Geographic Access to Breast Imaging for US Women

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Purpose: The breast imaging modalities of mammography, ultrasound, and MRI are widely used for screening, diagnosis, treatment, and surveillance of breast cancer. Geographic access to breast imaging services in various modalities is not known at a national level overall or for population subgroups.

Methods: A retrospective study of 2004-2008 Medicare claims data was conducted to identify ZIP codes in which breast imaging occurred, and data were mapped. Estimated travel times were made for each modality for 215,798 census block groups in the contiguous United States. Using Census 2010 data, travel times were characterized by sociodemographic factors for 92,788,909 women aged ≥30 years, overall, and by subgroups of age, race/ethnicity, rurality, education, and median income.

Results: Overall, 85% of women had travel times of ≤20 minutes to nearest mammography or ultrasound services, and 70% had travel times of ≤20 minutes for MRI with little variation by age. Native American women had median travel times 2-3 times longer for all 3 modalities, compared to women of other racial/ethnic groups. For rural women, median travel times to breast imaging services were 4-8-fold longer than they were for urban women. Black and Asian women had the shortest median travel times to services for all 3 modalities.

Conclusions: Travel times to mammography and ultrasound breast imaging facilities are short for most women, but for breast MRI, travel times are notably longer. Native American and rural women are disadvantaged in geographic access based on travel times to breast imaging services. This work informs potential interventions to reduce inequities in access and utilization.

Key Words: Travel time, access, mammography, breast imaging, disparities

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INTRODUCTION

Breast imaging is a key component of screening, diagnosis, treatment, and surveillance for breast cancer. Evidence-based US guidelines recommend biennial mammography for average-risk women ages 50-74 years, with a preference-based approach for women ages 40-49 years [1]. Every year in the United States, approximately 37 million screening and diagnostic mammograms are performed [2]. This translates to an estimated 70% of women aged 50-74 years undergoing screening mammography biennially, with between 9% and 14% receiving further diagnostic breast imaging (mammography, ultrasound, MRI) and/or biopsy [3].

The full scope of use of breast ultrasound and breast MRI is not known, but these are important breast imaging modalities for specific clinical scenarios. Ultrasound is predominantly used in the diagnostic work-up of imaging or clinical findings, and potentially it can be used for screening a subset of women at increased risk of breast cancer. Although few data support its use for screening based solely on higher mammographic breast density, use of additional imaging technologies might become more common as breast-density reporting laws are implemented. Recently passed breast-density reporting laws in several states mandate that women with dense breasts be directly informed of their increased cancer risk and told that they may benefit from supplemental screening beyond mammography [4].

Breast MRI is currently the most sensitive test for breast cancer, and it is recommended by groups including the American Cancer Society (ACS) and the National Comprehensive Cancer Network (NCCN) as an annual adjunct to mammography for screening of women at high risk for breast cancer [5,6]. Overall, mammography, ultrasound, and MRI, or a combination of these examinations, are critical in detecting, diagnosing, and characterizing the extent of breast cancer, and also in excluding malignancy of the breast. For each of the major clinical areas in which breast imaging is used, geographic access may determine both the availability and uptake of breast imaging services [7-11], which in turn may influence treatment decisions and ultimately outcomes [12,13].

Prior studies have shown that longer travel time to care is associated with lower utilization of specialized services. For example, evidence suggests that travel time to breast imaging facilities may influence women's utilization of breast cancer treatment, with longer travel times associated with a greater likelihood of mastectomy instead of breast-conserving surgery [8,10]. However, evidence is lacking on travel times required for various breast imaging modalities, despite the fact that the modalities of mammography, ultrasound, and breast MRI comprise the core of recommended screening and diagnostic imaging tests. Although women's ability to utilize breast services is multifactorial, proximity of services and travel time burden is one important component that warrants consideration [14-17]. Vulnerable populations have poorer access to health care resources [18-21], which may be due in part to geographic access barriers.

The current manuscript examines travel time to 3 types of breast imaging services—mammography, ultrasound, and MRI—for ZIP code areas of the continental United States. The authors describe population characteristics in relation to travel time for each of these breast imaging modalities, and provide an overall view of geographic access to breast imaging in the United States for subgroups of women.

METHODS

Study Population and Data

Data from the 2010 Census were used to determine the number of women aged 30 years and older in each census block group of the contiguous United States [22]. The age criterion was based on ACS guidelines, which recommend screening mammograms for *high-risk* women starting at age 30 years, as well as recognizing that an estimated 12,000 women under age 40 years are diagnosed with breast cancer each year [23,24]. Alaska and Hawaii were excluded because of the lack of quality, road-based geospatial data. Population characteristics were based on the U.S. Census 2010 and included: age, race/ethnicity, education, and median household income at the block group level. Rurality is based on the 4-tier rural−urban commuting area (RUCA) designation [25,26]. Briefly, these designations are made based on commuting patterns of the population for given areas, and include: 1. Urban Core; 2. Suburban; 3. Large Rural Town; and 4. Small Town/Isolated Rural [25,26].

Location of Breast Imaging Modalities

A utilization-based approach was used to identify breast imaging location, similar to prior studies [27-30]. Specifically, using a 20% sample of Medicare Part B claims data (carrier and outpatient files) from 2004-2008, claims and the associated ZIP codes were identified, for mammography, breast ultrasound, and breast MRI using International Classification of Diseases (ICD)-9 and Current Procedural Terminology (CPT) codes (Table 1). A total of 5,846 unique ZIP codes were identified, of which 5,497 provided mammography, 5,046 breast ultrasound, and 1,783 breast MRI. ArcGIS v10.1 was used to geocode each of these breast imaging modalities to the related ZIP code centroid.

Travel Time Calculation

The TIGER/Line shapefiles [31] were obtained and the centroid of each block group was calculated. Using the Network Analyst extension in ArcGIS v.10.1 and the Streetmap North America (N.A.) network dataset [32], the travel time was calculated from each block group centroid to the nearest facility offering: (1) mammography; (2) breast ultrasound; and (3) breast MRI. Continuous measures of travel time were generated for