

The Longwood Medical and Academic Area's Economic Contributions to Boston and Massachusetts

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The Longwood Medical and Academic Area's Economic Contributions to Boston and Massachusetts

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Executive Summary

The reputation of the Commonwealth of Massachusetts as a global innovator has long been anchored to its higher education and healthcare institutions. Located in the City of Boston, the Longwood Medical and Academic Area (LMA) is a 213-acre innovation hub that is home to 22 prominent institutions, including three Harvard-affiliated teaching hospitals, three Harvard graduate schools, and sixteen other colleges, universities, cultural institutions, and medical centers.

Rapid growth in such a small area led to the creation of a non-profit now known as MASCO to serve as the convening organization for the institutions in the LMA and to address their shared challenges, such as land use, transportation, and congestion. Today, MASCO serves as the preeminent organization planning and advocating for people who need to access the LMA, while also providing some of the transportation services necessary for them to move into and around the LMA safely and efficiently. MASCO also creates ways for LMA institutions to collaborate around shared development and access goals and provides other shared services.

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- *The LMA institutions employ nearly 68,000 workers and volunteers and educate 27,000 students.*
 - *These totals are the highest in LMA history.*
 - *Over ten years, total employment increased by nearly 30%, or nearly 15,000 jobs.*
 - *LMA doubled the state's growth rate during the same time.*

The LMA has one of the highest concentrations of jobs in the City of Boston and Commonwealth of Massachusetts. Together, LMA institutions employ nearly 68,000 workers, including researchers, educators, clinicians, administrators, and volunteers and educate 27,000 students. These totals are the highest in LMA history, with total employment increasing by nearly 30%, or nearly 15,000 jobs, in only 10 years. This is double the state's growth rate during the same period.

- More than 120,000 people move in and out of the LMA every day, more than the entire population of the City of Cambridge.
- More than 2.8 million patients seek care in the LMA every year, home to some of the most respected hospitals in the world, more than four times the population of Boston.
- Every 10 jobs in the LMA support 12 other jobs elsewhere in Massachusetts.
- LMA employees reside in every county and legislative district in Massachusetts.
- If the LMA were its own state, it would rank in the top 10 nationally in NIH awards and funding, just after Texas, even though it is only 0.0001% of its size.



- 64% of students graduating from LMA schools stay in Massachusetts, compared to about 50% at other colleges and universities in Greater Boston.¹
- The LMA supports more than 155,000 jobs across the Commonwealth, bringing value to every region of the state.
- The LMA drives \$30 billion in business revenues in Massachusetts, equivalent to the revenues of number 107 of the Fortune 500.
- The LMA also supports \$18 billion of the gross state product of Massachusetts, comparable to the gross domestic product of entire countries.
- Finally, \$10 billion of the Commonwealth's personal income ties back to the LMA, which is approximately one third of the total income of states like Vermont and Wyoming.

History suggests that the LMA remains uniquely positioned to drive rapid and impactful innovation. Nationally, larger health care clusters exist, but the LMA arguably holds the distinction of the most exceptional assembly of top healthcare, research, and education institutions. Their complementary areas of expertise form a knowledge and science powerhouse that has not been replicated anywhere else in the world.

Harvard Medical School has long served as a catalyst for the LMA. It chose Longwood with a vision to co-locate affiliated teaching hospitals. That vision continues to present new examples of how opportunities for collaboration result in improved teaching and medical care. Simmons University and Harvard Medical School together established the first academically affiliated school of social work in the country. Medically fragile newborns delivered at hospitals in the LMA are less than 100 feet away from specialty and emergency care at Boston Children's Hospital, the number one pediatric hospital in the country, which connects to other hospitals via second-level walkways. The proximity between institutions allows oncologists at Dana-Farber Cancer Institute to also treat patients at Brigham and Women's Hospital and maintain joint programs with other institutions affiliated with Harvard Medical School, including Boston Children's Hospital. These are just a few of the many examples of the critical benefits of collaboration the LMA provides.

The LMA has been vital to managing the recent and ongoing COVID-19 crisis at every phase, from initial response and vaccine trials to key innovations and treatment options. It also expects to be a key driver shaping the post-pandemic world. In 2020, hospitals transformed to increase capacity, researchers pooled their skills to develop therapies to improve patient outcomes, and multiple LMA institutions successfully trialed COVID-19 vaccines. In the spring, colleges housed medical staff in empty dormitories

¹ <https://www.mass.gov/doc/greater-boston-workforce-planning-blueprint/download>

that neighbored the hospitals of the LMA then dramatically shifted gears to safely educate students in-person and virtually in the fall, standing up some of the most comprehensive testing programs in the state.

The UMass Donahue Institute conducted the research that supports this report at the height of the pandemic, primarily using data from before 2020. After completing a series of interviews with those leading the institutions in the LMA, the research team found consensus that data from 2019 and the years prior better serve as a representation of the economic contributions of the LMA today and in the future rather than the pandemic-driven outliers of 2020.

MASCO, in its role as stewards of the area, has been asking about planning and policy changes at LMA institutions since the start of the pandemic. David Sweeney, President and CEO of MASCO, said from these surveys, “It’s become clear that the changes our hospital, higher education, and cultural institutions have been forced to implement this past year actually present great opportunity for the LMA. This already well-developed area has historically presented challenges to the physical growth of local institutions. We continue to hear that Greater Boston’s anchor institutions based in the LMA expect to successfully reposition themselves to take advantage of recent changes to enhance certain functions, such as research and clinical care.”

Introduction

Boston's Longwood Medical and Academic Area (LMA), also known as Boston's city-within-a-city, is located three miles southwest of downtown Boston, adjacent to the neighborhoods of the Fenway, Mission Hill, and Audubon Circle, and the Town of Brookline.

In 1882, Boston Children's Hospital moved from a small building in the South End to a new 60-bed hospital on Huntington Avenue and established the nation's first milk laboratory, complete with a herd of cows that provided children with tuberculosis-free milk. Shortly after in 1900, Harvard Medical School began building its campus on Longwood Avenue, driving development in what is now known as the LMA. Hospitals affiliated with Harvard Medical School were attracted by the proximity to the school and the fresh, recuperative air away from downtown. The Gardner Estate, now the Isabella Stewart Gardner Museum, was built in 1903. Simmons University purchased the land next to the Gardner Estate in the same year, constructing its main building in 1904, with other colleges and hospitals soon following. New England Deaconess Hospital, now Beth Israel Deaconess Medical Center, relocated to the LMA in 1907. Then, only 30 years after moving to Huntington Avenue, leadership at Boston Children's Hospital "understood that a closer association with Harvard Medical School would foster major scientific advances," and the hospital relocated next door to Harvard Medical School in 1914.² Many of the

"Nowhere else in the world has this kind of colocation of hospitals, industry, and academia, and the hub of that is the LMA." – Laura DeCoste, HMS

institutions based in the LMA have also established a presence across the Commonwealth, serving local municipalities and providing residents with access to the specialized tertiary care, education, and cultural institutions of the LMA.

Today, the LMA is home to world-class hospitals, colleges, and cultural institutions in a dense, 213-acre site that has become an epicenter of research and innovation and an economic engine for the Commonwealth. This unique concentration of 22 institutions includes three major Harvard affiliated teaching hospitals, three research or research treatment centers, three Harvard graduate schools, six historic colleges and universities, a private secondary school, an art museum, one public high school, a state mental health center, a children's treatment center, a religious institution, and an international pharmaceutical research company. "Nowhere else in the world has this kind of colocation of hospitals, industry, and academia, and the hub of that is the LMA," according to Laura DeCoste, Chief Communications Officer at Harvard Medical School.

The medical breakthroughs that have resulted from the close coordination among education, research, and healthcare are significant and global in impact. In 1923, the first heart valve repair took place at

² <https://bch150.childrenshospital.org/wp-content/uploads/2018/12/History-Trail.pdf>

Brigham and Women's Hospital. In 1947, Dana-Farber Cancer Institute introduced the first research program in chemotherapy for children with cancer. The iron lung was invented by researchers at the Harvard T.H. Chan School of Public Health, saving thousands afflicted with polio until a vaccine was developed in the 1950s. Boston Children's claims the first successful remission of acute leukemia in 1947, and the first implantable cardiac pacemaker was developed at Beth Israel Deaconess Medical Center in 1960. These are just a few examples from over a century of groundbreaking discovery in the unique environment of the LMA.

In 1996, recognizing the value of their partnership, five neighboring colleges in the LMA joined together to create the Colleges of the Fenway, a collaboration that collectively has more than 13,000 undergraduate students, 700 full-time faculty, and 2,300-course offerings. The Colleges of the Fenway comprises close to one fifth of Boston's total students attending four-year colleges and universities, contribute greatly to the region's character, and are an anchor of its international academic community. With 19,400 students in total, the Colleges of the Fenway surpasses both UMass Boston and Boston College in size and, through cross-registration, offers all of the cultural and educational opportunities of a larger university while providing smaller campus living environments.

The LMA is world-renowned in the higher education and medical communities. However, locally, its longevity and stability mask its contributions to the region's growth and the Commonwealth's economy. The LMA is the densest concentration of employment outside of the downtown core of Boston, recently containing more workers, students, and research funding than at any other time in its history, having added more than 1,200 jobs per year over the past ten years. The LMA contributed one of every 11 new jobs in Boston over that time.

MASCO is the non-profit organization that serves as the LMA's convening organization, creating ways institutions can collaborate around shared goals, enhance the quality of life for those visiting and working within the LMA, and strengthening community among the hospitals, life sciences, educational, religious, and cultural institutions. To further these purposes, MASCO asked the Economic and Public Policy Research group at the UMass Donahue Institute (UMDI) to evaluate the ways in which the institutions within the LMA enhance and support the Commonwealth's economy. The UMDI team conducted the study presented in this report by gathering data from MASCO (focusing on employment, financial data, and transportation statistics), and using economic modeling tools to measure economic impacts. The team supplemented this analysis with interviews with representatives from the LMA's institutions to better understand the impact of co-location, recent research successes, and the future of the LMA. The report has two main sections: a profile of the LMA and economic impacts. Interview findings are interspersed where relevant.

Profile of the LMA

In 1972, 11 institutions in the LMA founded the Medical Academic and Scientific Community Organization (better known as MASCO) to address growing transportation and land use problems following rapid development. Since then, MASCO has continued its planning work and expanded its services to address other issues common to its members, such as place-making and emergency preparedness, and operating shuttles, garages, a transportation management association, and even a childcare center. MASCO’s membership has continued to grow and now includes 18 members and four associate members.³ Along with membership, visitation has also grown. The LMA now accommodates 120,000 people a day.

