Characteristics of Workers and Jobs in the Massachusetts Health Care Industry

Chapter 224 Workforce Impact Study

Prepared by:
Commonwealth Corporation and
Center for Labor Markets and Policy, Drexel University

Prepared for:
The Commonwealth of Massachusetts
Office of the State Auditor

December 2016

Contents

Introduction

Our previous work examining healthcare labor markets in Massachusetts found major changes in the delivery of health care services that are reflected in sizable shifts in employment across the four sub-sectors of the state's health care industry. The delivery of health care services has changed from predominantly inpatient to outpatient delivery with a focus on providing care to patients in their own homes. An increase in home-based care has meant relative reductions in the role of providing services in institutional based care settings primarily in in nursing homes and hospitals. This trend is reflected in health care employment patterns, with a very rapid growth in payroll employment levels in home health care and individual and family services—healthcare sub-sectors that employ substantial numbers of workers in direct care occupations, as well as a slowdown of hospital employment growth and a decline in nursing home employment.

Employment in these rapidly growing subsectors is dominated by workers employed in direct care occupations include home health aides, personal care aides and attendants, community health workers, and social and human service assistants. These direct care workers are engaged in providing direct care services to the elderly, those with chronic conditions and individuals with disabilities, but have little to no formal health or medical education or training.

These changes in employment across different components of the state's health care industry have meant changes in the characteristics of the health care workforce and patterns of employment in the industry that are documented in other papers prepared as part of our study of healthcare labor market . In this paper we examine these changes from a different perspective focusing on the demographic characteristics, employment intensity and patterns of work (weekly hours, full-time employment, annual weeks, and annual hours), and the level and distribution of annual earnings of the health care workforce in Massachusetts.

The paper examines changes that have occurred in the demographic traits and the employment patterns and earnings of the state's health care workforce between 2011, the year before the passage of Chapter 224, and the most current year for which data are available, 2015. Our analysis in this paper is based on two combined years of American Community Survey (ACS) data with 2010-2011 averages representing the pre-Chapter 224 period and 2014-2015 averages representing the most recent period. We chose to use two combined years of ACS data

in order to obtain a sufficiently large sample to produce statistically reliable estimates. Details about data are presented in the next section.[1]

The first part of the paper presents the demographic characteristics of the health care workforce in Massachusetts including gender, race-ethnicity, nativity, age, educational attainment, disability and veteran status of the state's health care and non-health care workforce. This section presents the demographic traits of the entire health care workforce as well as workers in each of the four sub-sectors of the state's health care industry and the state's non-health care workforce. Demographic traits are presented for 2010-11 and 2014-15 identifying changes that have occurred in the demographic traits of health care workers in the state over the four years period.

The second section of this paper focuses on the employment characteristics of workers including the intensity and patterns of employment, and the level and distribution of annual earnings. We examine a number of measures of employment intensity including weekly and annual hours of work, annual weeks of work, and measures of employment patterns including the incidence of full-time employment and full-time and year-round employment among workers. Measures of the intensity of employment are presented for all health care workers across the state and in each sub-sector of the state's health care industry, as well as for the state's workforce outside the health care sector.

Findings from our examination of earnings are focused on the level of mean annual earnings of the health care and non-health care workforce for workers employed in major occupations within the health care industry. We also present an analysis of the distribution of annual earnings in the health care and non-health care sectors of the state and within the workforce of the four health care sub-sectors including changes that have occurred in these measures over the four-year period.

Demographic Characteristics of the Health Care Workforce in Massachusetts

In this section of the paper we present an examination of the demographic characteristics of the health care workforce in Massachusetts in 2010-11 and 2014-15 and changes that have

[1] See Appendix A for more details on data and methods for this section.

occurred in the traits of the health care workforce of the state over the four-year period. This section presents a comprehensive portrait of the state's health care workforce with an examination of a number of demographic traits of the workforce including gender, race-ethnicity, nativity, age, educational attainment, disability and veteran status. The examination is presented for all health care workers and health care workers in the four sub-sectors of the health care industry sector as well as workers employed in non-health care industries in Massachusetts.

We have defined the health care industry to include the following four industries: ambulatory care, hospitals, nursing homes and residential care facilities, and individual and family services. The rationale for our industry-based rather than occupation-based definition of the health care workforce and the reason for including the individual and family services industry in the health care industry are described in detail in our baseline paper, *Health Care Employment, Structure, and Trends in Massachusetts*.[2]

Our analysis of changes in employment across the four sub-sectors of the Massachusetts health care sector over the post-2012 period found uneven changes in employment across the four sub-sectors. Between 2012 and 2015, compared to the employment growth of 75,000 jobs or 15.5 percent the state's entire health care industry, employment growth in the health care sub-sectors varied from just 2.6 percent in nursing and residential care facilities and 3.3 percent in hospitals to 12 percent in the ambulatory health care sub-sector, and 126 percent in the individual and family services sub-sector. Nearly 63 percent of the total employment growth in the state's health care industry between 2012 and 2015 (47,000 out of 75,000) was from the individual and family services sub-sector even though it comprised only 8 percent of total employment in the state's health care sector in 2012 (37,300 out of 481,600).[3] These uneven changes in health care employment across sub-sectors have resulted in uneven changes in health care occupational employment between 2012 and 2015. Employment in health care practitioner fields increased by just 3 percent while personal care and service occupations grew by 21 percent over the three-year

[2] "Health Care Employment, Structure, and Trends in Massachusetts," Chapter 224 Baseline Study, Prepared for Office of State Auditor, Commonwealth of Massachusetts, by Commonwealth Corporation and the Center for Labor Markets and Policy, Drexel University, July 2014.

[3] See "Health Care Employment, Structure, and Trends in Massachusetts," Chapter 224 Workforce Impact Study, Prepared for Office of State Auditor, Commonwealth of Massachusetts, by Commonwealth Corporation and the Center for Labor Markets and Policy, Drexel University, December 2016.

period; with employment of home health aides growing by 24 percent and personal care aides by 54 percent.[4]

Our examination of the changes in the demographic characteristics of the health care workforce in Massachusetts is based upon a comparison of the demographic portrait of the workforce employed in the four health care sub-sectors in Massachusetts in 2010-11, before the passage of the Chapter 224 health care cost containment legislation, and 2014-15, the most recent time period for which data are available. The Massachusetts workforce is defined as all workers employed in Massachusetts regardless of where they reside. The Massachusetts health care workforce includes workers employed in the health care sector in Massachusetts regardless of their place of residence. For example, a medical assistant who is employed in the Greater Lawrence Family Health Center in Lawrence and resides across the border in New Hampshire is included as part of the Massachusetts health care workforce. This definition of the workforce is similar to that measured using the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW). Both capture the same concept of the health care workforce—all workers who are employed in the Massachusetts health care sector regardless of where they live.

Gender

The health care workforce in Massachusetts is overwhelmingly female. In 2014-15, over three-quarters (76.1%) of the state's health care workers were women, up slightly from 75 percent in 2010-11. The share of women in industries outside of health care was much smaller (44%) and women comprised nearly half of the state's overall workforce in 2014-15. Within the health care sector, women made up 78 percent of the 2014-15 workforce in the ambulatory care and individual and family services sectors and about 75 percent of the hospital and nursing and residential care sectors. All four health care sub-sectors staff three-quarters or more of their workforce with women. Between 2010-11 and 2014-15, the share of female workers declined in the nursing and residential care sub-sector and rose in the remaining three health care sub-sectors.

[4] See: "Special Topics Report: Selected Health Care Support and Direct Care Occupations in Massachusetts," Prepared by Commonwealth Corporation and the Center for Labor Markets and Policy, Drexel University for the Commonwealth of Massachusetts Office of the State Auditor, September 2015.

Table 1: Percent of Women in the Workforce, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Industry Sector	Female Share of the Workforce, 2010-11	Female Share of the Workforce, 2014-15	Absolute Change in the Female Share (Percentage Points)
Health Care Sector, Total	75.0	76.1	1.1
Ambulatory Care	76.2	77.9	1.7
Hospitals	73.1	74.8	1.7
Nursing and Residential Care Facilities	78.2	75.1	-3.1
Individual and Family Services	73.0	77.7	4.7
Non-Health Care Sectors	44.4	44.0	-0.4
All Industry Sectors	48.9	48.8	-0.1

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

Race-Ethnicity

The health care workforce in Massachusetts increased from 473,600 in 2010-11 to 522,000 in 2014-15, representing an increase of 48,400 or 10 percent. Although the workforce grew across all race-ethnicity groups, the rate of growth varied widely. The White workforce grew by just 3 percent or 11,200 workers, while the Black workforce, representing the second largest race group in the state's health care workforce, increased by one-third or 16,400 workers. The number of Hispanic workers in the state's health care sector increased sharply from 35,000 workers in 2010-11 to 49,500 in 2015-16, an increase of 14,500 workers or 41 percent. The state's Asian workforce in health care grew by 23 percent adding about 5,000 workers over the four-year period.

The workforce in industries outside of health care also increased over the four-year period, albeit at a slower pace; increasing by 204,500 workers or 7 percent. The rates of growth across race-ethnicity groups in non-health care industries were similar to trends in the health care sector, with the slowest growth occurring among White workers, 3.6 percent over four years between 2010-11 and 2014-15. Unlike the health care industry, where Hispanic workers made up the third largest group, Hispanics were the second largest race-ethnicity group in the non-health industries.

Table 2: Change in the Workforce by Race-Ethnicity, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Race-Ethnicity	2010-11	2014-15	Absolute Change	Relative Change	2010-11	2014-15	Absolute Change	Relative Change
	Health Care Sector				Non-Health Care Sectors			
White, Non-Hispanic	358,152	369,330	11,178	3.1%	2,222,388	2,302,556	80,168	3.6%
Black, Non-Hispanic	49,142	65,572	16,431	33.4%	128,642	150,153	21,511	16.7%
Hispanic	34,975	49,435	14,460	41.3%	210,711	273,667	62,956	29.9%
Asian, Non-Hispanic	22,077	27,093	5,017	22.7%	149,822	185,009	35,187	23.5%
Other, Non-Hispanic	9,276	10,584	1,308	14.1%	56,884	61,588	4,704	8.3%
Total	473,620	522,013	48,393	10.2%	2,768,446	2,972,971	204,526	7.4%

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

The rate of growth in the non-health care workforce over this period varied from 30 percent among Hispanic workers, 24 percent among Asian workers and 17 percent among Black workers.

The wide variation in the rate of workforce growth across race-ethnicity groups between 2010-11 and 2014-15 led to a change in the race-ethnicity composition of the workforce in the health care as well as non-health care industries in Massachusetts. Between 2010-11 and 2014-15 the share of White workers in the Commonwealth's health care sector dropped by nearly 5 percentage points (75.6% to 70.8%). This was a larger decline than the 3 percentage point

Table 3: Percentage Distribution of the Workforce by Race-Ethnicity, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Race-Ethnicity	2010-11 (Percent)	2014-15 (Percent)	Absolute Change (Percentage Points)	2010-11 (Percent)	2014-15 (Percent)	Absolute Change (Percentage Points)
	Health Care Sector			Non-Health Care Sectors		
White, Non-Hispanic	75.6	70.8	-4.8	80.3	77.4	-2.9
Black, Non-Hispanic	10.4	12.6	2.2	4.6	5.1	0.5
Hispanic	7.4	9.5	2.1	7.6	9.2	1.6
Asian, Non-Hispanic	4.7	5.2	0.5	5.4	6.2	0.8
Other, Non-Hispanic	2.0	2.0	0.0	2.1	2.1	0.0

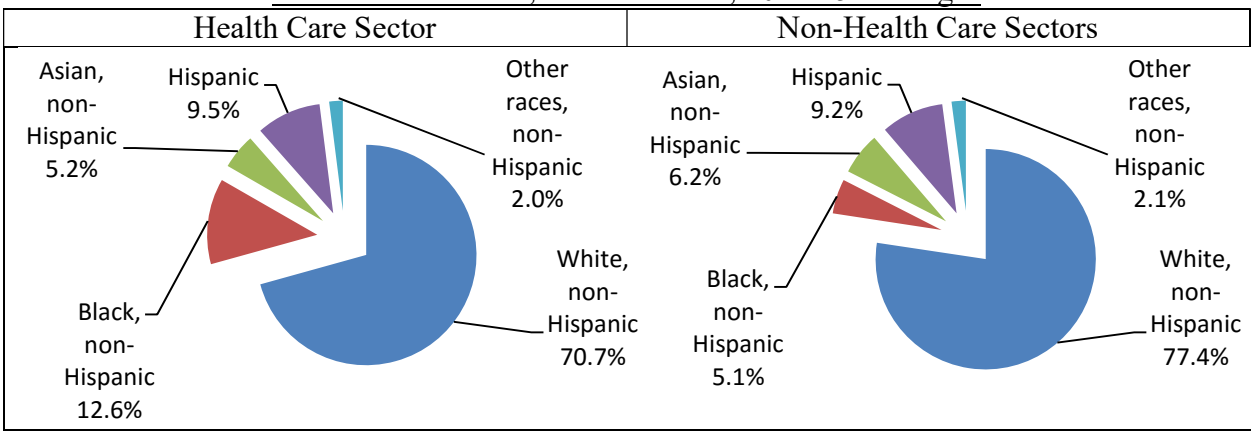
Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

decline in the share of White workers in the state's non-health care industries over the same four-year period (80.3% to 77.4%).

The share of Black and Hispanic workers increased in both health care and non-health care sectors, but the health care sector saw a much higher increase in the share of Black and Hispanic workers than the non-health care sectors. The Black share of the health care workforce in Massachusetts rose by 2.2 percentage points versus 0.5 percentage points in non-health care industries. The Hispanic share of the workforce increased by 2.1 percentage points in the health care sector versus 1.6 percentage points in industries outside the health care sector.

These changes widened the gap between the race-ethnicity composition of the state's health care and non-health care industries. In 2014-15 the state's health care industry employed a larger share of non-White workers than non-health care industries. Nearly 71 percent of the state's health care workforce consisted of White workers compared to 77 percent of the workforce outside the health care sector. In 2014-15, Black workers comprised 12.6 percent of the state's health care workforce. This was nearly 2.5 times higher than the 5.1 percent share of Black workers in the state's non-health care workforce. The share of Hispanic workers in the health care sector exceeded that of their non-health care counterparts (9.5% versus 9.2%) while Asian workers comprised a smaller share of the state's health care workforce (5.2%) than the non-health care workforce (6.2%).

Chart 1: Percentage Distribution of the Workforce by Race-Ethnicity, Health Care and Non-Health Care Sectors, Massachusetts, 2014-15 Averages



Source: 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

An examination of the changes within sub-sectors of the health care industry between 2010-11 and 2014-15 found sizable changes in the race-ethnicity composition of the workforce in each of the four sub-sectors. The share of White workers declined in all four health care sub-sectors with the largest percentage point decline in the individual and family services and ambulatory care sub-sectors where the White share of the workforce fell, respectively by 8.2 and 6.2 percentage points. In 2014-15, White workers comprised 65 percent of the workforce in individual and family services, down from 73 percent in 2010-11. Meanwhile, the share of Black workers increased from 10.3 percent in 2010-11 to 14.6 percent in 2014-15 and the share of Hispanic workers increased from 11.8 percent to 15.4 percent. The ambulatory care sector saw an increase in the share of Black and Hispanic workers of 2.7 and 1.9 percentage points, respectively; and an increase of 1.2 percentage points in the share of Asian workers.

In 2014-15, the race-ethnicity of the state's health care workforce varied across each of the four health care sub-sectors. White workers accounted for 74 percent of ambulatory care workers, 73 percent of hospital workers, and only 65 percent and 62 percent, respectively, of the workforce in individual and family services and nursing and residential care facilities. There was considerable concentration of Black workers in the nursing and residential care sector (23.5%) and the individual and family services sector (14.6%). In the state's hospital and ambulatory care sectors, Black workers accounted for about ten percent of the workforce. The share of Hispanic workers was higher in individual and family services (15.4%) and nursing and residential care (10%) relative to ambulatory care (9.1%) and hospitals (8.1%).

Table 4: Percentage Distribution of the Workforce by Race-Ethnicity in Sub-Sectors of the Health Care Industry, Massachusetts, 2010-11 and 2014-15 Averages

2014-15 (Percent)	White, Non-Hispanic	Black, Non-Hispanic	Hispanic	Asian, Non-Hispanic	Other, Non-Hispanic
Ambulatory care	74.4	9.5	9.1	5.1	1.8
Hospitals	73.0	9.8	8.1	7.2	2.0
Nursing and residential care facilities	62.0	23.5	10.0	2.2	2.3
Individual and family services	65.1	14.6	15.4	2.6	2.2

2010-11 (Percent)	White, Non-Hispanic	Black, Non-Hispanic	Hispanic	Asian, Non-Hispanic	Other, Non-Hispanic
Ambulatory care	80.6	6.8	7.2	3.9	1.6
Hospitals	76.5	9.1	5.3	7.3	1.8
Nursing and residential care facilities	64.4	20.9	10.5	1.6	2.7
Individual and family services	73.3	10.3	11.8	1.7	2.9

Absolute Change (Percentage Points)	White, Non-Hispanic	Black, Non-Hispanic	Hispanic	Asian, Non-Hispanic	Other, Non-Hispanic
Ambulatory care	-6.2	2.7	1.9	1.2	0.2
Hospitals	-3.5	0.7	2.8	-0.1	0.2
Nursing and residential care facilities	-2.4	2.6	-0.5	0.6	-0.4
Individual and family services	-8.2	4.3	3.6	0.9	-0.7

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Samples (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

Nativity

The ACS survey gathers data from all respondents regarding their place of birth to determine the nativity status of the population. Using ACS data, we have estimated the foreign-born share of the state's health care workforce. Foreign-born individuals include those who were born outside the U.S. or in one of its outlying areas. The foreign-born population identified in the ACS data files includes those who are legal permanent residents, naturalized citizens, refugees, temporary residents such as students or workers with temporary visas, as well as undocumented migrants. The ACS identifies foreign-born individuals but does not identify their visa status or whether they are undocumented.

The share of foreign-born workers is higher in the health care sector than in non-health care industries. Over 22 percent of the state's health care workforce was foreign-born in 2014-15; up from 20.5 percent in 2010-11. Foreign-born workers accounted for 19.6 percent of the non-health care workforce of the state in 2014-15, up from 18.5 percent at the beginning of the decade in 2010-11.

The share of the foreign-born workers in the health care workforce varies widely within the health care industry. In 2014-15, the highest share of foreign-born workers was in the state's nursing and residential care sub-sector. More than 31 percent of the workforce in this sub-sector was comprised of workers who were born abroad. This segment of the health care industry has a higher concentration of entry-level and non-clinical workers, a much different occupational staffing pattern than the remaining three health care sub-sectors. Nearly 53 percent of the workforce in the state's nursing and residential care sub-sector were employed in health care support and service occupations, such as home health aides and personal care aides, compared to 29 percent in individual and family services, 24 percent in ambulatory care, and 16 percent in hospitals. In 2014-15, foreign-born workers comprised 21 percent of the state's hospital workforce, 20 percent in the ambulatory care sub-sector, and 19 percent in the individual and family services sub-sector of the state.

