Research Report

# Subsidized Child Care in Massachusetts: Exploring geography, access, and equity

A joint report of:
The Institute for Child, Youth and Family Policy at Brandeis University
The Massachusetts Child Care Research Partnership
diversitydatakids.org
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# Subsidized Child Care in Massachusetts: Exploring geography, access, and equity

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# INTRODUCTION

Affordable child care is a crucial support for working parents, and the early educational experiences that occur in child care and preschool settings are equally crucial for children's development. In 2014, the Child Care Development Block Grant (CCDBG), which funds the Child Care Development Fund (CCDF)[1]--the largest federal source of funding assistance for low-income working parents to secure affordable, quality child care--was reauthorized. With reauthorization came new provisions requiring states to work towards more equal access to care and increased supply of high quality, affordable care. Motivated by these provisions, policymakers and researchers are paying increasing attention to issues related to child care access and supply, and are in pressing need of research, conceptual frameworks, measurement strategies, data sources, and technologies to better understand, measure, monitor, and address issues of increased and equal access to quality, affordable care.

This report provides a synthesis of five years of geographic and spatial research related to issues of access to federally subsidized child care for low-income working families in Massachusetts. The purpose of this research synthesis is to:

- Synthesize findings related to geographic access to and supply of subsidized child care in Massachusetts in order to inform child care policymaking in Massachusetts, other states, and at the federal level
- Synthesize geographic analysis methods, data sources, measurement approaches and technologies used to conduct this research in order to offer a starter resource/toolkit for other researchers, analysts and policymakers in Massachusetts, and in other states

This report is a product of the Massachusetts Child Care Research Partnership, in collaboration with the diversitydatakids.org project at Brandeis University. In addition to informing child care policy issues in Massachusetts, the report is designed to serve as a resource for other analysts, researchers and policymakers working to develop methods and tools to analyze, monitor and address issues of child care and early education access and supply. It may be particularly useful for those working to understand and address issues of equal access and racial/ethnic equity given the heightened child care affordability challenges affecting U.S. black, Hispanic, and low-income working family populations, relative to other groups (Baldiga et al., 2018). See Appendix A for an overview of the Massachusetts Child Research Partnership and the diversitydatakids.org project.

## Overview of Sections

This report contains seven substantive sections:

1. Overview of data and methods
2. Geography of need for subsidized child care in Massachusetts
3. Geography of <u>met</u> need for subsidized child care in Massachusetts
4. Geography of the "dual-mechanism" (voucher/contract) subsidized care system
5. Geography of "subsidized child care deserts" and patterns by child race/ethnicity
6. Geographic patterns in travel to subsidized child care
7. Conclusion

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[1] For more information about the Child Care Block Development Grant Fund, see: https://www.acf.hhs.gov/occ/fact-sheet-occ.

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Sections 2 through 6 are each focused on a particular topic that was the focus of study in connection with the Massachusetts Child Care Research Partnership operating from 2013 to 2018. Topics were identified and developed collaboratively by the academic research team at Brandeis University and Boston University, and the policy team at the Massachusetts Department of Early Education and Care ("EEC")--the state agency that oversees child care and early education in Massachusetts, including the Child Care Development Fund (CCDF) child care assistance program. Topics were chosen based on their relevance to current policy priorities in Massachusetts at the time and their broader relevance to researchers, federal policymakers, and policymakers in others states.

Each section (Sections 2 through 6) follows a similar structure, beginning with (i) an overview of the topic and research questions, (ii) data sources, definitions, measures and methods, and (iii) maps, findings, and implications for policy, practice and future research.

## Section 1. Overview of data and methods

Within Sections 2 through 6 of this report we describe the specific data sources, measures and methods used to conduct the research presented in each section. However, there are some foundational data sources, methods and technologies that provide the infrastructure for all of the research conducted, and these are described briefly below.

### Key data source 1: Analytic administrative dataset

The foundation for all the analyses presented in this report is the analytic administrative dataset created in connection with the Massachusetts Child Care Research Partnership between EEC and Brandeis and Boston Universities. The Massachusetts Child Care Research Partnership was sponsored by the federal Office for Planning, Research & Evaluation (OPRE), Administration for Children & Families (ACF), U.S. Department of Health & Human Services (HHS), under its Child Care Partnership Research Grant Program, 2013 cohort.

The analytic administrative dataset draws from the administrative systems used by the state of Massachusetts for the purposes of operating the child care assistance program. The dataset includes child-level records for all children participating in the subsidy system between January 2012 and June 2015. Within each child-level record, the dataset includes detailed monthly information on a child's subsidy usage (i.e., which months during the time period the child was utilizing child care assistance), eligibility type (e.g., income-eligible or TANF-eligible), subsidy type (e.g., contracted slot or voucher), child care provider, a set of personal characteristics (including age, race/ethnicity, nativity), and family information (including child's home address). Knowing each child's child care provider in each month, we can link to the provider-level administrative records to integrate information about providers with the information from child-level records (including provider address, provider type and provider caseload information).

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## Key data source 2: U.S. Decennial Census / American Community Survey / National Equity Research Database (NERD)

Using Geographic Information System (GIS) mapping and spatial methods (described below), we linked the analytic administrative dataset to contextual datasets that provide additional information about children's and providers' communities. The primary contextual datasets used included the 2010 U.S. Decennial Census and the 2014 American Community Survey, "ACS", (5-year estimates, 2010-2014).

The majority of ACS variables were accessed through the National Equity Research Database (NERD), a product of diversitydatakids.org that makes available state, sub-state regional, and community-level (e.g., county, city/town, neighborhood) contextual indicators based on ACS published variables (See Appendix B for additional information about NERD).

In selected cases (e.g. data used for analysis in Section 5), ACS variables were obtained via a special tabulations request to the U.S. Census Bureau. Special tabulations requests are required when ACS data for a particular set of variables, geographic units, or subgroups are unavailable from published ACS datasets or from Public Use Microdata Sample (PUMS) data. Special tabulations require a special request process directly with the U.S. Census Bureau, and typically come with an associated cost.[2]

## Key data source 3: Geographic boundary files

Analyses were conducted at a number of geographic levels, including the state, county, sub-state region, city/town, and neighborhood (i.e. census tract) levels. The data source for all geographic boundary files was the U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing (TIGER/Line) Files, Vintage 2014.

## Key method 1: Geographic Information System (GIS) Mapping and Spatial Analysis

A number of geographic information system (GIS) mapping and spatial analysis methods were used for the analyses presented herein.

**Georeferencing/geocoding** methods were used to "spatialize" the administrative data. For example, we used georeferencing methods (e.g., geocoding) to convert street addresses to degrees of latitude/longitude (e.g., "24 Beacon St, Boston, MA 02133" is converted to 42.358989/-71.063824). This process converted the data into a format that allowed it to "speak" to and be integrated into a GIS (e.g., this process puts the data in a format that allows us to plot points on a map).

**Spatial overlay, joining, and merging** are used to create and display maps with multiple "layers" of data (e.g., a map of Massachusetts city/town boundaries with the point locations of providers overlaid), and to cross reference point locations with larger units of geography (e.g., we can identify which city/town (i.e. the larger geographic unit) a child's street address (the point location) is located in, and then use spatial tools to merge the layers and add the city/town information into the child's record).

**Zonal statistics** were used to aggregate data from smaller aerial geographic units (e.g., points or neighborhoods) to larger aerial geographic units (e.g., city/town, county, region, state). For example,

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[2] More information related to Census custom tabulations can be found at: https://www.census.gov/about/policies/foia/foia_library/custom_tabulations.html.

we can count the number of individual children (i.e., points) that live within a larger geographic area (e.g., county). All common summary statistics can be generated using zonal statistics (e.g., counts, sums, averages, medians, min/max).

**Distance computation** methods are used to calculate the travel and estimated travel durations and distances, based on road networks, between points.

**Exploratory spatial data analysis (ESDA)** methods are used to explore spatial distributions and patterns, and to characterize and describe "geographies". ESDA allows for exploration of questions such as: How are subsidized child care providers in Massachusetts geographically distributed? Are providers clustered/concentrated together or are they uniformly spread out (i.e., dispersed)? Cluster analysis methods (analysis of spatial autocorrelation using global and local indicators of spatial autocorrelation, "LISA" indicators) and Nearest Neighbor Analyses were used. More information about ESDA methods are available in Section 5 (where ESDA methods were used for analysis) and in Appendix C.

## Key technologies: ArcGIS/ArcMap, Open Source Routing Machine (OSRM)/Georoute, STATA

Three core technologies were used to conduct all analyses. ArcMap 10.2 was used as the foundational GIS software for data management, map making, georeferencing, and spatial analyses (including overlays, joining, merges, zonal statistics, and exploratory spatial data analyses).

Open Source Routing Machine (OSRM) was used, in combination with STATA, for all distance computation work (Huber and Rust, 2016). The OSRM tool uses the latitude and longitude of two points, along with detailed maps of road networks (from OpenStreetMaps), to calculate the "real-world" shortest distance between two points (i.e., the shortest travel distance between a child's address and her provider's address). We calculate travel time from child home to provider location (by car) using a tool called "georoute" (Weber and Peclat, 2016).

## An important note about timeframes

It is important to note that the analyses in this report represent results from a historical time period. Most analyses utilize data from 2014, or data from the earlier period of 2010-2014. Therefore, the results reported are not reflective of conditions and results for other time periods, and are not necessarily reflective of current conditions, and therefore are not appropriate for informing policy and planning issues that require "real-time" data and results. The timeframe for each analysis is clearly presented in each section.

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## SECTION 2: GEOGRAPHY OF NEED FOR SUBSIDIZED CHILD CARE IN MASSACHUSETTS

2.1 Overview of topic and research questions

An early question that emerged from the Child Care Research Partnership in Massachusetts (and is relevant in other states as well) was: Where do families in need of subsidized child care live in Massachusetts, and how are families geographically spread out (or concentrated) across the state? In other words, what is the "geography of need" for subsidized child care in Massachusetts?

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By knowing where families in need of subsidized child care live and how families are geographically spread or concentrated across the state, policymakers can assess how well the geography of the child care assistance system (i.e., administrative offices, child care provider and early educational program locations) corresponds to the geography of need to indicate the degree of potential mismatch.  The first step in that assessment is mapping, documenting, and analyzing the geography of need for sub-sidized care.

In Massachusetts, there are several categories of eligibility for child care assistance, including: income-eligible (all parents are working, earn low-income and require financial assistance to obtain child care), TANF-eligible (families eligible for TANF are also eligible for child care assistance), child welfare-eligible (families connected with the child welfare system), and other vulnerable population eligibility groups (including homeless families, children with special needs, teenage mothers).  A family is considered "income-eligible" for child care assistance if family income is below 50% of state median income at the time of eligibility determination (the family remains eligible until income reaches 85% of the state median income), and if all parents in the household are working (or take educational courses/training) 20 or more hours per week (i.e., working or in school full time or part time).   Income-eligible families are families in need of subsidized child care because parents in these families require child care in order to pursue work or educational activities, but do not have earnings high enough to afford child care.  As of December 2014, income-eligible children represented roughly half (54%) of children under age 6 served through the child care assistance program in Massachusetts.

In Massachusetts, a family is considered "TANF-eligible" for child care assistance if a family is eligible for and/or receiving federal economic assistance through the Temporary Assistance for Needy Fam-ilies Program (TANF)[3].  Families receiving TANF in Massachusetts are those with incomes below 100% of the federal poverty line, and parents in these families are pursuing work or educational training and are therefore in need of part-time or full-time child care.  Families who qualify and/or receive eco-nomic assistance are deemed in need of subsidized child care and receive automatic eligibility for child care assistance.  As of December 2014, TANF-eligible children represented 28% of children under age 6 served through the child care assistance program in Massachusetts[4].

2.2 Data sources and methods

Understanding and analyzing the geography of need for subsidized care required three steps:

- Step 1:  Identify which children may be in need of subsidized care
- Step 2:  Identify where children in need of subsidized care live
- Step 3:  Map and analyze patterns related to where children in need of subsidized care live

We identify children in need of subsidized care (Step 1) using publicly available, published data from the American Community Survey, specifically the 2010-2014 5-year estimates.  The ACS data provide the number of children under age 6 with family income levels at different ratios to the federal poverty line.  In Massachusetts, as of 2012 (the midpoint of the period 2010-2014), the threshold for income

[3] In Massachusetts, the federal TANF economic assistance program is administered by the Department of Transitional Assistance (DTA).
[4] Income-eligible and TANF-eligible children combined represent 82% of subsidized children under age 6 in Massachusetts.  The remain-ing subsidy caseload is comprised of 15% child welfare-eligible children, and 3% vulnerable populations (homeless, teen mother, special needs).  Data as of December 2014.

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eligibility (i.e., 50% of state median income) was $49,079. This threshold equates to roughly 200% of the federal poverty level for a family of four.[5] Using ACS Table B17024, we obtained counts of children under age 6 with family income levels below 200% of federal poverty as an estimate of the number of children in need of subsidized care. This estimate would therefore include children in both income-eligible and TANF-eligible families[6]. Not all families that are estimated to be eligible for child care assistance using this approach are necessarily in need of assistance. For example, some low-income working families may arrange unpaid child care with family, friends or neighbors. Also, because our estimation approach does not consider parental work status, our estimates may include children in low-income families with a non-working parent. As a result, these estimates should be considered an upper bound estimate of the number of children income- and TANF-eligible for child care assistance. Please see Appendix D for more detailed discussion of technical issues related to estimating the number and share of children eligible for child care subsidies.

According to federal legislation, children ages 0-12 can be income- or TANF-eligible for child care assistance. However, this geographic analysis of child care need in Massachusetts focuses on young children under age 6. This group is of particular relevance to policymakers for a few key reasons:

- Children under age 6 represent over two-thirds (68%) of the overall child care assistance service population in Massachusetts (as of December 2014).
- Cost of child care and early education for infants, toddlers and preschool age children tends to be significantly higher than care for school age children, making this group potentially more vulnerable to affordability issues. Infants, toddlers and pre-schoolers are more likely to be enrolled in full day care than school age children, and hourly rates for young children tend to be higher for younger children. Statewide annual average cost of care for infant, toddler, preschool, and school age children in MA was $20,000, $18,500, $14,000, and $10,000, respectively as of February 2017 (Child Care Aware of America, 2017).
- There are concerns amongst federal child care policymakers that families in need of quality care for children under age 6 may face supply constraints, as evidenced by the identification of infants/toddlers as a priority population in the Child Care and Development Block Grant Act of 2014, which reauthorized the federal child care subsidy program, CCDF. Under reauthorization, states are asked to identify shortages in high quality care for infants/toddlers, among other priority groups, in their CCDF state plans.

Step 2 in the process is to obtain information about where children estimated to be in need of subsidized care live. The American Community Survey data is structured and reported in such a way that it provides information about the aggregate characteristics of children for 30 different geographic levels ranging from the national level, all the way down to the block group level. We obtained counts

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[5] In 2012, the federal poverty level for a family of four was $23,050 and 200% of the federal poverty level for a family of four was $46,100.
[6] This estimation approach does not account for parental work status due to data availability issues. While parental employment levels in Massachusetts were high as of the time of analysis (amongst children under age 6 living with two parents, 67% had two parents in the labor force, and amongst children living with one parent, 76% had a parent in the labor force per U.S. Census Bureau, American Community Survey, 2005-2009 5-year estimates, Table B23008), we do expect work status to vary within families with incomes < 200% federal poverty, and therefore recognize this as an important limitation to estimating need for subsidized care.

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of the number of children under age 6 with family income less than 200% federal poverty for all municipalities[7] in the state.

We chose municipalities as the geographic unit of analysis as Child Care Resource and Referral (CCR&R) regions in Massachusetts are based on aggregations of municipalities (i.e. cities and towns). Municipalities were also useful for the purposes of this analysis given our interest in examining statewide patterns in the geography of need--they provide enough detail to provide insights into local patterns in the data, without presenting so much detail that summarizing and digesting statewide patterns becomes intractable.  Municipalities are also an administrative geographic unit around which local child care markets often align.  For example, local child care markets often align with local school districts, which are often linked to municipal boundaries in Massachusetts.  While we chose munici-palities as the geographic unit for purposes of this analysis, similar analyses could be conducted at any reported ACS summary geographic level, all the way down to the block group level.  Other anal-yses in this report, that have different purposes, focus on smaller, more localized analyses (e.g. neigh-borhood level analysis in Section 5).

Map 1a presents the geographic distribution of children under age 6 estimated to be in need of sub-sidized child care in Massachusetts. The areas in the map represent the 351 municipalities in Massa-chusetts.  Municipalities are grouped into five categories based on the number of children under age 6 with family income under 200% of federal poverty using an optimization method called "Jenks' natural breaks," a common data division approach used in mapping.  The Jenks natural breaks method uses an iterative approach in which we start by specifying the number of groups we want to divide the data into, and then the groups are constructed so that similar values are grouped together (i.e. within-group variation is minimized), and differences between the groups are maximized (i.e. be-tween-group variation is maximized).  In other words, this data division approach looks for and groups the data based on the inherent or natural breaks found in the data.  Each of the five categories is represented by its own color, with the colors getting darker as the number of estimated children in need gets higher.

It is important to note that the analyses in this section represents results from a historical time period, 2010-2014.  Therefore, the local patterns of need reported are not necessarily representative of other time periods, and are not necessarily reflective of current conditions, and therefore are not appropriate for informing policy and planning issues that require "real-time" information about the geography of need.

2.3 Patterns/findings and implications for policy

We see in Map 1a that the 141,245 children under age 6 estimated to be in need of child care assistance (during the 2010-2014 time period) live in cities and towns that span the entire state.  A striking pattern is the high level of clustering of high need cities/towns, particularly around large urban hubs.  We see one prominent cluster of high need municipalities around the highest need city in the state, the City of Boston (home to over 18,000 estimated eligible children).  We then see the next most prominent cluster of municipalities around the second highest need city in the state, the City of Springfield (with just under 10,000 estimated eligible children)--located in an entirely different region of the state (over

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[7] In Massachusetts, the legal boundaries of municipalities correspond to census-defined geographic type/summary level 060 (county sub-divisions).