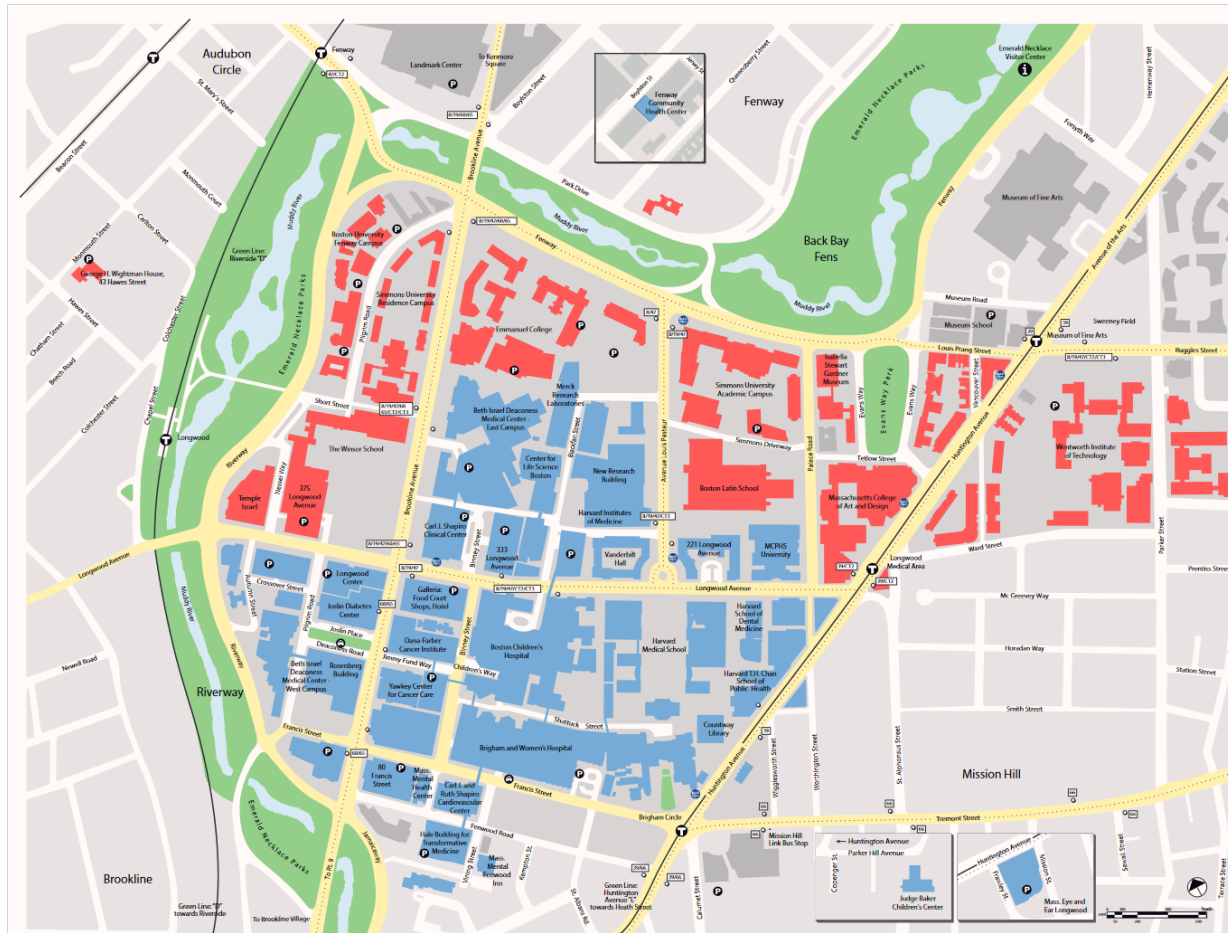
The institutions below are members of MASCO and located in the LMA.

Table 1: MASCO Member Institutions

Member Institutions	
Beth Israel Deaconess Medical Center	Massachusetts College of Art and Design
Brigham and Women's Hospital	MCPHS University
Boston Children's Hospital	Massachusetts Mental Health Center
Dana-Farber Cancer Institute	Simmons University
Emmanuel College	Temple Israel
Harvard University	Wentworth Institute of Technology
Medical School	The Winsor School
School of Dental Medicine	Associate Members
T.H. Chan School of Public Health	Boston University Wheelock College of Education and Human Development
Isabella Stewart Gardner Museum	Fenway Community Health Center
Joslin Diabetes Center	Massachusetts Eye and Ear Infirmary, Longwood Campus
Judge Baker Children's Center	Merck Research Laboratories

³ A list of current members and their institution type can be found in Table 8 on page 32.

Figure 1: Map of Longwood Medical Area



Source: MASCO

The LMA attracts 30% more NIH funding than University City in Philadelphia and 40% more than the Texas Medical Center, which is 2.5 times the size of the LMA.

Hospitals in the LMA see 2.8 million patients every year. To serve these patients and maintain the cutting-edge standards of care they expect, the area supports more employees than larger health care and academic clusters throughout the United States, which yields a rich diversity of people and skills. The number of research awards and total federal research dollars that flow into the LMA each year underpins this success. The LMA is the densest cluster of research activity in the nation, with more NIH awards for its research endeavors than any other similar academic biomedical cluster in the US. The LMA attracts 30% more NIH funding than University City in Philadelphia and 40% more than the Texas Medical Center, which is 2.5 times the size of the LMA.

The 2020-21 *U.S. News & World Report* rankings confirm that the LMA is the preeminent medical campus in the nation.

- Harvard University is ranked the #1 Medical School in Research in the country and #10 in Primary Care.
- The Harvard T.H. Chan School of Public Health is ranked the second best public health school in the nation.
- Boston Children's Hospital is named the country's #1 pediatric hospital.
- Dana-Farber/Brigham and Women's Cancer Center is ranked best for cancer care in New England for the 19th straight year, and ranked #5 in the nation.
- Brigham and Women's Hospital is ranked #5 in rheumatology, #6 in nephrology and #7 in cardiology and heart surgery. Brigham and Women's Hospital also achieved Magnet status for nursing excellence in 2018.
- Beth Israel Deaconess Medical Center is nationally ranked in two adult specialties: treatment of cancer and diabetes & endocrinology. It is rated high performing in five adult specialties: gastroenterology & GI surgery, geriatrics, nephrology, neurology & neurosurgery, and pulmonology & lung surgery.

In addition, the colleges and cultural institutions of the LMA also feature prominently in nation-leading metrics for education and regional cultural influence. A sample is provided below.

- Simmons University is ranked by *U.S. News and World Report* and *Niche* as one of the best colleges for nursing in America.
- The Massachusetts College of Pharmacy and Health Sciences is ranked the top university for earning power by *The Wall Street Journal/Times Higher Education College Rankings*.
- Temple Israel, established before the Civil War, is the largest Reform Synagogue in New England.

Employment

Massachusetts has long been defined by its “eds and meds” – the higher education and healthcare institutions that anchor the Commonwealth’s reputation as an innovator, and much of that reputation and regional brand identity is centered in the LMA. The healthcare, higher education, and cultural institutions in the LMA have steadily grown over the past ten years and now count nearly 68,000 workers, the highest number in the LMA’s history. That is 32% higher than those who work in Kendall Square and 80% more than work in the Seaport. One out of every 10 people who work in the City of Boston works in the LMA.

Total employment (workers excluding volunteers) increased by nearly 30% from 2008 to 2019, adding nearly 15,000 jobs over that time. Since 2010, the LMA accounted for one of every 11 jobs added in Boston.

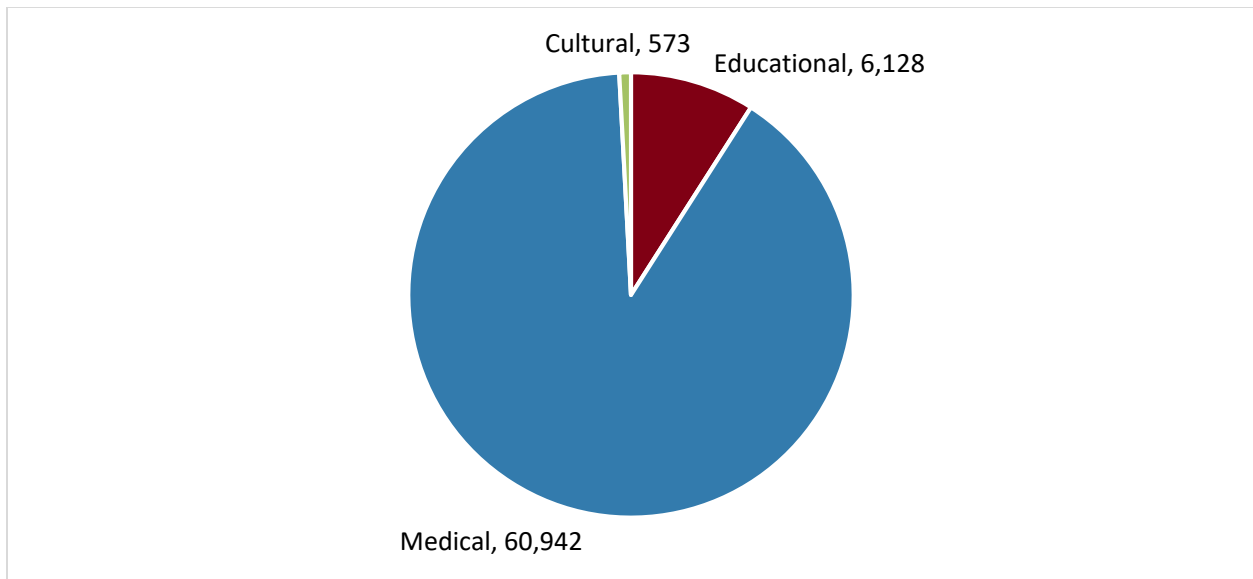
- Employment among the institutions of this 213-acre area exceeds the combined employment of the Commonwealth’s entire insurance industry and is similar to the total population of Franklin County.
- LMA employees could fill the TD Garden three times over.
- There are more employees in the LMA than the number of people who visit Disney World every day.

Research and medical positions drive employment in the LMA as both the foundational occupations and the growth leaders. Figure 2 below shows total employee and volunteer numbers by institution type in the LMA.

One out of every 10 people who work in the City of Boston works in the LMA. Since 2010, the LMA accounted for one of every 11 jobs added in Boston.

Employment at the medical centers comprises most employment in the LMA. There is great diversity within these jobs: employment at a hospital is not limited to doctors and nurses, or jobs that need advanced or even bachelor’s degrees. As Bernie Jones, Vice President of Public Policy and Chief of Staff for Brigham and Women’s Hospital put it, “We are a hotel, a research center, an academic institution, and a hospital all simultaneously.” Generalizing from the occupational mix of Brigham and Women’s Hospital, 60% of hospital staff work in patient spaces, though only 35% are doctors or nurses. The remaining quarter include occupations like health technicians and aides, janitorial staff, and maintenance. The final 40% of workers are not in patient spaces at all, and include administrators, cafeteria workers, gift shop workers, and many other occupations. A broad range of occupations facilitates economic opportunity across the spectrum of education and experience.