Table 5: Percent of Foreign-Born Workers in the Workforce, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Industry Sector	Percent Foreign-Born, 2010-11	Percent Foreign-Born 2014-15	Absolute Change, Percentage Points
Health Care Sector, Total	20.5	22.3	1.8
Ambulatory Care	16.0	20.1	4.1
Hospitals	20.8	21.0	0.2
Nursing and Residential Care Facilities	29.5	31.3	1.8
Individual and Family Services	19.0	19.1	0.1
Non-Health Care Sectors	18.5	19.6	1.1
All Industry Sectors	18.8	20.0	1.2

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Between 2010-11 and 2014-15, each of the four health care sub-sectors saw an increase in the share of foreign-born workers. The ambulatory care sub-sector had a 4 percentage point

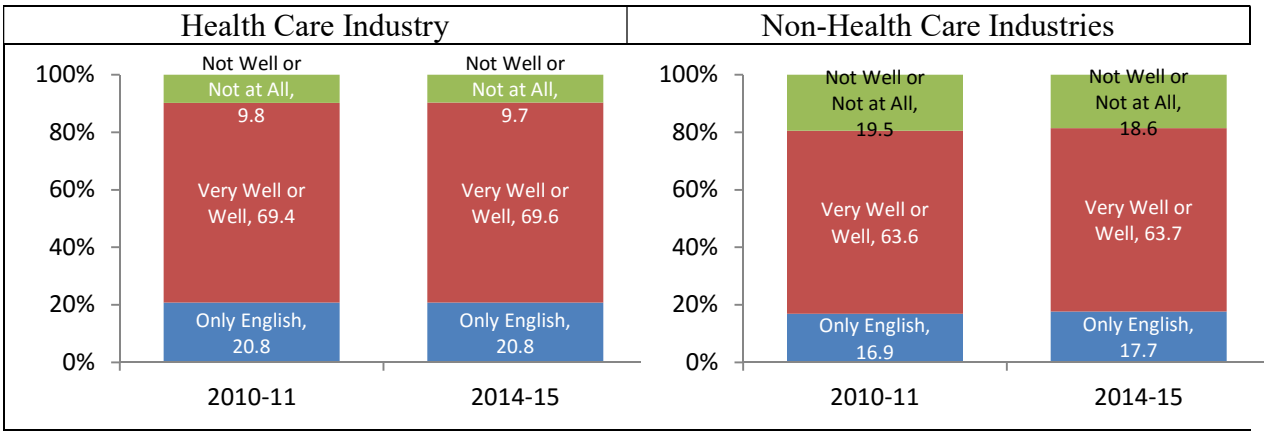
increase in the share of foreign-born workers; from 16 percent in 2010-11 to 20 percent in 2014-15. In the remaining three health care sub-sectors, the increase in the share of foreign-born workers ranged from 1.8 percentage points in nursing and residential care facilities to just 0.2 and 0.1 percentage point increases, respectively, in the hospital and individual and family services sub-sectors.

English Speaking Ability

The ACS questionnaire asks respondents who speak a language other than English at home about their English speaking ability. Respondents are asked to rate their English speaking ability on the following four point scale: 1=speaks English very well, 2=speaks English well, 3=speaks English but not well, and 4=does not speak English.

According to the self-rated English speaking ability of the foreign-born health care workforce in Massachusetts in 2014-15, 21 percent spoke only English, 70 percent spoke English very well or well, and 10 percent had limited English speaking ability (most of whom speak English but not well and only 2 percent do not speak English at all). The English speaking ability of the state's health care workforce is almost unchanged between 2010-11 and 2014-15.

Chart 2: Percentage Distribution of the Foreign-Born Workforce by Self-Rated English Speaking Ability, Health Care and non-Health Care Industries, Massachusetts, 2014-2015 Averages



Source: 2014, and 2015 American Community Survey Public Use Microdata Samples (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

In 2014-15, the state's foreign-born workforce outside the health care industry was nearly twice as likely as the health care workforce to have limited English speakers—19 percent of

foreign-born workers outside the health care sector compared to nearly 10 percent among their health care peers. Almost 64 percent of the state's non-health care workforce spoke English very well or well and 18 percent spoke only English. Among workers outside the health care sector there was a slight increase in the share of foreign-born workers who spoke only English, no change in the share of workers who spoke English very well or well and a small decline in the share of limited English speakers between 2010-11 and 2014-15.

An examination of the English speaking ability of foreign-born workers employed in each sub-sector of the state's health care industry finds that in 2014-15 the share of workers who spoke only English varied from 24 percent in the hospital sector, 20 percent in ambulatory care, 19 percent in individual and family services and 17 percent in nursing and residential care facilities. Seventy-two percent of foreign-born workers in nursing and residential care facilities assessed their English speaking ability as very well or well, 69 percent in both hospitals and the ambulatory care sub-sector, and 64 percent in individual and family services. Limited English speakers (speaking English not well or not at all) comprised 6.6 percent of the foreign-born workforce in hospitals, 10 percent in the ambulatory care sub-sector, 11 percent in nursing and residential care facilities and nearly 17 percent in the individual and family services sub-sector.

Table 6: Percentage Distribution of the Foreign-Born Workforce by Self-Rated English Speaking Ability, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

	2010-11			**2014-15**		
Industry Sector	Only English	Very Well or Well	Not Well or Not at all	Only English	Very Well or Well	Not Well or Not at all
Health Care Sector, Total	20.8	69.4	9.8	20.8	69.6	9.7
Ambulatory Care	19.9	70.0	10.0	20.4	69.2	10.3
Hospitals	23.0	69.3	7.7	24.0	69.4	6.6
Nursing and Residential Care Facilities	20.9	68.2	10.8	16.5	72.2	11.3
Individual and Family Services	12.4	70.9	16.7	19.3	63.9	16.9
Non-Health Care Sectors	16.9	63.6	19.5	17.7	63.7	18.6
All Industry Sectors	17.5	64.6	17.9	18.2	64.7	17.1

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Foreign-born workers in the health care sector were half as likely to be limited English speakers as their counterparts employed outside the health care sector. However, about one in ten foreign-born workers in the state's health care sector were limited English speakers in 2014-15. The prevalence of foreign-born workers with limited English speaking proficiency provides some insights into the potential barriers to labor market success and upward mobility among health care workers. Foreign-born workers with lower levels of education are more likely to have limited English language proficiency presenting additional challenges to their integration into and upward mobility in the labor market. Our analysis of the proficiency requirements of employment in the large and rapidly growing direct care occupations found that specific social skills related to persuasiveness and facility in communication are the most important requirements for employment. Indeed, the requirements for these proficiencies are quite high across a wide range of health care and medical specialty services occupations.

Even college-educated foreign-born workers face labor market hardships especially if their college degree was earned abroad. Compared to their counterparts with a U.S. college degree, foreign-educated college graduates have lower wages, higher unemployment rates, higher rates of involuntary part-time employment and higher rates of mal-employment (employment in jobs that do not utilize the skills and knowledge typically acquired from a college education).[5]

Age

Growth in the state's workforce – health care and non-health care – has occurred at two ends of the age distribution: 16 to 34 and 55-plus. The 16- to 34-year population in 2014-15 primarily consists of the millennial generation. Millennials were between the ages of between the ages of 18 and 34 years old in 2015 and 17 and 33 in 2014. The increase in the size of the 16- to 34-year old cohort between 2010-11 and 2014-15 is partly the result of the aging of millennials into adulthood and partly the result of an improvement in the state's labor market resulting in higher rates of employment among this population especially among young adults (20-24 and 25-34). In 2013, the youngest millennial had reached working age and in 2015 the youngest millennial was 18 years old. Although the millennial generation consisted of 66 million at birth

[5] Neeta P. Fogg and Paul E. Harrington, "Labor Market Underutilization Problems among College-Educated Immigrants in the United States," prepared with NOVA Research Company for the U.S. Department of Education, January 2013.

(there were 66 million births between 1981 and 1998; the years of birth defining the millennial generation), in 2015 there were 75.4 million millennials; many more than the number of millennial births. A study by the Pew Research Center has attributed this growth in the number of millennials to the entry of young millennial-aged immigrants.[6]

The increase in the size of the older workforce is a continuation of a trend of increased labor force attachment and employment as the baby boom generation ages into pre-retirement and retirement ages. Labor force participation and employment have been increasing among the nation's older workers (55-plus) since the mid-1990s, when about 30 percent of the nation's 55-plus population participated in the labor force. In 2015, the labor force participation rate of older workers was nearly 40 percent. Even during the Great Recession the number of employed older workers increased as employment among workers under age 55 dropped sharply.[7]

The findings in Table 7 clearly show the sharp increase in the health care workforce at either ends of the age distribution. Between 2010-11 and 2014-15, the number of young workers between the ages of 16 and 24 employed in the health care sector increased by nearly 23 percent while the number of 25- to 34-year old health care workers increased by 31 percent. The health care workforce in the prime working age groups, 35 to 54, declined by 5 percent among 35- to 44-year olds and 3 percent among 45- to 54-year olds. In sharp contrast, workers in the pre-retirement age of 55 to 64 saw a sizable increase of 14 percent and retirement-age workers increased their numbers by 7,500, representing a relatively large increase of 31 percent.

Industries outside the state's health care sector also saw a similar bi-modal change in their workforce with sizeable increases in younger and older workers accompanied by a decline in the prime-aged workforce. Between 2010-11 and 2014-15, the size of the 16- to 24-year old and 25- to 34-year old workforce in non-health care industries grew by 12 percent while the workforce of prime-aged workers between the ages of 35 and 44 declined by 1.9 percent. Their counterparts between 45 and 54 saw no change over the four-year period. In contrast, the older

[6] Fry, Richard, "Millennials overtake Baby Boomers as America's largest generation," *FACTTANK: News in the Numbers*, Pew Research Center, April 26, 2016 (http://www.pewresearch.org/fact-tank/2016/04/25/millennials-overtake-baby-boomers/)

[7] Fogg, Neeta P. and Paul E. Harrington, "Rising Demand for Older Workers Despite the Economic Recession: Accommodation and Universal Design for the New American Workforce," *Public Policy and Aging Report,* Winter 2011*,* Volume 21, Number 1, pp. 11-17.

Table 7: Change in the Number of Workers by Age, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

	2010-11	2014-15	Absolute Change	Relative Change	2010-11	2014-15	Absolute Change	Relative Change
Age	**Health Care Sector**				**Non-Health Care Sectors**			
16-24	39,292	48,207	8,915	22.7%	370,933	416,786	45,853	12.4%
25-34	90,205	117,912	27,707	30.7%	562,977	632,475	69,498	12.3%
35-44	105,328	100,232	-5,096	-4.8%	586,427	575,069	-11,358	-1.9%
45-54	122,143	118,188	-3,955	-3.2%	663,988	668,120	4,133	0.6%
55-64	91,960	105,236	13,277	14.4%	447,686	509,939	62,253	13.9%
65+	24,694	32,240	7,546	30.6%	136,436	170,583	34,147	25.0%
Total	473,620	522,013	48,393	10.2%	2,768,446	2,972,971	204,526	7.4%

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

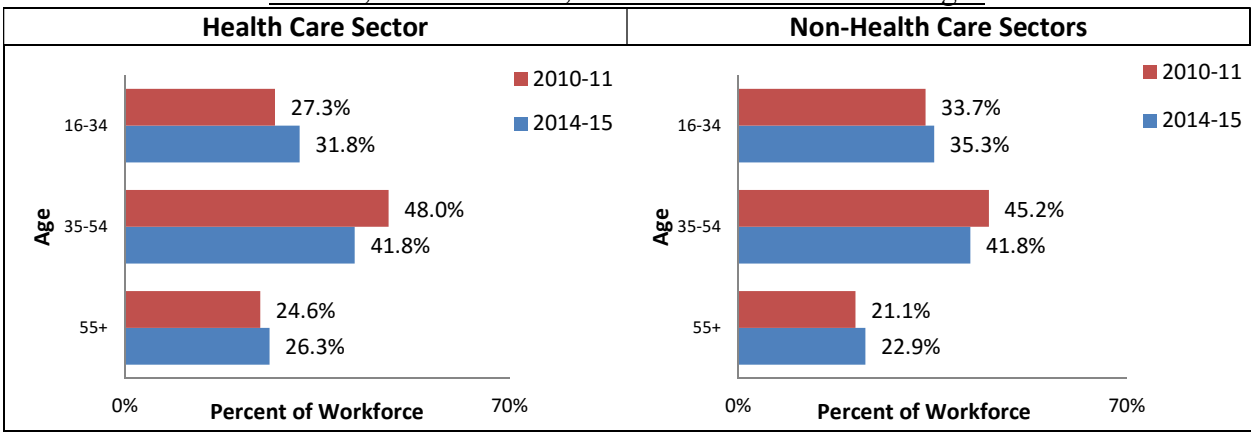
workforce grew sharply. There were 62,300 additional pre-retirement age workers in the state's non-health care industries in 2014-15 compared to 2010-11, a relative increase of 14 percent. The retirement-age workforce was one-quarter larger in 2014-15 relative to its size in 2010-11.

These demographic shifts have resulted in sizable changes in the age composition of the workforce both in the state's health care industry and in industries outside of health care. The share of younger and older workers increased while the share of prime aged workers declined. Between 2010-11 and 2014-15, the share of younger workers (16-34) increased from 27 to 32 percent in the health care sector and 34 to 35 percent outside the health care sector. Older workers (55+) comprised 26.3 percent of the health care workforce in 2014-15, up slightly from under 25 percent in 2010-11. Over the same four-year period the percent of the non-health care workforce that was 55 or older increased from 21 percent to nearly 23 percent. The share of the prime age workforce declined by over 6 percentage points in the health care sector (48% to 41.8%) and by 3 percentage points in non-health care industries (45.2% to 41.8%).

The state's health care workforce is older than the workforce employed outside the health care sector. In 2014-15, fewer than 9 percent of the workers in the state's health care industry were between the ages of 16 and 24 compared to nearly 14 percent among their counterparts employed outside the health care industry. The shares of 25- to 34-year olds, 35- to 44- year olds,

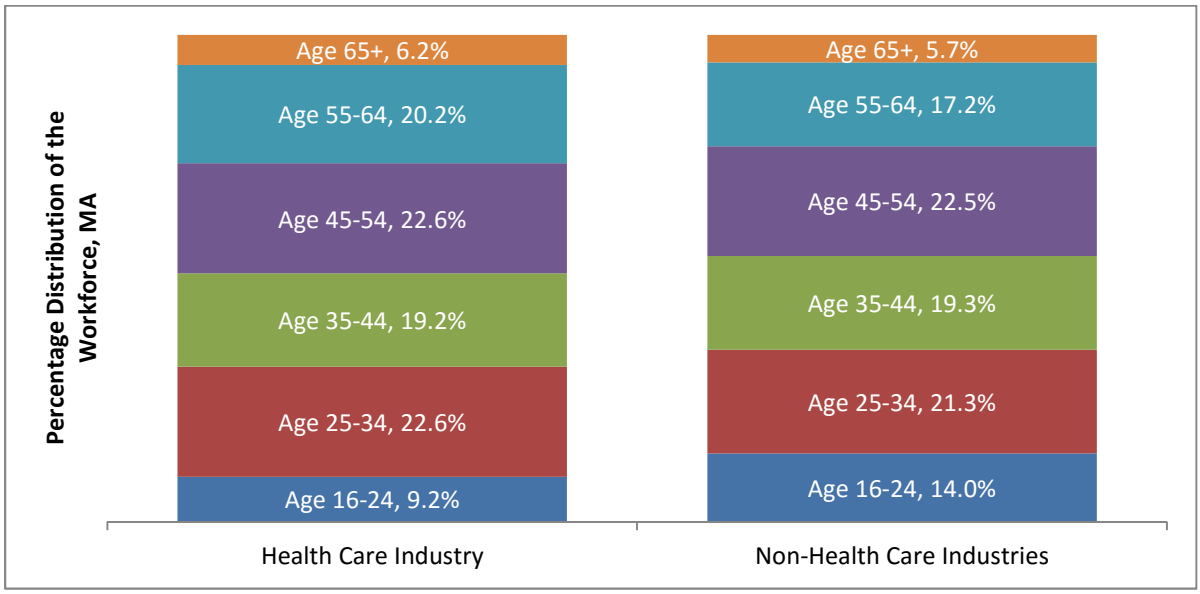
and 45- to 54-year olds in the health care industry were similar to their shares among workers employed in other industries. The state's health care workforce was more concentrated among the older age groups; 20 percent of health care workers in the state were 55- to 64 years old (versus 17% in non-health industries), and 6.2 percent were age 65 or older (versus 5.7% in non-health industries).

Chart 3: Percentage Distribution of the Workforce by Age, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

Chart 4: Percentage Distribution of the Workforce by Age, Health Care and Non-Health Care Industries, Massachusetts, 2014-15 Averages



Source: 2014, and 2015 American Community Survey Public Use Microdata Samples (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

In 2014-15, the median age of health care workers in Massachusetts was 44 years; two years higher than the median age of the state's workforce outside the health care sector. Between 2010-11 and 2014-15, the median age of health care workers declined from 45 to 44 years while the median age of workers outside the health care industry remained unchanged at 42 years. Despite this decline in the median age, the health care workforce continued to remain older than other workers in the state.

The median age of the workforce in each of the four health care industry sub-sectors reveals that in 2014-15, with a median age of 45 years, workers in the state's ambulatory care sub-sector were older than those in the other three health care sub-sectors. The median age was 44 years among workers in the hospital and individual and family service sub-sectors and 42 years in the nursing and residential care sub-sector. Between 2010-11 and 2014-15, the median age remained stable among workers in the ambulatory care and individual and family services sub-sectors, but the median age declined from 45 to 44 years among hospital workers and 44 years to 42 years among nursing home and residential care workers.

Table 8: Change in the Median Age of the Workforce, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

	2010-11	2014-15	Absolute Change
Industry	Median Age		
Non-Health Care Sectors	42	42	0.0
Health Care Sector, Total	45	44	-1.0
Ambulatory Care	45	45	0.0
Hospitals	45	44	-1.0
Nursing and Residential Care Facilities	44	42	-2.0
Individual and Family Services	44	44	0.0
All Industry Sectors	43	43	0.0

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files; tabulations by Center for Labor Markets and Policy, Drexel University.

Changes in the age composition of the workforce in each of the four sub-sectors of the state's health care industry also reveal an increase in the share of younger and older workers and a fall in the share of prime-aged workers. Between 2010-11 and 2014-15, the share of workers between 16 and 34 years old increased in the ambulatory care, hospital, and nursing and residential care sub-sectors, by 5.5, 4.6, and 4.3 percentage points, respectively; but declined in

the individual and family services sector by 0.7 percentage points. In 2014-15, younger workers comprised 35 percent of the workforce in nursing and residential care facilities, 32 percent in hospitals and individual and family services sub-sectors, and less than 30 percent of the ambulatory care sub-sector.