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## MAP 1A. THE GEOGRAPHY OF NEED FOR SUBSIDIZED CHILD CARE IN MASSACHUSETTS

Number of children under age 6 with family income < 200% Federal Poverty Level (FPL), by municipality (city/town)



**Number in city/town < 200% FPL**

- 0 - 412
- 413 - 1,171
- 1,172 - 3,102
- 3,103 - 9,706
- 9,707 - 18,553

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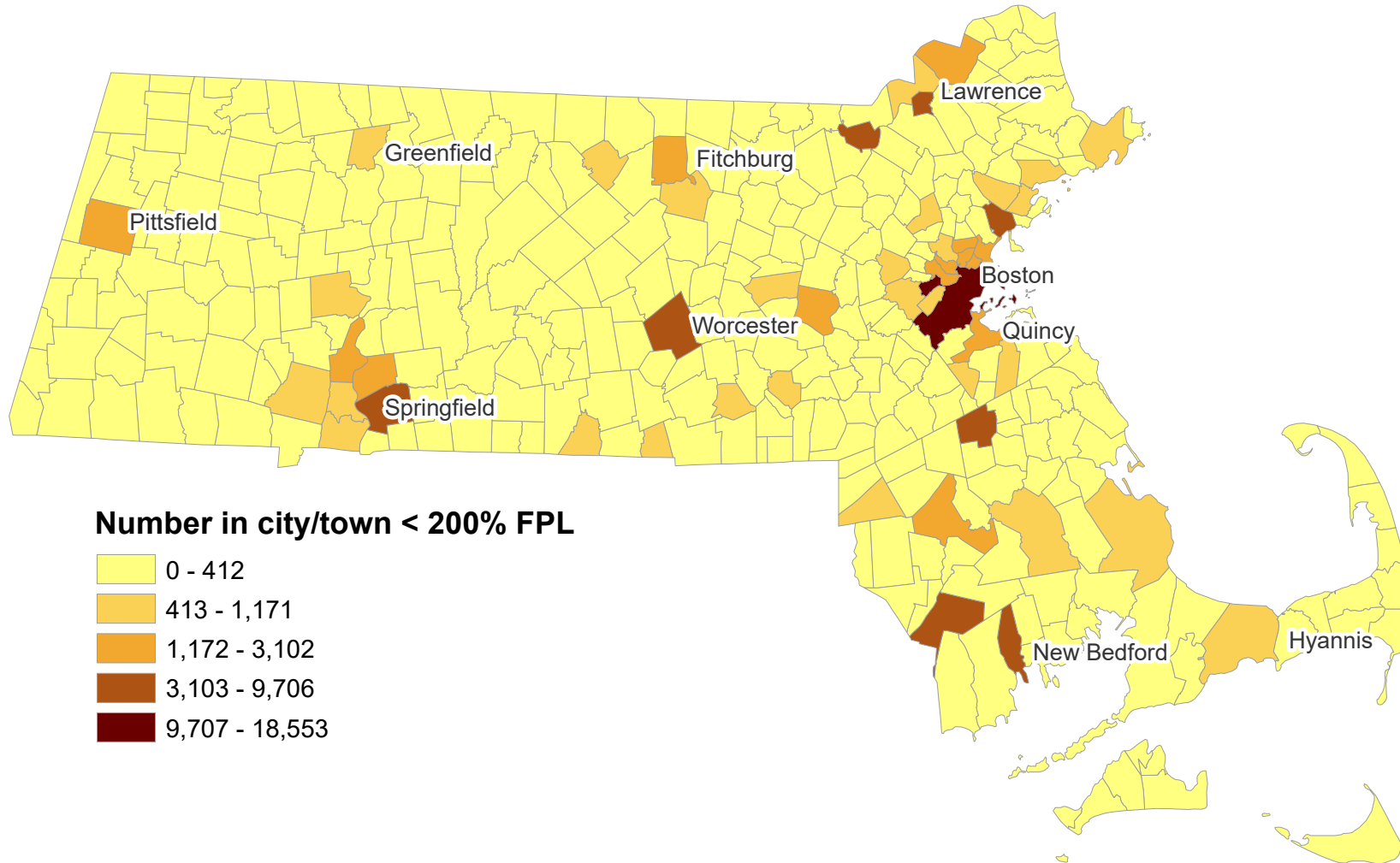
90 miles away).  While these two clusters are in different regions of the state, they both demonstrate strong clustering of high need municipalities around a large urban hub, which is characteristic of the geography of need in Massachusetts.  The ten highest need cities and towns[8], combined, are home to nearly half (48%) of estimated eligible children statewide.  Meanwhile, the geography of the other half of children estimated to be in need is very fragmented, with children fairly uniformly distributed across the roughly 300 remaining cities and towns.

An understanding of the highly bifurcated geography of need in Massachusetts (i.e., half of children in need clustered around large urban hubs with the other half dispersed across 300+ communities) is an important factor as the state considers, designs, and implements policies and practices to bolster the supply of high quality subsidized care, and to ensure equitable access to subsidized care.  A strategy that may achieve effective, efficient, and equitable service delivery in a high need area in a large urban hub, (e.g., increasing the number of contracted slots with high quality providers that already serve large numbers of subsidized children), may not be feasible and/or may not achieve the same outcomes in a region where children in need are spread across many communities that span a large geographic area.  In a lower density-of-need community, a high quality provider that already serves subsidized children may not exist, and if it does exist, increasing the number of slots with any one provider will not have the same impact that it would in a high density areas.  Increasing the number of slots with a single provider will increase supply on paper, but the added supply will only be helpful if there are children that live close enough to learn about and to feasibly utilize the slot consistently.

Likewise, awareness of this divide in the geographic density of need is important to understanding the context in which families are accessing the subsidy system.  This context is an important consideration in designing administrative policies and practices that facilitate access to the subsidy system, and that support stability and continuity of subsidy receipt over time.  Eligible families that live in communities where many of their neighbors are eligible for and utilizing child care assistance may find their neighbors to be important sources of information about the subsidy program.  Research has found that for certain groups, such as immigrant families, neighbors and those in local social networks play an important role in the amount and type of information families have about social programs (Bertrand, 2000; Borjas and Hilton, 1996).  Eligible families may learn of child care assistance availability, policies and eligibility from others in their locally-based social networks, which may in turn encourage participation.  Past research about Head Start participation has shown that neighbors' participation in Head Start (another publicly funded early childhood program) can shape norms and behaviors (Neidell and Waldfogel, 2009).  Black and Hispanic eligible children were found to be more likely to participate in Head Start when their neighborhood peers participated.  Likewise, in areas where there are higher densities of families in need of child care assistance, there may be more providers who serve subsidized children.  Thus, another way that families obtain information about subsidized child care options may be from local providers.  In sum, the bifurcated nature of the geography of need in Massachusetts has important implications for the functioning of the child care subsidy system, and warrants further study.

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[8] The 10 highest estimated need towns, in descending order (based on estimated number of eligible children) are: Boston, Springfield, Worcester, Lawrence, Lynn, Lowell, New Bedford, Brockton, Fall River, and Chelsea.

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**Summary statement:** By mapping and analyzing the geography of need for child care assistance in Massachusetts, we learn of a bifurcated geographic pattern in which roughly half of children in need are clustered around large urban hubs, and roughly half are widely dispersed across roughly 300 communities. This distinct "geography of need" has implications for the development, design, and implementation of strategies aimed at improving the supply of high quality affordable child care and ensuring equitable access to subsidized care. Maps and an understanding of this geography provides a valuable tool for policymakers weighing the potential effectiveness, efficiency and equity of different policy, programmatic and practical approaches.

## SECTION 3: GEOGRAPHY OF MET NEED FOR SUBSIDIZED CHILD CARE IN MASSACHUSETTS

### 3.1 Overview of topic and research questions

A question that followed from the mapping and analysis of the "geography of need" for subsidized care in Massachusetts was: Are families in need of care equally likely to be using/receiving child care assistance across cities and towns in Massachusetts? In other words, what is the "geography of met need" for subsidized child care in Massachusetts?

In Massachusetts, child care assistance vouchers are allocated across seven Child Care Resource and Referral (CCR&R) regions based on the overall level of anticipated need/demand for subsidies in each region[9]. Each of these regions is comprised of several cities and towns (ranging from 10 to nearly 100 cities/towns per region). There are no city/town-specific allocations of subsidies made, so the geographic distribution of children who are actually receiving child care assistance within a CCR&R region could be uniform (i.e. even) across cities/towns in the region, or it could be uneven.

It is important for policymakers to know if service rates across cities and towns within a CCR&R region are similar or different from one another. Differences in service rates could be driven by a number of factors, including differences in city/town level supply of subsidized care, e.g. different levels of capacity/sufficiency in the local supply of subsidized care, or differing levels of choice of quality subsidized providers. Differences in service rates could also be a function of local variation in family-side factors (e.g. differing levels of demand/need for subsidies, different parent preferences, different local norms and take-up behaviors), and/or system-side factors (e.g. different barriers/facilitators of access for obtaining and maintaining child care assistance, such as local availability of subsidies and local administrative practices and capacity). Having mapped and analyzed the geography of need, this section takes the next step to compare the geography of need with the geography of families being served by subsidies to capture *the geography of met need* for child care assistance in Massachusetts.

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[9] In MA, a child can receive child care assistance in one of two forms—a voucher or a contracted slot. Contracted slots are allocated across six EEC Regions, while vouchers are allocated across seven CCR&R Regions. The EEC regions are administrative regions defined by the lead CCDF agency in Massachusetts and are used for rate setting and other administrative purposes. The CCR&R regions are also defined by the state and represent "service regions", i.e. contracted CCR&R agencies are responsible for providing resource, referral and subsidy administrative services to families that live within the CRR&R catchment boundary.

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## 3.2 Data sources and methods

Understanding and analyzing the geography of <u>met</u> need for subsidized care requires four steps:

- Step 1:  Identify which children are in need of subsidized care, and where they live (completed in the prior section)
- Step 2:  Identify children utilizing subsidized care, and where they live
- Step 3:  Using a common unit of geography, compare children in need of care with children utilizing subsidized care (i.e., calculate "met need" at the community level)
- Step 4:  Map and analyze patterns in <u>met</u> need for child care assistance

To identify children utilizing subsidized care (Step 2), we draw from the analytic administrative dataset developed through the MA Child Care Research Partnership, which includes all children utilizing subsidies in a particular timeframe (in this case, during the month of December 2014).  The dataset includes not only information about the child's subsidy usage, but also additional information, including the child's street address.   Based on the child's street address, we use a method called "geocoding" where we locate and map each child's street point address using a Geographic Information System (i.e., we find the geographic location where the child lives in terms of degrees of latitude and longitude).  From there, again using a GIS, we can cross-reference the point location of each child with a map of the boundaries of the cities and towns in Massachusetts, and attach to each child's record the city/town where the child lives.   We then add up all children served by subsidies in each city/town, and combine those counts with our city/town-level counts of children who are estimated to be eligible for child care assistance (from Section 2).  This combination gives us a "service rate" (i.e. percent of estimated eligible children who are served by subsidies) for each city/town in the state.  Please see Appendix D for more detailed discussion of technical issues related to estimating met need for child care subsidies.

Note that this analysis includes children who receive subsidies on the basis of income-eligibility or TANF-eligibility, to align our universe of children served with our universe of children estimated to be in need (from prior section). Again, we focus on young children under age 6, for the reasons outlined in Section 2.

It is important to note that the analyses in this section represents results from a historical time period, 2014.  Therefore, the local patterns of met need reported are not necessarily representative of other time periods, and are not necessarily reflective of current conditions, and therefore are not appropriate for informing policy and planning issues that require "real-time" information about the geography of met need.

## 3.3 Patterns/findings and implications for policy

Map 2a presents the geographic distribution of the city/town service rate, that is the percent of children under age 6 estimated to be in need of subsidized child care who were served by subsidies (in December 2014). The areas in the map represent the 351 municipalities in Massachusetts.

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# MAP 2A. THE GEOGRAPHY OF MET NEED FOR SUBSIDIZED CHILD CARE IN MASSACHUSETTS

Percent of children under age 6 with family income < 200% FPL receiving child care assistance, by municipality (city/town)



**% under age 6 (<200% FPL) served**

- 0% - 5%
- 5% - 13%
- 13% - 18%
- 18% - 27%
- 27% - 100%
- CCR&R Region Boundary

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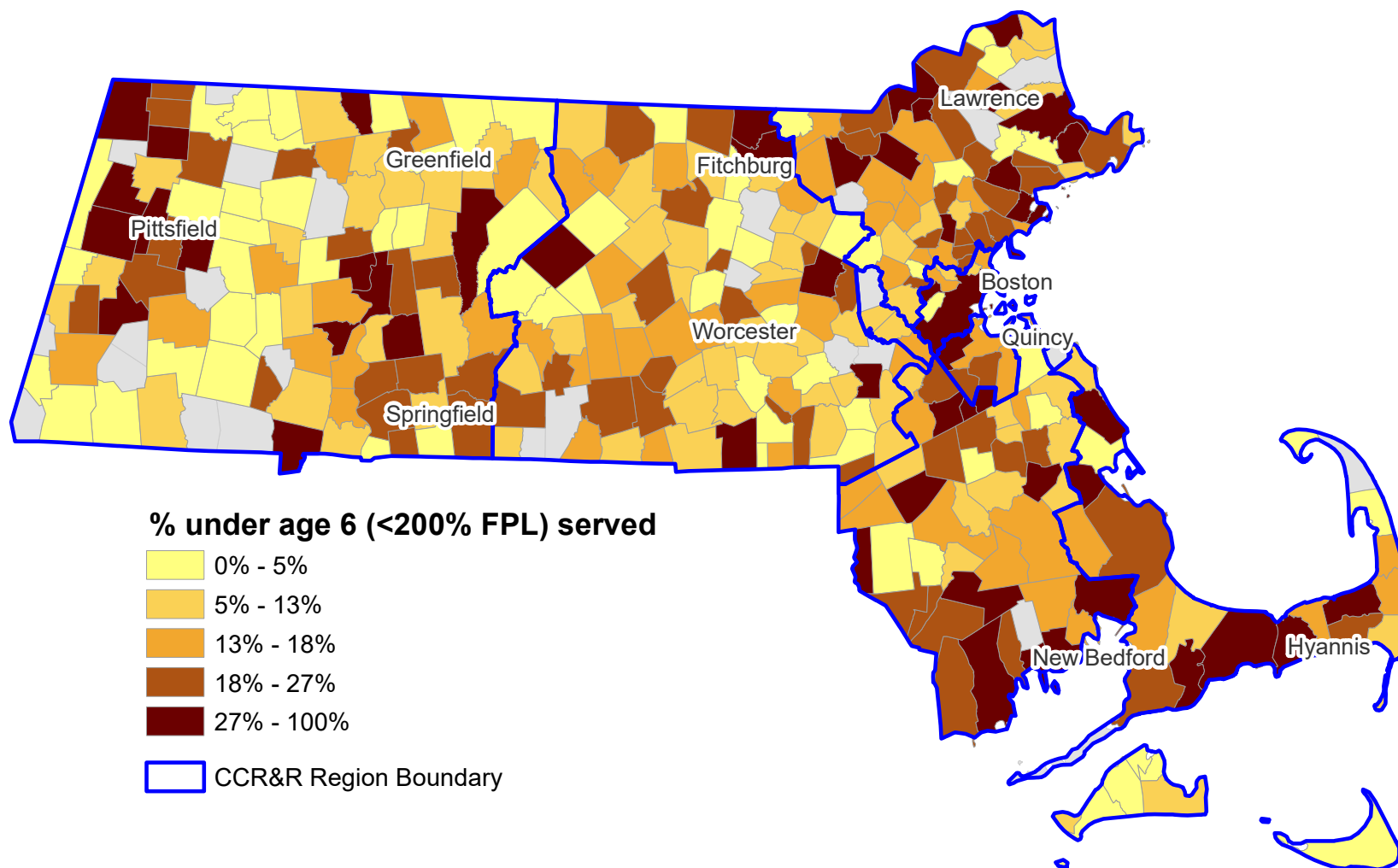
Municipalities are grouped into five categories based on the quintile[10] in which the city/town service rate falls. In other words, we first order the cities/towns from highest to lowest based on their service rates, and then divide the cities/towns into roughly 5 equal quintiles. Each of the five quintiles/categories is represented by its own color, with the colors getting darker as the service rate (i.e., level of met need) gets higher.

We see in Map 2a that city/town service rates vary substantially between localities across the state, and that there are substantial differences in service rates between cities/towns even within the same CCR&R region. City/town service rates range from 0% (no estimated eligible children served) to 100% (all estimated eligible children served). The unweighted mean service rate is 18%, the median service rate is 15%, and the standard deviation is 17%.

Compared to Map 1a, which exhibited striking clustering patterns around urban hubs, the geography of met need is better characterized as a checkerboard pattern, with pockets of clustering throughout the state. In other words, while we do tend to see concentrations of higher met need cities/towns around large urban hubs (except around Springfield, MA), and some expansive regions of lower met need cities/towns in less dense areas (e.g., west of Springfield and south of Pittsfield), we observe many instances where high met need cities/towns are adjacent to low met need cities/town (i.e., checkerboarding).

Other important findings are that service rates in the five highest need cities/towns (i.e. the five cities with the largest number of estimated eligible children) tend to have service rates higher than the statewide service rate (except Worcester), but the rates vary substantially (Table 1).