Figure 2: Employees and Volunteers in the LMA by Institution Type in 2019

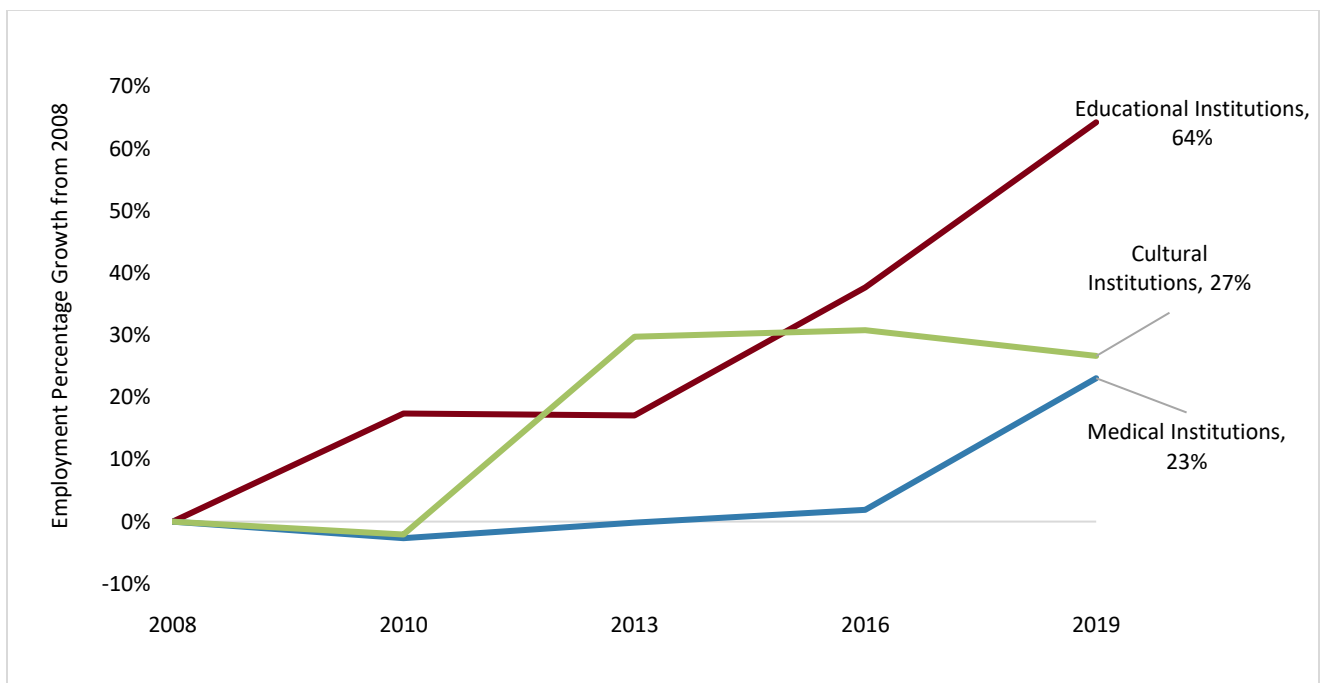


Source: MASCO member surveys Note: This graph includes associate member employee numbers and non-payroll workers (contracted employees, researchers, physicians, contract employees, and volunteers).

“The LMA not only provides area residents with world-class medical care, but the LMA also provides essential, family-sustaining careers for thousands of workers in our communities, which strengthens our entire region. The LMA features some of the best-trained workforces in the world. Those innovative workforces include both those who go to work each day to save and improve lives inside LMA hospitals and lab spaces – and the workers who are proud to build those spaces. For generations, those of us in the construction industry have seen firsthand the positive impact that the LMA has had on our entire region. Construction workers who build the LMA enjoy great, family-sustaining careers. Those workers and their families can also rely on the world-class care provided within the walls of the structures they build. The Greater Boston Building Trades Unions appreciates the great partnership that it enjoys with the LMA, along with the important opportunities and access to care that the LMA provides to our region. We take pride knowing that we are building state-of-the-art facilities to help our medical professionals deliver world-class care,” said Brian Doherty, General Agent of the Greater Boston Building Trades Unions.

The addition of both payroll and independent researchers was the primary driver of the large increase in total employment at the medical institutions from 2008 to 2019. Both medical and educational institutions contributed to the area’s growth, with medical driving absolute growth, and education experiencing the largest proportional increase with 64% increase from 2008 to 2019, shown in Figure 3 below. This figure includes employees on payroll and non-payroll (not including contract employees and volunteers) over the past decade. These employment numbers exclude the considerable investment and growth attributable to the institutions of the LMA that has occurred outside of the area during this same time. The interviews suggest that the leadership of the institutions of the LMA do not think that the economic uncertainty resulting from the pandemic will reduce their ability to meet long-term growth targets.

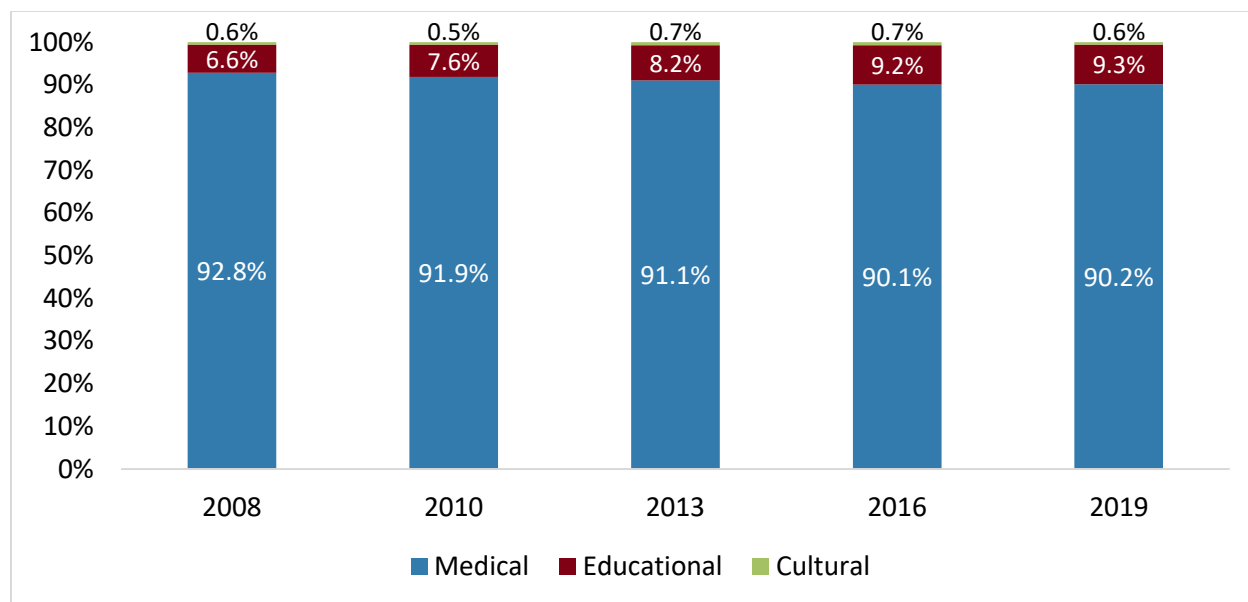
Figure 3: LMA Employment Growth from 2008 to 2019



Source: MASCO member surveys. Note: This graph includes associate member employee numbers and non-payroll workers (researchers and physicians) while excluding contracted employees and volunteers. MASCO itself is included in cultural institutions.

As suggested by the employee and volunteer totals in Figure 2, Figure 4 shows that the medical institutions are the largest employer in the LMA and have been so for years. However, the educational and cultural institutions continue to play a role in the overall growth of the LMA by keeping pace with the employment growth of the hospitals. As shown in the previous figure, both have grown proportionally faster than the medical institutions resulting in stable or increasing shares of total employment.

Figure 4: Share of LMA Employment by Institution Type, 2008-2019



Source: MASCO member surveys Note: This graph includes associate member employee numbers and non-payroll workers (contracted employees, researchers, physicians) while excluding volunteers.

The institutions in the LMA comprise nearly 10% of all jobs in Boston and over 40% of jobs in health care and social assistance. Table 2 shows the employment in the LMA by industry sector in comparison to each sector’s overall employment in the city and state. The LMA’s large share of healthcare and social assistance employment is evident at both the city and state level. The LMA has 41% of all such jobs in the city and nine percent of all healthcare and social assistance jobs in Massachusetts. The LMA’s educational institutions account for 11% of Boston’s educational employment.

Table 2: Employment Numbers by Industry and Share in the Region

Industry Sector	LMA Total	Boston Total	Share of Boston	MA Total
Educational Services	6,116	54,685	11.2%	362,015
Health Care and Social Assistance	59,518	145,208	41.0%	660,270
Other Services, Except Public Administration	173	22,301	0.8%	122,222
Arts, Entertainment, and Recreation	207	11,713	1.8%	69,187
Total	66,014	670,886	9.8%	3,633,365

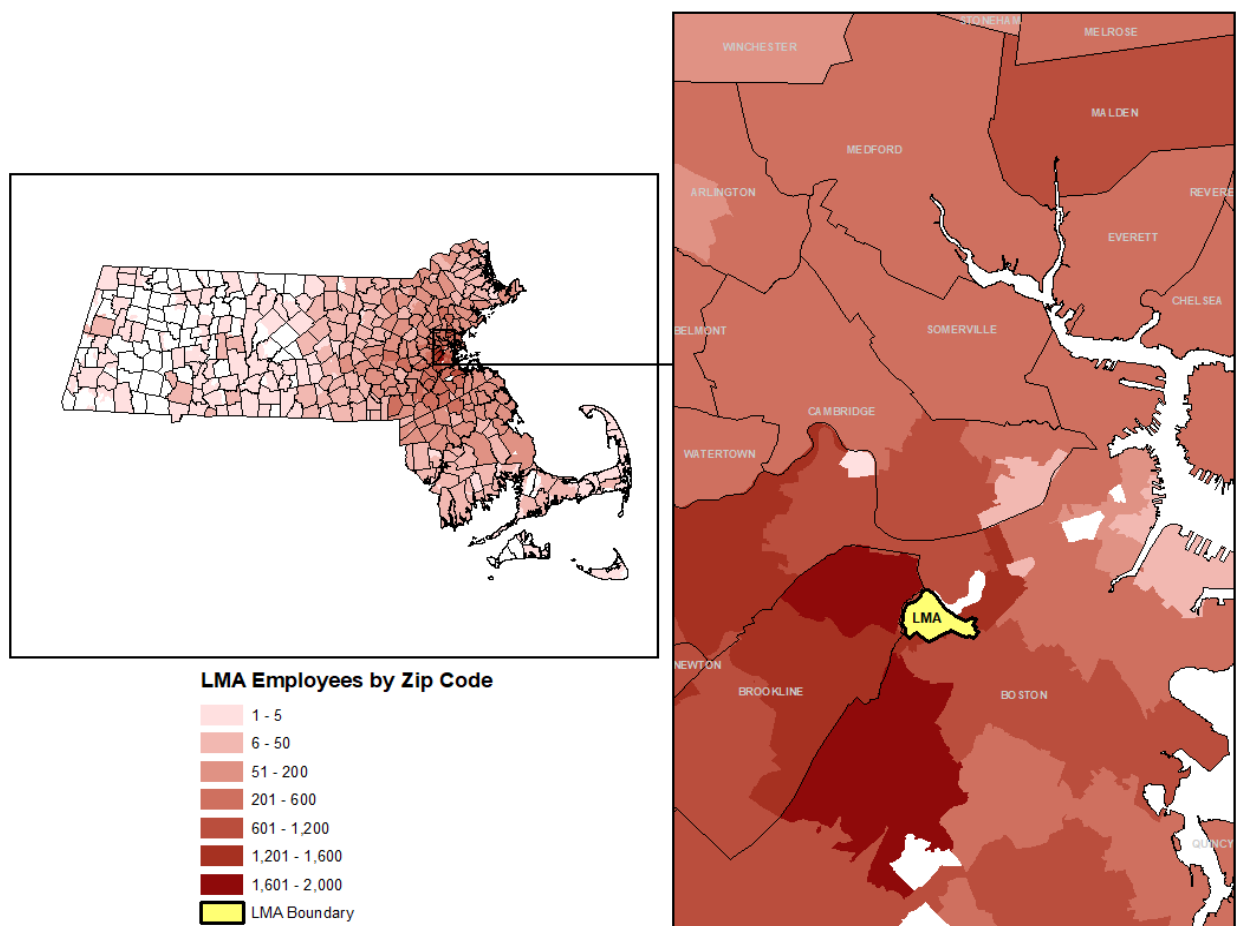
Source: U.S. Bureau of Labor Statistics, ES-202; MASCO member surveys Note: This table includes associate member employee numbers and non-payroll workers (contracted employees, researchers, physicians, and contract employees) while excluding volunteers.