Prime-aged workers (35-54) saw declines in their share of the workforce ranging from 7 percentage points in hospitals, 6 percentage points in the ambulatory care sector and nursing and residential care sector, and 1.5 percentage points in the individual and family services sector. After this decline in their share of the workforce, 35-54 year old workers comprised 42-43 percent of the state's ambulatory care and hospital sub-sectors, and 40 percent of the nursing home and residential care and individual and family services sub-sectors in 2014-15.

Table 9: Percentage Distribution of the Workforce by Age, Health Care Industry Sub-Sectors, Massachusetts, 2010-11 and 2014-15 Averages

	AGE		
Health Care Industry	**16-34**	**35-54**	**55+**
Ambulatory Care			
2010-11	24.1%	49.4%	26.5%
2014-15	29.6%	43.0%	27.3%
Absolute Change (Percentage Points)	+5.5	-6.4	+0.8
Hospitals			
2010-11 (Percent)	27.5%	49.0%	23.5%
2014-15 (Percent)	32.1%	42.0%	26.0%
Absolute Change (Percentage Points)	+4.6	-7.0	+2.5
Nursing and Residential Care Facilities			
2010-11 (Percent)	30.7%	46.3%	23.0%
2014-15 (Percent)	35.0%	40.3%	24.7%
Absolute Change (Percentage Points)	+4.3	-6.0	+1.7
Individual and Family Services			
2010-11 (Percent)	32.9%	41.6%	25.4%
2014-15 (Percent)	32.2%	40.1%	27.7%
Absolute Change (Percentage Points)	-0.7	-1.5	+2.3

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Samples (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

The share of older workers (55+) rose across all four sub-sectors of the health care industry ranging from an increase of 2.5 percentage points in hospitals and 2.3 percentage points in individual and family services, to 1.7 percentage points in nursing and residential care facilities and 0.8 percentage points in ambulatory care sub-sector. In 2014-15, the share of older workers stood at nearly 28 percent in individual and family services, 27 percent in ambulatory care, 26 percent in hospitals, and nearly one-quarter in nursing and residential care facilities.

Educational Attainment

A comparison of the number of health care sector workers by educational attainment in 2010-11 and 2014-15 found that while the health care workforce in the state increased by 48,400 or 10 percent over the four-year period, the numbers of health care workers without a high school diploma/GED or with just an associate's degree declined over the same period. The remaining educational attainment categories saw increases in the number of health care workers. The largest increase occurred among workers with a bachelor's degree. The number of health care workers with a bachelor's degree grew by 21,011 between 2010-11 and 2014-15, representing an increase of nearly 20 percent. Workers with a master's degree also saw a sizable increase of 11,800 or 22 percent. Health care workers with a doctorate degree also grew sharply over the four-year time period, increasing by 3,560 workers or 22 percent.

The number of workers with just a high school diploma/GED and those with some college education also increased but below the average rate. There were 5,600 more high school graduate health care workers in 2014-15 representing a 7 percent increase relative to 2010-11. There were 7,300 additional workers with some college education representing a growth rate of 8 percent. These workers could be enrolled in college and working toward earning a college degree; they may have earned a postsecondary certificate or they may have quit college before earning any credential. The rate of growth in health care workers with a professional degree was considerably below average. Most professional degreed workers in the health care sector are physicians, dentists and other specialized providers. The size of the health care workforce with a professional degree increased by fewer than 1,500 workers or just 4 percent.

The Massachusetts workforce outside the health care industry grew by 7.4 percent between 2010-11 and 2014-15 with growth occurring across each educational category. The rate of workforce growth was below average among three educational groups: high school graduates,

workers with some college without a degree, and workers with an associate's degree. The rate of workforce growth was above average in the remaining educational groups, ranging from an increase of 8 percent among high school dropouts and those with professional degrees to 14.5 percent among workers with a doctorate degree.

Table 10: Change in the Number of Workers by Educational Attainment, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 to 2014-15 Averages

	2010-11	2014-15	Absolute Change	Relative Change	2010-11	2014-15	Absolute Change	Relative Change
	Health Care Sector				**Non-Health Care Sectors**			
No high school diploma	23,374	22,134	-1,240	-5.3%	202,623	219,064	16,442	8.1%
High school diploma/GED	81,062	86,666	5,604	6.9%	651,694	672,761	21,068	3.2%
Some college, no diploma	89,947	97,263	7,316	8.1%	527,953	545,684	17,731	3.4%
Associate's degree	66,595	65,489	-1,107	-1.7%	196,570	209,005	12,436	6.3%
Bachelor degree	107,741	128,752	21,011	19.5%	706,486	792,909	86,423	12.2%
Master's degree	53,248	65,038	11,791	22.1%	352,319	387,933	35,615	10.1%
Professional degree	35,266	36,724	1,458	4.1%	63,133	68,155	5,022	8.0%
Doctorate degree	16,389	19,949	3,560	21.7%	67,670	77,461	9,791	14.5%
Total	473,620	522,013	48,393	10.2%	2,768,446	2,972,971	204,526	7.4%

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Underlying the 8 percent increase in the number of employed high school dropouts between 2010-11 and 2014-15 in sectors outside the state's health care industry is the sharp employment drop among high school dropouts during the recession. Employment among high school dropouts fell sharply during the Great Recession (more than other educational groups) and, as the state's economy grew and the labor market tightened, employment began to rise across all groups including high school dropouts. In comparison to their employment at the trough of the recession in 2010-2011, the employment of high school dropouts in the state's non-heath care industries was much higher in 2014-15.

In contrast, within the health care industry the number of employed high school dropouts declined over these four years. This is partly due to the continued growth in health care employment during the recession and changes in the state's health care industry that began in

2008. First, the health care industry was largely shielded from the Great Recession. In fact, health care sector employment increased during the recession, albeit at a slower pace than at any time since 2000. Furthermore, the shift from inpatient to outpatient care that began in the state's health care sector in 2008 resulted in rapid growth for certain occupations in the state's health care sector (home health and personal care aides) that have little to no specialized medical or health knowledge requirements and only require basic "soft skills" such as social skills and positive character traits. These occupations provide employment opportunities to workers from other industries and occupations who have the soft skills but do not have health or medical knowledge.

Uneven growth/decline in the workforce by educational attainment between 2010-11 and 2014-15 in the state's health care and non-health care sectors has resulted in a change in the educational composition of the workforce. The health care sector has seen a decline in the shares of workers with an associate's degree or lower level of education and an increase in the workforce with a bachelor's degree or higher, with the exception of workers with professional degrees who comprised a somewhat smaller share of the health care workforce in 2014-15 (7%) compared to 2010-11 (7.4%).

A 2014-15 comparison of the education level of the state's health care and non-health care workforce reveals that the health care workforce in Massachusetts is better-educated than the rest of the state's workforce. Most of this difference in education occurs at the lower end. In 2014-15, about 21 percent of the state's health care workforce had either completed just a high school education or had failed to complete high school (17% high school graduates and 4% high school dropouts). In non-health care industries this educational group comprised 30 percent of the workforce (23% high school graduates and 7% high school dropouts).

However, we have learned from our conversations with leaders in different segments of the state's health care industry that one of the ways in which employers will address the cost containment pressures from Chapter 224 and the ACA is to train health care workers to perform their jobs to the top of their license. This means that the job duties of workers across the health care hierarchy, from CNAs and home health aides all the way to advanced practitioners (Nurse Practitioners and Physician's Assistants), are expected to change so that workers in every job are performing duties at the highest level within their position. The presence of workers with limited

education, skills and English language proficiency (foreign-born and native-born) is likely to pose a challenge to health care employers in implementing this strategy successfully.

Table 11: Percentage Distribution of the Workforce by Educational Attainment, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Educational Attainment	Health Care Sector			Non-Health Care Sectors		
	2010-11	2014-15	Absolute Change	2010-11	2014-15	Absolute Change
No H.S. diploma	4.9	4.2	-0.7	7.3	7.4	0.1
H.S. diploma/GED	17.1	16.6	-0.5	23.5	22.6	-0.9
Some college, no diploma	19.0	18.6	-0.4	19.1	18.4	-0.7
Associate's Degree	14.1	12.5	-1.6	7.1	7.0	-0.1
Bachelor's degree	22.7	24.7	2.0	25.5	26.7	1.2
Master's degree	11.2	12.5	1.3	12.7	13.0	0.3
Professional degree	7.4	7.0	-0.4	2.3	2.3	0.0
Doctorate degree	3.5	3.8	0.3	2.4	2.6	0.2

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

In 2014-15, nearly 19 percent of health care industry workers in the state had completed some college education without earning a college degree, about the same share as workers outside the health care industry. This group of workers could still be enrolled, have quit college or earned a certificate. Unfortunately, the ACS data do not provide information about certificates earned by respondents.

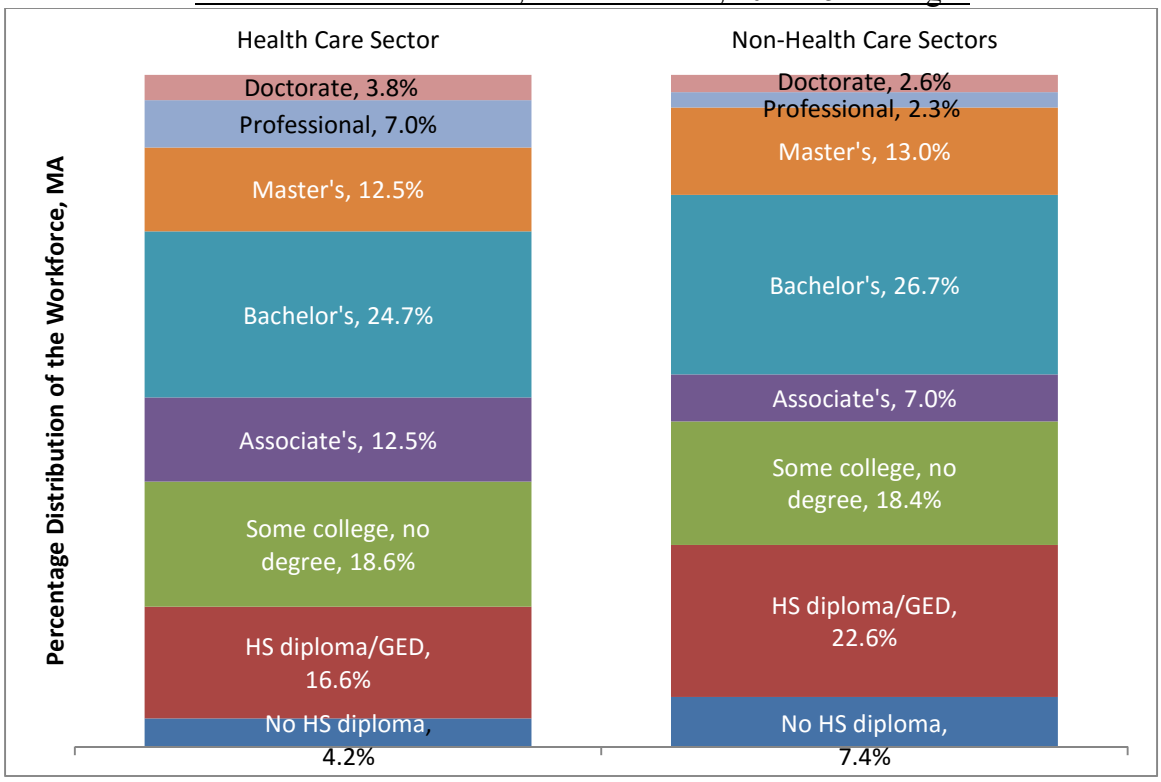
The share of health care workers with an associate's degree was nearly twice as large as that for non-health care workers (13% among health care workers versus 7% among non-health care workers). This difference is likely attributable to the prevalence of nurses with an ASN in the state's nursing workforce.

Another educational category with a much higher concentration among health care workers is, unsurprisingly, workers with a professional degree. In 2014-15, the health care workforce of the state had more than three times the share of workers with a professional degree compared to the non-health care workforce in the state (7% versus 2.3%). Examples of professional degrees include MD, DDS, DVM, LLB, JD, etc. Most of the professional degrees

among employees in the health care sector include physicians with a professional degree, such as an MD or a DDS.

The share of workers with a bachelor's degree was slightly lower among health care workers (24.7%) compared to non-health care workers (26.7%). This was also the case for the size of the workforce with a master's degree (12.5% among health care workers and 13% among non-health care workers). Workers in the health care sector were somewhat more likely than non-health care workers to have earned a doctorate (3.8% health care versus 2.6% non-health care).

Chart 5: Percentage Distribution of the Workforce by Educational Attainment, Health Care and Non-Health Care Sectors, Massachusetts, 2014-15 Averages



Source: 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

The educational attainment of the nursing workforce spans the educational spectrum. The nursing occupation comprises workers with associate's degrees, bachelor's or master's degrees, as well as doctorates. An examination of the education of the registered nursing (RN) workforce in Massachusetts found that while the total number of RNs in the state's health care workforce

increased by 6,500 or 9.8 percent between 2010-11 and 2014-15, RNs with an associate's degree declined by 1,070 or 5 percent. During this period RNs with a bachelor's degree increased by nearly 4,000 or 11 percent and those with a master's or higher degree increased by 1,850 or 28 percent. The share of RNs with a bachelor's or higher degree in Massachusetts has increased from 62 percent in 2010-11 to 65 percent in 2014-15.

Table 12: Distribution of Registered Nurses in the Health Care Sector by Educational Attainment, Massachusetts, 2010-11 and 2014-15 Averages

Educational Attainment	2010-11	2014-15	Absolute Change	Relative Change
Associate's	21,167	20,099	-1,069	-5.0%
Bachelor's	34,886	38,853	3,967	11.4%
Master's or higher	6,692	8,548	1,856	27.7%
Total	66,785	73,306	6,521	9.8%
Percentage Distribution				
Associate's	31.7%	27.4%	-4.3%	
Bachelor's	52.2%	53.0%	0.8%	
Master's or higher	10.0%	11.7%	1.6%	

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.
Note: Since the sample size of RNs with less than associate's degree education was not large enough for statistical precision, that educational category is not reported in the table. Therefore, the total is greater than the sum of the three education categories.

The educational attainment of the workforce has changed across the four sub-sectors of the health care industry. The ambulatory care sub-sector saw an increase in the share of workers with education below the associate's degree level (38% in 2010-11 to 39% in 2014-15). Among workers with more than college credentials there was a higher share of workers with a master's degree and a doctorate degree in 2014-15 compared to 2010-11. However, workers with an associate's degree, bachelor's degree and professional degree comprised smaller shares of the ambulatory care sub-sector in 2014-15 (42%) compared to their share in 2010-11 (45%). Our analysis of employment trends in the ambulatory care sub-sector of the health care industry in Massachusetts found that nearly 60 percent of the increase in employment in this sector over the three years between 2012 and 2015 has been in home health care services that are heavily staffed with occupations like home health aides with typically minimal educational and training

requirements.[8] Changes in employment across sectors of an industry with widely different occupational staffing patterns are likely to affect the characteristics of the industry's workforce, especially their educational attainment.

The hospital workforce had smaller shares of workers with education at or below associate's degree level. Between 2010-11 and 2014-15, hospitals in the state saw a 4.4 percentage point decline in the share of the workforce with educational attainment at or below the associate's degree level (47.7% in 2010-11 to 43.3% in 2014-15). The share of workers with a bachelor's degree rose by nearly 3 percentage points; 27.7 percent in 2010-11 to 30.6 percent in 2014, while workers with a master's degree increased their share of the state's hospital workforce by 1.5 percentage points (10.3% to 11.8%). The share of workers with professional degrees declined by 4/10ths of a percentage point, while the share of workers with doctorate degrees increased by the same amount (0.4 percentage points).

The nursing and residential care sector saw a decline in the share of poorly educated workers and an increase in the share of workers with college degrees—associate's degree or higher. The biggest increase occurred in the share of workers with a bachelor's degree. Between 2010-11 and 2014-15, the share of the state's nursing and residential care sector workforce with a bachelor's degree increased from 12.5 percent to 17.9 percent; an increase of 5.4 percentage points. Although overall employment in the nursing and residential care sector has increased in the state, all of the increase has come from residential care facilities. Employment in nursing care facilities has declined as many nursing homes in the state have closed. Nursing homes are increasingly operating as skilled nursing facilities serving patients with higher levels of acuity that cannot be treated in the home. These skilled nursing facilities that are now serving patients with higher levels of acuity require staff with higher levels of educational attainment, particularly nursing staff with bachelor's degrees.

The individual and family services sub-sector in the state has seen an increase in the share of its workforce with education at or below some college and no degree of over 4

[8] See "Health Care Employment, Structure, and Trends in Massachusetts," Chapter 224 Workforce Impact Study, Prepared for Office of State Auditor, Commonwealth of Massachusetts, by Commonwealth Corporation and the Center for Labor Markets and Policy, Drexel University, December 2016.

percentage points and a decline in the share of workers with an associate's degree or a bachelor's degree of 5 percentage points.

There were sizable differences in the educational attainment of the workforce by sub-sector of the state's health care industry. Employment patterns within these sub-sectors of the health care industry are changing, contributing to some of the change in the occupational staffing and education level of the workforce. However, given that, there are still sizeable fundamental differences in the occupational staffing patterns across the four sub-sectors resulting in corresponding differences in the educational attainment of the workforce. The nursing and residential care sub-sector in Massachusetts is staffed with workers in health care support and services occupations which have low educational requirements and are often considered entry-level jobs. Ambulatory care and hospitals in the state are staffed with larger shares of higher level jobs in health diagnostic practitioner occupations such as physicians and nurses, and health technician and technologist occupations.

Table 13: Percentage Distribution of the Workforce in Sub-Sectors of the Health Care Industry by Educational Attainment, Massachusetts, 2010-11 and 2014-15 Averages

	Ambulatory Care			Hospitals			Nursing and Residential Care Facilities			Individual and Family Services		
Educational Attainment	2010-11	2014-15	Change	2010-11	2014-15	Change	2010-11	2014-15	Change	2010-11	2014-15	Change
No H.S. diploma	2.9	3.2	0.3	3.0	2.4	-0.6	13.0	8.7	-4.3	6.2	7.3	1.1
H.S. diploma/GED	16.1	16.3	0.2	13.6	12.1	-1.5	29.1	27.6	-1.5	14.0	16.5	2.5
Some college, no diploma	19.1	19.5	0.4	15.9	15.2	-0.7	27.4	26.0	-1.4	16.3	16.9	0.6
Associate's Degree	14.8	12.8	-2.0	15.2	13.6	-1.6	12.3	12.6	0.3	9.7	7.0	-2.7
Bachelor's degree	20.2	20.0	-0.2	27.7	30.6	2.9	12.5	17.9	5.4	30.0	27.6	-2.4
Master's degree	12.9	13.9	1.0	10.3	11.8	1.5	4.9	5.5	0.6	21.3	22.4	1.1
Professional degree	10.0	9.5	-0.5	9.5	9.1	-0.4	na	na	--	na	na	--
Doctorate degree	4.0	4.7	0.7	4.8	5.2	0.4	na	na	--	na	na	--

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Samples (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.
Note: Since the sample sizes of professional degree and doctorate degree workers in nursing and residential care facilities and individual and family services were not large enough for statistical precision, those educational categories are not reported in the table.