### Table 1. Met need in five highest estimated need cities/towns

|  | Estimated need: Estimated number of children eligible | Estimated met need: Percent of estimated eligible served |
| --- | --- | --- |
| Statewide | 141,245 | 21% |
| Boston | 18,553 | 29% |
| Springfield | 9,706 | 23% |
| Worcester | 7,981 | 16% |
| Lawrence | 5,290 | 37% |
| Lynn | 4,888 | 23% |

The largest need area, City of Boston, has a service rate of 29%, which is higher than the statewide service rate of 21%, but this is not the highest service rate among the five highest need cities. Lawrence (4th highest need city) has a service rate of 37%, which is nearly twice the statewide rate. Meanwhile,

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[10] Note that the quintile data division approach used for this analysis differs from the natural breaks approach used for the geography of need mapping/analysis in Section 2. The data division approach was determined for each map/analysis based on (i) the purpose of the analysis, and (ii) the nature of the measure being mapped/analyzed. The purpose of the geography of need analysis was to explore natural patterns and clustering of city/town-level counts of children. The value for a given city/town could range from 0 to over 18,000, and there was no common city/town-level lower or upper bound value of this measure. For these two reasons, natural breaks were chosen. The purpose of the geography of met need analysis was to explore statewide patterns by comparing service rates between different cities/towns across the state. City/town level service rates do have a common lower and upper bound (values can range from 0% to 100%). For these two reasons, quintiles were used to demonstrate how cities/towns compare relative to one another on a common-scale metric.

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the third largest need city, Worcester, has a service rate of 16%, which is well below the statewide rate. Each of these five cities is a principal city in a larger CCR&R service region comprised of numerous cities and towns. Another interesting finding is that service rates in these principal cities are not necessarily reflective of service rates in other cities/towns within the same service region, nor necessarily representative of the service rate in its CCR&R region overall.

The finding of substantial variation in the level of met need across cities/towns raises important considerations and questions for policymakers, researchers, and practitioners alike. Our main knowledge gap in light of this finding is the extent to which local differences in levels of met need are driven by family-side factors that vary locally, or system-side factors that vary locally, or both, or if family-side and system-side factors matter differentially in different service regions and cities/towns.

On the system-side front, these findings could motivate state policymakers to consider how supply and local access issues, local market dynamics, and local administrative practices/experiences may be hindering/facilitating subsidy usage in different cities and towns across the state, and to consider which existing or proposed policy levers could be used to address local variation in the subsidy system.

On the family-side front, these findings raise more questions than answers, and serve as motivation for researchers and policymakers to investigate how family-side factors (levels of demand for subsidies, parent preferences, local norms, take-up behaviors) that influence demand for care, participation in the subsidy system, and access to subsidized care, vary at the local city/town level across the state.

**Summary statement:** By mapping and analyzing the geography of met need for child care assistance in Massachusetts, we learn of substantial variation in the level of met need across cities and towns in the state. While higher met need cities/towns tend to be located near larger urban hubs, and less dense regions tend to have cities and towns with lower met need, the exceptions to these patterns are numerous, resulting in no one single overarching geographic pattern. The finding of local level variation in met need means that eligible families, depending on where they live, are not equally likely to access and use subsidized care, raising numerous questions and considerations about the role of the family-side and system-side factors at work at the local level that may be driving variation in local levels of met need.

## SECTION 4: GEOGRAPHY OF THE "DUAL-MECHANISM" (VOUCHER/CONTRACT) SUBSIDIZED CARE SYSTEM

### 4.1 Overview of topic and research questions

The Massachusetts subsidy system can be characterized as a "dual-mechanism" subsidy system in that there are two different mechanisms through which state disburses subsidies--(1) child care vouchers or (2) contracted child care slots.

For income-eligible families, the assignment of vouchers or contracted slots is based on available options at the time a child is called off the subsidy wait list[11]. In other words, a parent does not chose

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[11]Note: TANF-eligible families are exclusively served through vouchers.

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whether they receive a voucher or a contracted slot. Income-eligible families could turn down a slot or voucher based on preferences up to three times, however the long waitlist creates an incentive to accept the assigned voucher or slot. Income-eligible families who accept a contracted slot must use the contracted provider they are assigned--i.e., a parent is offered a slot with a specific provider and can accept or reject the slot with that provider, but a parent does not have the option of choosing between multiple slots (at different providers). Income-eligible families who are assigned a voucher can use the voucher with any provider that accepts vouchers or with a contracted provider that has contracted slots but also accepts vouchers.

Statewide, about half of income-eligible children under age 6 in Massachusetts receive vouchers (52%) and about half (48%) receive contracted slots (data as of December 2014). Families receiving vouchers have greater flexibility to choose their provider, but may also face the uncertainty of finding a provider that will accept the voucher, as provider participation in the subsidy system is voluntary. Families receiving contracted slots have less choice when it comes to selecting a provider, but have the certainty of a subsidized child care slot. In fact, greater certainty of supply for families is one of the policy goals of the contracting system in Massachusetts (particularly for certain groups of families, including those in need of infant/toddler care and those living in underserved urban and rural areas). In sum, both subsidy mechanisms--vouchers and contracted slots--bring a mix of benefits and challenges for families, and so understanding the geography of the dual-mechanism system helps us to understand important characteristics of families' local subsidized child care choice sets.

Because only a small number of states nationally have a dual-mechanism subsidy system, these systems are understudied and little is known about the capacity and usage characteristics of dual-mechanism systems at a local (sub-state) level. The need to understand more about dual-mechanism systems has recently increased, however, as these systems are expected to become more common in the wake of the 2014 CCDBG reauthorization, which highlighted the use of dual-mechanism systems as a tool for bolstering supply and achieving more equal access (Child Care and Development Block Grant Act of 2014). The findings are also highly relevant to Massachusetts policymakers given the large role of contracts in the Massachusetts subsidy system, providing insights about the system as the state evaluates the criteria and processes used to award and allocate contracts, and the role of geography in that process.

The maps and analyses in this section explore the geography of the dual-mechanism system in Massachusetts, aimed at learning more about the following research questions:

- **Local variation in capacity of the dual-mechanism system**: How does the licensed capacity of contracted providers vs. voucher-only providers vary locally?
- **Local variation in usage of the dual-mechanism system**: How does the share of subsidized children that use contracted vs. voucher-only providers vary locally (with an in-depth look at the share of voucher holders who use their vouchers with contracted providers)?
- **Local patterns in the relationship between capacity and usage**: Are voucher holders more likely to use contracted providers in local markets with greater contracted provider capacity/presence?
- **Local patterns in the relationship between capacity and met need:** Do local markets with greater contracted provider capacity/presence have lower unmet need?

4.2 Definitions, Data Sources, and Methods

## Definitions

- **Voucher holder or voucher child** = child who receives/uses child care assistance in the form of a voucher.
- **Contract child** = child who receives/uses child care assistance in the form of a contracted slot.
- **Contracted provider** = provider who holds a contract with the state to serve children through contracted slots.  Note:  contracted providers can also serve voucher children in addition to the children they serve through contracted slots if they have additional capacity.
- **Voucher-only provider** = provider who serves voucher children (and does <u>not</u> hold a contract with the state to serve children through contracted slots).
- **Subsidy provider** = any provider serving voucher and/or contract children (i.e. a voucher-only or a contracted provider).
- **Licensed capacity =** the total number of children that a child care provider is licensed to serve at one time.
- **Subsidy capacity =** the licensed capacity of a subsidy provider.  For example, if a subsidy provider is licensed to serve 10 children (i.e. licensed capacity=10), her subsidy capacity is 10, whether she serves 1 subsidized child or 10 subsidized children.  Note that subsidy providers are not required to serve only subsidized children. If a subsidy provider is licensed to serve 10 children, she could serve anywhere from 1 to 10 children, and only 1 of those children could be a subsidized child or up to all 10 of the children served could be subsidized children.
- **Statewide/Local subsidy capacity =** the total subsidy capacity (i.e. the total licensed capacity, per definition above) of all subsidy providers in the state or city/town (calculated by summing the total subsidy capacity, i.e. the total licensed capacity, of all subsidy providers in the state or city/town).  For example, a town with 2 subsidy providers, each licensed to serve 10 children, would have a local subsidy capacity of 20, whether these two providers serve 2 subsidized children or 20 subsidized children.

## Approach

Understanding and analyzing the geography of the dual-mechanism system and its local capacity and usage characteristics required five steps:

- Step 1:  Examining the geographic distribution of contracted providers (providers serving children through contracted slots) and voucher-only providers (providers serving only voucher holders).
- Step 2 (Capacity):  Examining the relative licensed capacity held by contracted vs. voucher-only providers at the local level.
- Step 3 (Usage):  Examining the shares of income-eligible contract and voucher children who are served by contracted vs. voucher-only providers at the local level.

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- Step 4 (Capacity and Usage):  Examining the relationship between local contracted provider capacity and local subsidy usage (specifically, the relationship between contracted provider presence and voucher holder usage patterns).
- Step 5 (Capacity and Met Need): Examining the relationship between local contracted provider capacity and local levels of met need.

It is important to note that a voucher holder may use his or her voucher with a contracted provider if they choose, and this is a common practice.  Statewide, in December 2014, roughly 40% of income-eligible voucher children under age 6 used their voucher with a contracted provider.  The result is that, as of the time of analysis, nearly two-thirds (65%) of income-eligible children under age 6 were ultimately served by a contracted provider in Massachusetts.

**Data and methods.**  Data on the location and licensed capacity of a provider come from the Massachusetts analytic administrative subsidy data system (provider listings include the number of voucher and contract children served by each provider).  These data are used to explore the geographic distribution of providers (Step 1) and to examine the capacity of providers at the local level (Step 2).  From the administrative data, we can obtain the provider that serves each voucher and contract child in December 2014, and by linking to the data from Step 1, we can determine whether each provider is a contracted or a voucher-only provider.  These data can then be aggregated to the city/town level[12] to examine local usage patterns (Step 3).  To compare local capacity and local usage patterns, we combine data from Steps 1, 2 and 3 at the city/town level.  To compare capacity and met need, we combine provider location information and capacity data from Steps 1 and 2 with data on the level of estimated met need at the city/town level.  Met need is calculated for each city/town by dividing the number of income-eligible children under age 6 served by subsidies by the number of children under age 6 with family income under 200% of the federal poverty level.  Please note that this calculation of met need focuses on income-eligible children because that this is the group affected by the dual-mechanism system (TANF-eligible children are exclusively served with vouchers); and therefore reported city/town met need levels will differ from city/town levels reported under a different definition (that considered both income-eligible and TANF-eligible children) in Section 3.

4.3 Patterns/Findings and Implications for Policy

Maps 3a1 and 3a2 show the locations of all contracted providers and all voucher-only providers statewide, respectively.   We see a clear difference in the geography of contracted providers compared with the geography of voucher-only providers, with contracted providers perceptibly more clustered/concentrated, particularly around large urban hubs, and voucher-only providers more dispersed across the state[13].  These two distinct geographic distributions indicate that the presence of contracted providers, relative to voucher-only providers, is likely to vary at the local level.

[12] City/town level is defined as the county subdivision level, Census geographic summary level 060.  In Massachusetts, the legal boundaries for municipalities (i.e., cities/towns) correspond to this Census geographic summary level.
[13] Nearest Neighbor Index Ratios are 0.38 for voucher-only providers and 0.29 for contracted providers (note:  values closer to zero, i.e. zero distance between "neighbors", indicates higher levels of clustering), and are both statistically significant (p<.01).

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Pittsfield
Greenfield
Fitchburg
Lawrence
Springfield
Worcester
Boston
Quincy
New Bedford
Hyannis

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Massachusetts Subsidized Child Care: Geography, access, equity

# Map 3a2. Locations of All Voucher-Only Providers Statewide

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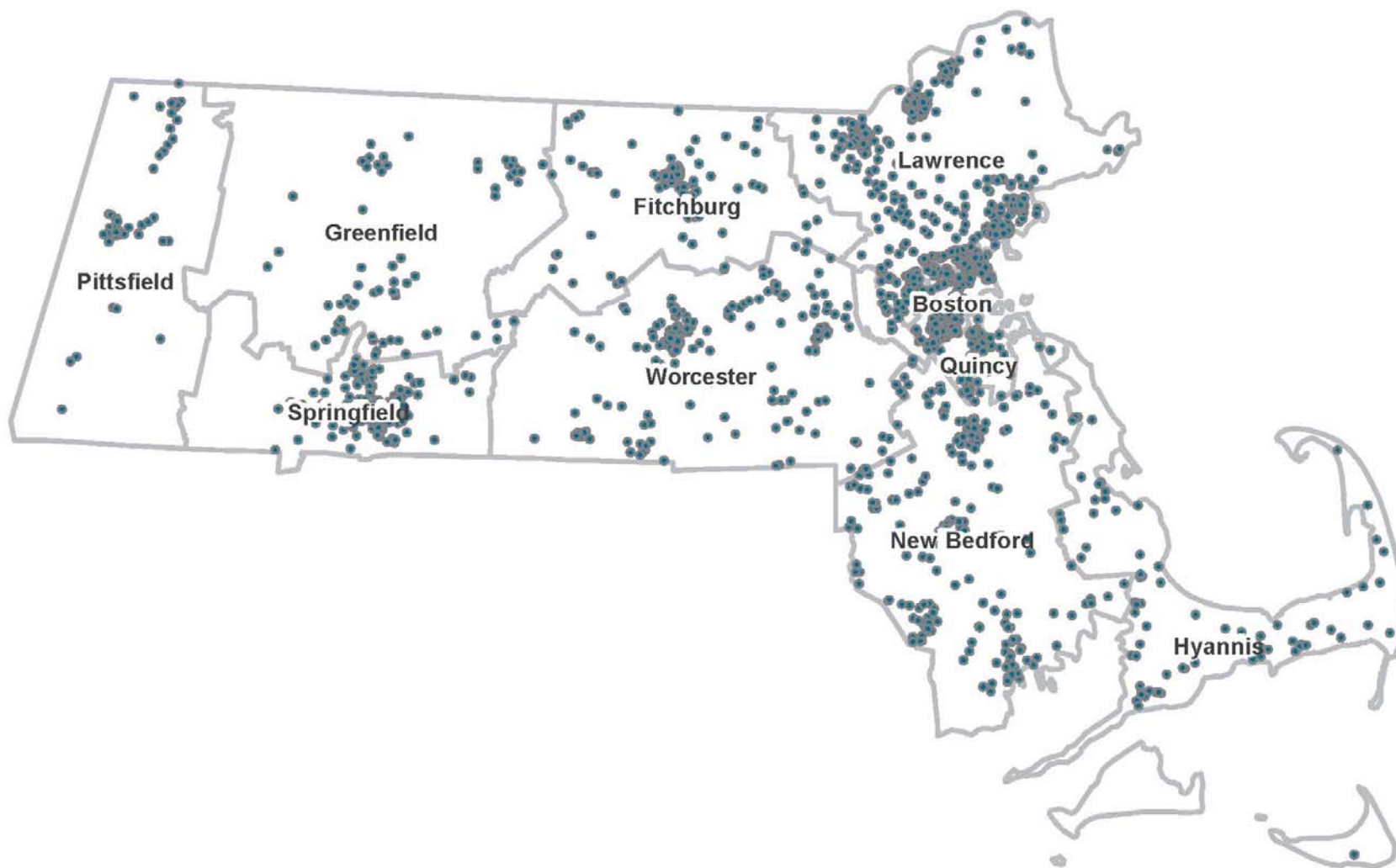
Statewide, total subsidy capacity (i.e. the total licensed capacity of subsidy providers) is balanced be-tween the subsidy capacity of contracted providers and the subsidy capacity of voucher-only provid-ers. Contracted providers hold 47% of statewide subsidy capacity (i.e. total licensed capacity held by subsidy providers), and voucher-only providers hold 53% of statewide subsidy capacity. The question is whether we observe this roughly equal split when we look at the local level. In other words, does the split at the local level mirror this roughly equal split at the statewide level?

Map 3b shows the share of all subsidy provider licensed capacity that is held by contracted providers for each city/town in Massachusetts. The map di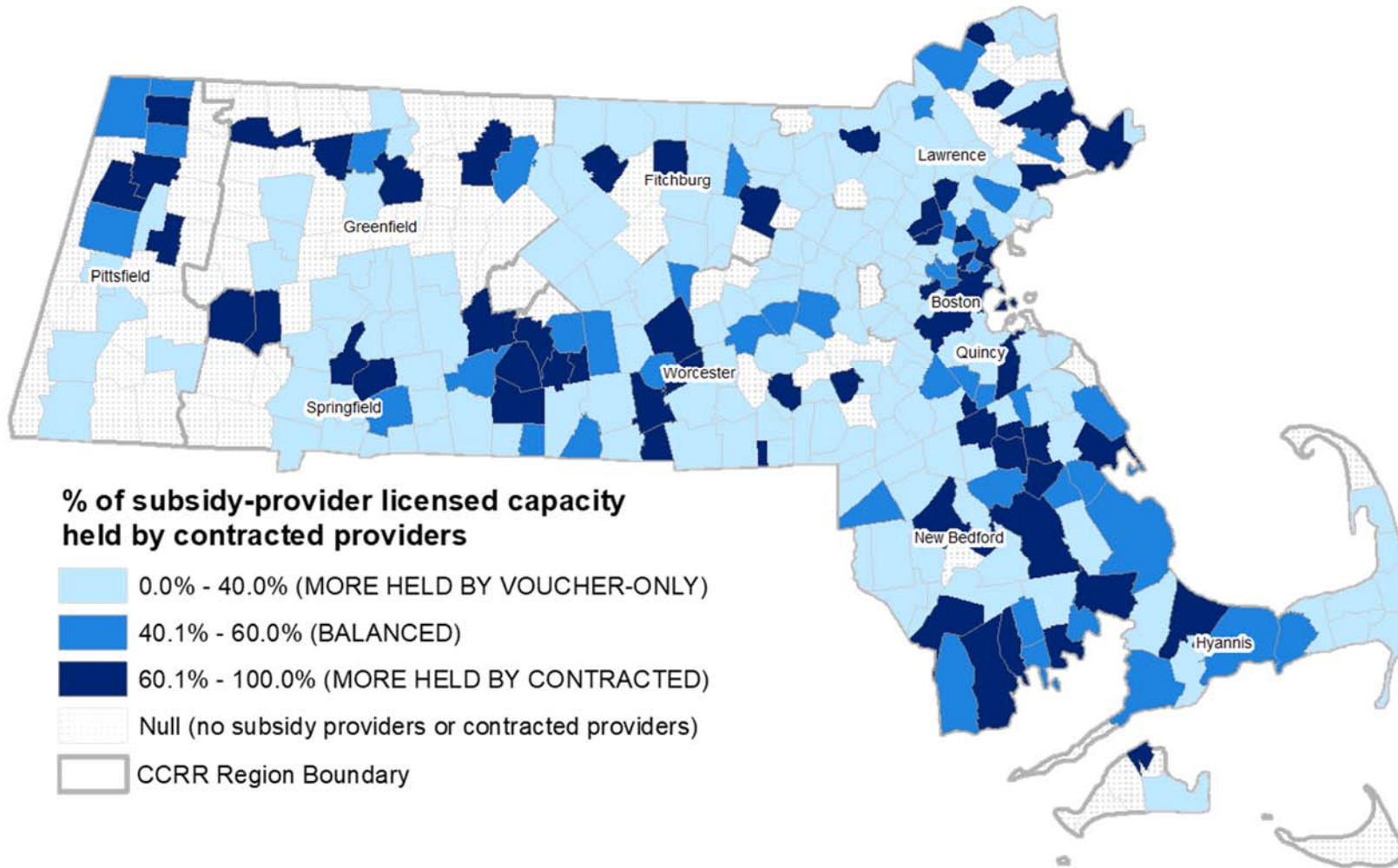splays three shades of blue. The middle shade of blue represents cities/towns where the dual-mechanism system is considered balanced, that is, where the percent of total licensed subsidy capacity held by contracted providers is between 40%-60%. The darkest shade of blue represents cities/towns where there is an imbalance: contracted providers hold the vast majority (>60%) of total licensed subsidy capacity. The lightest shade of blue represents cit-ies/towns where there is an imbalance in the other direction: contracted providers hold a much smaller share (<40%) of total licensed subsidy capacity.