LMA employees come from every county and legislative district in Massachusetts.

The heat map below shows the place of residence of people employed by the LMA. The yellow shaded area of the map is the LMA boundaries. The vast majority of employees (93%) live in Massachusetts and most commute from nearby,

especially the Boston metro area. Notably, 33% of employees live in Boston and come from every neighborhood. However, the map also shows that workers in the LMA are spread across the state. In fact, LMA employees come from every county and legislative district in Massachusetts.

Figure 5: LMA Employment by ZIP Code



Source: MASCO member surveys; UMass Donahue Institute Note: This map only shows the ZIP code of residence of payroll employees living in Massachusetts. Contract workers and those living elsewhere are not shown.

COVID-19 disrupted commuting patterns and may cause some longer-term shifts in the area, though there is an expectation that in the future commuting patterns will generally return to resemble 2019.

Throughout the interviews, there was near unanimity that the institutions of the LMA would retain some remote work going forward. However, there was also consensus that most of the jobs in the LMA would continue to require or benefit from in-person presence, including the medical, teaching, research, food service, cleaning, and maintenance occupations that comprise the bulk of jobs. The two key motivations for continuing some remote work were employee morale (and thus retention) and repurposing freed space for research or other clinical purposes.

Research, Innovation, and NIH Funding

As institutions on the vanguard of innovation, the hospitals, colleges, and universities in the LMA attract significant federal dollars to Massachusetts. This research funding plays a major role in supporting the innovation ecosystem in the state and its associated reputational, workforce, and business creation benefits. The ability of researchers to respond to new challenges is grounded in a foundation of collaboration, in which the strength of the LMA community is unparalleled.

“Over a decade ago, a number of Colorado hospitals voted to move their facilities lock, stock, and barrel to Fitzsimmons Army Campus. They did it to replicate what we have here in the LMA.” – Dick Argys, BCH

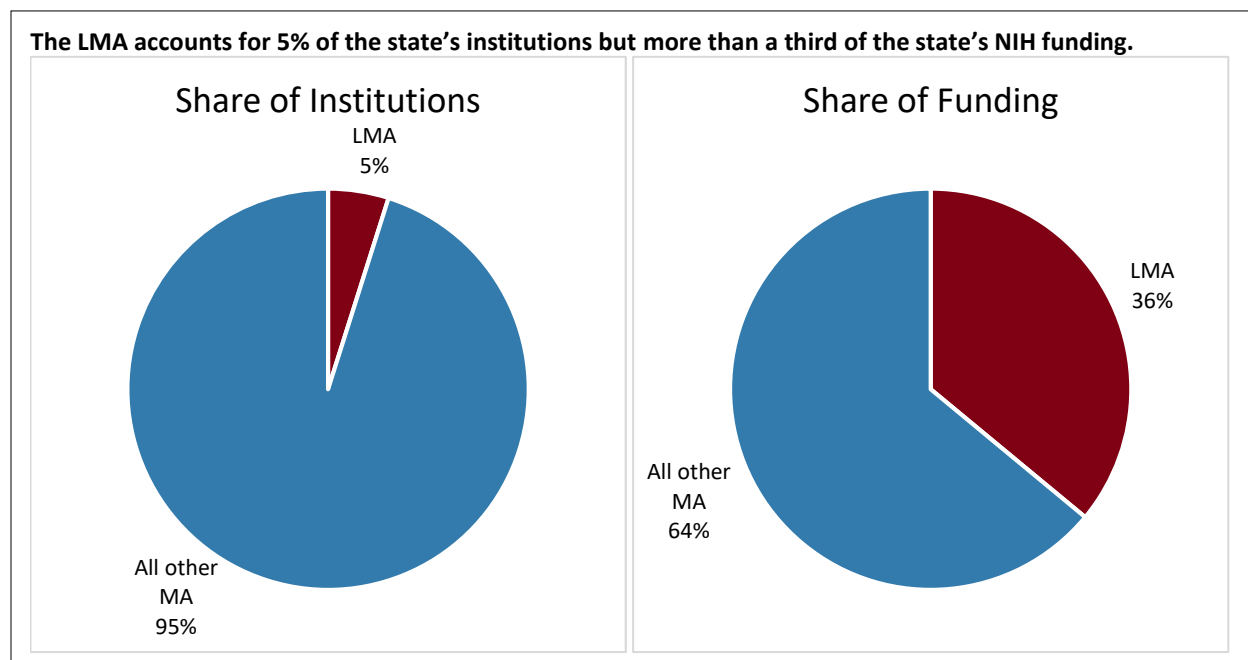
The success supported by the collaboration in the LMA inspires others to attempt to replicate it and propels those that are here to continue investing in it. Dick Argys, Senior Vice President and Chief Administrative Officer at Boston Children’s Hospital, told the UMDI team of his previous experience in Colorado: “Over a decade ago, a number of Colorado hospitals voted to move their facilities lock, stock, and barrel to Fitzsimmons

Army Campus. They did it to replicate what we have here in the LMA.” Laura DeCoste at Harvard Medical School said, “People are trying to use every square inch of the LMA because you can’t underestimate the value of fostering collaboration to boost innovation.”

Much of the funding that supports research in the LMA comes from the National Institutes of Health. The NIH is the largest public funder of biomedical research in the world, investing billions of dollars every year in promising research. The LMA has an outsized impact on the state’s ability to attract NIH funding. In FY2020, LMA institutions received approximately \$1.2 billion of NIH funding from 2,000 awards, representing over a third of the state’s totals despite the LMA comprising less than five percent of all research organizations and 0.004% of the state’s land. Of every dollar the NIH awards to Massachusetts, 36 cents goes to the LMA. Within Boston, the LMA attracts half of all NIH awards and funding, despite comprising only one-fifth of all research organizations. If the LMA were its own state, it would rank eighth nationally in total NIH funding, behind Texas and ahead of Illinois.

LMA institutions received approximately \$1.2 billion of NIH funding from 2,000 awards, representing over a third of the state’s totals despite the LMA comprising less than 5% of all research organizations and 0.004% of the state’s land.

Figure 6: LMA’s Share of State NIH Funding and Institutions Receiving Awards



Source: NIH FY2020 Awards

“Together with our cross-town partner MGH, we are the first and second largest hospital-based research enterprises in the country.” – Bernie Jones, BWH

As top recipients of NIH funding, the LMA’s institutions average \$117 million in awards annually per organization, over seven times as large as the state’s institutional average. According to Bernie Jones at Brigham and Women’s Hospital, “Together with our cross-town partner

MGH, we are the first and second largest hospital-based research enterprises in the country.” Similarly, Boston Children’s Hospital is the largest pediatric research hospital in the country and fourth among all hospitals in NIH funding, behind Vanderbilt University Medical Center.

Though the total dollars awarded per organization is in a class above, the value of the LMA’s average award (i.e. funding amount per proposal approved by the NIH) is roughly similar to that of the nation, state, and city. The conclusion from these two facts is that the scope of research within these institutions is what drives the LMA’s lead in total number of awards and funding. On average, each organization in the LMA received over 200 awards in FY2020 compared to 18 for the other research organizations in Massachusetts. This amount is not just a simple consequence of the size of each organization but also the frequent and multidisciplinary collaboration that occurs *between* organizations. The ability of the LMA to continually win competitive federal research grants further reinforces our findings of its importance as a center of innovation that drives global science forward.

Bob Coughlin, Managing Director in JLL's Life Sciences industry practice and former President and CEO of the Massachusetts Biotechnology Council, said, "The medical community plays a leading role in the life sciences industry in Massachusetts, and it's booming. COVID-19 brought a lot of change to our personal and professional lives, and entire industries are looking to keep their employees remote. But there's some jobs that you can do from home and there are some jobs that you can't. You can't cure a disease or develop a vaccine from your living room. We need lab space, and we need research space, and we need more of it. The LMA is a hotspot of research talent, it draws more research funding than any other area, and I know we are looking at a bright and active future for life sciences, for medicine, and for the LMA here in the Commonwealth."

On average, each organization in the LMA received over 200 awards in FY2020 compared to 18 for the other research organizations in Massachusetts.

NIH funding is only one source of research funds. Industry, philanthropy, the state, and foundations together contribute an amount equal to NIH awards for some hospitals, essentially doubling the total research budget. Thus, total funding for research at LMA institutions could approach as much as \$2.4 billion per year when including private industry and other funding sources. Together this research supports clinical studies, scholarly articles, and spinoff companies. Dana-Farber Cancer Institute alone runs approximately 800 clinical trials at a time, while researchers at Boston Children's Hospital publish 30,000 articles per year.

Between the colleges and hospitals, hundreds of companies have spun out of LMA research. These companies want to stay in Massachusetts to remain close to this research hub.

The recent and ongoing COVID-19 pandemic has galvanized an even higher level of collaboration between the medical and healthcare institutions in the LMA. An effort to drive the science and processes that can combat the public health emergency has developed within and between the LMA's organizations, doctors, researchers, and students. Allison Moriarty, Vice President of Research, Administration and Compliance at Brigham and Women's Hospital provided an example of the benefits of the close relationships in the LMA: "The response to COVID has been a great example of how communities can come together to collaborate and problem solve to move solutions forward quickly. That was an enormous benefit of having such a tight-knit community where these partnerships were already established."

A prime example of the relationships and convening power of LMA institutions is the Massachusetts Consortium on Pathogen Readiness (MassCPR). Formalized by Harvard Medical School on March 2, 2020, MassCPR brought together Boston-based and Chinese researchers weeks before shutdowns were declared in most of the United States. MassCPR is focused on the whole spectrum of issues, from disease surveillance to vaccines, which will need to be addressed in this pandemic as well as any in the future. MassCPR member institutions include all of the hospitals of the LMA, and LMA researchers are involved in steering the consortium.

“The response to COVID has been a great example of how communities can come together to collaborate and problem solve to move solutions forward quickly. That was an enormous benefit of having such a tight-knit community where these partnerships were already established.” – Allison Moriarty, BWH

Other recent pandemic-related efforts have included, but have not been limited to:

- Clinical Care: At the beginning of the pandemic, Beth Israel Deaconess Medical Center and Brigham and Women’s Hospital transformed to focus on the immediate crisis. Brigham and Women’s Hospital played a primary role in standing up the temporary field hospital at the Boston Convention and Exhibition Center, with other medical institutions lending their support.
- Research: Early on, the Beth Israel Deaconess Medical Center Barouch Lab showed that coronavirus antibodies provide immunity to COVID-19 in mammal models. Boston Children’s Hospital Drs. Burns and Friedman and their teams have been at the forefront of defining the “multi-system inflammatory syndrome” in children and working with other institutions to outline research initiatives and treatment for it.
- Vaccine Development: The principal investigators for the Moderna and Johnson & Johnson vaccine trials are in the LMA at Brigham and Women’s Hospital and the Beth Israel Deaconess Medical Center.
- Vaccine Trials: As a part of US Operation Warp Speed, Brigham and Women’s Hospital served as one of 90 test centers, and the only one in New England, for COVID-19 vaccine trials. The Fenway Community Health Center ran trials of the AstraZeneca UK vaccine.
- Materials Development: Beth Israel Deaconess Medical Center, Dana-Farber Cancer Institute, and Brigham and Women’s Hospital all pioneered new strategies for sterilizing and safely reusing PPE in the face of a global shortage. Beth Israel Deaconess Medical Center clinically validated new 3D-designed swabs for testing. Brigham and Women’s Hospital postdoctoral researcher Dr. Srinivasan and team developed a safer way to use a single ventilator for multiple patients (iSAVE).
- Therapies: Boston Children’s Hospital, Beth Israel Deaconess Medical Center, Brigham and Women’s Hospital, Dana-Farber Cancer Institute, and Harvard Medical School researchers are all involved in clinical trials for a variety of therapies that would lessen the negative impacts for patients most hard-hit by COVID-19. Brigham and Women’s Hospital and Beth Israel Deaconess Medical Center were leaders in the Remdesivir trials.
- Drug Development: Multi-center collaboration aims to rapidly identify FDA-approved drugs that can prevent or treat COVID-19 infections. According to the Wyss Institute, “The United States’ Defense Advanced Research Projects Agency signed an agreement worth up to \$16 million over the next year with the Wyss Institute for Biologically Inspired Engineering at Harvard University

to identify and test FDA-approved drugs that could be repurposed to prevent or treat COVID-19.”