In 2014-15, nearly 9 percent of the state's nursing and residential care workforce had failed to complete high school; a much higher share of workers without a high school education compared to 3 percent in the ambulatory care sector and 2 percent in hospitals and 7 percent in the individual and family services sector. Workers in the state's nursing and residential care sector were 1.6 times as likely to have just completed high school compared to their counterparts employed in individual and family services and ambulatory care (28% versus 16% to 17%), and more than twice as likely as hospitals workers to have completed just a high school level education (28% versus 12%).

The college-educated workforce in the nursing and residential care sub-sector is more concentrated at the lower end. In 2014-15, over one-quarter of the workforce in this health care sub-sector had completed some college with no degree, 13 percent had an associate's degree, and 18 percent and 6 percent, respectively, had a bachelor's or master's degree. The individual and

family services sub-sector had a higher concentration of workers with bachelor's (28%) or master's degrees (22%). Both sectors had too few workers with a professional or doctorate degrees resulting in a sample size that was not large enough to produce statistically reliable estimates.

Workers with some college education but without a college degree comprised one-fifth of all workers in the state's ambulatory care sub-sector, one-sixth of hospital workers, 26 percent of nursing and residential care workers and 17 percent of the workforce in the individual and family services sub-sector.

In 2014-15, one-half of the state's workforce employed in hospitals and the ambulatory care sub-sector has a college degree (bachelor's or higher). Ambulatory care workers were slightly more likely to have a master's or a professional degree whereas hospital workers were more likely to have a bachelor's degree or a doctorate. These differences reflect the different staffing pattern of these sub-sectors. Diagnostic physician occupations are workers with both professional degrees as well as doctorate degrees. The educational attainment of the nursing workforce spans the educational spectrum, although the state's nursing workforce with a bachelor's degree has increased over the four year period between 2010-11 and 2014-15. The nursing occupation comprises workers with associate's degrees, bachelor's, or master's degrees, as well as doctorates.

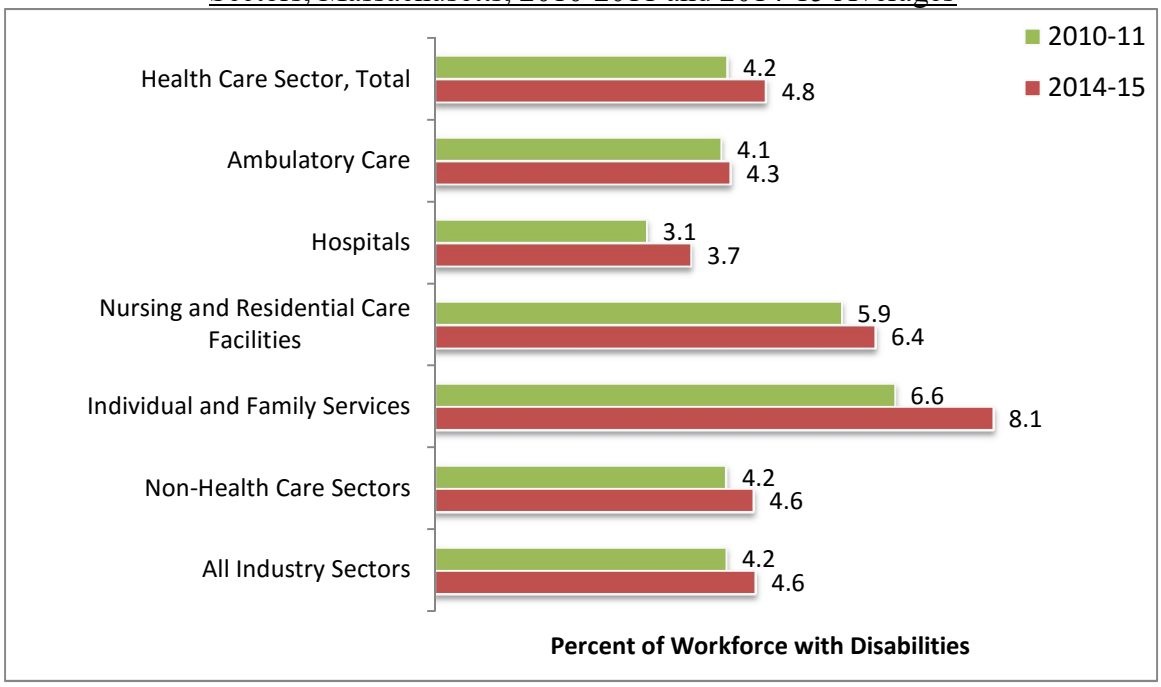
Disability Status

Workers with disabilities comprised 4.2 percent of the health care workforce as well as the non-health care workforce in 2010-11. By 2014-15, the share of workers with disabilities increased to 4.8 percent in the health care sector workforce and 4.6 percent in the state's workforce outside the health care sector. The incidence of disabilities typically rises with age and the aging of the workforce might underlie some of the increase in the share of the workforce with disabilities. The share of workers with disabilities increased across all four sub-sectors of the health care industry with the smallest increase among workers in the ambulatory care sub-sector and the largest increase in the individual and family services sub-sector.

In 2014-15 the share of the workforce with disabilities comprised 8.1 percent in the individual and family services sub-sector, and 6.4 percent in the nursing and residential care sub-sector. The workforce in the ambulatory care and hospital sub-sectors were less likely to be

comprised of workers with disabilities; 4.3 percent of the ambulatory care workforce and 3.7 percent of the hospital workforce were comprised of workers with disabilities.

Chart 6: Percent of Workforce with Disabilities, Health Care and Non-Health Care Sectors, Massachusetts, 2010-2011 and 2014-15 Averages



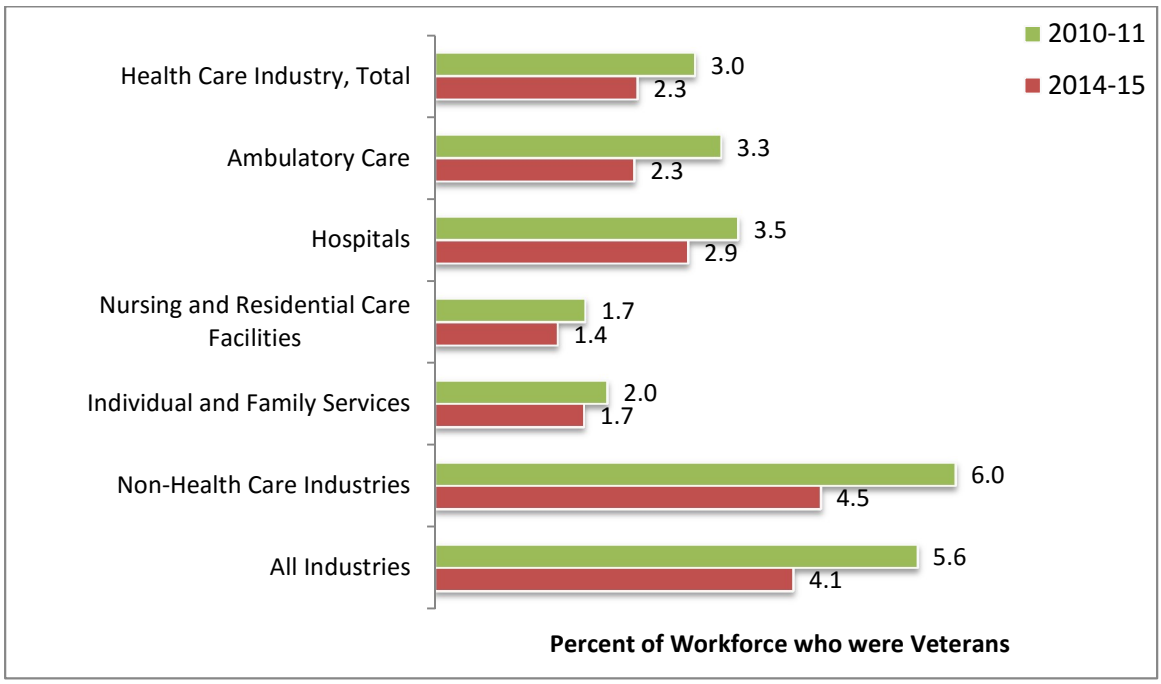
Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Veteran Status

Employment of veterans is lower in the state's health care industries compared to non-health care industries. In 2014-15, only 2.3 percent of the state's health care workers were identified as veterans compared to 4.5 percent in the state's workforce outside the health care sector. Given that most veterans are male and most health care industry workers are female, the veteran share of health care workers is expected to be smaller than their share in the non-health care sector.

Between 2010-11 and 2014-15, the share of veterans in the workforce declined from 5.6 percent to 4.1 percent across the state, 3 percent to 2.3 percent in the health care industry, and 6 percent to 4.5 percent in non-health care industries. Within the health care industry, veterans were least likely to work in nursing and residential care facilities and individual and family services (1.4% and 1.7%) and somewhat more likely to work in the ambulatory care sub-sector (2.3%) and hospitals (2.9%).

Chart 7: Percent of the Workforce who were Veterans, Health Care and Non-Health Care Industries, Massachusetts, 2010-2011 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Characteristics of Jobs in the Health Care Sector in Massachusetts: Hours, Weeks and Earnings

In this section we examine other gauges to measure changes in the health care workforce. These include employment intensity, employment patterns, and the level and distribution of earnings of the state's health care workforce. Changes in employment could occur in the form of intensity of employment: weekly hours, annual weeks and annual hours of employment or the pattern of employment: full-time employment (during a typical week) and full-time year-round employment. Changes in the size and composition of the workforce and the intensity and pattern of employment can in turn also affect the level and distribution of earnings among workers. These changes could come about from adjustments made by health care employers in response to the dual mandate of Chapter 224 and the ACA – to contain costs while maintaining or improving the quality of health care services that they provide – and from the labor supply response of workers.

At the time of our baseline study, we had performed a review of the Health Care Workforce Transformation Fund planning grant proposals submitted by 51 health care employers in order to shed light on the workforce training needs and potential workforce issues resulting from Chapter 224. The review found that some employers were focused on higher level workers, such as adding more advanced practitioners to their workforce to take on more of the delivery of primary care from physicians. Other employers wanted to train their workers to move them up the career ladder or create new, higher level roles for some workers to improve worker skills and productivity. A number of employers planned to train all staff members to be effective at delivering team-based care and other service delivery models. Employers had also identified the integration of behavioral health care with primary care resulting in an increase in staff interaction with patients with complex health and behavioral health needs resulting in a need to train their staff, particularly non-clinical staff, in effectively handling such interactions to provide quality care to these patients. The review of these proposals found that health care sector employers were adjusting to Chapter 224 in different ways.

It also appeared at that time that some health care sector employers could choose to contain costs by increasing their service delivery using workers in lower level occupations – by either cutting back in the number of workers in higher level jobs and/or by increasing their hiring in lower-level occupations. This kind of adjustment would increase the concentration of the industry's jobs in lower-level occupations that in turn would put a downward pressure on earnings in the industry and also change the hours and weeks of employment depending on the employment patterns of workers in these lower-level occupations. Conversely, some employers could choose to have fewer workers, but deliver services and contain costs through improved worker productivity by having working workers practice at the top of their license. This type of adjustment by employers would result in a greater concentration of the health care workforce in higher level occupations, leading to an increase in earnings; while at the same time reducing employment opportunities for workers in lower-skill and lower-wage occupations.

Both of these avenues would change the employment patterns, employment intensity and earnings of workers. The hours and weeks of employment and earnings in the health care sector could also change from a shift in the industry distribution of the health care workforce. If the health care workforce becomes concentrated in industry sectors with more full-time and year-round employment and higher earnings, we can expect a rise in overall full-time year-round

employment among health care sector workers and an increase in the industrywide earnings. Conversely, if employment shifts to lower level occupations there could be a downward pressure on the hours, weeks and earnings of health care workers.

Our analysis of employment trends between 2012 and 2015 has found that statewide employment levels rose by 195,000 jobs or 6 percent. Health care practitioner and technical occupations saw a much slower rate of growth of only 3 percent, adding 6,100 jobs; health care support occupations saw a growth of 5 percent, adding 5,300 jobs over the three years between 2012 and 2015.[9] In contrast, employment rose by 21 percent in personal care and service occupations and 11 percent in community and social service occupations.

Driving the sharp increase in employment in these occupational groups were three occupations: personal care aides, home health aides, and community health workers. Between 2012 and 2015, employment of home health aides increased by 10,800 jobs or 54 percent. Home health aides saw employment grow by nearly one-quarter or 4,620 jobs and community health workers, although very small in number, saw a doubling of employment in three years, from 1,290 to 2,530, a growth rate of 96 percent. Together these three occupations comprised 2 percent of the total employment in the state in 2012 (60,500 out of 3.202 million), but accounted for nearly 9 percent of the job growth that occurred in the state between 2012 and 2015 (16,700 out of 195,000).[10] Uneven changes in employment across different health care sectors and occupations, especially the sharp increase in employment of lower wage direct care workers, are expected to affect employment patterns and wages in the state's health care industry.

Data and Methods

As with the previous section, data in this section are derived from analysis of the ACS PUMS data files. We have combined ACS PUMS data for two years (2010-2011 and 2014-2015) to produce estimates of hours and weeks of employment and earnings of workers employed in Massachusetts—in the health care industry and in all other industries (outside health care) before the passage of Chapter 224 and the current time period. As with the previous section, workers were identified by their place of employment and not their place of residence. So if a worker was

[9] Special Topics Report, September 2016, op. cit.
[10] Ibid.

employed in Springfield, Massachusetts but lived in Hartford, Connecticut, she was included in our analysis of the Massachusetts workforce.

Respondents to the ACS survey were asked two questions regarding their employment status: the first question asks respondents about their employment status in the week prior to the ACS survey and the second asks respondents if they were employed at any time during the year prior to the ACS survey. Respondents who were employed at any time during the year prior to the ACS survey were asked about the number of weeks that they were employed during the year, the usual weekly hours of work during the time that they were employed and the total wages or the salary that they had earned during the year. We have analyzed these three employment traits (hours, weeks and earnings) of workers employed in the health care industry in Massachusetts and those who were employed outside the state's health care industry.

As noted above, the Massachusetts workforce (in the health care and non-health care industries) consists of those workers who were employed in Massachusetts; that is, those respondents to the ACS survey who had identified Massachusetts as their place of employment (regardless of where they lived). Data on the place of employment on the ACS PUMS data files are provided for only those respondents who were employed at the time of the ACS survey. However, questions regarding hours, weeks, and earnings pertain to the job that respondents had held during the year prior to the ACS survey.

This means that workers who had a job during the year prior to the ACS survey but did not have a job at the time of the ACS survey had to be excluded from our analysis as we could not ascertain their place of work. Therefore our analysis of the hours, weeks, and earnings, includes only those respondents who were employed at both times—the year prior to the ACS survey and the week prior to the ACS survey.[11]

Each of these measures is computed as a 2-year average for the years 2010-2011 and 2014-2015. For example, mean weekly hours of employment measures the average of the mean weekly hours of employment from the 2010-2011 and 2014-2015 ACS surveys. For annual earnings, we first computed nominal annual earnings for each year from the 2010-2011 and

[11] This is expected to exclude very few workers from our analysis of weekly hours, annual weeks, sub-sector of employment and earnings since most residents of the state who worked in the health care industry during the year prior to the ACS surveys were also employed during the week prior to the ACS survey.

2014-2015 ACS data. We then converted these estimates of nominal annual earnings for each year to real (inflation-adjusted) annual earnings in 2015 dollars using the Consumer Price Index and then computed 2-year averages of the real annual earnings measured in 2015 dollars.

Hours and Weeks of Employment of Health Care Industry Workers

The hours of work that employees in an industry perform in a typical week or during the year provide valuable insights into the way employers are deploying their workforce. Information on the weekly hours or annual weeks of employment sheds light on the extent to which the industry's workers are engaged in full-time work and whether they are employed during most of the year or just part of the year.

Utilizing a few key measures of hours and weeks of employment, we have analyzed the intensity of work among workers in the health care industry. These measures include: (i) mean weekly hours of work and distribution of workers by weekly hours of employment, (ii) percent of workers employed full-time (35-plus weekly hours), (iii) percent of workers employed full-time and year-round (35-plus weekly hours for 40-plus annual weeks), and (iv) mean annual hours of work. Using the 2010-2011 and 2014-2015 ACS PUMS data we have provided estimates of each of these five measures for the health care and non-health care workforce in Massachusetts.

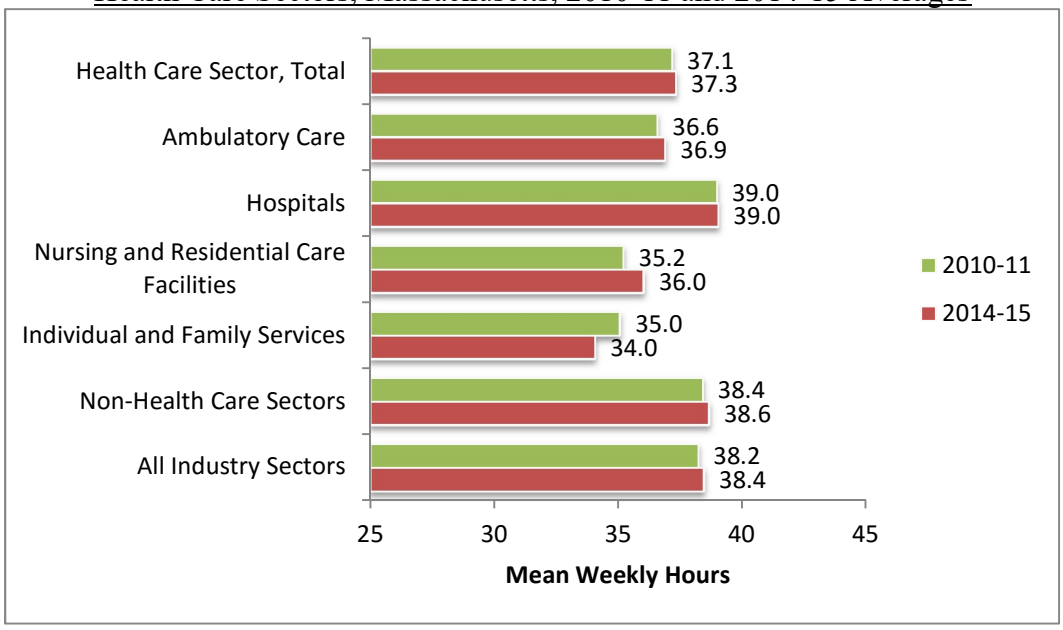
Weekly Hours of Work

As the state's economy improved, the mean weekly hours of employment among workers in the Commonwealth increased by 0.2 hours; from 38.2 hours to 38.4 hours between 2010-11 and 2014-15. Mean weekly hours of health care and non-health care workers also increased by 2/10th of an hour over the four years. The average workweek of health care workers was shorter than that of non-health care workers. In 2014-15 the average workweek of a health care worker consisted of 37.3 hours, whereas their non-health care counterparts were employed for 38.6 hours per week; a difference of 1.3 hours per week.