As clearly demonstrated in Map 3b, the geography of the dual-mechanism system in Massachusetts is characterized by imbalance, rather than balance, at the local level. We observe very little of the middle shade of blue which represents towns where contracted provider and voucher-only provider capacity are roughly in balance. The color we observe most frequently is the lightest shade of blue, which represents cities/towns where contracted providers hold a small share of the capacity. How-ever, we also observe numerous clusters of the darkest shade of blue (cities/towns where contracted providers hold the vast majority of the capacity), and these clusters are almost always found in large urban hubs, where the largest numbers and concentrations of children in need of and using subsi-dized child care live.

Map 3c compares the shares of all subsidized children who are served by contracted providers (Map A) and the share of all voucher children who are served by contracted providers (Map B). In Map A we observe local variation in the share of subsidized children served by contracted providers. We also observe clustering of like values. In other words, cities/towns where large shares of subsidized chil-dren are served by contracted providers tend to be located next to (and in clusters of) cities/towns that also have large shares of subsidized children being served by contracted providers. We see multi-city clusters characterized by low, medium or high contracted provider usage. Notably, the clusters with high contracted provider usage (dark blue) tend to form around large urban hubs. Clusters with balanced usage (medium blue) tend to form in the outer ring areas of large urban hubs, and clusters with low contracted provider usage (light blue) tend to form in the lower density areas in between.

In Map B, we see that in almost all cities/towns where the share of voucher holders who use con-tracted providers is high (i.e. the dark blue areas), the share of all subsidized children who use con-tracted providers is also high (i.e. dark blue in Map A). This indicates that when cities/towns have higher shares of children served by contracted providers, this is driven in part by larger shares of voucher holders using contracted providers (and this appears to be especially true in large urban areas with large concentrations of children in need of and using child care assistance). The correlation between the local share of subsidized children served by contracted providers and the local share of voucher children served by contracted providers is very high, r=0.75 (p<.05).

## Map 3b. Share of subsidy provider capacity held by contracted providers



**% of subsidy-provider licensed capacity held by contracted providers**

- 0.0% - 40.0% (MORE HELD BY VOUCHER-ONLY)
- 40.1% - 60.0% (BALANCED)
- 60.1% - 100.0% (MORE HELD BY CONTRACTED)
- Null (no subsidy providers or contracted providers)
- CCRR Region Boundary

Map labels: Pittsfield, Greenfield, Fitchburg, Lawrence, Springfield, Worcester, Boston, Quincy, New Bedford, Hyannis

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## MAP 3C. SHARE OF CHILDREN SERVED BY CONTRACTED PROVIDERS

Map A: All subsidized children

Map B: Voucher children
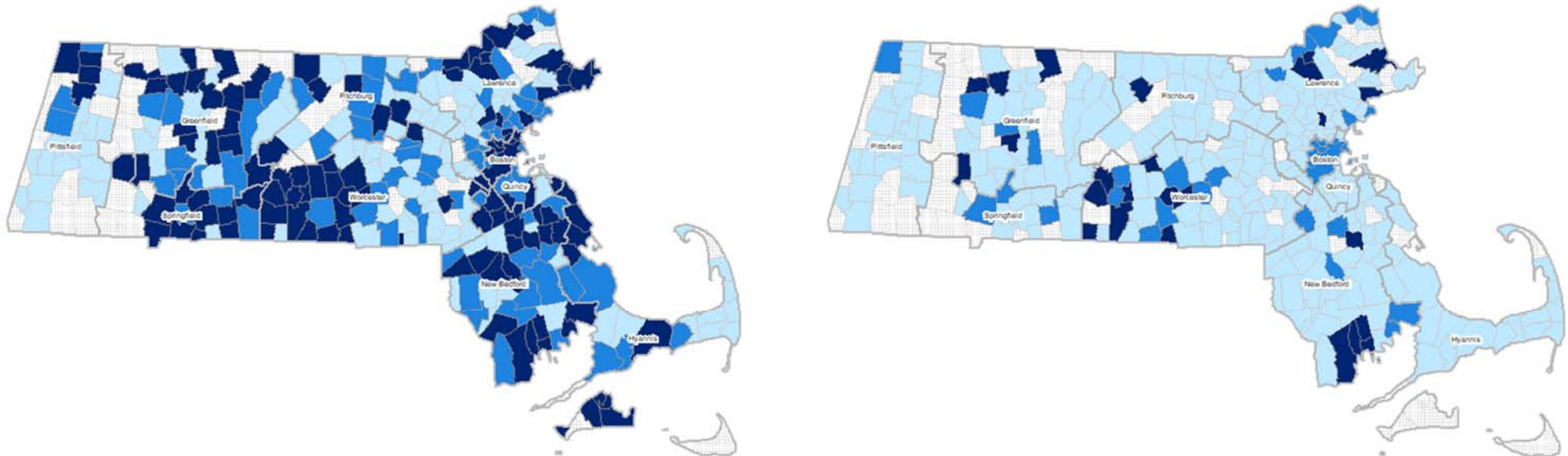


**% children under 6 with contracted provider**

- 0.0% - 40.0% (MORE WITH VOUCHER-ONLY)
- 40.1% - 60.0%
- 60.1% - 100.0% (MORE WITH CONTRACTED)
- Null (no subsidized or voucher children)
- CCRR Region Boundary

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Given this strong correlation, the logical question that follows is whether voucher holders are more likely to use contracted providers in local markets with greater contracted provider presence/capacity. In Map 3d, we look at the share of licensed subsidy capacity held by contracted providers and the share of voucher children using contracted providers side by side. We see a correlation (r=0.41, p<.05) in which the share of voucher children using contracted providers tends to be higher in cities/towns with greater contracted provider capacity/presence. However, there are many exceptions to this pattern, which suggests that there are cities/towns where contracted provider capacity/presence is high, but voucher holders are <u>not</u> more likely to use contracted providers (i.e. they are more likely to use voucher-only providers despite high contracted provider presence), indicating that the balance between contracted provider and voucher-only provider presence in a local area--while playing a role in shaping choices and behaviors--cannot be the sole driver of the choices and behaviors of voucher holders.

Finally, in Map 3e we compare local subsidy provider capacity characteristics (i.e. the balance of contracted vs. voucher-only providers) with the level of usage, i.e. met need (i.e. share of estimated income-eligible children under age 6 using subsidies). Specifically, we were curious to know if cities/towns with greater contracted provider presence/capacity have higher levels of met need. Map 3e shows a very weak relationship between the share of subsidy capacity held by contracted providers and met need. In other words, there are numerous places where contracted provider capacity/presence is very high, but the share of eligible children served is very low, and vice versa (i.e. contracted provider capacity is low, but share of estimated eligible children served is high). This pattern indicates that even markets that are saturated with contracted providers are not necessarily fully addressing the service gaps occurring in many localities. On the flipside, there are cities/towns where more of the local need is met, but need is being met without high contracted provider capacity/presence in these local subsidized care markets.

**Summary statement**: This analysis of the geography of Massachusetts' "dual-mechanism" subsidy system (i.e. a child care assistance system that serves children via vouchers and contracted slots) provides a first look at how capacity levels and usage of contracted vs. voucher-only providers varies at the local level. At the state level, the capacity of contracted and voucher-only providers is roughly equal (the two types of providers hold roughly equal shares of licensed subsidy capacity), and income-eligible subsidized children are roughly equally likely to receive a voucher or a contracted slot. Despite this overall statewide balance in the capacity and usage of both subsidy mechanisms, the local geography of the dual-mechanism system is characterized by imbalances in capacity and usage, rather than balance. In most local markets, either contracted providers or voucher-only providers hold a vast majority of local subsidy capacity--there are very few cities/towns where we observe a balance. Large urban markets tend to have much higher contracted provider presence, while lower density areas tend to have greater voucher-only provider presence. This indicates that, for subsidy eligible families, the balance between contracted and voucher-only provider presence and capacity in their local subsidized child care choice sets varies greatly depending on where a family lives. We also find

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# Map 3d. Capacity vs. Usage (Voucher Children)

### Map A: Capacity

% of subsidy provider capacity
held by contracted providers
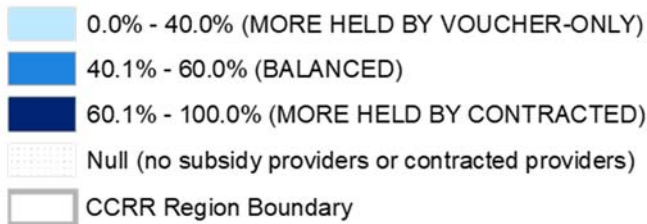
### Map B: Usage

% of voucher children
served by contracted providers



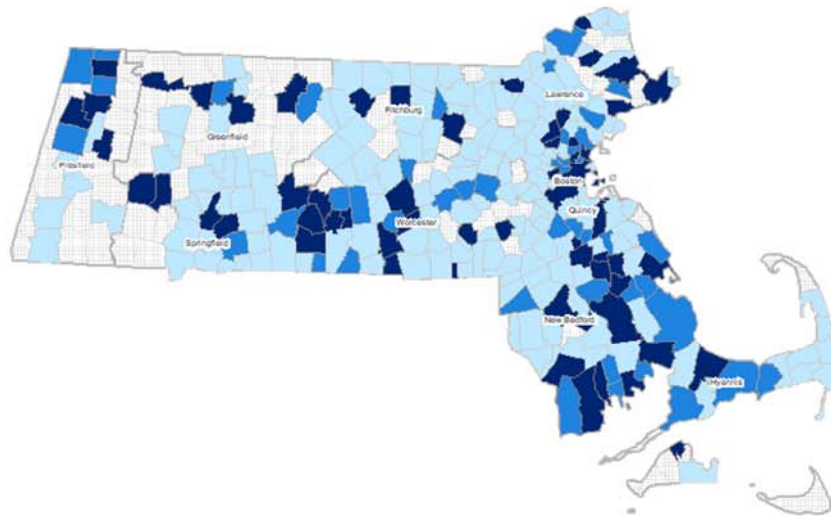**% of subsidy-provider licensed capacity
held by contracted providers**

- 0.0% - 40.0% (MORE HELD BY VOUCHER-ONLY)
- 40.1% - 60.0% (BALANCED)
- 60.1% - 100.0% (MORE HELD BY CONTRACTED)
- Null (no subsidy providers or contracted providers)
- CCRR Region Boundary



**% voucher children under 6 with contracted provider**

- 0.0% - 40.0% (MORE WITH VOUCHER-ONLY)
- 40.1% - 60.0%
- 60.1% - 100.0% (MORE WITH CONTRACTED)
- Null (no subsized children)
- CCRR Region Boundary

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# Map 3e. Capacity vs. Met Need

## Map A: Capacity
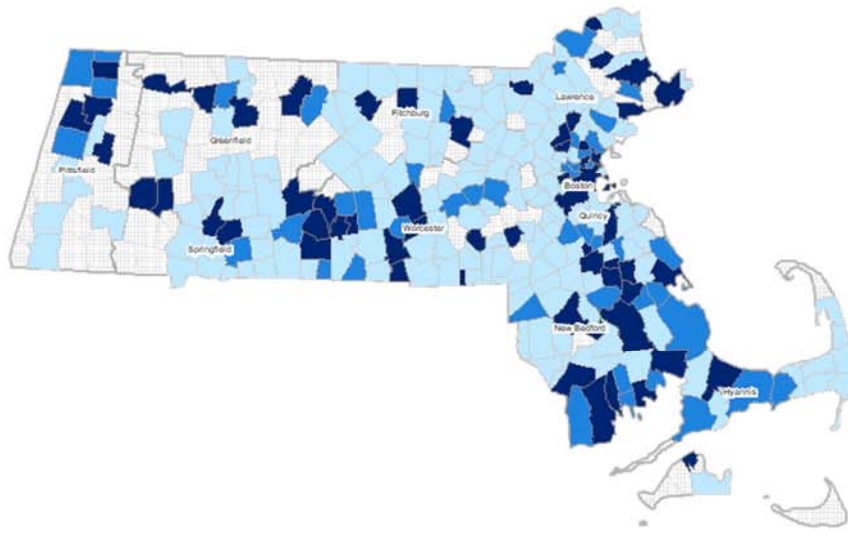
% of subsidy provider capacity
held by contracted providers
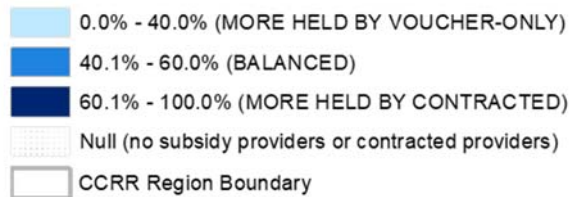
## Map B: Met Need

% of estimated income-eligible
children under 6 served



**% of subsidy-provider licensed capacity
held by contracted providers**

- 0.0% - 40.0% (MORE HELD BY VOUCHER-ONLY)
- 40.1% - 60.0% (BALANCED)
- 60.1% - 100.0% (MORE HELD BY CONTRACTED)
- Null (no subsidy providers or contracted providers)
- CCRR Region Boundary

**% of estimated income-eligible served**

- 0.0% - 7.0%
- 7.1% - 14.0%
- 14.1% - 100%
- Null (no estimated eligible children)
- CCRR Region Boundary

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that in local markets where contracted provider presence and capacity is high, voucher holders are more likely to use contracted providers, indicating that the balance of contracted and voucher-only providers in the local market, at least in part, may be an important (although not the only) factor in the choices and behaviors of voucher holders.  Finally, we find that the level of contracted provider presence/capacity is *not* related to the local level of met need.  This is an important finding as Massachusetts considers its criteria for the allocation and assignment of contracts, and the role of geography in that process, and is also informative to other states that may be considering whether and how to use contracts to bolster supply and increase equity in local access to subsidized child care.

## SECTION 5:  GEOGRAPHY OF "SUBSIDIZED CHILD CARE DESERTS" AND PATTERNS BY CHILD RACE/ETHNICITY

### 5.1 Overview of topic and research questions

Over the past two decades, researchers and policymakers have focused considerable attention on food deserts--local areas, especially low-income communities, with limited access to affordable and nutritious food outlets (U.S. Department of Agriculture, Economic Research Service, 2009)--as evidenced by the U.S. Department of Agriculture's adoption of food desert measures as the primary national/federal indicator of food access used for policy monitoring.  In recent years, large national early childhood advocacy organizations (Child Care Aware), and think tanks alike (e.g. Center for American Progress) have brought increasing attention to the concept of "child care deserts"-- local areas with limited supply of child care providers. This increasing focus on "child care deserts" is part of a larger research and policy agenda focused on issues of equity in local access to child care.  This research agenda is important given the very localized nature of early childhood programs: Nearly 60% of low-income families in the U.S. who utilize non-parental care outside of the home access a child care center within 3 miles of their home address, indicating that a majority of low-income working families in the U.S. access child care close to home (National Survey of Early Care and Education Project Team, 2016).

Despite the growing attention to issues of local child care access, there is little systematic research on local variation in the availability of child care and the pervasiveness of child care shortage areas.  There is even less information about the availability of and shortages in *subsidized* child care at the local level.  In this section, we first examine the prevalence of subsidized child care shortage areas-- "subsidized child care deserts"--in Massachusetts, and then explore issues of racial and ethnic equity in local access by examining whether subsidy eligible children of different racial/ethnic backgrounds are more (or less) likely to live in shortage areas relative to other groups.

**Why focus on differences by race and ethnicity?**   Knowing that children of different racial and ethnic groups tend to live in different neighborhoods due to high levels of residential segregation amongst children (Acevedo-Garcia et al., 2014) motivates us to investigate whether the conditions in those different neighborhoods--in terms of availability of subsidized child care--are equitable across the state.  In the context of residential segregation, local inequities in the availability of subsidized child care can translate into systematic racial/ethnic inequities in the local availability of care, which could

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have numerous downstream implications for racial/ethnic equity. A lack of locally available subsidized care could serve as a barrier to obtaining child care to support working parents and quality early educational experiences for children. Therefore, systematic differences in local availability that occur along racial/ethnic lines, have the potential to reinforce and perpetuate population level racial/ethnic inequities in the very parental economic stability and healthy child development outcomes that the CCDF program is designed to promote.