- **Communication:** Harvard Medical School students created the COVID-19 Health Literacy Project to deliver COVID-19 public health information in 30 languages, making it more accessible to people around the world. Harvard Medical School and Harvard T.H. Chan School of Public Health scientists have been high-profile speakers at press conferences, on radio, and television and have been advising governments, businesses, and others on how to safely navigate the crisis.
- **Vaccinations:** Beth Israel Deaconess Medical Center and Brigham and Women’s Hospital provided medical oversight at the Fenway Park and Gillette Stadium mass vaccination sites, respectively. Massachusetts College of Pharmacy and Health Sciences is at the forefront of training vaccinators to prepare for the mass rollout of vaccines, and the Temple Israel of Boston is the site host for Beth Israel Deaconess Medical Center’s patient vaccination clinic.

Patients

The LMA is home to some of the most respected medical institutions in the world: Boston Children’s Hospital, Brigham and Women’s Hospital, Beth Israel Deaconess Medical Center, Dana-Farber Cancer Institute, and the Joslin Diabetes Center. Patient referrals are rooted in both the global reputation of these hospitals and the vast network of doctors who trained there. Doug Vanderslice, Executive Vice President and Chief Financial Officer of Boston Children’s Hospital summarized the appeal of the LMA thusly, “We bring in a lot of patients from outside of New England, both nationally and internationally, for care for rare and complex diseases. Few if any other places have the medical, surgical, and nursing expertise and the ancillary services to accommodate them.”

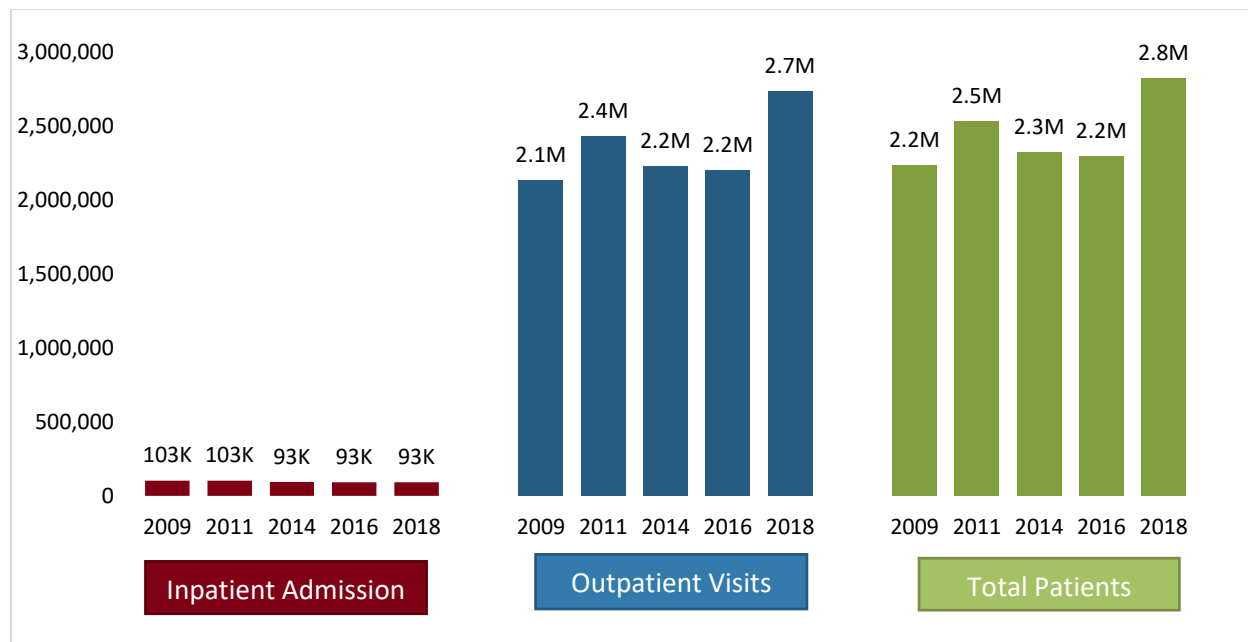
The overall number of patients seen in LMA medical institutions increased from 2.2 million in 2009 to 2.8 million in 2018, or 27%.

The medical institutions of the LMA have continued to attract more patients from around the world, and with them new revenue and economic activity to Massachusetts. They have been able to accomplish this because of the opportunity that the proximity, physical connections, and shared facilities within the LMA provide. The overall number of patients seen in LMA medical institutions increased from 2.2 million in 2009 to 2.8 million in 2018, or 27%.

The annual change in total patients essentially follows that of outpatient visits, which regularly account for well over 90% of total visits. The number of beds available, which are difficult and expensive to increase, limits total inpatients to around 96,000 per year. However, investments and innovations adapted to the LMA’s current land use have allowed the hospitals to grow the number of people who can benefit from the quality of care available without the expense of replacing buildings. Outside of the LMA, the hospitals have also made significant investments to grow their facilities closer to their patients.

Part of this growth in outpatient care seen in the LMA is connected to a national trend. The healthcare industry has been making efforts to improve efficiency and lower costs. As a result, many changes in treatment strategies have occurred in the past few years. There has been a decrease in hospital admissions as more people are served through outpatient care. There are continued efforts from hospitals to make sure that people get the right care at the right time in the right setting, resulting in a drop in inpatient utilization and a corresponding increase in outpatient numbers.

Figure 7: Total Patients and Change over Time in LMA



Source: MASCO member surveys Note: Number of admissions exclude newborns, including neonatal and swing admissions. Inpatients are distinct patients and outpatient visits can be recurring individuals

On the LMA’s bridges and walkways: “Providers at Dana-Farber see patients at Brigham and Women’s and Boston Children’s and can quickly, regardless of traffic or weather, move between those hospitals. In addition, the bridges are beneficial for patients and families - if someone gives birth at the Brigham to a medically fragile or complex infant, the family can use the bridges to move to and from Children’s.” – Kate Audette, DFCI

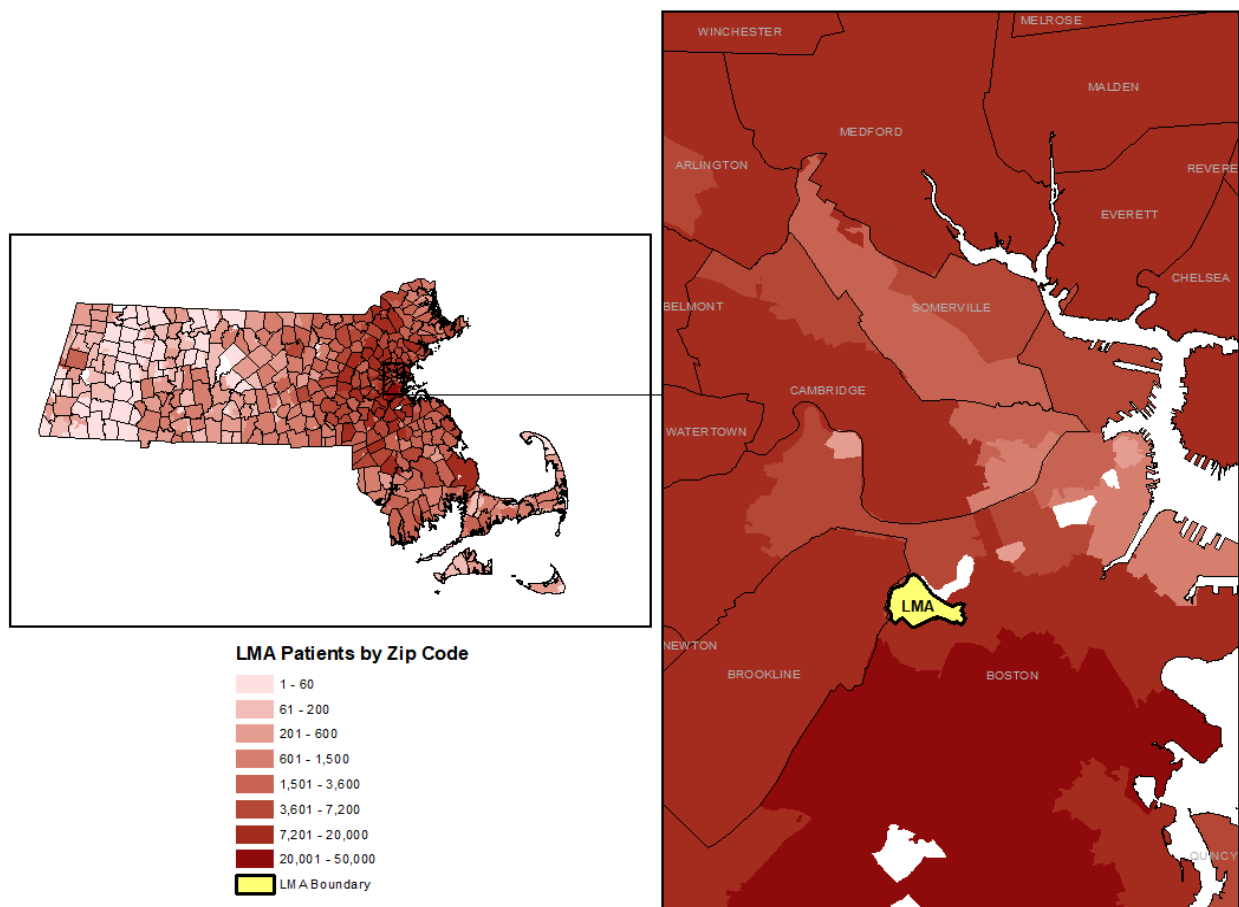
The clinical partnerships between the hospitals are just as important to the success of the LMA as the reputation of the individual hospitals. For example, the doctors at Dana-Farber Cancer Institute staff oncology beds at both Brigham and Women’s Hospital and Boston Children’s Hospital, which not only provides patients the resources of world-class hospitals but also connects them with oncologists at the leading edge of research. This collaboration is not limited to cancer care. A series of bridges and

walkways connect the hospitals in the LMA to allow for the easy movement of doctors, researchers, and

patients. Kate Audette, Director of Governor Affairs at Dana-Farber Cancer Institute described their benefits: “The importance of the bridges and walkways that connect the hospitals can’t be understated. For example, providers at Dana-Farber see patients at Brigham and Women’s and Boston Children’s and can quickly, regardless of traffic or weather, move between those hospitals. In addition, the bridges are beneficial for patients and families - if someone gives birth at the Brigham to a medically fragile or complex infant, the family can use the bridges to move to and from Children’s.”