The mean weekly hours of employment increased by 0.8 hours among nursing and residential care sub-sector workers (35.2 to 36 hours) and 0.3 hours among ambulatory care sub-sector workers (36.6 to 36.9 hours), remained constant at 39 hours per week among hospital workers and declined among workers in the state's individual and family services industry from 35 hours per week in 2010-11 to 34 hours per week in 2014-15.

Across the four sectors of the state's health care sector, hospital workers had the longest average workweek (39 hours). The shortest workweek was among workers in the individual and family services sector (34 hours).

Chart 8: Mean Weekly Hours of Employment among Workers in the Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

While average weekly hours provides a good summary of the employment intensity of workers, a look at the distribution of workers by weekly hours of employment provides further insights into the variation across workers in the length of their typical workweek. In Table 14 we have provided a distribution of the health care workforce by the length of their workweek in 2010-11 and 2014-15 ranging from less than 30 hours per week, 30 to 39 hours per week, and 40 hours or more per week.

Between 2010-11 and 2014-15, the percent of workers with less than 30 hours of work per week declined in the health care industry as well as in non-health care industries. Within the health care industry the share of workers with a low intensity workweek (less than 30 hours) declined between 2010-11 and 2014-15 in all but one sub-sector—individual and family services. The share of workers with a low intensity workweek declined in the ambulatory care sub-sector (-1.2 percentage points or -5.5%), hospitals (-0.5 percentage points or -3.5%), and nursing and residential care facilities (-0.2 percentage points or -0.7%). The share of workers

with a low intensity workweek increased among individual and family services sub-sector workers (+3.4 percentage points or +14%).

Table 14: Percentage Distribution of the Workforce by Weekly Hours of Employment, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages

Weekly Hours of Employment	Health Care Sector, Total	Ambulatory Care	Hospitals	Nursing and Residential Care Facilities	Individual and Family Services	Non-Health Care Sectors	All Industry Sectors
Percent of Workers with Under 30 hours per week							
2010-11	18.6	21.2	14.2	21.0	23.7	17.8	17.9
2014-15	18.3	20.0	13.7	20.9	27.1	17.4	17.5
Absolute Change	-0.3	-1.2	-0.5	-0.1	3.4	-0.4	-0.4
Percent of Workers with 30-39 hours per week							
2010-11	20.8	21.1	19.0	21.9	25.5	14.2	15.1
2014-15	20.6	22.0	19.5	21.2	18.7	13.1	14.2
Absolute Change	-0.2	0.9	0.5	-0.7	-6.7	-1.1	-0.9
Percent of Workers with 40+ hours per week							
2010-11	60.6	57.7	66.8	57.0	50.9	68.0	66.9
2014-15	61.1	57.9	66.8	57.9	54.2	69.5	68.2
Absolute Change	0.5	0.2	0.0	0.9	3.3	1.5	1.3

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Workers in the health care industry were somewhat more likely to be employed for less than 30 hours per week in 2014-15 compared to those in the non-health care industries (18.3% versus 17.4%). Workers with a low intensity workweek comprised a smaller share of the state's hospital workforce (14%) compared to ambulatory care (20%), nursing and residential care facilities (21%) and individual and family services (27%).

Workers who are employed for 40 or more hours per week represent the other extreme: those with a high intensity workweek. Our examination found that high intensity work was more prevalent outside the state's health care sector than within the health care sector. The non-health care industries saw an increase of 1.5 percentage points or 2.2 percent in the share of high intensity workers between 2010-11 and 2014-15, while in the health care industry the share of high intensity workers increased by just 0.5 percentage points over the four years, representing an increase of 0.8 percent.

The share of high intensity workers remained constant at two-thirds in the state's hospital sector and increased in the remaining three sub-sectors of the health industry— by 0.2 percentage points or 0.5 percent in the ambulatory care sector, 0.9 percentage points or 1.5 percent in nursing and residential care facilities, and by 3.3 percentage points or 6.6 percent in the individual and family services sub-sector. Even after an increase of 3.3 percentage points, the individual and family services sub-sector continued to have the lowest share of high intensity workers in 2014-15 (54%), compared to the remaining three sub-sectors.

The middle group, workers with 30-39 weekly hours of employment, saw a decline in their share of the workforce in the state's health care sector as well as in industries outside the health care sector. The decline was much smaller in the health care industry (-0.2 percentage points or -1.1%) compared to non-health care industries (-1.1 percentage points or 7.4%).

Within the health care industry the change in workweek patterns were similar in three out of the four sub-sectors. The workforce in the ambulatory care and nursing and residential care sub-sectors moved slightly from a low and middle intensity workweek to a high intensity workweek while hospital workers saw a small decline in the share of low intensity workers, an increase in middle intensity workers, and no change in the share of high intensity workers.

The state's individual and family services sub-sector saw a decline of 6.7 percentage points in the share of middle intensity workers (30-39 hours) and an increase of 3.4 percentage points in the share of low intensity workers (less than 30 hours) and 3.3 percentage points in the share of high intensity workers (40-plus hours). This finding supports what we learned from employers in the home care sector; the preferred workweek among their employees was at two extremes. Some employees preferred a short workweek, while others wanted to work many more hours. Employers told us that in some cases their employees asked for many more hours (a high-intensity workweek) but that if they were unwilling to extend the workweek substantially due to concerns that over-extended workers would lead to a decline in service quality and rising unreimbursed overtime costs, high intensity workers sometimes secured additional hours of work by working for two or more employers, thus avoiding employer overtime costs while still working long hours. Home care employers also expressed concerns about the preference of employees to work a short workweek which they viewed as contributing to their labor supply problems.

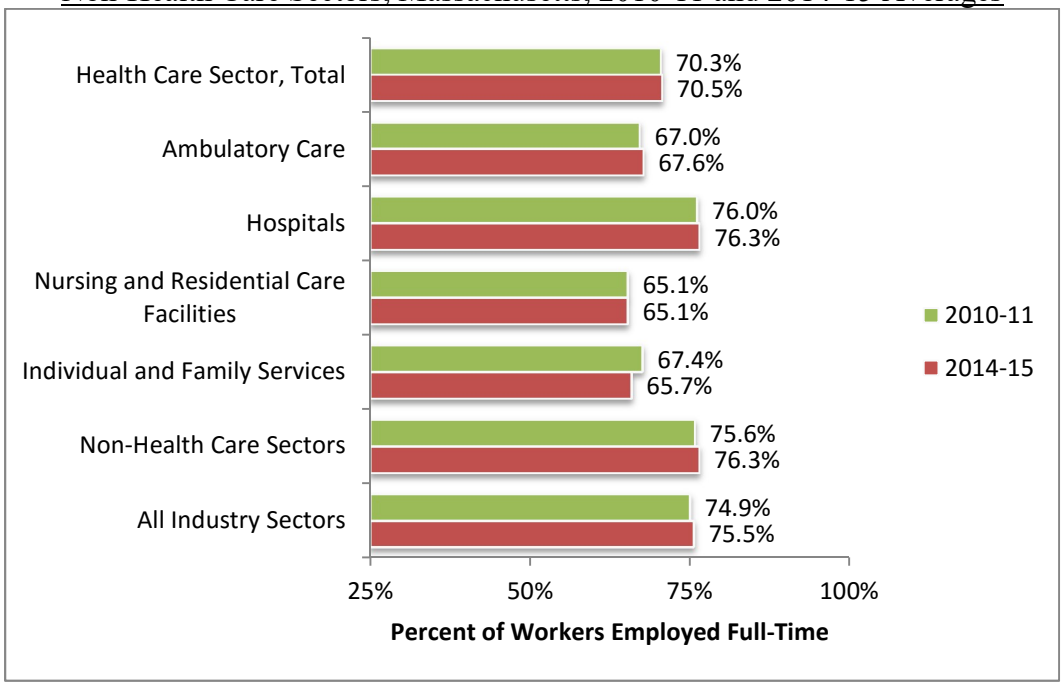
Full-Time Employment

Another frequently used measure of the intensity of employment is the share of the workforce that is engaged in full-time employment. Full-time employment is based upon weekly hours of employment, defined as a workweek of 35 hours or more. An examination of the proportion of workers with a workweek of 35 hours or more can shed light on the extent to which the industry provides its workers with full-time employment opportunities and the extent to which workers take the opportunity to work full-time.

Between 2010-11 and 2014-15, the share of the workforce employed full-time increased in both the health care industry and the non-health care industries across the state. Within the health care industry, the share of the workforce that was employed full-time increased in the ambulatory care and hospital sub-sectors (+0.6 and +0.3 percentage points), remained unchanged in the nursing and residential care sub-sector and declined in the individual and family services sub-sector (-1.7 percentage points).

In 2014-15, more than 70 percent of the state's health care workforce was employed for 35 hours or more; 6 percentage points less than the rate of full-time employment in the state outside the health care sector (76%). Within the health care sector, full-time employment was considerably more prevalent in hospitals (76%) than the ambulatory care sub-sector (68%), individual and family services sub-sector (66%), and nursing and residential care facilities (65%).

Chart 9: Percent of Workers that were Employed Full-Time (35+ weekly hours), Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Full-Time and Year-Round Employment

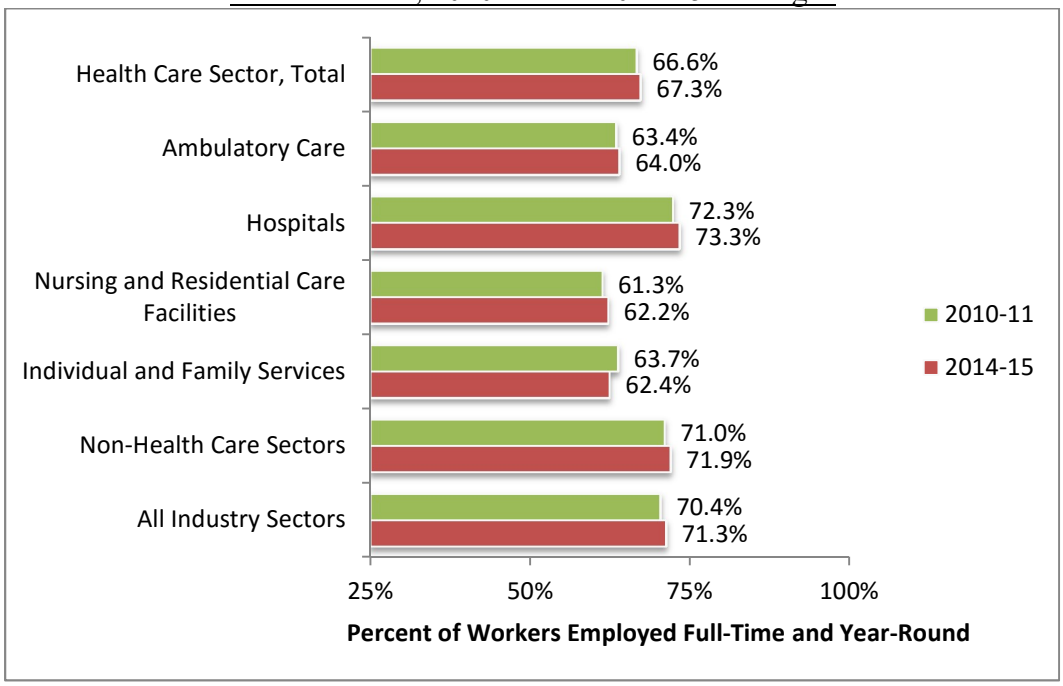
Weekly hours of employment measures the employment intensity during a week, but it does not provide a measure of employment patterns over a longer time period such as during an entire year. The ACS PUMS data files provide information on the number of weeks in a year during which workers were employed. Using data on weekly hours of work and annual weeks of work, we have produced a measure of employment intensity during the year—full-time and year-round employment. Year-round employment is defined as employment for 40 or more weeks during a year and workers are considered as employed full-time and year-round if they worked for 35 or more weekly hours and 40 or more weeks during the year.

Our analysis of full-time and year-round work among health care and non-heath care workers and workers in each of the four sub-sectors of the health care sector found patterns that are similar to the patterns of full-time work. Three out of four of these industry sectors saw an increase in the share of the workforce engaged in full-time and year-round work. The exception was the individual and family services sub-sector, which saw a 2 percentage point decline in the

share of full-time year-round employment, from nearly 64 percent in 2010-11 to 62 percent in 2014-15.

A comparison of full-time year-round employment in 2014-15 across industries finds that the health care workforce in the state was less likely to work in full-time year-round jobs

Chart 10: Percent of Workers Employed Full-Time and Year-Round (35+ weekly hours & 40+ annual weeks), Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

than their counterparts employed in other industries outside the health care sector (67% versus 72%). Within the health care sector, the hospital workforce was most likely to engage in full-time and year-round employment (73%). Workers in the remaining three health care sub-sectors were considerably less likely to be employed full-time and year-round (64% in ambulatory care and 62% in nursing and residential care and individual and family services sub-sectors).

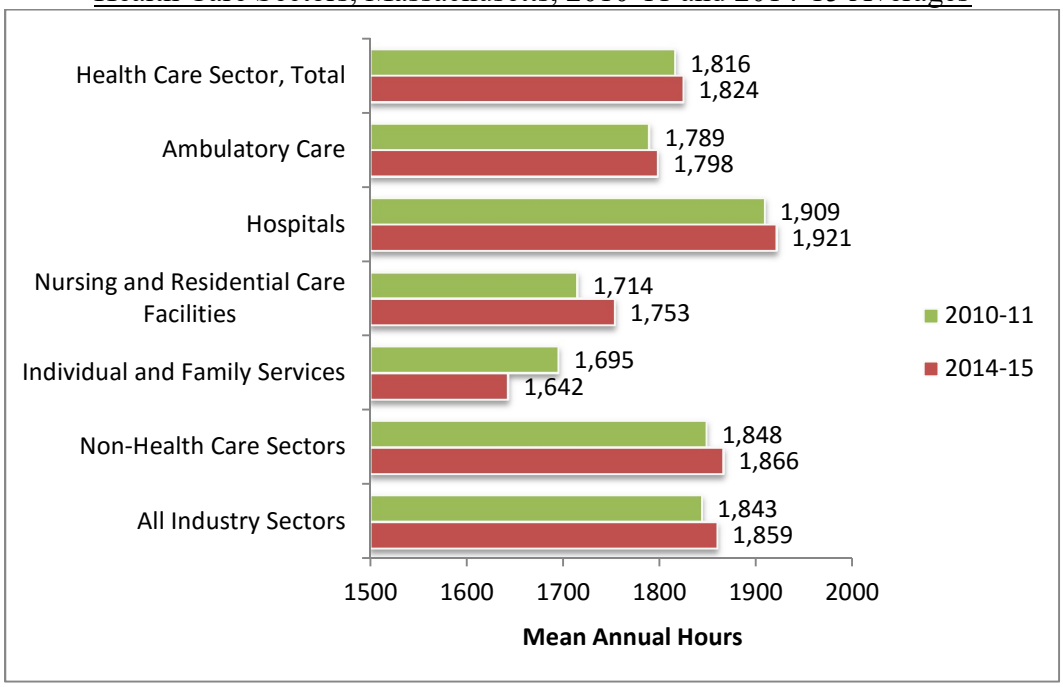
Annual Hours of Work

Another gauge of employment intensity measures the actual hours of employment per year. Annual hours of employment are computed from information on the number of weekly

hours and annual weeks of work during a year.[12] For example an individual who was employed for 35 hours per week for the entire year (52 weeks) would have worked for 1,820 hours during the year (35 hours * 52 weeks).

On average, health care workers in Massachusetts were employed for 1,824 hours during the year in 2014-15, up from 1,816 hours in 2010-11. Over the four years between 2010-11 and 2014-15 the mean annual hours of employment increased in three out of four sub-sectors of the health care industry—ambulatory care, hospitals and nursing and residential care. The fourth health care sub-sector, individual and family services saw a decline in the mean annual hours of employment from 1,695 hours in 2010-11 to 1,642 hours in 2014-15.

Chart 11: Mean Annual Hours of Employment among Workers in the Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

[12] Beginning in 2008, the Census Bureau changed the format for reporting annual weeks of employment in the American Community Survey Public Use Microdata Sample data files. Data on annual weeks of employment that were provided in a continuous format prior to the 2008 ACS are now (in the 2008 ACS PUMS and after) provided in a range format using the following ranges: 50-52 weeks, 48 to 49 weeks, 40 to 47 weeks, 27 to 39 weeks, 14 to 26 weeks, and less than 14 weeks. So, if a respondent was employed for 20 weeks during a given year, ACS PUMS data files prior to 2008 would report annual weeks for this respondent as 20 weeks, whereas ACS PUMS data files in 2008 and in the years after 2008 would report this as a range (14 to 26 weeks). For 2010-11 and 2014-15 ACS data, we have used the linear interpolation method to compute annual weeks of work for each respondent by using the midpoint estimates of each range of annual weeks to represent the annual weeks of work. These midpoint estimates of annual weeks of work were used along with weekly hours to estimate annual hours of employment.

In 2014-15, the mean annual hours of health care industry workers in the state was smaller than that of workers in non-health care industries; 1,824 hours versus 1,866 hours. Within the health care sector, hospital workers had the highest mean annual hours of work; 1,921 hours. This exceeded the mean annual hours of all health care and non-health care workers. The mean annual hours of employees in the state's ambulatory care industry was 123 hours less than their hospital counterparts, 1,798 hours. Workers in the remaining two health care sub-sectors were employed even less intensively during the year: 1,753 mean annual hours in the nursing and residential care sub-sector and just 1,642 hours in the individual and family services sub-sector.

In summary, our analysis of the intensity of work among workers found that on every measure— mean weekly hours, percent of workers with full-time employment, percent of workers with full-time and year-round employment, and mean annual hours of employment — workers in the state's health care sector as well as non-health care industries saw an increase in their employment intensity between 2010-11 and 2014-15. However, health care workers in the state continued to be employed less intensively than non-health care workers. All four measures of employment intensity presented above were lower among workers in the state's health care sector compared to those of workers in non-health care industries. Within the health care sector, employment intensity increased over the four years in all but one sub-sector—individual and family services. On each measure of employment intensity, the workforce in this sub-sector of the health care sector reduced their employment intensity.