We explore two research questions in this section:

**Research question 1:** Using <u>existing definitions</u> of child care deserts, what is the prevalence of subsidized child care deserts in Massachusetts, how are they geographically distributed, and do we observe racial/ethnic inequities in who lives in deserts?

**Research question 2:** Using <u>alternate equity-focused definitions</u> of "child care deserts", what is the prevalence of subsidized child care deserts, how are they geographically distributed, and do we observe racial/ethnic inequities in who lives in deserts?

5.2 Definitions, Data Sources, and Methods

To conduct analysis of our research questions, we first needed to identify the location of child care deserts by coding each neighborhood (census tract) as a desert (or not a desert) based on the definitions below (Step 1), and then create a map of all neighborhoods in the state to see the prevalence and geographic distribution of child care deserts. We next explored racial/ethnic inequities using descriptive summary statistics by calculating the number and shares of subsidy eligible children under age 6 that live in child care deserts, for eligible children overall, and for eligible children in each of three major racial/ethnic groups in Massachusetts: Non-Hispanic white, Non-Hispanic black, and Hispanic children (Step 2).

**Definitions:**

**Neighborhood =** Census tract.

**Neighborhood counts of subsidy-eligible children under age 6** = Number of children under age 6 (from U.S. Decennial Census, 2010) multiplied by the percent of children under age 18 with family income under 200% of the federal poverty line (from American Community Survey, 2010-2014, obtained via special tabulation)[14]. Note that for counts of subsidy-eligible children in each racial/ethnic group, we utilized counts of children under age 6 for each specified racial/ethnic group from U.S. Decennial Census (2010), and multiply those counts by the group-specific share of children under 18 that have family incomes under 200% of the federal poverty level from the ACS 2010-2014 Special Tabulations.

[14] Note that percent of children under age 18 with family income under 200% FPL by child race/ethnicity were used as they were the best data available to the authors for estimating percent of children under age 6 with family income under 200% FPL by child race/ethnicity. The data were available to the authors from a special tabulation dataset that authors had access to. The special tabulations request was made for another purpose, with children under age 18 as the focal age group. While the percent of children under age 18 under 200% FPL and the percent of children under age 6 under 200% FPL can be different within a census tract, the estimates for children under 18 are a close estimate for children under age 6, making it a valid proxy measure for these purposes.

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**Neighborhood counts of subsidized seats** = Number of subsidized children that are served (through contracts and vouchers) by subsidy-participating providers located in the neighborhood. In other words, we identify all providers in a neighborhood that serve at least 1 subsidized child (i.e. we identify subsidy-participating providers located in the neighborhood), we obtain the total count of subsidized children served by each individual subsidy-participating provider, and then we sum the counts for all subsidy-participating providers in the neighborhood to get a neighborhood count of subsidized children served, or subsidized "seats" located in the neighborhood. This "seat count" is designed as a measure of the standing number of seats located in and currently being utilized in a neighborhood.

**Neighborhood counts of subsidized children** = Number of children that reside in the neighborhood that receive/use child care subsidies (in the form of a contracted slot or a voucher)[15]. Note that subsidized children can use their subsidies with providers located in the same neighborhood where they reside or in a different neighborhood.

**Level of unmet need =** Number of subsidy-eligible children living in the neighborhood in excess of number of subsidized (i.e. subsidy-participating) children living in the neighborhood.

**Level of supply constraint** = Number of subsidy-eligible children living in the neighborhood in excess of the number of subsidized seats located in the neighborhood.

**"Extreme unmet need" cluster =** Cluster of contiguous neighborhoods where the unmet need levels are high relative to unmet need levels in other neighborhoods statewide, and where these high neighborhood unmet need levels are highly correlated amongst contiguous neighborhoods in the cluster.

**"Highly constrained supply" cluster =** Cluster of contiguous neighborhoods where the level of supply constraint is high relative to constraint levels in other neighborhoods statewide, and where these high neighborhood levels of constrained supply are highly correlated amongst contiguous neighborhoods in the cluster.

**Subsidized child care desert (Measure 1)** = A census tract that meets the following criteria: (i) 50 or more subsidy eligible children, and (ii) either zero subsidized seats in the tract OR more than 3 eligible children per subsidized seat in the tract. Note that this definition applies the Malik and Hamm (2017, Center for American Progress) definition of a child care desert to subsidized child care.

**Extreme subsidized child care desert (Measure 2)** = A census tract that meets two conditions: (i) neighborhood is part of a cluster of "extreme unmet need" neighborhoods, *and* (ii) neighborhood is part of a cluster of "highly constrained supply" neighborhoods.

**Data and methods.** Data on the locations of subsidy-participating providers and subsidized children come from the Massachusetts administrative subsidy data system (data as of December 2014). Data on subsidy eligible children come from U.S. Census Decennial Census (2010) and American Community Survey (2010-2014, as described in more detail in definitions section above).

Using Exploratory Spatial Data Analysis (ESDA) methods, clusters, for purposes of the analysis of "extreme child care deserts" are identified using Local Indicators of Spatial Autocorrelation (using the "Cluster and Outlier Analysis (Anselin Local Moran's I)" tool in ArcMap), or "LISA" indicators. Exploratory

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[15] Includes children in all eligibility categories: income-eligible, TANF-eligible, homeless, supportive and children with special needs.

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spatial data analysis methods utilize statistical tests to help determine whether patterns found in the neighborhood-level data values are *spatially random* versus *spatially associated*. If neighborhood child care availability level, for example, is *spatially random*, then the level of child care availability in one neighborhood will not depend on the level of child care availability in the surrounding (contiguous/bordering) neighborhoods. Also, the spatial pattern we observe would be equally as likely as any other spatial pattern, and the *locations* of high or low child care availability neighborhoods could be altered without affecting the information content of the data. When spatial randomness is violated (i.e. not present), then there is *spatial autocorrelation*. The literal meaning of spatial autocorrelation is self-correlation (autocorrelation) of observed values of a single attribute (in this case neighborhood child care supply constraint OR neighborhood unmet need), according to the geographical (spatial) ordering of values. There are two kinds of spatial autocorrelation: positive, when the relationship between the value at a location and the values of its neighbors is positive, and negative, otherwise.

The LISA clusters displayed on the maps represent groups of contiguous/bordering neighborhoods that form when we find positive spatial autocorrelation, i.e. when we find instances where a neighborhood itself has highly constrained supply and high unmet need levels, *and* its contiguous/bordering neighborhoods *also* have highly constrained supply and high unmet need levels. For additional technical information about measures of spatial autocorrelation, please see Appendix C.
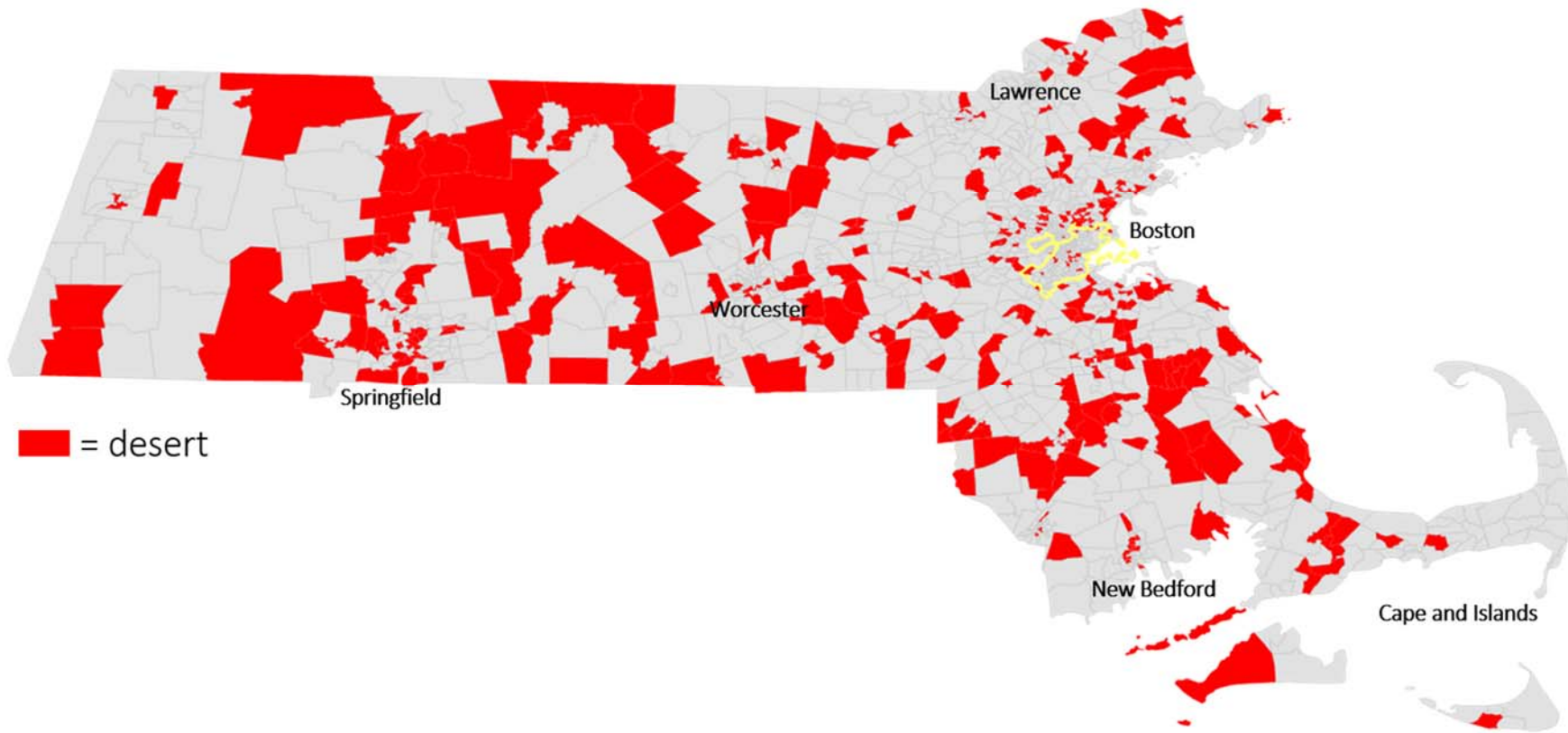
5.3 Patterns/Findings and Implications for Policy

Map 4a shows the geography of subsidized child care deserts in Massachusetts (using Measure 1, Malik and Hamm, Center for American Progress, 2017 definition). Out of roughly 1,000 neighborhoods statewide where subsidy income- and TANF-eligible children live, 349 neighborhoods are classified as deserts using this definition. These neighborhoods span the entire state, and are found in both large urban hubs, and in lower density areas away from large urban hubs. Notably, there are relatively few subsidized child care deserts inside the City of Boston--the largest service and need area in the state (twice as large as the second largest service/need area (Springfield, MA), in terms of children served/children estimated to be eligible for subsidies).

Figure 1 provides the share of subsidy eligible children that live in subsidized child care deserts statewide using Measure 1. Half (51%) of subsidy eligible children overall live in subsidized child care deserts. Subsidy eligible children of different race/ethnicities are roughly equally likely to live in subsidized child care deserts, based on this definition, with 49%, 52% and 55%, of non-Hispanic white, non-Hispanic black and Hispanic children living in subsidized child care deserts, respectively.

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# MAP 4A. GEOGRAPHY OF SUBSIDIZED CHILD CARE DESERTS IN MASSACHUSETTS (MEASURE 1)



**= desert**

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MAP 4B.  GEOGRAPHY OF "EXTREME" SUBSIDIZED CHILD CARE DESERTS IN MASSACHUSETTS (MEASURE 2)



= extreme desert

Lynn

Chelsea

Springfield

Worcester

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**Figure 1. Share of Subsidy-Eligible Children in Subsidized Child Care Deserts (Measure 1)**
**Massachusetts Statewide**
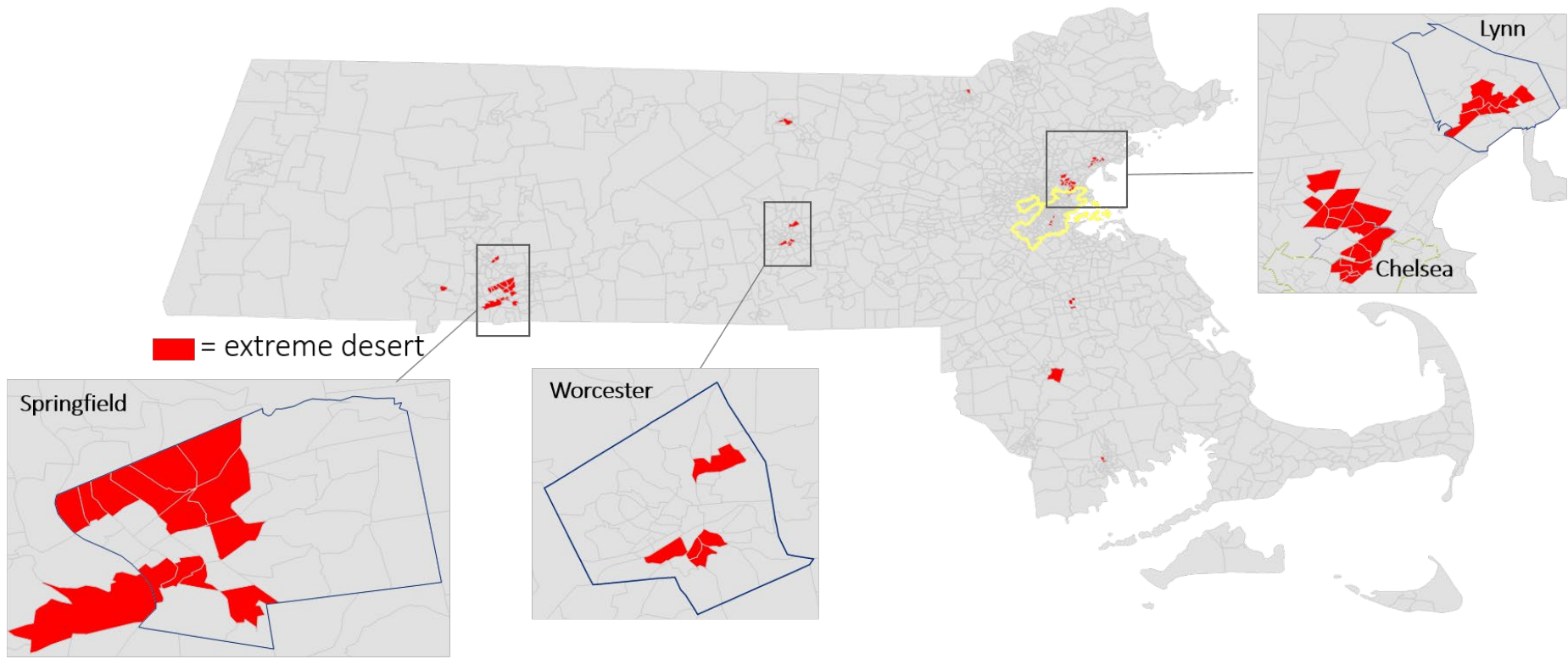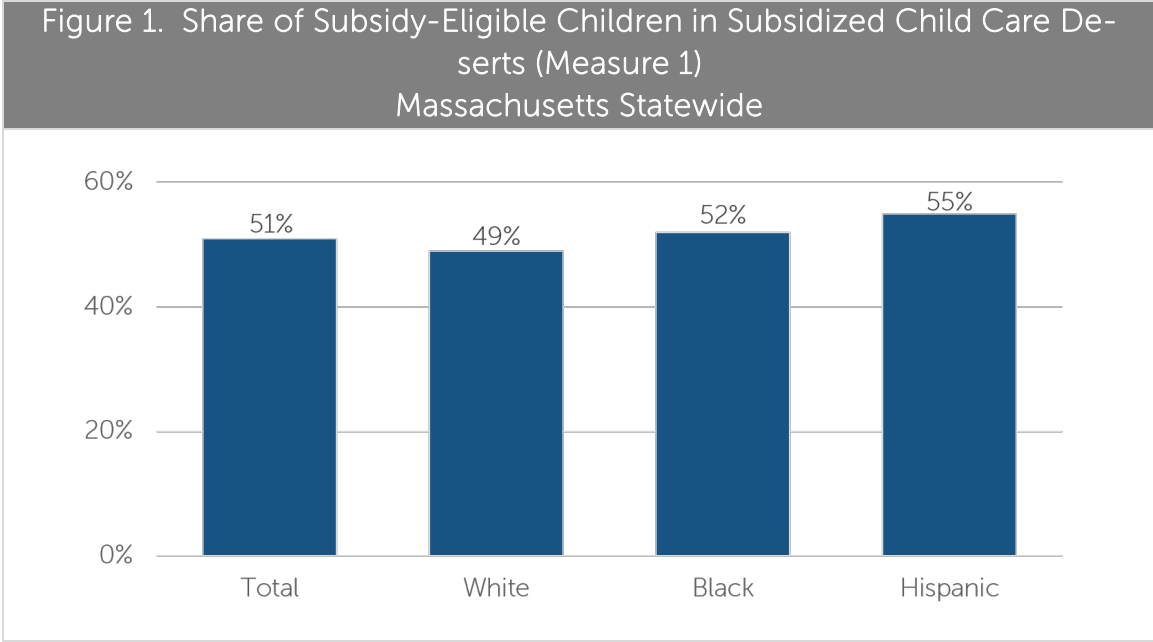


Based on this first measure of child care deserts, we conclude that child care deserts are pervasive, signaling that the subsidized care system may be facing systematic constraints and shortages overall. Moreover, we would conclude, based on this measure, that subsidy eligible children of different racial/ethnic groups are roughly equally likely to face supply constraints at the local level, suggesting that while local availability may be constrained for all, it is not unequal across racial/ethnic groups.