The map below shows the patient visits to the LMA by their home ZIP code. The medical institutions in the LMA maintain a comprehensive presence outside of the LMA where they can provide services nearer to their patients. The LMA primarily provides health care to local residents, but is also a global destination for specialized treatment. Patients coming from out-of-state represent new economic activity for Massachusetts, as without the LMA they would not have come.

Figure 8: LMA Patient Visits by ZIP Code



Source: MASCO member surveys; UMass Donahue Institute Note: The patient numbers represent visits to the LMA from Massachusetts for which ZIP code level data was available and comprise about half of all visits in 2019. There were patients residing in ZIP codes outside of Massachusetts, however, they are not shown in this map.

Students

The agglomeration of colleges, medical centers, and cultural institutions combine to create a powerful draw for talented students. “We recruit students and faculty from all over the world, and our ability to

“We recruit students and faculty from all over the world, and our ability to form strategic relationships with the internationally-recognized institutions in the LMA is a huge competitive advantage. The people in the LMA want to be a part of the educational experience. They not only want to be world-renowned practitioners but they also want to be world-renowned educators.” – Rick Lessard, MCPHS University

form strategic relationships with the internationally-recognized institutions in the LMA is a huge competitive advantage,” according to Rick Lessard, President of MCPHS University. He also described the passion that doctors and practitioners bring to their work: “The people in the LMA want to be a part of the educational experience. They not only want to be world-renowned practitioners but they also want to be world-renowned educators.”

There are over 27,000 students in the LMA, enough to more than fill the TD Garden. These students are shared between the various Harvard schools, the Colleges of Fenway, Winsor School, Boston Latin School, a preschool, and continuing education students. Harvard Medical School, Harvard School of Dental Medicine, and Harvard T.H. School of Public Health are all in the LMA as are the five institutions of the Colleges of the Fenway.⁴ The Colleges of the Fenway alone comprise close to 19% of Boston’s total students attending four-year colleges and universities. With almost 20,000 students, COF surpasses both UMass Boston (16,000) and Boston College (14,700). Overall, the number of students in the LMA increased 15% from 2008 to 2019, driven in large part by the increase in undergraduate and masters level students.

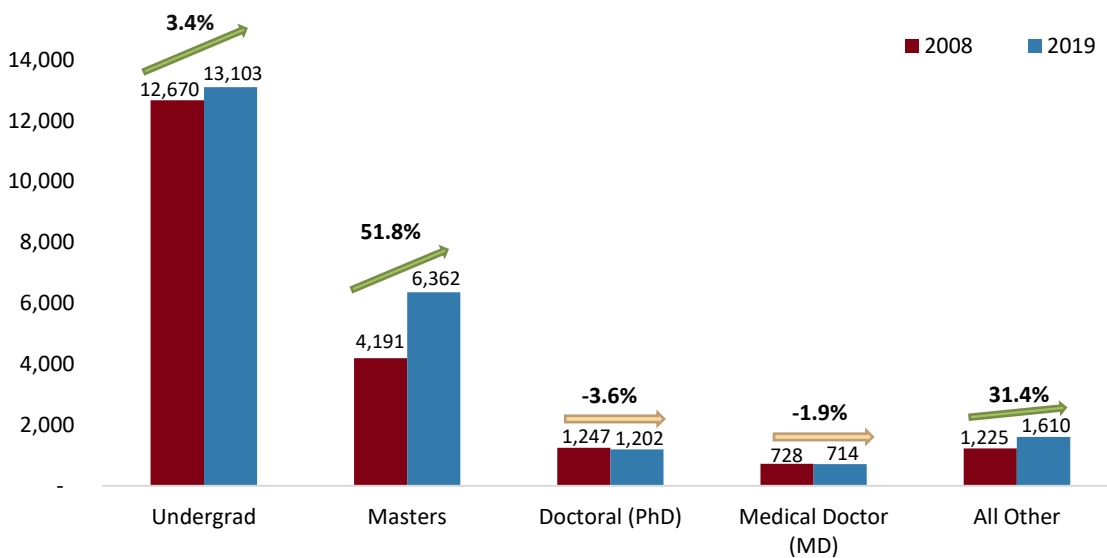
Studies have shown that fewer than 50% of students in Greater Boston intend to stay in the area after graduation. However, 64% of LMA alumni stay in Massachusetts. These institutions are training the future workforce critical to the ongoing economic vitality of Massachusetts.

Master’s students increased by nearly 52% since 2008.

Figure 9 shows the total number of students enrolled in the LMA over time and their breakdown by education level. The total number of students has been increasing since 2008 to almost 23,000 in 2019, about half of whom are undergraduates. The next biggest group, and the one driving growth, is master’s students. Their numbers increased by nearly 52% since 2008.

⁴ The Colleges of the Fenway describes itself as “collaborative of five neighboring Boston-based colleges and universities in the Fenway area.” The Colleges of the Fenway includes Emmanuel College, Massachusetts College of Art and Design, MCPHS University, Simmons University, and Wentworth Institute of Technology.

Figure 9: Changes in LMA Student Populations, 2008-2019

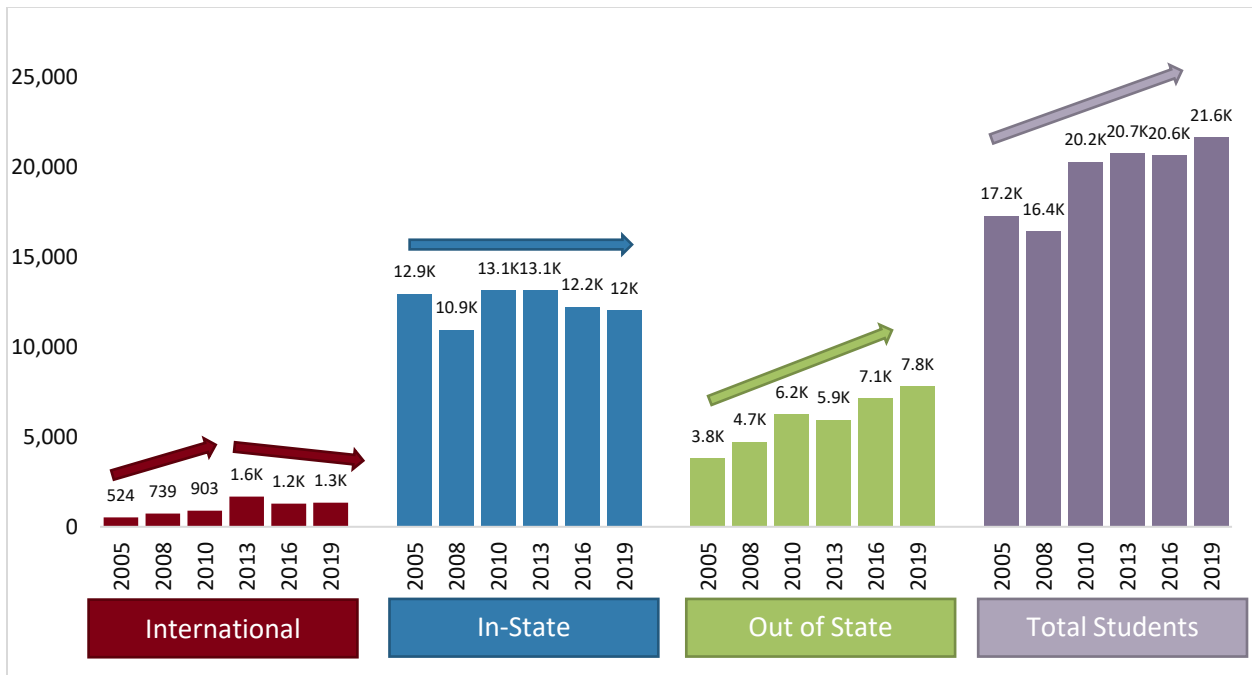


Source: MASCO member surveys Note: The All Other category includes preschool, K-12, academic and religious, and other students. It does not include continuing education/non-traditional and fully on-line students. The number of on-line or remote students has increased, particularly since 2008 from 300 to 3,212 in 2019 or over 10 times.

Another way that the LMA has recently attracted economic activity to Massachusetts has been by bringing in more out-of-state and international students than ever before. Figure 10 shows the demographics of students based on their place of origin. The share of out-of-state and international students has grown by a quarter over the past 15 years, with the number of international students tripling and out-of-state students doubling. This growth has not come at the cost of greatly reduced in-state admissions. In fact, the number of in-state students has remained relatively consistent since 2005, while out-of-state and international students drove top-line growth. During this time, Massachusetts demographics have not supported enrollment growth at colleges: the number of 15-19 year olds has declined by 10% or 47,000 people since 2010. By attracting from outside of Massachusetts, the colleges of the LMA are offsetting demographic headwinds, bringing in new economic activity, and training future global health and business leaders who will have connections to Massachusetts.

The share of out-of-state and international students has grown by a quarter over the past 15 years, with the number of international students tripling and out-of-state students doubling.

Figure 10: Share of MASCO Students' Origins

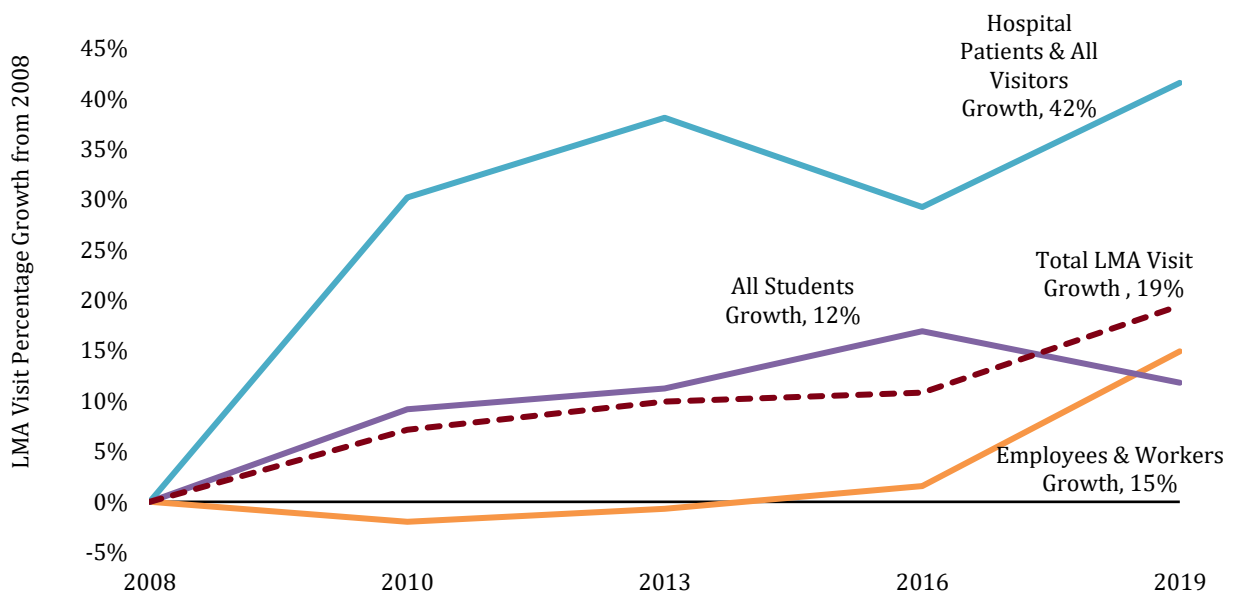


Source: MASCO member surveys

Longwood Medical Area Daily Visits

The LMA is one of the major employment centers in Boston, with more than 120,000 people moving in and out of the LMA every day including employees, students, volunteers, researchers, patients, and visitors. The daily trips to the LMA have been consistently increasing since 2008. From 2008 to 2019, they increased by one-fifth. Recently, from 2016 to 2019, they increased by eight percent. The highest contributor to this growth has been the number of patients and visitors, which has risen 42% since 2008. Figure 11 below shows the number of people who have visited and commuted to the LMA over time.