Earnings of Health Care Sector Workers in Massachusetts

Using the ACS PUMS data files combined for 2010-2011 and 2014-2015, we have produced real (inflation-adjusted) mean annual earnings (measured in 2015 dollars) of the workforce in the health care industry and outside the health care industry in Massachusetts in 2010-11 and 2014-15. We have also analyzed the change in real mean annual earnings that has occurred over the four years.

Mean Annual Earnings of Workers in the Health Care and Non-Health Care Sectors

In 2014-15 the mean annual earnings of health care sector workers in Massachusetts was $60,600, up from $59,850 in 2010-11, representing an increase of $750 or 1.3 percent over four years. The rate of increase in the mean annual earnings of the state's workforce outside the

health care sector was twice as high, 2.6 percent over the same four-year period, from $57,600 in 2010-11 to $59,100 in 2014-15.

Within the health care sector, hospital and ambulatory care sector workers saw their mean annual earnings increase between 2010-11 and 2014-15, while workers in the nursing and residential care sector and the individual and family services sector saw a decline in their annual earnings. Hospital workers saw the largest increase in annual earnings, $2,500 or 3.6 percent; the mean annual earnings of ambulatory care workers rose by $800 or 1.3 percent. Employees in the remaining two sectors experienced a decline in earnings, $105 or 0.3 percent in the nursing and residential care sector and nearly $700 or 1.8 percent decline in the individual and family services sector.

In 2014-15, hospital workers in the state had the highest mean annual earnings, $71,900. This was nearly 19 percent higher than the overall mean annual salary of $60,600 among all health care workers in the state. Workers in the state's ambulatory care sector also had considerably higher mean annual earnings ($66,700), which was 10 percent higher than the mean annual earnings of all health care workers. Health care sector workers who were employed in the state's nursing and residential care sector and in the individual and family services sector earned considerably lower earnings than their counterparts employed in hospitals and ambulatory care. Employees of the state's nursing and residential care sector had mean annual earnings of just $36,300, a little over half of the mean annual earnings of hospital workers. Individual and family services sector workers earned a mean annual salary of $37,300. This was $1,000 more than the mean salary of nursing and residential care workers but still substantially lower than mean annual earnings of hospital and ambulatory care sector workers.

The different occupational staffing patterns of these industry sub-sectors partly underlie these earnings differences. The hospital and ambulatory care sectors have higher shares of workers in high level health diagnostic and treatment occupations such as physicians and registered nurses, whereas nursing and residential care facilities employ many more workers in lower-level health care support occupations (such as certified nursing assistants, home health aides and other occupational aides and assistants and orderlies) and low-level service occupations.

The individual and family services sub-sector has a concentration of workers in managerial and non-health professional occupations with over half of these workers holding a bachelor's or higher degree. However, the mean earnings of these workers are only slightly higher than those of nursing and residential care workers. Lower earnings in the individual and family services sub-sector could be from the composition of most professional positions in this industry. These consist of community and social service occupations such as counselors and social workers, which are characterized by lower salaries. And as noted in previous sections, the lower employment intensity of workers in this sub-sector also underlies the lower annual earnings of the workforce in this industry. It should also be noted that between 2010-11 and 2014-15, the share of workers in service occupations, mainly personal care aides, increased sharply in this sub-sector of the state's health care industry. Over this four-year period, the share of service occupations in this sector increased from 16 percent in 2010-11 to 23 percent in 2014-15, while the share of management occupations declined from 63 percent to 52 percent. A large majority of this increase in service occupations came from the sharp rise in the number of personal care aides, an occupation that is characterized by low earnings.[13] These changes in the occupational composition of employment in the state's individual and family services sub-sector contributed to the earnings decline in this sub-sector between 2010-11 and 2015-16.

Table 15: Mean Annual Earnings of the Workforce, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)

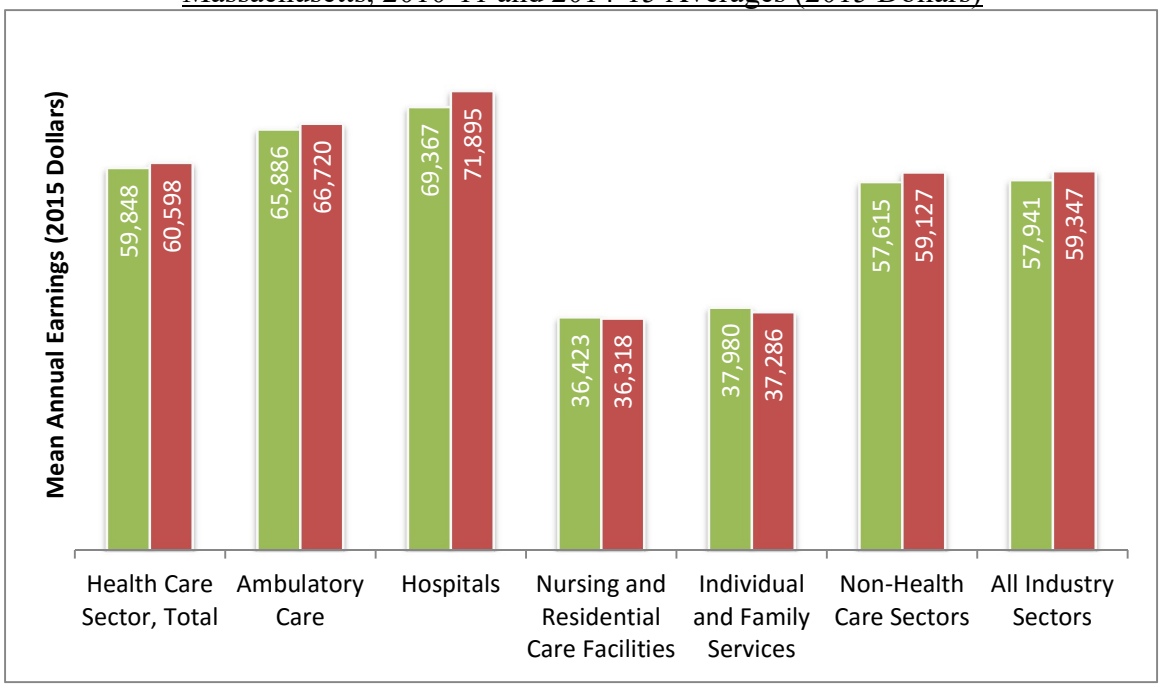
	2010-11	2014-15	Absolute Difference	Relative Difference
Health Care Sector, Total	59,848	60,598	750	1.3%
Ambulatory Care	65,886	66,720	834	1.3%
Hospitals	69,367	71,895	2,527	3.6%
Nursing and Residential Care Facilities	36,423	36,318	-105	-0.3%
Individual and Family Services	37,980	37,286	-694	-1.8%
Non-Health Care Sectors	57,615	59,127	1,513	2.6%
All Industry Sectors	57,941	59,347	1,406	2.4%

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

[13] Special Topics Report, September 2016, op. cit.

The gaps between the earnings of workers across the four sub-sectors of the state's health care sector widened between 2010-11 and 2014-15. The mean annual earnings increased in the two sub-sectors that already had higher earnings in 2010-11 (hospitals and ambulatory care) and declined in the remaining two sub-sectors with lower earnings in 2010-11 (nursing and residential care, and individual and family services). The gap between the mean annual earnings of hospital workers and nursing and residential care workers was $33,000 or 91 percent in 2010-11; that is, the mean annual earnings of workers employed in the state's hospitals were 91 percent higher than the mean annual earnings of workers employed in the nursing and residential care sector ($69,400 versus $36,400). By 2014-15, the earnings gap between workers in these two sectors had increased to $35,600 or 98 percent; the mean annual earnings of workers in the state's hospitals ($71,900) were 98 percent higher than the earnings of workers in the nursing and residential care sector ($36,300).

Chart 12: Mean Annual Earnings of the Workforce, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Mean Annual Earnings of Health Care Sector Workers by Occupation

The health care sector is staffed with workers in varying occupations. These range from physicians, managers and registered nurses to health technicians and technologists and administrative staff. They include health care support workers (aides, assistants, and orderlies), service workers including home health care workers and personal care aides, and blue collar workers. We have examined the 2010-11 and 2014-15 real (inflation-adjusted) mean annual earnings of workers employed in ten occupations within the health care industry in Massachusetts and the absolute and relative change in the real mean annual earnings in each occupation over the four-year period.

As noted in a previous section, the real mean annual earnings of the health care sector workforce in Massachusetts increased by 1.3 percent between 2010-11 and 2014-15. Over the same time period the real mean annual earnings of the non-health care workforce in the state increased by 2.6 percent, twice the rate of increase in the annual earnings of health care workers. Within the health care sector, workers in only four out of the ten occupations saw an increase in mean annual earnings. The earnings of health diagnosing and treating practitioners (excluding RNs) increased by 3 percent, more than twice the rate of increase in the annual earnings in the state's health care sector overall. The mean annual earnings of health technicians and technologists increased sharply between 2010-11 and 2014-15, rising by nearly $6,200 or 12 percent over four years. Earnings of managerial occupations in the health care sector also increased at a rate (2.2%) above the industry average and office and administrative workers saw a small increase in their wages, 0.8 percent.

The mean annual earnings of workers in the remaining six occupations in the state's health care sector declined between 2010-11 and 2014-15. The largest decline occurred among licensed practical nurses (LPNs) with the real mean annual earnings of these workers falling from $48,800 to $45,000, a decline of $3,800 or nearly 8 percent. The mean annual earnings of RNs also declined from nearly $73,000 in 2010-11 to $71,800 in 2014-15, a decline in annual earnings of nearly $1,200 or 1.6 percent. Health care support occupations, which include the fast growing home health aide occupation, also lost ground with a 3.3 percent decline in annual earnings over the four-year period. And real mean annual earnings declined by 1.6 percent for service occupation workers in the health care sector. This occupation includes the fast growing personal care aide occupation.

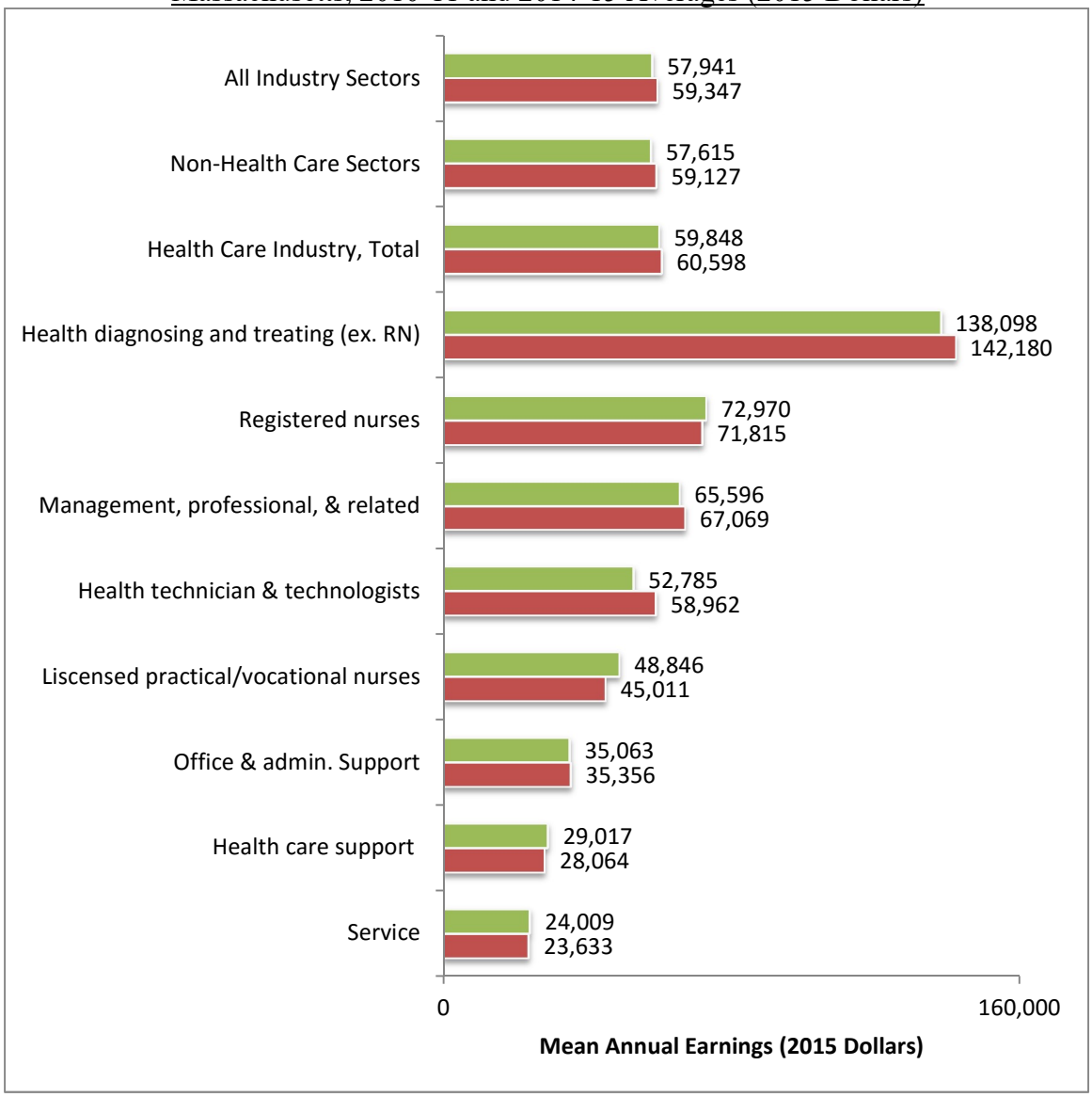
Table 16: Mean Annual Earnings of the Health Care Sector Workforce by Occupation, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)

	2010-11	2014-15	Absolute Difference	Relative Difference
Health diagnosing and treating practitioner, excl. RN	138,098	142,180	4,082	3.0%
Registered nurses	72,970	71,815	-1,154	-1.6%
Management, professional, and related	65,596	67,069	1,472	2.2%
Health technicians and technologists	52,785	58,962	6,177	11.7%
Construction, and maintenance	54,709	54,218	-491	-0.9%
Licensed practical/vocational nurses	48,846	45,011	-3,835	-7.9%
Office and admin. Support	35,063	35,356	294	0.8%
Production, transportation and material moving	31,105	29,842	-1,263	-4.1%
Healthcare support	29,017	28,064	-954	-3.3%
Service	24,009	23,633	-376	-1.6%
Health Care Sector, Total	59,848	60,598	750	1.3%
Non-Health Care Sectors	57,615	59,127	1,513	2.6%
All Industries	57,941	59,347	1,406	2.4%

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Findings presented in the following chart (Chart 13) reveal that the mean annual earnings of health diagnosing and treating practitioners (excluding RNs) were higher than the earnings of the remaining nine occupations ($142,200 per year in 2014-15). The second highest mean earnings in the health care sector were among registered nurses ($71,800 per year in 2014-15). Health care sector workers in management and professional occupations (these exclude health professional occupations such as health diagnosing and treating practitioners) earned $67,100 per year in 2014-15. The fourth highest earnings in the health care sector were among technicians and technologists in health fields, earning on average $59,000 per year in 2014-15. LPNs in the state earned $45,000 per year while clerical workers in the state's health care sector earned $35,400 in 2014-15. Workers employed in health care support occupations and service occupations in the state's health care industries had the lowest salaries among the ten occupations, earning $28,000 and $23,600, respectively, in 2014-15.

Chart 13: Mean Annual Earnings of the Health Care Sector Workforce by Occupation, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)



Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

Distribution of Annual Earnings in the Health Care and Non-Health Care Sectors

The final section in the analysis of earnings focuses on the distribution of earnings across workers in the health care sector. Trends in employment intensity (hours and weeks of work) and earnings over the 2010-11 and 2014-15 period presented in previous sections point to an increase in the inequality of earnings distribution in the state's health care sector. Our analysis of the trends in mean annual earnings between 2010-11 and 2014-15 found that most of the earnings increases occurred in high wage occupations while workers in low wage occupations saw a

decline in their real annual earnings. Furthermore, employment in the state's health care sector has shifted from hospitals and nursing homes toward outpatient, residential and home care, resulting in increased employment in lower wage health care support and service occupations, such as home health aides and personal care aides.

A look at earnings along different points of the distribution provides clearer insights into changes that have occurred in the earnings of different groups of workers. The earnings distribution shows workers by their earnings from lowest to highest. Earnings percentiles represent the earnings of workers at different points along the earnings distribution. For example, the $11,515 earnings at the 10th percentile of the earnings distribution of health care sector workers in Massachusetts in 2014-15 indicates that 10 percent of health care sector workers in Massachusetts earned less than $11,515 per year in 2014-15.

Table 17 examines the earnings of workers in the state's health care sector and non-health care industries at the 10th, 20th, 50th, 80th and 90th percentiles of the earnings distribution in 2010-

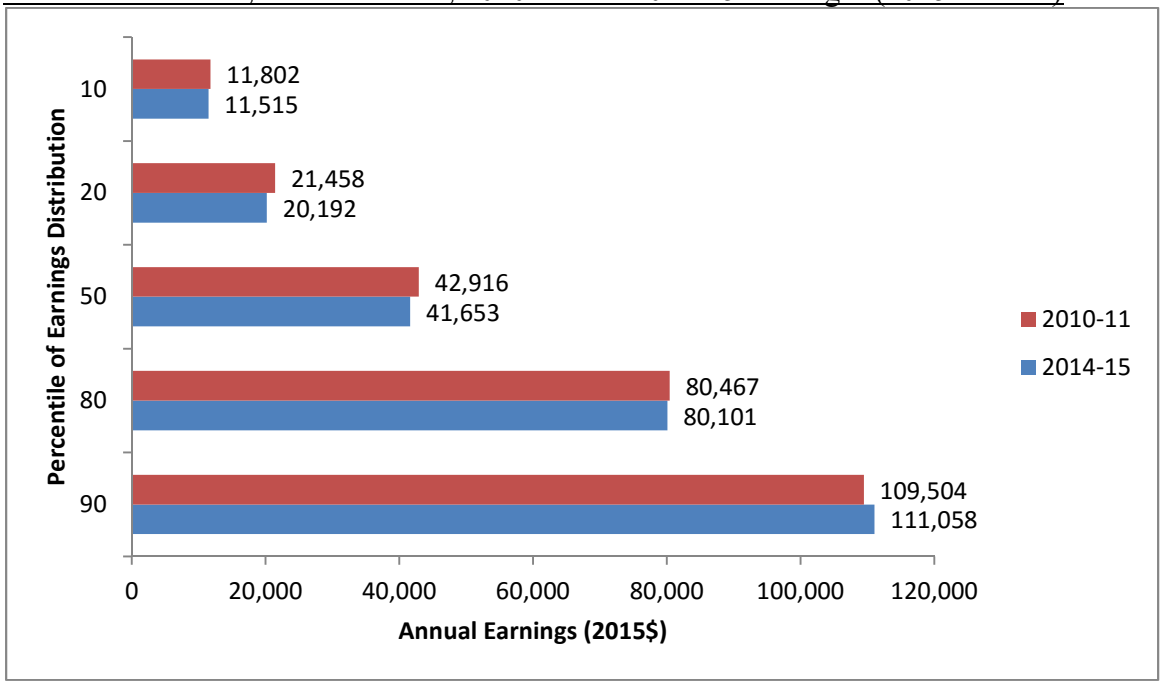
Table 17: Annual Earnings of Workers at Selected Earnings Distribution Percentiles within the Industry, Health Care and Non-Health Care Sectors, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)

Percentile of Earnings Distribution	2010-11	2014-15	Absolute Change	Relative Change
Health Care Sector				
10	11,802	11,515	-287	-2.4%
20	21,458	20,192	-1,265	-5.9%
50 (Median)	42,916	41,653	-1,263	-2.9%
80	80,467	80,101	-365	-0.5%
90	109,504	111,058	1,554	1.4%
Mean	59,848	60,598	750	1.3%
Non-Health Care Sectors				
10	6,570	6,708	138	2.1%
20	15,450	15,019	-431	-2.8%
50 (Median)	42,916	42,202	-713	-1.7%
80	82,347	85,107	2,760	3.4%
90	112,789	120,145	7,355	6.5%
Mean	57,615	59,127	1,513	2.6%

Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

11 and 2014-15. The mean annual earnings of health care workers declined at the 10th, 20th, 50th, and 80th percentiles but increased at the 90th percentile. Health care workers at the 10th percentile and 20th percentile saw their earnings decline, respectively, by 2.4 percent and 6 percent. The median earnings (earnings at the 50th percentile) of the state's health care workforce declined by nearly 3 percent; from 42,900 in 2010-11 to 41,600 in 2014-15. Even health care workers at the 80th percentile of the earnings distribution suffered an earnings loss between 2010-11 and 2014-15 of $400 or 0.5 percent.