While Measure 1 proved useful for characterizing systematic shortages in the subsidized child care system overall, we were concerned that this measure was obscuring meaningful qualitative differences in the amount of shortage and isolation from care that children in different neighborhoods faced. Using Measure 1 (the established Malik & Ham measure), a neighborhood with 40 eligible children in excess of subsidized seats, with no surrounding "desert" neighborhoods could achieve the same child care desert score as a neighborhood with 481 children in excess of subsidized seats that is completely surrounded/bordered by other neighborhoods with 200+ children in excess of subsidized seats. While both neighborhoods have shortages, there are policy-relevant qualitative differences in children's levels of access in these two neighborhoods. Measure 2 was therefore motivated by and designed to detect these policy-relevant qualitative differences, and to explore whether children of different race/ethnicities systematically face qualitatively different neighborhood conditions.

Map 4b shows the geography of "extreme" subsidized child care deserts in Massachusetts (Measure 2). Out of roughly 1,000 neighborhoods statewide where subsidy-eligible children live, 59 neighborhoods are classified as extreme deserts using this definition. These neighborhoods are concentrated in roughly 10 locations across the state, with the three largest clusters found near Springfield, Chelsea/Malden/Revere, and Lynn. These "extreme" deserts are again mostly found outside of the City of Boston (largest service area in the state), and are essentially exclusively found in large urban hubs.

Figure 2 provides the share of subsidy-eligible children that live in "extreme" subsidized child care deserts statewide. Statewide, just under one-fifth (17%) of subsidy-eligible children overall live in extreme subsidized child care deserts. However, unlike the findings for Measure 1, we observe major

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racial/ethnic differences, with only 6% of subsidy-eligible white children living in extreme subsidized de-serts compared to 24% and 28% of black and Hispanic subsidy-eligible children, respectively. Black and Hispanic children are 4 to 5 times more likely to live in extreme subsidized child care deserts than white children, and substantial shares (more than a quarter) of black and Hispanic children are living in neigh-borhoods with these conditions.



Figure 2. Share of Subsidy-Eligible Children in "Extreme" Subsidized Child Care Deserts (Measure 2)
Massachusetts Statewide
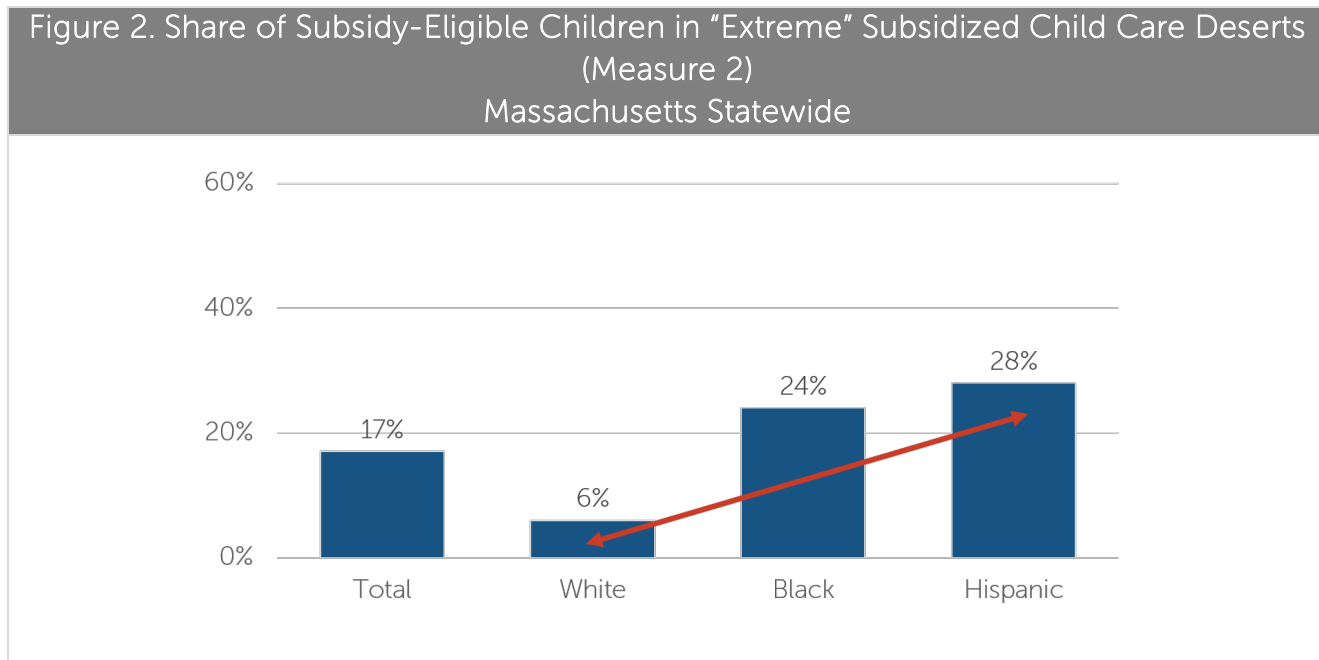
Based on this second measure, we conclude that "extreme" child care deserts are present but not nec-essarily pervasive, and that black and Hispanic eligible children are much more likely than white eligible children to live in neighborhoods with these "extreme" conditions. Moreover, large shares of black and Hispanic subsidy eligible children live in areas with both very high unmet need and very constrained supply, which raises concerns that these two groups may face systematically higher barriers to local access to subsidized care than white subsidy eligible children in Massachusetts.

Table 2. Neighborhood Average Levels of Unmet Need and Supply Constraint in Child Care Deserts (Measure 1) and Extreme Deserts (Measure 2)

|  | Deserts (Measure 1) n=349 | Extreme Deserts (Measure 2) n=59 |
|---|---|---|
| Estimated unmet need (Number of eligible children in excess of number of children served) | 120 | 234 |
| Estimated supply constraint (number of eligible children in excess of total subsidy capacity) | 134 | 248 |

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**Summary statement.** Mapping and analysis of subsidized child care shortage areas (i.e. "child care deserts") in Massachusetts reveals high prevalence of neighborhoods where the number of children eligible for subsidies meaningfully exceeds the number of subsidized seats in the neighborhood, signaling that there may be many neighborhoods where a lack of adequate supply of subsidized care could be creating a barrier to access for children and families who live there. Large shares of eligible children (half) live in shortage areas, and children of different racial/ethnic groups are roughly equally likely to live in these types of neighborhoods. When we examine the presence and geography of "extreme" child care deserts--areas with both extremely limited supply of subsidized care relative to potential need, and extremely high levels of unmet need amongst children living in the neighborhood *relative to other neighborhoods statewide*--we find that these "extreme" conditions are less widespread, concentrate in about ten areas across the state (mostly around urban hubs), and affect smaller shares of eligible children overall. While smaller shares of eligible children overall live in these "extreme" deserts, large shares of black and Hispanic children (over 25%) live in "extreme" deserts, which means that these groups are likely facing systematically higher barriers to access to subsidized care at the local level in Massachusetts.

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### Section 6: Geographic patterns in travel to subsidized child care

6.1 Overview of topic and research questions

While there is relatively little research that specifically examines how low-income working parents' transportation access influences their ability to access child care, related research has identified transportation as an important barrier to participation in early childhood programs, particularly for certain groups, such as immigrant families (Greenberg et al., 2016; Neidell and Wadfogel, 2009). Other research has identified a relationship between transportation access, particularly car access, and employment outcomes for low-income workers (Smart and Klein, 2015; and Blumenberg and Pierce, 2016). These findings are particularly concerning to policymakers in light of the lower levels of transportation access, particularly car access, that low-income workers face relative to middle- and upper-income workers. Nationwide, while 6.6% of all adults lack access to a vehicle, 20% of adults living below the federal poverty line lack access to a vehicle (Vock, 2018).

These past findings suggest the need for more research related to the transportation strategies, behaviors, and needs of low-income working parents, including how low-income parents get their children to and from child care each day. Despite policymakers' concerns about the transportation barriers facing low-income families, most states have little systematic information about the distances that low-income parents travel to child care providers, and how distances and travel times may vary across localities that can be extremely diverse in terms of their geographic size and density, the quality of their public transportation networks, traffic density, walkability of streets, etc.

The present analysis provides preliminary information related to three basic research questions:

- What share of subsidy-participating children live within walking distance of their child care provider?

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- How do travel times to provider vary by region and by town in Massachusetts for subsidy-participating children?
- What share of subsidy-participating children currently utilize state-supported (i.e. subsidized) transportation to access child care, and how does utilization vary (if at all) by child age?

Understanding low-income parents' transportation needs and behaviors is important for policy design and implementation, especially as child care assistance dollars can be (and are) used in many states, including Massachusetts, to assist families with child care-related transportation logistics and costs.

6.2 Definitions, Data Sources, and Methods

Addressing these preliminary transportation-related questions, required 5 steps:

- Step 1:  Identify the location of the home address for all subsidy-participating children
- Step 2:  Identify which provider each subsidy-participating child attends (at a specified point in time) and where that provider is located
- Step 3:  Calculate the distance and travel time between child home address and provider address
- Step 4:  Aggregate individual child-level distances and travel times to higher levels of geography (city/town, regional and state)
- Step 5:  Map and analyze statewide, regional and city/town-level patterns in travel distances, travel time and transportation subsidy use

Analyses in this section include all income-eligible voucher children[16] using child care subsidies during 2012 to 2013, except for analysis of children utilizing transportation subsidies (research question 3), which includes *all* children in the subsidy system (n=54,397) as of December 2014.

To identify the home address of children utilizing subsidized care (Step 1), we draw from the analytic administrative dataset developed through the Child Care Research Partnership.  The dataset includes not only information about the child's subsidy usage, but also additional information, including the child's street address, which we use for geocoding.  The child-level record tells us the provider that is serving the child in a given month, and so we can obtain the provider's service address by linking to our provider information files within the administrative database, which contain the street address of all providers.  We geocode the provider's address and can then calculate the distance and travel time between the child's home address location and the provider's address location.

To calculate the distance between points, we utilize a tool called Open Source Routing Machine "OSRM" (Huber and Rust, 2016).  This tool uses the latitude and longitude of the two points (i.e. the origin and destination points, in this case the child's address and the provider's address, respectively), along with detailed maps of road networks (from OpenStreetMaps) to calculate the "real-world" shortest distance between two points.  We calculate travel time from child home to provider location (by car) using a tool called "georoute" (Weber and Peclat, 2016).  All travel times reported in this section are based on driving times by car and represent one-way (i.e. not round trip) travel times.

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[16] This analysis includes only income-eligible voucher children because this was the focal population for the evaluation study conducted in connection with the Massachusetts Child Care Research Partnership, and the data used for this analysis came from a database prepared for conducting the evaluation study.

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As described in earlier sections, we can cross-reference the point location of each child with a map of the boundaries of the cities and towns and the CCR&R regions in Massachusetts, and attach to each child's record the city/town and CCR&R region where the child lives.  From there, we can sum-marize and aggregate the individual travel distances and durations to provider for each child in our sample to larger geographic units (city/town, CCR&R region and statewide).

6.3 Patterns/Findings and Implications for Policy

- What share of subsidy-participating children live within walking distance of their child care provider?
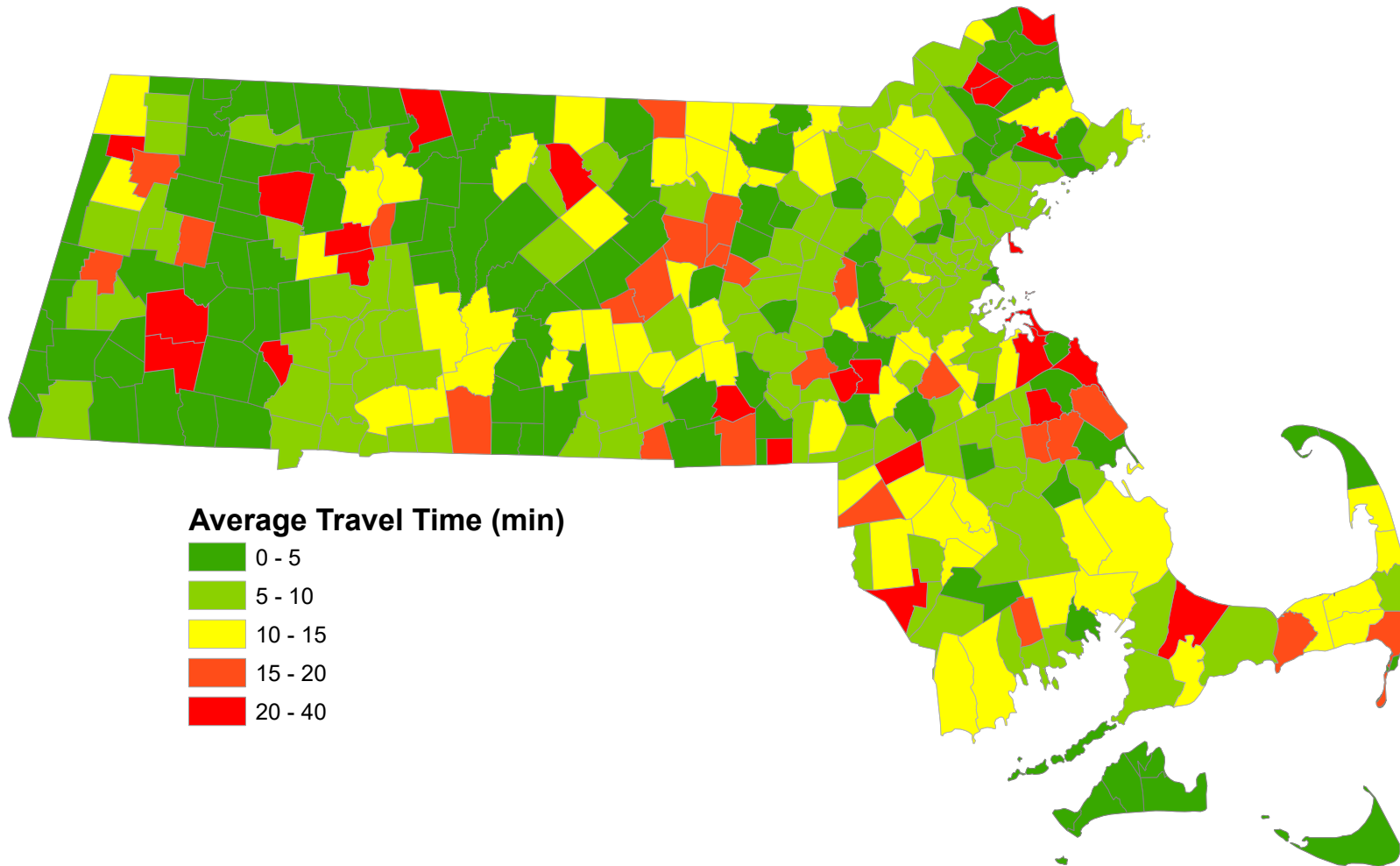
At the time of analysis, Massachusetts' distance-related criteria[17] for qualifying for child care-related transportation subsidies required that the child live more than a half mile from their child care provider. One half mile is a generally accepted threshold (by transportation planners, policymakers and re-searchers alike) for reasonable "walking distance".   We therefore calculated the share of subsidy-participating children that lived more than one half mile from their child care provider and found that 90% of children statewide met the criteria at time of analysis (2012-2013).  This finding has a number of implications for policy.  First, it indicates that virtually all families are likely accessing some form of transportation *other than walking* to transport their children to and from child care each day.  If a vast majority of families require transportation in order to successfully and consistently access child care, then understanding whether transportation access is serving as a barrier to continuity of care and subsidy receipt is a highly relevant issue for policymakers in Massachusetts.  This finding also indicates that using a distance threshold criteria of a half mile will result in almost universal eligibility for transportation subsidies in Massachusetts.  This means that this particular distance-criteria--while detecting a minimal condition for a family's "need" for transportation support--is not be an effective tool for differentiating between different families' need levels.  Motivated by this finding, the state could consider additional *distance-related* criteria (and perhaps related travel time and transportation ac-cess level criteria) that may provide additional information to help determine family need levels for transportation support.

- How do travel times to provider vary by region and by town in Massachusetts for subsidy-par-ticipating children?

Map 5a shows the average travel times to provider for all cities/towns in the state, divided into 5 cat-egories:  0 to 5 minutes, 5-10 minutes, 10-15 minutes, 15-20 minutes, and 20-40 minutes.  The statewide average travel time is 9 minutes (one way), with a standard deviation of 9 minutes.  The standard deviation tells us how much dispersion or variation there is in travel time values for individual families around the mean. So, statewide, most families are traveling somewhere between less than 1 minute to roughly 18 minutes one way, indicating substantial differences in family travel times.

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[17] At the time of analysis, transportation support eligibility was determined based on a number of eligibility criteria, including but not limited to the distance-criteria referenced above.  Specifically, families living more than a half mile from care were deemed eligible if the parent met additional criteria, including that the parent did not have access to personal transportation resources or public transportation, or a parent's or child's disability prevented him/her from traveling via personal or public transportation.  Parents were considered as having inadequate access to public transportation if public transit was not available during the days/hours needed to get to work or care, or if public transit travel would take more than 45 minutes to get from a parent's home to care, or more than an hour to get from home to care and then to work.

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# Map 5a. Average (one-way) travel time to provider by city/town (in minutes)



**Average Travel Time (min)**
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 40

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The first two categories, 0-5 and 5-10 minutes, are coded in dark green and light green, respectively. The middle category, 10-15 minutes, is coded in yellow.  And the last two categories, 15-20 and 20-40 minutes, are coded in light red and dark red, respectively.  The intuitive red-yellow-green color scheme was chosen to include "green" cities and towns where travel times, on average, are relatively low; "yellow" cities/towns where travel times are higher (i.e. slower), and "red" cities/towns where travel times are very high relative to other cities/towns.  While green is the color we see the most of in the map, there are numerous cities/towns with moderate to slow (i.e. yellow) relative travel times, and very high (i.e. red) relative travel times.  Nearly one-third of cities/towns fall in the yellow or red categories, and we see roughly the same number of red cities/towns as we see yellow cities/towns. The map also reveals strong clustering patterns—i.e. low travel time cities/towns tend to cluster together, as do moderate, and high travel time cities/towns.  The patterns in Map 5a indicate a high level of local variation in the amount of time parents may be spending to bring their children to care, indicating that parents from moderate/slow and high travel time city/towns may be more likely to experience transportation access as a barrier to continuity of child care arrangements and subsidy receipt.