Figure 11: LMA Daily Visit Growth from 2008 to 2019



Source: MASCO member surveys Note: Associate members are not included in employment numbers. Total LMA visit numbers include employees and workers (volunteers, contracted employees, researchers, and physicians), patients, visitors, and students (including Boston Latin School, childcare to 12th grade, in-person higher education, and continuing education students).

Another way to evaluate visits to the LMA is examining commuter flow data from the US Census Bureau, which includes every establishment in the LMA (not just the MASCO members shown in Figure 5 on page 10). This data shows that the LMA is a major commuting destination, requiring over 61,000 workers to make their way there from across the Commonwealth and beyond. The data also shows that roughly 1,200 people live in the LMA, most of whom work outside the region.

Figure 12: Worker Inflow/Outflow Map for the LMA



Source: US Census Bureau, OnTheMap, 2018

Transportation

Given limited road space, congestion, lack of direct mass transit service, and large numbers of people needing to move in and out of the small area every day, transportation is and will continue to be a central shared challenge for LMA institutions, and improving access will remain critical to the economic success of the LMA, and by extension the Commonwealth. As an organization, MASCO plays a key role in both transportation and land use planning. Maria Megdal, Senior Vice President and Chief Administrative Officer at Dana-Farber Cancer Institute, told the UMDI team, “MASCO’s advocacy on urban planning is unparalleled. It would be a challenge for the institutions to be doing this in one-off arrangements with the city or to keep from unintentionally infringing on one another’s master planning efforts.”

Pre-pandemic, almost half of LMA employees commuted by transit, compared to just a third of Boston residents generally, aided by millions of dollars in member-funded annual MBTA pass subsidies and MASCO’s 37-vehicle shuttle system, which eliminates 1.25 million car rides in the LMA per year.

As a regional and national leader in multi-modal transportation solutions, MASCO's member-driven transportation demand management programs have supported mode shifting towards more transit, walking, and biking. They have done this by making investments in a shuttle system, local walk and bike infrastructure, and advocacy and planning for commuter rail infrastructure. This strategy helps preserve limited roadways for those that need it most, including visitors and patients who have no other choice but to travel by car due to discharge requirements or disability. Pre-pandemic, almost half of LMA employees commuted by transit, compared to just a third of Boston residents generally, aided by millions of dollars in member-funded annual MBTA pass subsidies and MASCO's 37-vehicle shuttle system, which eliminates 1.25 million car rides in the LMA per year. MASCO's transportation programs align with the city's transportation objectives, including promoting forms of travel that reduce reliance on single-occupancy vehicles and reduce congestion and greenhouse gases.

To support MBTA ridership, MASCO operates last-mile shuttles connecting MBTA stations to destinations in the LMA. In addition to park and ride shuttles, these services help keep private vehicles off the roads, reducing congestion and improving air quality. Pre-pandemic, MASCO shuttles transported over 2.6 million riders annually. The service costs \$10 million per year to operate, with major funding coming from Harvard Medical School, Beth Israel Deaconess Medical Center, Brigham and Women's Hospital, and other MASCO members. Early data suggests that at the time of this writing (early March 2021) half of pre-pandemic ridership has already returned.

MASCO is also the area's state-designated Transportation Management Association, known as CommuteWorks, which provides a menu of best-in-class subsidized commuter programs for LMA employees, such as Emergency Ride Home, walk and bike Incentives, and a groundbreaking commuter safety program called Karma Commuting. The TMA has attracted over 10,000 program participants and is central to a districtwide strategy of reducing private, single-occupancy vehicle use among employees, while also enhancing commuter choice and affordability.

Economic Contributions

Up to this point in the report, the data and analysis has focused on the direct contributions of the LMA. This section takes the analysis further by measuring how the LMA’s contributions to employment, payroll, visitation, and non-payroll expenditures spread throughout the economy of Massachusetts.

The LMA’s contribution to the Commonwealth’s economy does not stop at the institutions within its borders. Individuals employed in the LMA spend their money on goods and services, many of which are provided by firms within the Commonwealth. Institutions also make purchases in the form of intermediate goods and services from vendors. For example, Simmons University counted roughly \$30 million of purchases from Boston-based vendors. Students and visitors also spend money on local businesses. City government spends the revenue it receives as well. All of these activities form the economic “ripple effect” of the activity occurring within the LMA.

In order to estimate the statewide economic contributions of the LMA, UMDI used a six-region REMI PI+ economic impact model. REMI models leverage economic and demographic data and linkages between economic actors (firms, workers, and households) to estimate how a change in economic conditions could affect the broader economy. UMDI leveraged the operational data provided by MASCO to form a basis for this economic analysis. The REMI model was then used to estimate the magnitude of the economic activity created across the Commonwealth from the LMA’s operations.

- *The LMA supported over 155,700 jobs in the Commonwealth, 151,300 of which were in the private sector.*
- *The LMA supported 12 jobs elsewhere for every 10 in the LMA.*

Table 3: Summary Inputs to REMI Model

Input	2019
Employment	64,265
Wages (\$M)	\$3,402.3
Student Spending (\$M)	\$0.3
Visitor Spending (\$M)	\$54.1
Local Government Spending (\$M)	\$9.5

Source: MASCO member surveys, UMDI calculations

Though the direct impacts of the LMA are more intensely concentrated around Greater Boston, every region of the state sees economic activity that can be traced back to the LMA. All told, operations at the LMA supported over 155,700 jobs in the Commonwealth, 151,300 of which were in the private sector. Through the multiplying effects of economic linkages, each job in the LMA supported 1.2 jobs elsewhere in the Commonwealth, or 12 jobs for every 10 in the LMA. The majority of these jobs were located near

the LMA in the Metro Boston region, which is made up of Essex, Middlesex, Suffolk, and Norfolk Counties. Most of the remaining jobs are concentrated in the nearby Central and Southeast regions, both of which have close economic linkages to the Metro Boston region. While 100 miles or more removed, 581 jobs in the Pioneer Valley and Berkshires are also supported by the LMA.

The LMA also created or supported almost \$30 billion in output (business revenues) and almost \$18 billion in value added (gross state product), as well as just over \$10 billion in personal income. These 22 establishments create or support approximately three percent of the total \$595.5 billion gross state product of Massachusetts despite comprising only one-hundredth of one percent (0.01%) of all establishments in the state, an impact on the state's economy 200 times larger than the LMA's share of businesses.

Table 4: Summary Results by Region

Region	Total Employment	Private Non-Farm Employment	Output (\$M)	Value Added (\$M)	Personal Income (\$M)
Metro Boston	141,209	137,433	\$27,557.90	\$16,580.20	\$8,158.40
Southeast	7,811	7,469	\$1,017.40	\$622.70	\$1,013.70
Pioneer Valley	521	496	\$75.00	\$43.60	\$48.60
Central	4,828	4,585	\$684.30	\$417.00	\$677.40
Berkshires	60	58	\$11.40	\$6.20	\$3.60
Cape and Islands	1,325	1,273	\$173.70	\$107.40	\$128.70
Massachusetts	155,753	151,315	\$29,519.70	\$17,777.10	\$10,030.40

Source: MASCO member surveys, UMDI calculations, PI*

While the LMA is a major employment center in the Commonwealth, less than half (41.3%) of jobs supported by the economic contributions of the LMA represent people employed by LMA institutions. UMDI estimates that roughly half as many jobs (22.3%) are positions supported by business-to-business spending, such as spending on supplies and contractors. Another third of the positions are estimated to be supported by induced spending, such as the personal consumption spending of individuals who work in the LMA or at a vendor. While the LMA's operations support a number of government positions, through either direct payments or the creation of new tax revenue from economic growth, at 2.8%, public sector employment is a relatively small share of the total employment impact.

Table 5: Employment Impacts by Source

Employment Impacts by Employment Source	Metro Boston	Southeast	Pioneer Valley	Central	Berkshires	Cape and Islands
Private Non-Farm	137,433	7,469	496	4,585	58	1,273
Direct	64,265	0	0	0	0	0
Business to Business	32,871	975	69	641	7	170
Induced	39,716	6,494	427	3,944	51	1,103
<i>Consumption-Based</i>	23,996	3,241	150	2,143	9	418
<i>Other Induced</i>	15,720	3,253	277	1,802	42	685
Government	3,776	342	25	243	1	52
Total Employment by Region	141,209	7,811	521	4,828	60	1,325

Source: MASCO member surveys, UMDI calculations, PI*

Hospitals were the largest employers of persons whose jobs were supported by the LMA, with most of those positions located within the LMA itself. Educational services, another major employer in the LMA, is also well-represented, with most of its jobs located within the LMA. Although employment among LMA institutions is quite significant, the majority of jobs created or supported by the area's activities are actually outside of the LMA.

Table 6 shows the top 10 sectors by employment impact, most of which are in areas of the economy and state that are not directly connected to the LMA. They include industries that benefit from business-to-business spending, such as administrative and support services, professional, scientific, and technical services, and wholesale trade. Other sectors are industries that benefit from an increase in consumer spending, such as real estate, retail trade, and food services and drinking places.

Table 6: Employment Impacts by Top Ten Industries

Employment Impact by Industry Sector (Top Ten Industries)	Metro Boston	Southeast	Pioneer Valley	Central	Berkshires	Cape and Islands
Hospitals; private	59,296	74	6	92	1	10
Construction	14,447	1,859	61	994	2	318
Administrative and support services	8,000	425	37	253	7	126
Retail trade	6,255	1,107	62	674	19	156
Educational services; private	7,239	72	18	87	1	9
Professional, scientific, and technical services	6,984	224	14	149	1	48
Food services and drinking places	5,224	521	21	255	2	189
Ambulatory health care services	3,474	473	37	272	1	48
Real estate	3,685	317	16	176	1	76
Wholesale trade	2,438	255	18	138	1	15
All other industries	20,391	2,141	205	1,495	22	278
Total Private Non-Farm Employment by Region	137,433	7,469	496	4,585	58	1,273

Source: MASCO member surveys, UMDI calculations, PI*

Conclusions

The goal of this study was to evaluate and measure the breadth of the LMA's economic contributions to greater Boston and the Commonwealth of Massachusetts. Through our research, we found that these contributions are significant, broad in impact, and growing at a fast pace. Together, the institutions in the LMA provide a resilient, strong, and stable foundation that will be critical as the city and state look forward to economic recovery from the COVID-19 pandemic.

Though not without its share of challenges, the LMA can be viewed as a microcosm of what the City of Boston strives to be. Diverse leadership, young students partnering with experienced hands, and a spectrum of professions coming together to care for others, educate the future workforce, and innovate. These traits promote the resilience and agility that are important not only in our current crisis, but will also be critical in the future as individuals, businesses, and policymakers begin imagining what a post-pandemic economy and society will look like.

As the host for a unique cluster of medical, educational, and cultural institutions, the LMA is an economic anchor for Boston and Massachusetts. Each of the institutions within the LMA is recognized as a global leader in its respective field and, when acting collectively, the LMA provides the research and innovation that many see as the core competitive advantage of the Bay State.

The LMA creates and supports 12 jobs for each 10 of its own and, despite its small geographical footprint, is responsible for a share of gross state product 200 times its share of employers. These large economic impacts support thousands of workers and touch every community across the Commonwealth.