Chart 14: Annual Earnings of Workers at Selected Earnings Distribution Percentiles within the Health Care Sector, Massachusetts, 2010-11 and 2014-15 Averages (2015 Dollars)



Source: 2010, 2011, 2014, and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

At the very top of the earnings distribution, the 90th percentile, representing a level of earnings topped by only 10 percent of the industry's workforce, earnings rose between 2010-11 and 2014-15 from $109,500 in 2010-11 to $111,100 in 2014-15, representing an increase in earnings of nearly $1,600 or 1.4 percent. Earnings fell among all but the very highest earners in the state's health care workforce, indicating an increase in earnings inequality in the state's health care industry.

Earnings in the state's non-health care industries followed a similar trend, declining at the bottom and rising at the top of the earnings distribution. While annual earnings at the 20th and 50th percentile declined (by -2.8 and -1.7 percent respectively), annual earnings increased by 3.4 percent at the 80th percentile and 6.5 percent at the 90th percentile. At the very bottom of the earnings distribution in the non-health care sector, the 10th percentile, annual earnings rose by $138 or 2.1 percent.

A comparison of the annual earnings at different percentiles of the earnings distribution provides a measure of the gap between the earnings of workers across the earnings distribution. Ratios of earnings at different percentiles of the earnings distribution are frequently used to measure earnings inequality at different levels of the earnings distribution. Table 18 presents the ratio of earnings at different levels of the earnings distribution for health care workers in 2010-11 and 2014-15. These ratios provide a measure of the level of earnings inequality among health care workers and the change in these ratios provide a measure of the change in the earnings inequality among health care workers over the four-year period. Table 18 also presents the same findings for the state's workforce employed outside the health care sector.

Our findings show an increase in earnings inequality between 2010-11 and 2014-15 in the health care sector as well as the non-health care sector of the state. In 2014-15, the annual earnings of workers in the health care sector at the 90th percentile of the earnings distribution were 9.6 times higher than the annual earnings of workers at the 10th percentile; up from 9.3 times higher in 2010-11. The 90th to 20th percentile annual earnings ratio increased from 5.1 in 2010-11 to 5.5 in 2014-15. The 90th percentile earnings were also higher than median earnings (50th percentile), increasing from 2.6 to 2.7 times higher in between 2010-11 and 2014-15.

Annual earnings gaps were also sizable relative to the 80th percentile. Earnings at the 80th percentile were 7 times higher relative to the 10th percentile, 4 times higher relative to the 20th percentile, and 1.9 times higher than median earnings. The ratio of annual earnings in the health care sector at the 80th percentile relative to the 10th and 20th percentile increased between 2010-11 and 2014-15, further indicating an increase in earnings inequality across the earnings distribution in the state's health care sector.

While earnings inequality in the state's health care sector was quite high and had increased between 2010-11 and 2014-15, it was still considerably lower than the earnings

inequality in the state's non-health care industries. Annual earnings at the 90th percentile in the non-health care sector were 17.9 times higher than the annual earnings at the 10th percentile in 2014-15; up from 17.2 in 2010-11. The annual earnings ratio in the non-health care industries of the state was higher than the health care sector at every level of the earnings distribution in 2014-15.

Table 18: Ratio of Annual Earnings at Different Points along the Earnings Distribution, Health Care and Non-Health Care Industries, Massachusetts, 2010-11 and 2014-15 Averages

Ratio of Earnings at Selected Earnings Percentiles	2010-11	2014-15	Absolute Change
Health Care Sector			
90/10	9.3	9.6	+0.3
90/20	5.1	5.5	+0.4
90/50	2.6	2.7	+0.1
80/10	6.8	7.0	+0.2
80/20	3.7	4.0	+0.3
80/50	1.9	1.9	0.0
Non-Health Care Sectors			
90/10	17.2	17.9	+0.7
90/20	7.3	8.0	+0.7
90/50	2.6	2.8	+0.2
80/10	12.5	12.7	+0.2
80/20	5.3	5.7	+0.4
80/50	1.9	2.0	+0.1

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

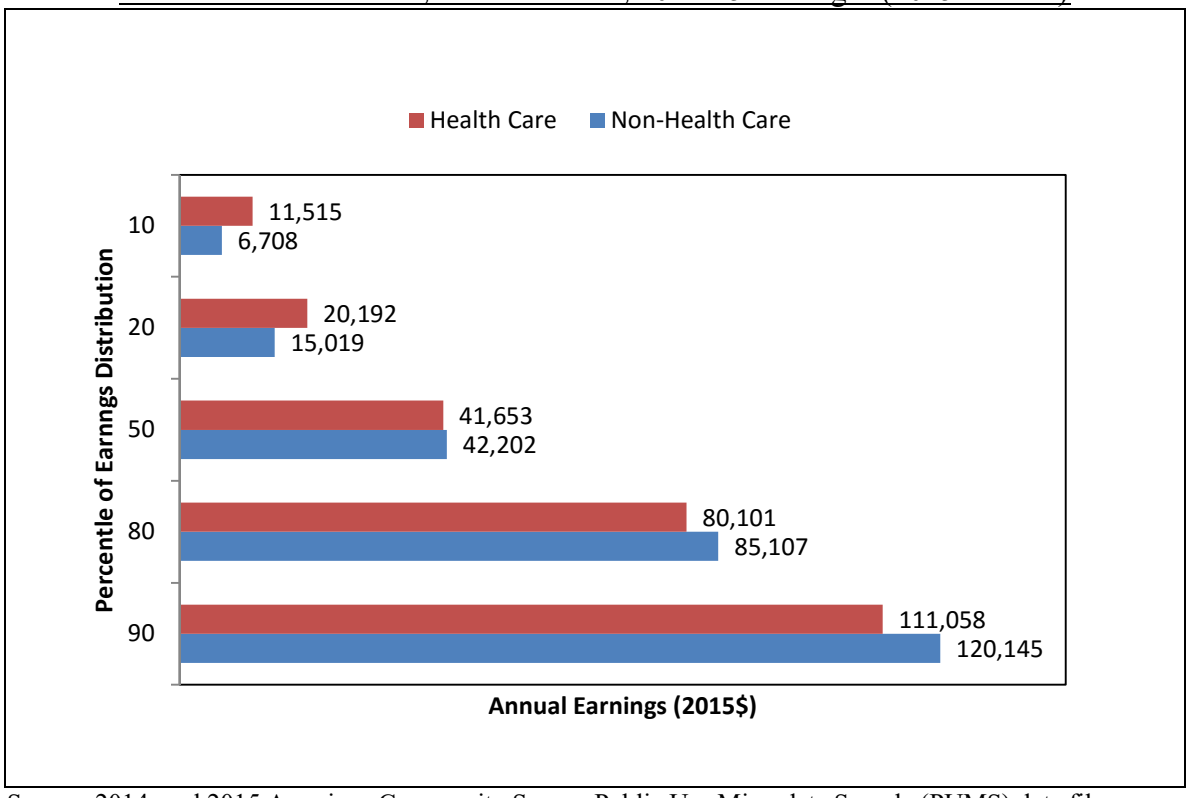
A comparison of the level of earnings along selected points of the earnings distribution in the health care sector and non-health sectors in Massachusetts presented in Table 19 and Chart 15 reveals large earnings gaps along the earnings distribution between the two sectors of the state economy. In 2014-15, annual earnings of workers at the 10th percentile of the earnings distribution in the health care sector ($11,500) were nearly 72 percent *higher* than that of their counterparts in non-health care industries in the state ($6,700); a gap of $4,800. At the 20th percentile of their respective earnings distributions, workers in the health care sector earned $5,200 or 34 percent more than workers in the non-health care sector ($20,200 versus $15,000).

Among workers at higher levels of the earnings distribution there was a reversal in the earnings gap between health care and non-health care workers. At the 80th percentile of the

Table 19: Differences between the Annual Earnings of Health Care and Non-Health Care Workers at Selected Earnings Distribution Percentiles, Massachusetts, 2014-15 Averages (2015 Dollars)

(A) Percentile of Earnings Distribution	(B) Annual Earnings: Health Care Sector	(C) Annual Earnings: Non-Health Care Industries	(D) Absolute Difference (B - C)	(E) Relative Difference (D / C)
10	$11,515	$6,708	4,807	72%
20	20,192	15,019	5,173	34%
50	41,653	42,202	-549	-1%
80	80,101	85,107	-5,006	-6%
90	111,058	120,145	-9,087	-8%

Chart 15: Annual Earnings of Health Care and Non-Health Care Workers at Selected Earnings Distribution Percentiles, Massachusetts, 2014-15 Averages (2015 Dollars)



Source: 2014, and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

earnings distribution the annual earnings of health care workers were $5,000 or 6 percent *lower* than that of their non-heath care counterparts. At the boundary of the highest decile (90th percentile) workers in the health care industry earned nearly $9,100 or 8 percent lower than non-health care sector workers ($111,100 versus $120,100).

Compared to non-health care industry workers, Massachusetts workers in the health care sector had higher earnings at lower percentiles and lower earnings at higher percentiles of the earnings distribution, revealing a narrower and less unequal distribution of earnings in the state's health care industry compared to the non-health care industries.

Although the state's health care sector has much less inequality in the distribution of annual earnings than non-health care industries, earnings inequality in the state's health care sector has increased between 2010-11 and 2014-15. Part of this change is attributable to the change in the industry distribution of employment in the health care sector away from hospitals and ambulatory care and toward residential, outpatient, and home care. This has resulted in a shift towards lower wage occupations of home health aides, home care workers and personal care aides and, therefore, a suppression of wages at the bottom of the earnings distribution.

Within the state's health care sector, earnings inequality rose across all four sub-sectors. The ratio of annual earnings at the 90th percentile relative to the 10th percentile rose sharply in the individual and family services sub-sector. Annual earnings at the 90th percentile in this sub-sector were 12.4 times higher than annual earnings at the 10th percentile—up from 8.9 times higher in 2010-11. The 90/10 annual earnings ratio also increased in the nursing and residential care sector (9.0 to 10.1) and the hospital sector (6.2 to 6.8). The rise in the 90/10 ratio in these three sub-sectors of the state's health care sector is attributable to an increase in annual earnings at the 90th percentile and a decline in annual earnings at the 10th percentile. This did not happen in the ambulatory care industry, which saw an increase in annual earnings at the 90th as well as the 10th percentile. The net effect was a decline in the 90/10 annual earnings ratio from 11.8 in 2010-11 to 10.8 in 2014-15.

The ratio of annual earnings at the 90th percentile relative to the earnings at the 20th percentile and the 50th percentile (median) increased among workers across all four sub-sectors of the state's health care sector. Annual earnings at the 90th percentile were 6.4 times higher than annual earnings at the 20th percentile in the state's ambulatory care industry in 2014-15; up from

6 times higher in 2010-11. Over the four years between 2010-11 and 2014-15, the 90/20 percentile ratio of annual earnings increased from 5.0 to 5.7 among workers in the individual and family services sector, 4.3 to 4.7 in the nursing and residential care sector, and 4.0 to 4.4 in the hospital sector.

Earnings at the 50th percentile, also known as median earnings, represent the mid-point of the earnings distribution with the earnings of one half of workers below the median and the other half above the median. The ratio of earnings at the 90th percentile relative to the 50th percentile or the median also increased across all four health care sub-sectors between 2010-11 and 2014-15; from 3.1 to 3.2 among ambulatory care workers, 1.9 to 2.4 in individual and family services, 2.2 to 2.4 in nursing and residential care facilities, and 2.2 to 2.3 among hospital workers.

Table 20: Annual Earnings and Ratio of Annual Earnings of Workers at Selected Earnings Distribution Percentiles within Sub-Sectors of the Massachusetts Health Care Sector, 2010-11 and 2014-15 Averages (2015 Dollars)

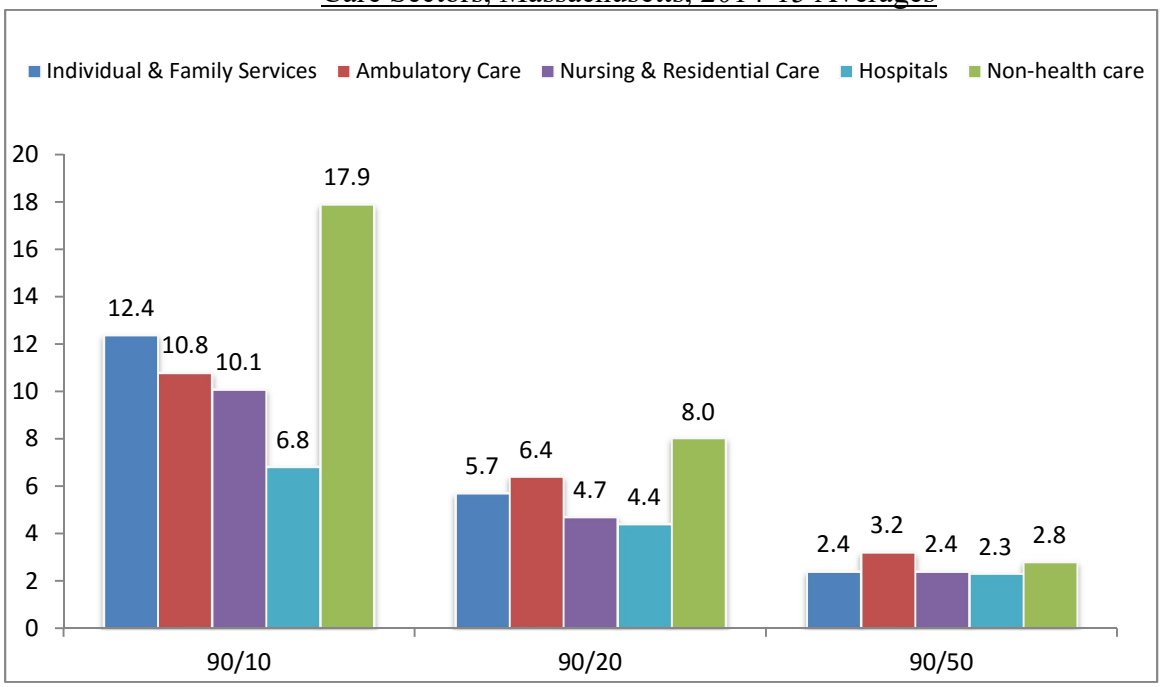
Percentiles of Earnings Distribution	Ambulatory Care		Hospitals		Nursing and Residential Care Facilities		Individual and Family Services	
Annual Earnings								
	2010-11	**2014-15**	**2010-11**	**2014-15**	**2010-11**	**2014-15**	**2010-11**	**2014-15**
10	10,950	12,015	19,312	18,523	7,510	7,009	7,510	5,807
20	21,458	20,192	30,041	28,836	15,771	15,019	13,411	12,620
50	41,612	40,385	54,752	55,529	30,661	30,038	34,332	30,289
90	128,747	130,164	120,454	126,202	67,892	70,673	66,797	72,091
Ratio of Earnings								
	2010-11	**2014-15**	**2010-11**	**2014-15**	**2010-11**	**2014-15**	**2010-11**	**2014-15**
90/10	11.8	10.8	6.2	6.8	9.0	10.1	8.9	12.4
90/20	6.0	6.4	4.0	4.4	4.3	4.7	5.0	5.7
90/50	3.1	3.2	2.2	2.3	2.2	2.4	1.9	2.4

Source: 2010, 2011, 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

A comparison of the 2014-15 earnings gaps in each of the four sub-sectors of the health care sector presented in Chart 16 reveals that the individual and family services sub-sector had the largest 90/10 percentile annual earnings ratio; the annual earnings at the 90th percentile ($72,100) was 12.4 times higher than the annual earnings at the 10th percentile ($5,800). The 90/10 percentile annual earnings ratio was 10.8 in the ambulatory care sector, 10.1 in nursing and

residential care facilities and 6.8 in the state's hospitals. The gap between the 90th and 10th percentile annual earnings in the state's non-health care sector (17.9) was larger than the 90/10 annual earnings ratio in all four sub-sectors of the state's health care sector.