When we summarize individual home-to-provider travel times at the CCR&R region level, we learn two key things (Figure 3) that have implications for policy and practice:

- Average travel times vary substantially *between* CCR&R region (ranging from 8 minutes in the Boston Region to 12 minutes in the Hyannis/Cape Cod Region)
- Average travel times vary substantially *within* CCR&R regions (in all regions, the standard deviation travel time is roughly equal to or greater than the average travel time)

Figure 3.  Average Travel Time to Subsidized Child Care Provider (Minutes) By CCR&R Region
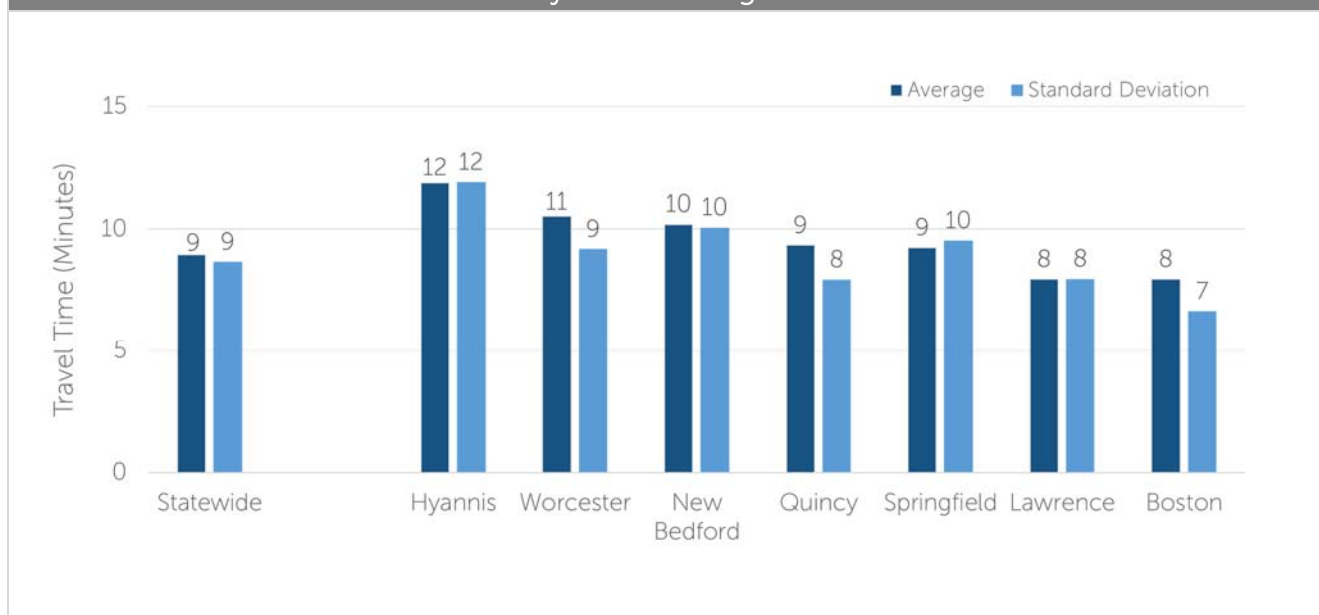


The findings of substantial differences *between* regions in family travel burden warrants consideration of region-specific studies that examine whether families in particular regions are experiencing transportation barriers that may be, in turn, influencing stability of child care arrangements and subsidy

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receipt. These further studies could help to inform whether region-differentiated transportation sup-port policies may improve stability for families participating in the subsidy system, and may also in-crease access for families NOT currently accessing the subsidy system, for whom transportation ac-cess barriers may be serving as a barrier to accessing the subsidized care system.

The findings of substantial differences *within* regions in family travel burden indicates that even within regions, different families may be experiencing very different levels of transportation access (and trans-portation barriers, in turn), and may have very different transportation needs. Therefore, region-spe-cific transportation related policies that are designed and implemented with this variation in mind--rather than design/implemented to meet the needs of the "average" family in the region--may have the potential to be more effective, efficient and equitable.

- What share of subsidy-participating children currently utilize state-supported (i.e. subsidized) transportation to access child care, and how does utilization vary (if at all) by child age?

The final transportation-related topic we explore is the share of all subsidy-participating children that are currently utilizing child care-related transportation support subsidies. As of December 2014, 65% of subsidy-participating children used transportation subsidies (Figure 4). All children with at least 1 billed transportation support day in the month are included in counts of those utilizing transportation support subsidies, and it is important to note that the level of transportation subsidy utilization varies widely between families, ranging from 1 day to 20+ days per month.



Figure 4. Share of Subsidy-Participating Children Utilizing Transportation Subsidies
By Child Age Group
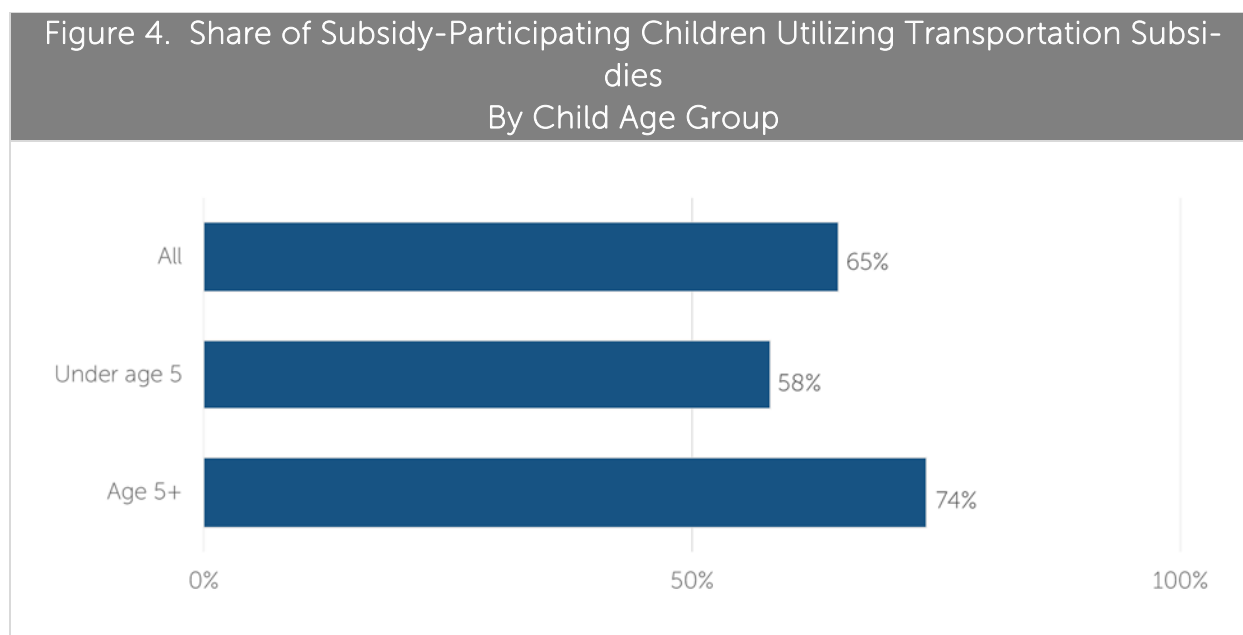
Figure 4 reveals that transportation subsidy use is higher for children ages 5 and older (74%), but also that children under age 5 *also* utilize transportation subsidies at high rates (58%). This finding indicates that family need and usage of transportation supports is prevalent for parents of children across age groups.

**Summary statement.** By analyzing the distances that subsidy-participating children travel to their pro-viders across the state, we learn that 90% of children live outside of reasonable walking distance (1/2

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mile) from their provider.  This means that essentially all families accessing subsidized child care are likely utilizing some form of transportation *other than walking* to get their children to and from care each day.   Given past research that finds that low transportation access can serve as a barrier to child care access, this finding motivates a need to understand more about how low-income parents across the state are accessing child care on a daily basis, levels of variation in parents' transportation access, and the role of transportation subsidies/supports in either facilitating or hindering access to care.   We also learn through this analysis of substantial variation, both between and within CCR&R regions across the state, in the amount of time parents are spending traveling to and from care, suggesting that one-size-fits all transportation support policies may not be effective, efficient and equitable.

## Section 7. Conclusion

Early childhood care and education is a locally-based, locally-accessed resource.  A vast majority of families in the U.S. access care close to home, at locations that enable working parents to feasibly and consistently get to work.  The local area around which a family lives forms the family's primary choice set for care, and therefore has the potential to shape parent behaviors and decision-making, as a majority of families will search for and seek care within those local choice sets.

Given the localized nature of early childhood care and education (ECE), it is logical for policymakers to think systemically about how the geography of ECE opportunities and the geography of families relate to one another as they engage in policy and program planning, assessment, design and implementation.  However, an intentional focus on issues of local access and the role of geography in ECE policy has been lacking until recently.   The main lessons of this report confirm the importance of looking "under the hood", i.e., looking at ECE systems at multiple levels of geography, from the neighborhood to the state level, for understanding the functioning of ECE systems.   None of the analyses in this report suggest that local areas are simply microcosms or mirror images of the larger regional or state areas to which they belong.  This local heterogeneity suggests that family-side and system-side factors vary in how they interact at the local level, making an understanding of geographic variations crucial for considering how policy can help produce efficient and equitable ECE systems.

The first objective of this report was to summarize five years of research related to access and supply of subsidized child care in Massachusetts in order to inform Massachusetts state policymaking, and child care policymaking in other states and federally.  The Child Care Development Fund Program is the largest source of federally funded child care assistance for U.S. low-income children and families. Therefore, the effective, efficient, and equitable functioning of the state subsidy systems that administer this program is crucial for promoting economic stability, family well-being and healthy child development in the U.S. The research summarized in this report provides insights into the functioning of the Massachusetts subsidy system that can both inform Massachusetts state-specific policy and policy in other states and at the federal level.  These insights are especially timely as CCDBG reauthorization provisions and policies are adopted and implemented nationally.

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Key lessons from this report include:

> Understanding the "geography of need" is important for understanding the context/backdrop in which state policies are made. It can be thought of as the "base map" for ECE state policymaking.

A primary goal of state level ECE policy is to ensure that ECE systems are reaching the children who need care and education, particularly vulnerable children. Understanding where children in need live and how they are distributed across the state is a crucial contextual factor to inform policymaking to achieve this goal. Massachusetts' geography of need for subsidized child care is characterized by "bifurcation" – i.e. it includes areas of extremely high concentrations of need, particularly around urban hubs, paired with areas of low concentration (i.e. dispersion) of children in need across many disparate cities/towns.

There are many implications of this bifurcated geography for considering service delivery systems. For example, policymakers in this context should consider whether approaches that are effective, efficient and equitable in high concentration areas produce similar outcomes in more dispersed areas of need.

> Understanding the "geography of met need" provides a window into how family-side and ECE system-side factors interact differently in localities across a state.

In Massachusetts (similar to many other states), only a portion (an estimated 21% of estimated eligible children under 6) of children and families in need of child care assistance are served by the subsidy system. At any point in time, there are nearly 25,000 children on the waitlist for child care assistance in Massachusetts, which is a result of limited funding for child care assistance to support families in need. The analysis in this report shows that the level of met need varies meaningfully across different cities/towns in Massachusetts, ranging from 0% (no eligible children served) to 100% (all eligible children served). Two different children, both equally eligible for subsidized care, but who live in different cities/towns, have very different likelihoods of participating and accessing the subsidy system. These differences mean that the cities and towns within the state do not necessarily take on the "average" levels of met need observed statewide (i.e. levels of met need are not uniform across cities/towns), which tells us that system-side and family-side factors are interacting differentially at the local level, and producing very different levels of local met need. These local differences raise questions about why service rates are so much higher in some areas, compared with others. Are there differing levels of demand? Are families in different localities facing barriers to accessing the subsidy system and/or barriers to obtaining subsidized child care? Are there underlying imbalances in local allocations of child care assistance? Are local ECE systems functioning differentially across localities and driving these differences in local levels of met need?

> Examining the "geography of the dual-mechanism (contract/voucher) system" in Massachusetts offers insights for policymakers considering the role of geography for either (i) shaping existing contracting systems, or (ii) introducing/implementing new contracting systems.

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In Massachusetts, contracts are intentionally allocated across six EEC regions, but there are no geographic criteria for allocating contracts within EEC regions.  We find that, within service regions, contracted providers tend to geographically concentrate and cluster around urban hubs.  This clustering results in many city/town-level ECE markets being dominated by contracted providers (i.e. contracted providers hold more than half of local subsidized care capacity). Meanwhile, many other cities/towns are characterized by an absence of contracted providers--the majority of local subsidy capacity in those areas is held by voucher-only providers.  This geographic imbalance between contracted and voucher providers is not inevitable, though; statewide subsidized capacity is split roughly equally between contract and voucher-only providers.  However, in practice, we observe very few "balanced" markets, where contracted and voucher-only providers have roughly similar presence in the local market.   More work is needed to understand whether these imbalances are causing inefficiencies and/or inequities in the subsidy system, or could even benefit the functioning of the subsidy system. However, a key takeaway is that without intentional strategies for shaping the geographic reach of contracts, the geography of a contract system will emerge "on its own", i.e., from the confluence of many factors (some geographic in nature, others not), and this geography could take any number of shapes, with varying implications for the efficiency and equitability of the subsidy system.

> Travel analysis tell us that essentially all parents (90%) are likely accessing some form of transportation, *other than walking*, to get to child care providers, and that local travel times vary substantially, making transportation access a relevant consideration for ECE policymakers.

90% of children in Massachusetts live outside reasonable walking distance (half-mile) from care, which suggests that essentially all families are utilizing some mode of transportation, other than walking, to get to care.  We also find that travel times vary across the state, with average travel times of about 9 minutes (one way), suggesting modest average travel burden for accessing care.  However, while many families face moderate travel burdens, many others face substantially higher travel burdens, upwards of 20 to 40 minutes (one way).  This could signal that transportation access is more likely to be a barrier to access in some localities than others, making a one-size-fits all approach to meeting families' travel needs likely inefficient and possibly inequitable.  More work is needed to understand how travel barriers may be influencing families' ability to access and maintain child care, but the preliminary findings point to the importance of examining transportation issues at the local level.

> By examining patterns in subsidized "Child Care Deserts", we identify areas where children are very isolated from access to child care providers.  In the context of high levels of child racial/ethnic residential segregation, this isolation could translate into significant potential inequities in access to care.

When using definitions of "Child Care Deserts" established by others in the field (Malik and Hamm, Center for American Progress, 2017), we observe a subsidized child care system rife with shortage areas that span the entire state, and conclude that half of subsidy income-eligible children live in a "desert".  Deeper examination of the application of these definitions showed us that while they are useful for characterizing systematic shortages in the system overall, these definitions may obscure

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meaningful qualitative differences in the amount of shortage and isolation from care that children in different neighborhoods are facing. Using the established Malik & Ham measures, a neighborhood with 40 eligible children in excess of subsidized seats, with no surrounding "desert" neighborhoods could achieve the same child care desert score as a neighborhood with 481 children in excess of subsidized seats that is completely surrounded/bordered by other neighborhoods with 200+ children in excess of subsidized seats. While both neighborhoods have shortages, there are policy-relevant qualitative differences in children's levels of access in these two neighborhoods.

We developed a definition for "Extreme Child Care Deserts" designed to identify neighborhoods that are qualitatively distinct in terms of having extremely high levels of unmet need paired with extremely constrained supply of care, and that are also surrounded by neighborhoods with similar conditions. We find that nearly 1 in 5 subsidy income-eligible children live in these extreme deserts and also observe large racial/ethnic differences, with nearly one-quarter of black and Hispanic eligible children living in these "extreme deserts" compared with only 6% of white eligible children.

This analysis points to the importance of ensuring that definitions and measures are designed for the intended purposes. In this case, existing established measures were more informative for understanding overall, systematic shortages across the system, while the newly-developed measures were more informative for identifying the most potentially vulnerable neighborhoods/areas, and for examining the implications of racial residential segregation for equity in local access to care.

The second objective of this report was to synthesize methods, data sources, measurement approaches and technologies that may serve as a starter toolkit for other researchers, analysts and policymakers focused on ECE policy issues in Massachusetts, other states, and at the federal level.

By summarizing the research questions across five different analyses, the report shows examples of how to ask spatial questions of different data sources, and how to consider issues of place and space in analyzing child care and early education policy research questions. Some of the research questions highlight how spatial methods and GIS can be used to conduct inductive and exploratory analyses, where examination of geographic patterns and properties can help generate hypotheses and to identify new policy-relevant issues that warrant investigation (research questions in sections 2, 3 and 5). Other research questions described in this report show examples of how GIS/spatial methods can be used to inform specific research questions, defined a priori (research questions in sections 4 and 6).

The report displays use of a wide range of GIS/spatial analysis methods and corresponding softwares and online tools including the following:

- Descriptive mapping
- Georeferencing/geocoding
- Nearest Neighbor Analysis
- Zonal statistics / spatial summary statistics
- Exploratory Spatial Data Analysis (ESDA): Cluster analysis, Local Anselin Moran's I (LISA)
- Distance calculations (street network travel distance and travel duration)

Finally, the report provides examples of ways in which administrative data from state child care and early education licensing databases and child care subsidy administrative data systems can be used,

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on its own and in combination with contextual data sources (e.g. Census and American Community Survey data) to conduct investigations of policy-relevant spatial questions or other policy-relevant questions that require the use of GIS for new variable creation or data integration.