Previous recessions demonstrated that the “eds and meds” of Massachusetts have historically been resilient industries that are somewhat insulated from macroeconomic cycles, providing both stability in the short-term and some measure of certainty in making long-term investments to support future growth.

The LMA's standing as a well-established center with a stable economic base disguises the area's recent rapid and far-reaching growth. Total employment in the LMA has grown by 30% in just 10 years, double the state's growth during the same time.

Further, unlike many other sectors in the knowledge economy, health care and education offer diverse employment opportunities for workers with varying levels of skill and education, while also providing clear career ladders. LMA institutions take an active role in training the workforce of tomorrow and, by attracting students, professionals, and out-of-state funding, the LMA adds to the overall human capital

of the state. This training, especially in areas of research and specialty care, has also created a web of relationships from Massachusetts to current and future leaders around the world.

While there are numerous economic contributions outlined throughout this report, there are less visible, but no less important, benefits to the broader community. LMA institutions have spent decades working to improve access to health care and education and, more recently, they have renewed their focus on the social determinants of health to lessen disparate health outcomes between races and income groups. The sophistication of leading LMA institutions provides unique opportunities to tackle complex longstanding inequities.

Though not without its share of challenges, the LMA can be viewed as a microcosm of what the City of Boston strives to be. Diverse leadership, young students partnering with experienced hands, and a spectrum of professions coming together to care for others, educate the future workforce, and innovate. These traits promote the resilience and agility that are important not only in our current crisis, but will also be critical in the future as individuals, businesses, and policymakers begin imagining what a post-pandemic economy and society will look like.

As the scale of the COVID-19 pandemic became clearer, the institutions of the LMA were quick to refocus their complex organizations to tackle their immediate challenges. Hospitals and colleges found ways to pursue their missions remotely while also engaging in key research aimed at ending the pandemic. Perhaps this adaptability has been developed over a century of tackling scientific challenges, persisting through two world wars and the Spanish Flu. Maybe the sophisticated business practices of the medical and education sectors prepared the area for these challenges. Or, perhaps the collaborative foundation that was already well-established in the LMA contributed to their resiliency. Whichever it was, the LMA was able to move nimbly and thoughtfully to respond to a crisis that has disrupted the lives of every person in the state and around the world.

Josh Greenberg, Vice President of Government Relations at the Boston Children's Hospital summarized, "At the beginning of the pandemic, the skill with which people pulled together to figure out operational approaches, make decisions, keep people safe, and keep people working is just dramatically different [than what was seen in other sectors]. There is a quality improvement operational culture in the health care system that could be beneficial to lots of other parts of society."

This combination of longevity and innovation positions the LMA to help the city and state rebuild the economy and move forward into the future.

Appendix 1: Economic Modeling Methodological Notes

Employment

For the purposes of estimating its economic contributions, a total of 64,265 people were employed in the LMA in 2019. This includes direct employees as well as physicians and researchers who worked in the LMA but may have been self-employed or employed by an outside institution. It does not include contractors coming into the LMA, such as those who provide services like catering or cleaning, because the economic model would automatically account for those typical services. Including them would have introduced double counting. The total also excludes unpaid interns or volunteers, who are generally excluded from economic accounts.

Of those employees, the vast majority (90.8%) worked in the medical institutions, while most of the remaining workers (8.6%) worked in educational institutions. The remaining workers (less than one percent) worked in the LMA's cultural institutions, or for MASCO itself.

Payroll

Institutions in the LMA paid almost \$3.8 billion in salaries and wages in 2019. As with employment, most of those wages (\$3.1 billion, or 91.1%) were paid by medical institutions. Of the remaining salaries and wages, educational institutions paid \$254.9 million (7.5%), and cultural institutions paid \$47.4 million (1.4%).⁵

Non-Payroll Expenditures

Data provided by MASCO estimated off-campus student spending at \$348,400 in 2019. For the purposes of modeling the LMA's economic impact, that spending was spread across two industries, retail trade and accommodation and food services, based on those two industries' shares of total state spending in 2019.

UMDI also used hospital visitation data provided by MASCO to estimate spending by out-of-state hospital visitors. Using data from the Massachusetts Office of Travel and Tourism to estimate the daily expenditure of out-of-state visitors, UMDI derived an estimate of \$54.1 million, or roughly \$200 per hospital visitor, which would likely have not been spent in Massachusetts had these hospital visitors not travelled to the LMA.

UMDI also noted the \$9.5 million in payments in lieu of taxes (PILOT) made by MASCO members in 2019. While many MASCO members noted other, non-direct financial community benefits, this analysis

⁵ MASCO did not provide payroll data on its own employees, so for the purposes of modeling economic impacts, UMDI assumed that those salaries were in line with similar professional organizations.

focused only on cash payments to the City of Boston, which UMDI assumed would translate into additional local government spending as the city incorporated these payments into its budget.

Table 7: Inputs to REMI Model

Input	2019
Industry Employment (Educational Services)	5,543
Industry Employment (Hospitals)	58,356
Industry Employment (Museums)	212
Industry Employment (Professional Organizations)	154
Wages (Educational Services)	\$254.9 M
Wages (Hospitals)	\$3.1 B
Wages (Museums)	\$47.4 M
Consumption Demand (Retail)	\$0.2 M
Consumption Demand (Food Services and Drinking Places)	\$0.1 M
Visitor Spending	\$54.1 M
Local Government Spending	\$9.5 M

Source: MASCO member surveys, UDMI calculations

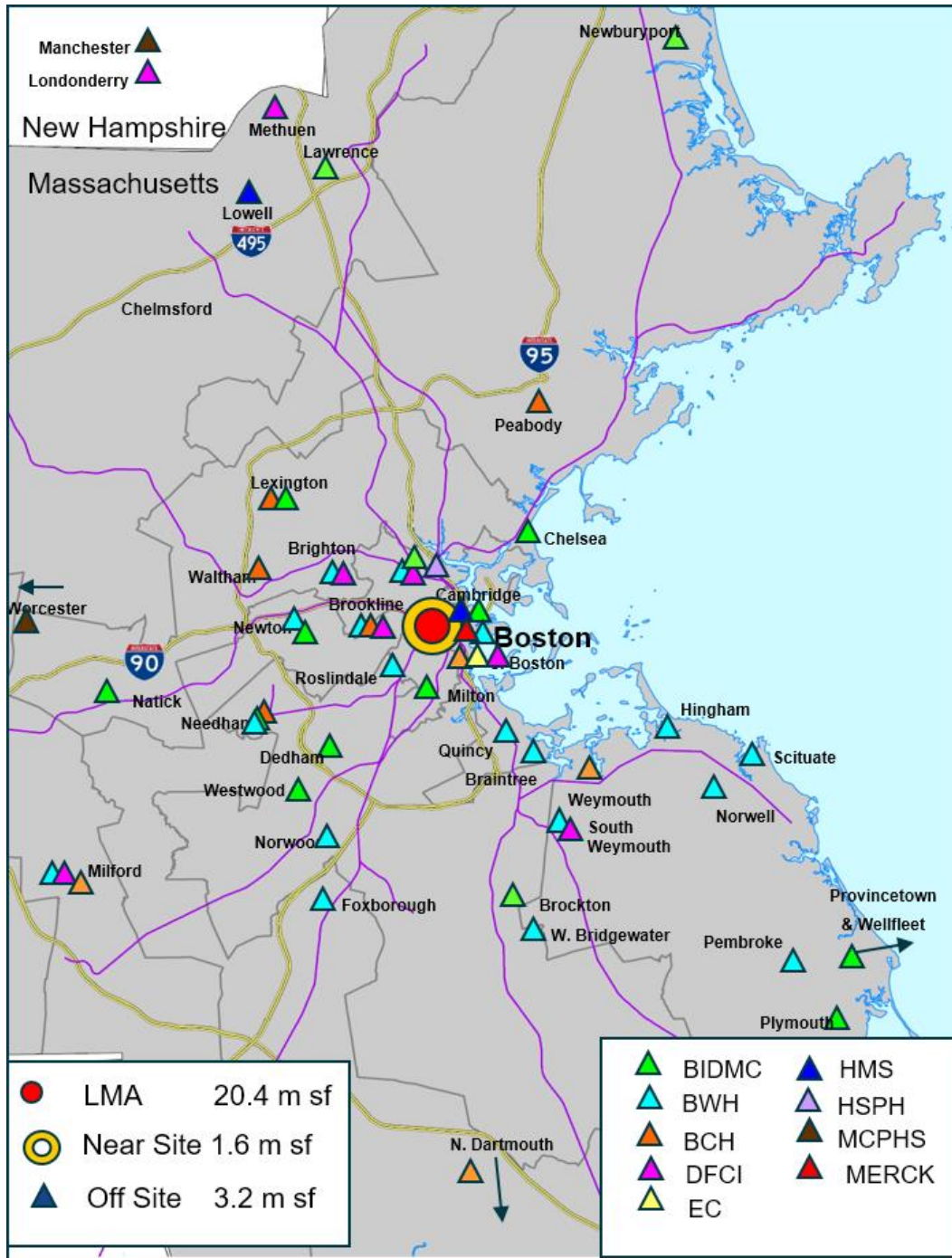
Appendix 2: List of MASCO Members

Table 8: List of MASCO Member Institutions

MASCO Members	Institution Type
Beth Israel Deaconess Medical Center	Medical Institution
Brigham and Women's Hospital	Medical Institution
Boston Children's Hospital	Medical Institution
Dana-Farber Cancer Institute	Medical Institution
Emmanuel College	Educational Institution
Harvard University	Medical Institution
Medical School	
School of Dental Medicine	
T.H. Chan School of Public Health	
Isabella Stewart Gardner Museum	Cultural Institution
Joslin Diabetes Center	Medical Institution
Judge Baker Children's Center	Medical Institution
Massachusetts College of Art and Design	Educational Institution
MCPHS University	Educational Institution
Massachusetts Mental Health Center	Medical Institution
Simmons University	Educational Institution
Temple Israel	Cultural Institution
Wentworth Institute of Technology	Educational Institution
The Winsor School	Educational Institution
Associate Members	
Boston University Wheelock College of Education and Human Development	Educational Institution
Fenway Community Health Center	Medical Institution
Massachusetts Eye and Ear Infirmary, Longwood Campus	Medical Institution
Merck Research Laboratories	Medical Institution

Appendix 3: Regional Presence of LMA Institutions

Figure 13: Map of Regional Locations of LMA Institutions



Appendix 4: List of Interviewees

Table 9: List of Interviewees

Institution	Name	Title
Beth Israel Deaconess Medical Center	Walter Armstrong	Senior Vice President of Capital Facilities and Engineering
Boston Children's Hospital	Dick Argys	Chief Administrative Officer
	Doug Vanderslice	Executive Vice President of Finance, Real Estate, and IT and Chief Financial Officer
	Josh Greenberg	Vice President of Government Relations
	Kate Lewandowski	Senior Project Manager
Brigham and Women's Hospital	Allison Moriarty	Vice President of Research Administration and Compliance
	Bernie Jones	Vice President of Public Policy and Chief of Staff
Dana-Farber Cancer Institute	Kate Audette	Director of Government Affairs
	Lesley Solomon	Senior Vice President for Innovation and Chief Innovation Officer
	Maria Megdal	Senior Vice President, Chief Administrative Officer
	Melany Duval	Senior Vice President, Chief Philanthropy Officer
Harvard Medical School	Jennifer Ryan	Chief of Staff
	Laura DeCoste	Chief Communications Officer
Mass College of Pharmacy and Health Sciences University	Rick Lessard	President