Chart 16: Ratio of Annual Earnings at Different Points along the Earnings Distribution, Sub-Sectors of the Health Care Sector and Non-Health Care Sectors, Massachusetts, 2014-15 Averages



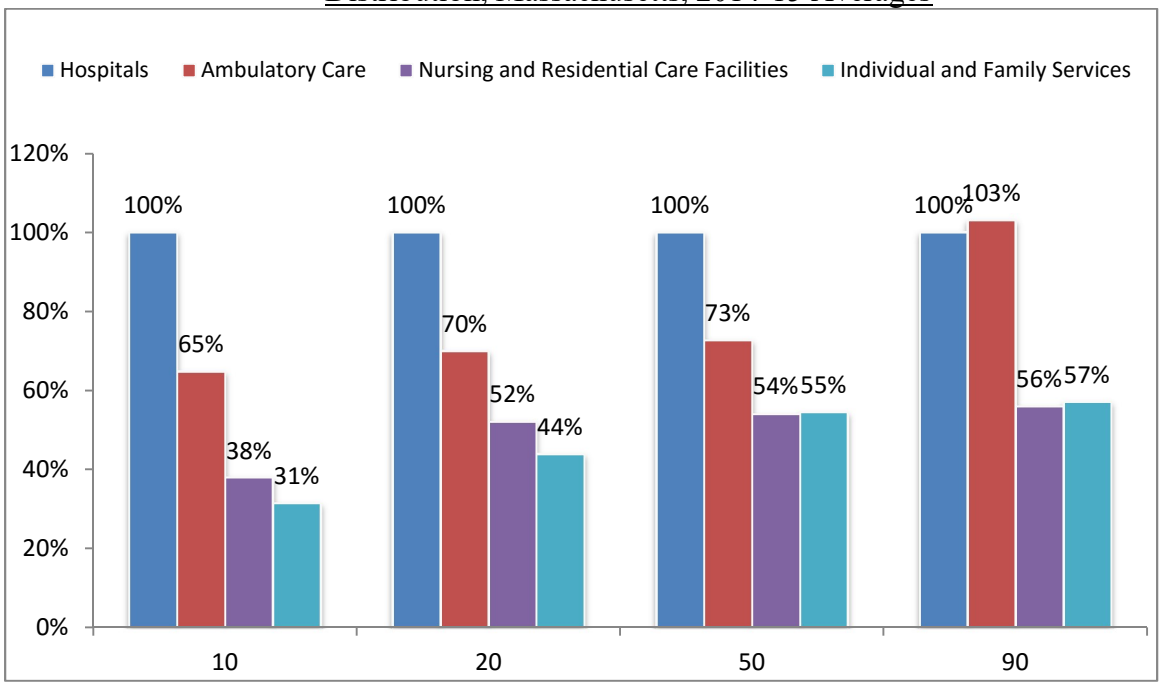
Source: 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

The 90/20 percentile annual earnings ratio was 6.4 among workers in the ambulatory care sector, 5.7 among individual and family services workers, 4.7 in the nursing and residential care sector, and 4.4 among hospital workers. The 90/median earnings ratio was also highest among ambulatory care workers (3.2) and lowest among hospital workers (2.3).

The earnings inequality is found to be consistently lower among hospital workers than workers in the other three sub-sectors of the state's health care sector. Across the earnings distribution, hospital workers had higher earnings than workers in the other three sub-sectors. However the earnings advantage of hospital workers compared to workers in the remaining three health care subsectors was much higher at the 10th percentile. At the 10th percentile, for every $1 of annual earnings of hospital workers, workers earned 65 cents in the ambulatory care sub-

sector, 38 cents in the nursing and residential care sub-sector, and 31 cents in the individual and family services sub-sector (Chart 17). At the 90th percentile, for every $1 of annual earnings of hospital workers, workers earned $1.03 if they were employed in the ambulatory care sub-sector, 56 cents in the nursing and residential care sub-sector, and 57 cents in the individual and family services sub-sector. The state's hospital workforce had a considerably larger earnings advantage over their counterparts in the other three health care subsectors at the bottom of their earnings distribution than at the top of the earnings distribution, yielding a less unequal earnings distribution than the rest of the state's health care industry.

Chart 17: Annual Earnings of Workers in Each Health Care Sub-Sector Relative to Annual Earnings of Hospital Sub-Sector Workers at Different Points along the Earnings Distribution, Massachusetts, 2014-15 Averages



Source: 2014 and 2015 American Community Survey Public Use Microdata Sample (PUMS) data files, tabulations by Center for Labor Markets and Policy, Drexel University.

On each of the measures presented above, earnings inequality in the state's health care and non-health care industries increased between 2010-11 and 2014-15. Within the health care sector, inequality in the distribution of earnings increased in all four sub-sectors. However, even after increasing over the past four years, the earnings inequality among workers in the state's health care sector was considerably lower than the earnings inequality among workers employed outside the state's health care sector. Within the state's health care sector, earnings inequality

based on every measure was lower among hospital workers than among workers in the remaining three health care sub-sectors.

Appendix A: American Community Survey Public Use Microdata Files

This assessment of the demographic characteristics of the workforce, employment intensity, employment patterns, and the level and distribution of annual earnings of the health care workforce and the non-health care workforce is based on our analysis of the American Community Survey Public Use Microdata Sample files. The American Community Survey (ACS) is an ongoing annual survey conducted by the U.S. Census Bureau. The ACS survey is designed to replace the long-form decennial census survey that was administered to a sample of households in the nation and used in addition to the short-form survey that was administered to every household in the nation. The long-form sample survey of the decennial census was used in every decennial census until the year 2000. The long-form decennial census survey was discontinued beginning with the 2010 decennial census. The Census Bureau introduced the ACS in 1996 as a pilot survey conducted in a few counties across the nation with a survey instrument containing basic questions about age, gender, race-ethnicity, as well as detailed questions about housing and population characteristics that were previously gathered with the decennial census long-form survey. Full implementation of the ACS began in 2005.

After collection, the Census Bureau releases ACS data for public use in two formats: the first format, called summary data, consists of data files in which each measure reported reflects the sum of activity in a geographic area including the nation, state, and sub-state areas down to census tracts and blocks. Summary file data are familiar to many readers as they are simply more detailed versions of tabulations released by the Census Bureau

The second format, called microdata, consists of data files in which each de-identified record represents an individual respondent. Microdata files (Public Use Microdata Samples or PUMS data files) contain data at the individual respondent level and the Census Bureau protects the confidentiality of individual respondents by limiting geographic information available in public use data files. We use these individual response microdata files to produce our own weighted measures of demographic, employment, earnings and related outcomes reported in this paper.

The smallest geographic area identified on the ACS PUMS data files is an area with about 100,000 residents. Two such geographic areas are identified on the ACS PUMS data files.

The first represents the place of residence of respondents and is called the Public Use Microdata Area or PUMA. The second geographic area identified on the ACS PUMS data files represents the place of work of respondents. The ACS survey asks respondents to provide the address of the job that they held at the time of the ACS survey. Information regarding the place of work of respondents is provided on the ACS PUMS data files in the form of Place of Work PUMA or POWPUMA. POWPUMAs are equivalent to the PUMA in size but are reported separately in the data file to identify the place of employment of respondents. This information is useful to answer questions regarding commuting patterns of workers and also to identify the workforce of an area which in many cases, particularly in cities, is very different from the residents of an area. Our analysis of the characteristics of the state's workers in the health care industry uses POWPUMAs to identify all workers who were employed in the health care industry located in Massachusetts regardless of their place of residence. So for example, if a resident of the City of Providence in Rhode Island was employed at a community health clinic in City of Fall River in Massachusetts, she would be included in our analysis as part of the health care workforce in Massachusetts.

We needed to use two years of combined ACS PUMS data files for our analysis so that we could have a sufficiently large sample to produce statistically reliable estimates of the demographic characteristics, employment patterns, and the level and distribution of earnings of the health care workforce in the state. We have used two years of ACS data (2010 and 2011) that would include the period before the implementation of Chapter 224 and two years of more recent ACS data (2014 and 2015) to observe the current period. A comparison of data from these two periods provides changes in the demographic traits, employment patterns, and the level and distribution of earnings of the state's health care workforce before and after the passage of Chapter 224 legislation.

Our baseline paper on the demographic traits, employment patterns, and level and distribution of earnings had included analysis of the health care workforce for the entire state and eight sub-state regions. In this paper our analysis of the changes that have occurred in the state's health care workforce between 2010-11 and 2014-15 is restricted to the state level because of large and unexpected changes in the ACS sub-state geography made effective in 2012. The boundaries of PUMAs and POWPUMAs were redrawn based on new population counts from the 2010 decennial census enumeration. The 2012 ACS PUMS data contain the 2010-decennial census based on revised PUMAs and POWPUMAs. The definition of POWPUMAs used in the

2012 ACS microdata files was very different from that of POWPUMAs used in pre-2012 ACS PUMS data files. In the 2012 ACS PUMS data file, the entire state was divided into just 5 POWPUMAs. In contrast ACS PUMS data files prior to 2012 divided the entire state into 48 POWPUMAs. The 2012 POWPUMAs did not allow analysis of the eight regions of the state. Consequently, we are unable to produce comparable data for eight sub-state regions of the state from the 2010-11 and 2014-15 ACS PUMS data.[14]

[14] We sent inquiries to the U.S. Census Bureau regarding the rationale for such a drastic change in the number of POWPUMAs identified on the 2012 Massachusetts ACS PUMS data file and to see if the POWPUMA boundaries that were used in the ACS files for 2012 and after could be redrawn so that comparable sub-state regions could be constructed with POWPUMAs. We were told that the Census Bureau had not scheduled redrawing of POWPUMA boundaries until the 2020 decennial census. A description of the problems with new POWPUMA boundaries in Massachusetts is presented in Appendix B.

Appendix B: Problems with Revised Place of Work Geography in the American Community Survey Public Use Microdata Files

The American Community Survey (ACS) asks respondents to provide the street address of their place of work during the week prior to the ACS survey. Data gathered from this information are utilized by researchers and policymakers to answer several important questions regarding commuting patterns and the traits of residents of an area compared to that of the area's workforce. For example, out of 316,000 employed residents of Boston, one-third commuted outside the city for to work while two-thirds worked within the city boundaries; or out of 564,000 workers whose job was located in Boston, only 38 percent were Boston residents and the remaining commuted into the city.

An examination of ACS Public Use Microdata Samples (PUMS) can answer a whole array of questions about these different groups of workers. The ACS PUMS data contain individual level data from the ACS. Geographic information is provided on the ACS PUMS data file at an aggregated level for areas with a population of 100,000 or more. The place of work and place of residence of respondents is identified only at this aggregated level on the ACS PUMS data file to protect confidentiality of respondents so the data for any individual respondent cannot be identified by inference. The geographic area representing a respondents' residence is called Public Use Microdata Area or PUMA and their place of work area is called Place of Work Public Use Microdata Area or POWPUMA.

ACS PUMS data files in 2011 and prior years contain PUMAs and POWPUMAs for each state that were delineated based on the 2000 decennial census population. After the 2010 decennial census, the PUMAs and POWPUMAs were delineated again based on the 2010 census population. These redrawn boundaries first appeared in the 2012 ACS PUMS data files. For Massachusetts, the 2010-census based delineation resulted in 52 PUMAs; the same number as before, albeit with some change in boundaries. However, there was a drastic reduction in the number of POWPUMAs in the revised 2010-census based delineation. The number of redrawn POWPUMAs in Massachusetts dropped to just 5; down from 48 in the previous delineation. Furthermore, the size of each POWPUMA was extremely lopsided. The largest POWPUMA contains 2.23 million or two-thirds of employed persons in Massachusetts while the smallest 62,500 or less than 2 percent of the state's employed population.

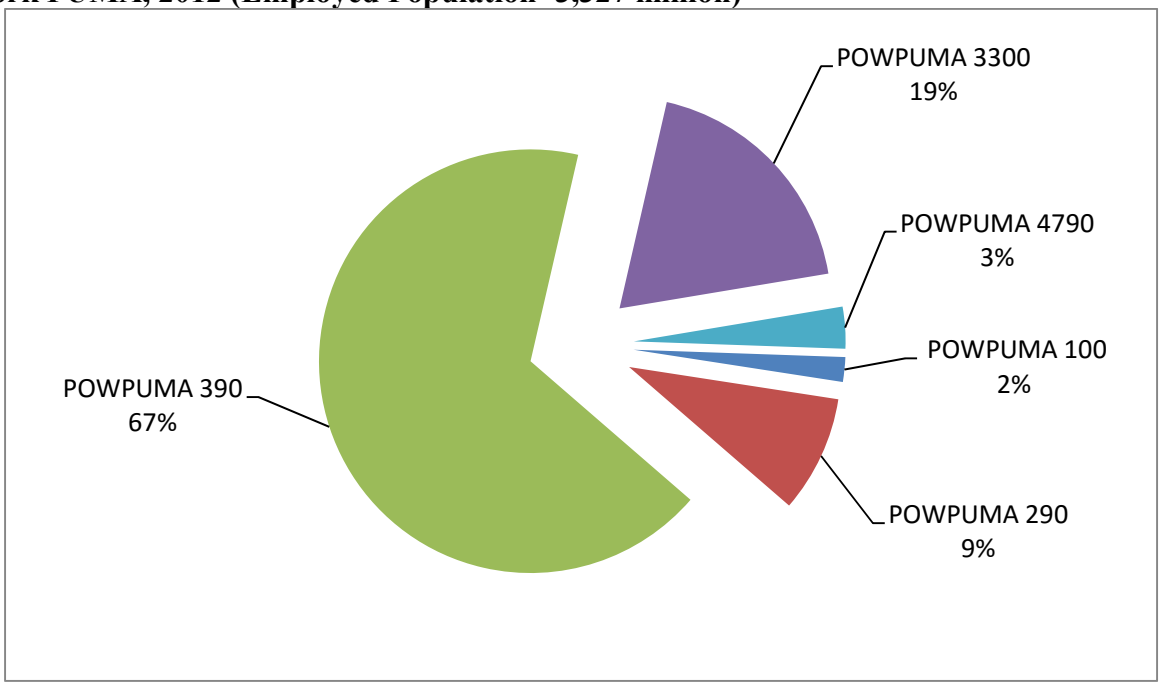
While we expect some changes in the comparability of PUMAs and POWPUMAs over a decade, a change such as the one that was made after the 2010 decennial census has greatly reduced the use of POWPUMAs and therefore the use of ACS data in Massachusetts. With this type of construction of POWPUMAs it is not possible to divide the state into any meaningful regions for analysis. In fact, it is not very different from having just one POWPUMA for the entire state!

A comparison of changes in the number of POWPUMAs across all states found Massachusetts to have the largest reduction in POWPUMAs. In fact with the exception of Vermont, all New England states were among the 10 states with the largest reduction in the number of POWPUMAs. Mid-Atlantic States (New York, New Jersey, Pennsylvania) and California and Michigan were also among these top 10 states.

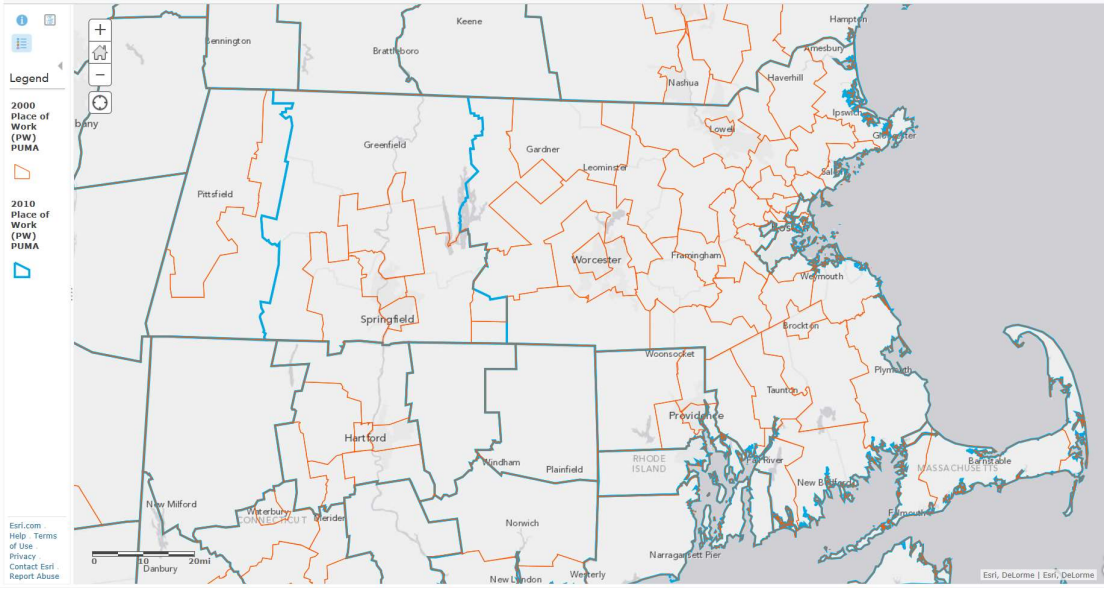
Pre-2010 and Post-2010 Delineation PUMAs and POWPUMAs in Massachusetts

	Pre-2010 delineation	Post-2010 delineation
PUMAs	52	52
POWPUMAs	48	5

Percentage Distribution of the Employed Population in Massachusetts by the New Place of Work PUMA, 2012 (Employed Population=3,327 million)



Changes in the Place of Work PUMAs (POWPUMAs) in Massachusetts: Red Boundaries represent 48 POWPUMAs in 2005-2011 ACS files and the Blue Boundaries represent the 5 POWPUMAs in ACS data files in 2012-2021



Change in the Number of Place of Work PUMAs after the 2010 Census-Based Delineation

	Number of POWPUMAs			
State	Before 2010-based Delineation	After 2010-Census Based Delineation	Absolute Change	Relative Change
Massachusetts	**48**	**5**	**-43**	**-90%**
New Hampshire	11	3	-8	-73%
Connecticut	25	8	-17	-68%
New Jersey	58	19	-39	-67%
Rhode Island	7	4	-3	-43%
California	71	41	-30	-42%
Michigan	56	33	-23	-41%
Pennsylvania	63	38	-25	-40%
New York	61	38	-23	-38%
Maine	10	7	-3	-30%
S. Dakota	7	5	-2	-29%
S. Carolina	23	17	-6	-26%
Oklahoma	17	13	-4	-24%
Idaho	9	7	-2	-22%
Mississippi	23	18	-5	-22%
Colorado	10	8	-2	-20%
Nevada	5	4	-1	-20%
Alabama	26	22	-4	-15%
Minnesota	27	23	-4	-15%
Montana	7	6	-1	-14%

	Number of POWPUMAs			
State	Before 2010-based Delineation	After 2010-Census Based Delineation	Absolute Change	Relative Change
Washington	22	19	-3	-14%
Kansas	16	14	-2	-13%
Louisiana	26	23	-3	-12%
Ohio	52	46	-6	-12%
Arkansas	19	17	-2	-11%
New Mexico	11	10	-1	-9%
N. Carolina	48	45	-3	-6%
Virginia	35	33	-2	-6%
Illinois	36	34	-2	-6%
Indiana	38	36	-2	-5%
Florida	40	38	-2	-5%
Tennessee	32	31	-1	-3%
Alaska	4	4	0	0%
Arizona	9	9	0	0%
Delaware	3	3	0	0%
Wash., D.C.	1	1	0	0%
Hawaii	3	3	0	0%
Iowa	19	19	0	0%
Maryland	16	16	0	0%
N. Dakota	5	5	0	0%
Vermont	4	4	0	0%
Wisconsin	26	26	0	0%
Texas	70	71	1	1%
Missouri	27	28	1	4%
Kentucky	25	26	1	4%
Georgia	43	46	3	7%
W. Virginia	12	13	1	8%
Nebraska	9	10	1	11%
Oregon	13	15	2	15%
Wyoming	4	5	1	25%
Utah	7	9	2	29%
Total	3250	2990	-260	-8%