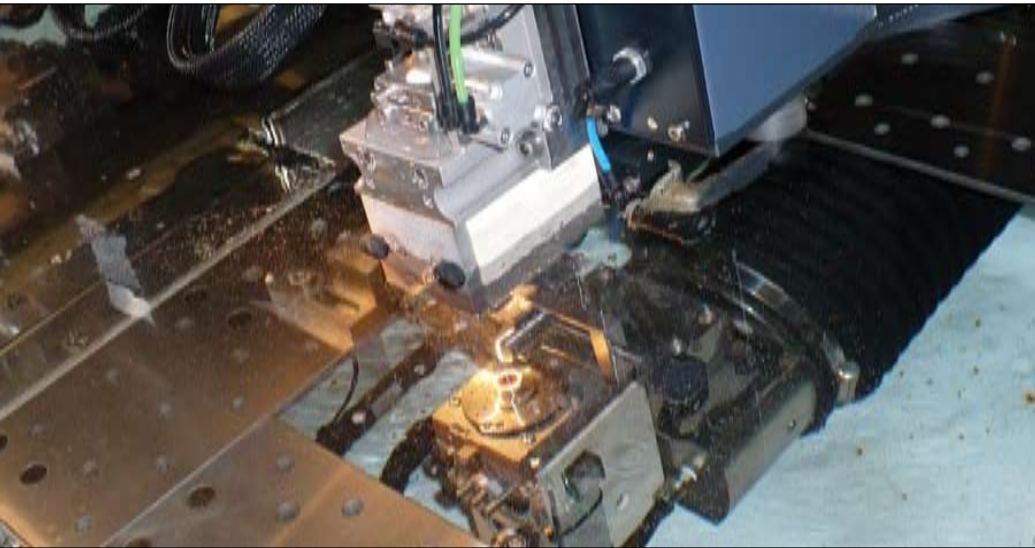
Consists of establishments primarily engaged in manufacturing ophthalmic goods. Examples of products made by these establishments are prescription eyeglasses (except those manufactured in a retail setting), contact lenses, sunglasses, eyeglass frames and reading glasses made to standard powers.

334510: Electromedical Apparatus Manufacturing

Consists of establishments primarily engaged in manufacturing electromedical and electrotherapeutic apparatus, such as magnetic resonance imaging equipment, medical ultrasound equipment, pacemakers, hearing aids, electrocardiographs and electromedical endoscopic equipment.

334517: Irradiation Apparatus Manufacturing

Consists of establishments primarily engaged in manufacturing irradiation apparatus and tubes for applications, such as medical, therapeutic, research and scientific evaluation. Irradiation can take the form of beta-rays, gamma-rays, X-rays or other ionizing radiation.



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