By not only summarizing findings, but by also describing the rationale and motivation for exploring spatial questions, the analytic approach, the methods, and the data sources for each analysis, the goal is that this report will serve as a resource to policymakers, planners and researchers alike, seeking to utilize GIS and spatial methods in their work to advance the goals of more effective, efficient and equitable early childhood care and education systems across the U.S. The authors welcome questions and continued dialogue about how a geographic lens, GIS technologies, and spatial methods can increasingly be used to inform and advance early care and educational policy in the U.S. over time.

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# Appendix A.
## Overview of the Massachusetts Child Care Research Partnership and diversitydatakids.org

## Massachusetts Child Care Research Partnership

In 2013, the Institute for Child, Youth and Family Policy (ICYFP) at the Heller School received a grant from the Office of Planning, Research and Evaluation at the U.S. Department of Health and Human Services to establish a collaborative child care research partnership with the Massachusetts Department of Early Education and Care, under the federal Child Care Research Partnership Grant Program. The Administration for Children and Families (ACF) funds and oversees Child Care Research Partnership Grants in several U.S. states and territories to support new research and evaluation activities developed and conducted through partnerships between Child Care and Development Fund (CCDF) lead agencies in states and territories and researchers from institutions of higher education, research organizations and other eligible organizations.

The Massachusetts Child Care Research Partnership project evaluated state policy changes designed to make accessing child care subsidies more user-friendly for low-income and vulnerable families. The research partnership project was designed to: (1) evaluate the impacts of a recent policy change designed to make child care subsidies easier to renew so that families would be less likely to lose their subsidies and experience interruptions in their child care coverage; (2) document the implementation of the policy change, and (3) examine any differential effects on families, with a focus on traditionally under-participating families such as Hispanic and immigrant families. The grant period ran for five years (10/1/2013 - 9/30/2018). The Principal Investigator is Dr. Pamela Joshi, ICYFP Associate Director, and the Co-Investigators are Erin Hardy, ICYFP Senior Research Fellow and Dr. Yoonsook Ha, Assistant Professor at the Boston University School of Social Work.

## diversitydatakids.org

diversitydatakids.org ("DDK") is an indicator and policy research project that serves as the leading national project dedicated to tracking progress towards greater racial/ethnic equity in wellbeing for children in the U.S. The project maintains a state-of-the-art website (diversitydatakids.org), conducts equity-focused research and analysis, and engages in a variety of dissemination, outreach, user engagement, and partnership activities that bring action to the project's data and research insights. The overarching objective of the project is to make a positive impact on the narratives and decisions that affect U.S. children, from the national to the neighborhood level, by supplying stakeholders with data and insights that are actionable and accessible.

The diversitydatakids.org project is supported by the W.K. Kellogg Foundation.

## Where can I learn more?

Please direct correspondence to: Institute for Child, Youth and Family Policy, Heller School for Social Policy and Management, Brandeis University, 415 South Street, MS 035, Waltham, MA 02453, Email: icyfp@brandeis.edu.

# Appendix B.
# The National Equity Research Database (NERD)

## A product of diversitydatakids.org

## What is NERD?

The National Equity Research Database, or "NERD" is a product of the Institute for Child, Youth and Family Policy's flagship research project, diversitydatakids.org. It is a database of 286 socio-economic indicators on a wide range of subjects, including demography, education, employment, health, housing, earnings and ancestry that are available at six summary geographic levels, ranging from the census tract level up to the national level.

## Why use the NERD?

NERD uses American Community Survey (ACS) data released by the U.S. Census Bureau, and is designed to address the need for local data on racial/ethnic inequities across the country. The motivation for developing NERD and its local offshoots is to enable a better understanding of racial/ethnic equity issues across communities in the U.S., allowing researchers to focus their time and efforts on discovering, analyzing, and reporting inequities in their communities instead of on the cumbersome task of constructing equity-relevant ACS indicators for multiple geographic summary levels, racial/ethnic groups, and years required to conduct equity-focused analyses.

NERD is unique in providing a wide range of socio-economic indicators, for six summary geographic levels, broken out by race/ethnicity (160 of the 286 indicators), over time, from 2009 to 2016.  By providing data for racial/ethnic groups at many different levels of geography over time, NERD allows users to examine how socio-economic characteristics, living conditions, and opportunities are changing for different racial/ethnic groups across neighborhoods, municipalities, cities, metropolitan areas, and counties across the U.S. The level of detail NERD provides brings into full view the large spatial and racial/ethnic inequities that persist across city neighborhoods, for example, and for broader regional areas, such as the broader metropolitan areas that neighborhoods are situated in.

NERD is currently in beta mode. Data and documentation may be incomplete or modified in future releases. We anticipate leaving beta mode with the first major update in early 2019, which will add a new wave of data and additional indicators.

The diversitydatakids.org project is supported by the W.K. Kellogg Foundation.

## Where can I learn more?

Please direct correspondence to: Institute for Child, Youth and Family Policy, Heller School for Social Policy and Management, Brandeis University, 415 South Street, MS 035, Waltham, MA 02453, Email: nerd@brandeis.edu.

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# Appendix C.
# Exploratory Spatial Data Analysis Methods
# Introductory Information

## Information about Exploratory Spatial Data Methods

In Section 5 (Geography of "subsidized child care deserts" and patterns by child race/ethnicity), we use Exploratory Spatial Data Analysis (ESDA) methods, to identify clusters (i.e. extreme deserts) using Local Indicators of Spatial Autocorrelation, "LISA" measures.  ESDA methods utilize statistical tests to help determine whether patterns found in the spatial data are spatially random versus spatially associated.  If neighborhood child care availability level, for example, is spatially random, then the level of child care availability in one location will not depend on the level of child care availability in the surrounding (contiguous/bordering) neighborhoods.  Also, the spatial pattern we observe would be equally as likely as any other spatial pattern, and the locations of high or low child care availability neighborhoods could be altered without affecting the information content of the data. When spatial randomness is violated (i.e. not present), then there is *spatial autocorrelation*.  The literal meaning of spatial autocorrelation is self-correlation (autocorrelation) of observed values of a single attribute (in this case neighborhood child care supply constraint OR neighborhood unmet need), according to the geographical (spatial) ordering of values.  There are two kinds of spatial autocorrelation:  positive, when the relationship between the value at a location and the values of its neighbors is positive, and negative, otherwise.

The LISA clusters displayed in Maps 4A and 4B represent groups of contiguous/bordering neighborhoods that form when a neighborhood itself has highly constrained supply and high unmet need levels, and this neighborhood's contiguous/bordering neighborhoods also have highly constrained supply and high unmet need levels.

## Measures of Spatial Autocorrelation Explained (Global and Local)

A Global Moran's I statistic provides a single measure of the presence of spatial autocorrelation for an attribute in a region (a state, for example) as a whole.  A Moran's I value of 1 represents perfect positive spatial autocorrelation, a value of 0 represents little/no evidence of spatial autocorrelation (i.e. a random spatial pattern), and a value of -1 represents perfect negative spatial autocorrelation (or perfect dispersion).

Spatial autocorrelation measures require a weights matrix that defines a local neighborhood or area around each geographic unit (in this case, the geographic unit is the census tract).  The value at each unit is compared with the weighted average of the values of its neighbors.  Weights **(w$_{ij}$)** for this study are constructed based on contiguity with neighboring/surrounding tracts and take the form:

$$(1)\ w_{ij} = \frac{C_{ij}}{\sum_{j=1}^{N} C_{ij}}$$ with **C$_{ij}$**, equal to 1 when i is linked to j (in other words, when i is contiguous to j) and **C$_{ij}$**

**= 0** otherwise.

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Once the weights matrix is defined, a Moran's I statistic for the entire study geography, or region as a whole, can be calculated using the following formula:

$$(2) \; Moran's \; I = \frac{N}{\Sigma_i \Sigma_j \, w_{ij}} \times \frac{\Sigma_i \Sigma_j \, w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\Sigma_i (y_i - \bar{y})^2}$$ ...where there are N units, the attribute value for each unit i is $y_i$, and $w_{ij}$ is the weight (or connectivity) for units i and j.

Notice that the locational information for this formula is found in the weights. For non-neighboring tracts, the weight is zero, so these add nothing to the correlation.

In addition to global tests of spatial autocorrelation, we can also perform Local Moran's i tests to determine the extent to which each neighborhood (and its relationship to its surrounding neighbors) contributes to the overall presence of spatial autocorrelation in the state. In other words, we can compute a measure of spatial association for each neighborhood in Massachusetts--a Local Indicator of Spatial Autocorrelation (LISA) statistic--using the following equation:

$$(3) \; I_i = z_i \sum_j \left( w_{ij} z_j \right)$$ where $z_i$ and $z_j$ are standardized scores of attribute values for units i and j, and j is among the identified neighbors of i according to the weights matrix $w_{ij}$.

We summarize LISA results using a cluster map, which indicates cases that are statistically significant (p-value<0.05) and describes the type of spatial association. In a cluster map there are five possible types of spatial association:

| LISA Statistic Value | Own-Neighborhood Value (i) | Linked-Neighbor Values (j) |
|---|---|---|
| Not significant | n.a. | n.a. |
| High–High | High | High |
| Low–Low | Low | Low |
| High–Low | High | Low |
| Low–High | Low | High |

As an example, a neighborhood with a "high-high" LISA value is a neighborhood with a statistically significant LISA value (i.e., p-value<0.05) and is a neighborhood which has high neighborhood unmet need and is also surrounded by one or more high unmet need neighborhoods. In other words, the individual neighborhood's value for the attribute (in this case, unmet need) is high and the values of the contiguous (surrounding) neighborhoods are also high on that same attribute.

To identify extreme deserts, we first identify tracts that fall in LISA clusters based on unmet need, and then identify tracts that fall in LISA clusters based on supply constraint, and then identify neighborhoods that meet both conditions to be considered an extreme subsidized child care desert.

# Appendix D.
## Estimating Met Need for Child Care Subsidies

## Introduction

Gaining an understanding of the level of met need for child care subsidies is a crucially important endeavor for child care policymakers and researchers.  Obtaining the counts and shares of children that are *likely eligible for and in need of* subsidies and comparing those with the numbers and shares of children *actually served* by the system helps policymakers and researchers understand the overall reach of a state's subsidy system, and informs their understanding of the potential additional needs/demands the system may be facing (i.e. potential <u>unmet</u> need).  Investigating the patterns of *which* children are served (by geography, age, eligibility category, etc.), and the evenness with which the system serves different groups of children also yield crucially important information for subsidy system planning, evaluation, and allocation of resources.

While estimating met need for subsidies is crucially important for policy, planning, and evaluation, the data sources currently available to support these estimates have limitations and often pose technical challenges that require tradeoffs, described in this appendix.  These limitations and challenges are important to be aware of when interpreting estimates of met need, and are also helpful for understanding differences in estimates of met need that may arise between sources, since different approaches are often used to estimate met need depending on the main focus and purpose of a particular analysis (examples discussed below).

## Overview of definition, data sources, and approach used in the report

For purposes of the present report, we estimate met need by comparing an estimated "universe" of TANF-eligible and income-eligible children with the number of children served by the child care subsidy system under these two eligibility categories. Our analysis includes children under age 6.

To estimate the "universe" of eligible children, we utilize publicly available, published data from the American Community Survey from the time period 2010-2014.  The ACS data provide the number of children under age 6 with family income levels at different ratios to the federal poverty line.  In Massachusetts, as of 2012 (the midpoint of the 2010-2014 period), the threshold for income eligibility (i.e., 50% of state median income) was $49,079. This threshold equates to roughly 200% of the federal poverty level for a family of four.[18]  Using ACS Table B17024, we obtained counts of children under age 6 with family income levels below 200% of federal poverty as an estimate of the number of children in need of subsidized care.  This estimate would therefore include children in both "income-eligible" and "TANF-eligible" families.

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[18] In 2012, the federal poverty level for a family of four was $23,050, and 200% of the federal poverty level for a family of four was $46,100.

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To obtain the number of children served by the subsidy system we draw from the analytic administrative dataset developed through the MA Child Care Research Partnership, which includes all children utilizing subsidies in a particular timeframe (in this case, during the month of December 2014). The dataset includes not only information about the child's subsidy usage, but also additional information, including the child's street address. Based on the child's street address, we use a method called "geocoding" where we locate and map each child's street point address using a Geographic Information System. From there, again using a GIS, we can cross-reference the point location of each child with a map of the boundaries of the cities and towns in Massachusetts, and attach to each child's record the city/town where the child lives.

To calculate city/town level estimates of met need, we add up all children served by subsidies in each city/town, and combine those counts with our city/town-level estimates of the universe (i.e. counts) of children who are estimated to be TANF-eligible or income-eligible for child care assistance. This combination gives us the level of estimated met need, or the "service rate" (i.e. percent of estimated eligible children who are served by subsidies) for each city/town in the state.

## Limitations and comparison with other approaches

While the approach used offers the most precise approach possible for purposes of conducting a city/town level analysis of met need using public, published data sources, it has important limitations and differences from approaches used for other purposes, discussed here.

**Imperfect mirroring of eligibility criteria.** The eligibility criteria for TANF-eligibility and income-eligibility for child care subsidies considers both a family's income and the work status of the parents in the family. Our approach used to estimate eligible children only considers family income level and does not consider the work status parents, due to data limitations. There are no publicly available, published ACS tables that tell us the number of children who have family incomes below the income-threshold for subsidies, *and* have parents working a certain number of hours (to align with work requirements in the subsidy eligibility criteria). The ACS does contain this information in its "microdata" (i.e. child record-level data), but those data are not publicly available (except through custom tabulation) at the city/town level. The smallest geographic level reported for ACS microdata is the Public Use Microdata Areas, PUMAs, which have minimum populations of roughly 100,000 residents and are typically much larger than cities/towns as a unit of analysis.

Because our estimation approach does not consider parental work status, our estimates may include children in low-income families with a non-working parent. While parental employment levels in Massachusetts were high as of the time of analysis (amongst children under age 6 living with two parents, 67% had two parents in the labor force, and amongst children living with one parent, 76% had a parent in the labor force per U.S. Census Bureau, American Community Survey, 2005-2009 5-year estimates, Table B23008), we do expect work status to vary within families with incomes < 200% federal poverty, and therefore recognize this as an important limitation to estimating need for subsidized care. As a result, our estimates should be considered an upper bound estimate of the number of children income- and TANF-eligible for child care assistance[19].

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[19] For statewide and regional estimates of met need that apply both income and work criteria to estimation of eligible children, see Isaacs et al. (2015), "Review of Child Care Needs of Eligible Families in Massachusetts", *Research Report of the Urban Institute*. Available here.

**Identifying "true demand/need" for subsidies.** It is important to note that our estimates compare the number of children estimated to be eligible with the number of children served. Not all families that are estimated to be eligible for child care assistance using this approach are necessarily in need of assistance. For example, some low-income working families may arrange unpaid child care with family, friends or neighbors, or may have children that are eligible for other early education or child care programs, including Head Start or public preschool programs. The question of which eligible families are in need of subsidies is a complicated one to answer. Subsidy wait lists can give us an indication of potential demand ("true need") for subsidies, but there may also be eligible families who need subsidies who have *not* applied to be on the wait list, so relying solely on wait list data may underestimate the number of children truly in need. Also, waitlist information is often unavailable at small levels of geography, like the city/town level, so this can also be a limitation to using wait list data to estimate true need/demand.

Other sources have used simulation and estimation techniques to determine what may be a more precise estimate of the "true demand/need" for subsidies, in other words, estimates that attempt to narrow the eligible service population universe down to families most likely to be in need of subsidies. For example, estimates from a 2015 Urban Institute Research Report (Isaacs et al., 2015) narrow the service population down to "likely applicants", applying a 50% estimated take-up rate. This take-up rate is based on take-up rates in states where subsidies are widely available, i.e. states that provide child care assistance to all families who apply, unlike Massachusetts where many more families apply than are served. Depending on the purpose of a given analysis, this type of adjustment may be important and useful.

For purposes of the analysis of met need across cities/towns presented in this report, we chose not to apply an adjustment factor given that it is very possible that take-up rates vary by city/town and we may obscure some of those differences by applying a consistent adjustment rate across cities/towns. If anything, our analysis of met need across cities/towns may inform hypotheses and future research into local variation in take-up rates, and the impact of those variations on local service rates.

**Timeframe alignment.** Our estimates of met need utilize data on the universe of children from the time period 2010-2014, and data on children served from one particular service month, December 2014. The universe of children indicates the estimated number of children eligible at any one point in time, on average, during the 2010 to 2014 timeframe. Over a 5-year period the number of children eligible for subsidies may change at different points in time (for example, the number eligible in the last month of the 5-year period is not necessarily the same as the number eligible in any other month during the period). Despite this potential for imprecision, 5-year estimates are the best consistently reliable and available source of information on potentially eligible children from the American Community Survey at the city/town level. ACS 1-year estimates are only available for geographies with populations of 65,000 or more, and ACS 1-year supplemental estimates are only available for geographies with populations of 20,000 or more, and 1-year estimates are less precise than 5-year estimates given smaller sample sizes. Timeframe alignment issues are important to keep in mind, particularly for policymakers looking for "real-time" data on eligible children and met need. Having "real-time" estimates was not the priority for purposes of the met need analysis in this report given the focus on gaining an initial understanding of statewide patterns in met need across localities. However, for other applications where real-time estimates are a higher priority and/or required, e.g. analyses of met need to inform subsidy resource allocations, the estimation approach should consider whether other sources of information can be used in combination with our approach to get a more precise sense of "real-time" unmet need levels for particular regions, localities, and/or groups of children across the state.

## Summary

This appendix provides discussion of some of the limitations of the approach used to estimate met need in this report.  The goal is to remind readers, as they interpret measures of met need, both in this report and from other sources, of the importance of paying careful attention to (i) how the universe of children eligible for subsidies is defined and measured, (ii) the alignment between the timeframe used for the eligible universe and for the universe of children served, and (iii) other relevant attributes of the eligible and served universes of children that can produce differences across estimates, including the level of geographic analysis, child age, and eligibility category/type.