Original Investigation

Associations of County-level Radiologist and Mammography Facility Supply with Screening Mammography Rates in the United States

Andrew B. Rosenkrantz, MD, MPA, Linda Moy, MD, Margaret M. Fleming, MD, MSc, Richard Duszak Jr, MD

Rationale and Objectives: The present study aims to assess associations of Medicare beneficiary screening mammography rates with local mammography facility and radiologist availability.

Materials and Methods: Mammography screening rates for Medicare fee-for-service beneficiaries were obtained for US counties using the County Health Rankings data set. County-level certified mammography facility counts were obtained from the United States Food and Drug Administration. County-level mammogram-interpreting radiologist and breast imaging subspecialist counts were determined using Centers for Medicare & Medicaid Services fee-for-service claims files. Spearman correlations and multivariable linear regressions were performed using counties' facility and radiologist counts, as well as counts normalized to counties' Medicare fee-for-service beneficiary volume and land area.

Results: Across 3035 included counties, average screening mammography rates were 60.5% ± 8.2% (range 26%–88%). Correlations between county-level screening rates and total mammography facilities, facilities per 100,000 square mile county area, total mammography-interpreting radiologists, and mammography-interpreting radiologists per 100,000 county-level Medicare beneficiaries were all weak ($r = 0.22–0.26$). Correlations between county-level screening rates and mammography rates per 100,000 Medicare beneficiaries, total breast imaging subspecialist radiologists, and breast imaging subspecialist radiologists per 100,000 Medicare beneficiaries were all minimal ($r = 0.06–0.16$). Multivariable analyses overall demonstrated radiologist supply to have a stronger independent effect than facility supply, although effect sizes remained weak for both.

Conclusion: Mammography facility and radiologist supply-side factors are only weakly associated with county-level Medicare beneficiary screening mammography rates, and as such, screening mammography may differ from many other health-care services. Although efforts to enhance facility and radiologist supply may be helpful, initiatives to improve screening mammography rates should focus more on demand-side factors, such as patient education and primary care physician education and access.

Key Words: Screening mammography; Medicare; physician supply; geographic variation; health policy.

INTRODUCTION

Screening mammography rates are highly variable among populations (1). In particular, previous investigations have focused on the impact of a wide variety of patient characteristics on screening rates, such as demographic, behavioral, and psychosocial factors (2–5). Screening mammography rates are also influenced by characteristics of patients' insurance and of the physicians who order mammograms and counsel women regarding undergoing screening (6–11). Awareness of factors that may drive changes in screening rates may thus be important for designing targeted interventions and optimizing efforts at improving screening compliance.

For other radiology services, supply-side factors (eg, the availability of scanners and physicians) have been associated with variation in utilization (12). Although screening mammography rates are clearly heavily influenced by a range of demand-side factors (eg, those related to patients and referring physicians as drivers of utilization), it is also possible that screening rates

Acad Radiol 2017; ■:■■–■■

From the Department of Radiology, Center for Biomedical Imaging, NYU School of Medicine, 660 First Ave, 3rd Floor, NYU Langone Medical Center, New York, NY 10016 (A.B.R., L.M.); Department of Radiology and Imaging Sciences, Emory University School of Medicine, Atlanta, Georgia (M.F., R.D.). Received October 14, 2017; revised November 10, 2017; accepted November 24, 2017. Disclosures: The authors Rosenkrantz and Duszak are supported by research grants from the Harvey L. Neiman Health Policy Institute. **Address correspondence to:** A.B.R. e-mail: Andrew.Rosenkrantz@nyumc.org

https://doi.org/10.1016/j.acra.2017.11.023

are also influenced by supply-side factors relating to the resources and infrastructure required to offer screening services (13). Namely, the local supply of both mammography facilities and radiologists performing mammography may impact the ease of obtaining and thus demand for a mammogram and consequently impact screening rates. However, the relationship of supply-side factors and screening rates is not firmly established. Past studies have commonly explored supply-side factors in limited geographic regions (14–16) or outside of the United States (17,18), and far more heavily focused on facility supply with minimal attention to the supply of radiologists offering mammography screening services (13–18). Most importantly, earlier studies have yielded inconsistent results regarding any potential relationships (13–18), and the topic has received little attention in recent years despite considerable interval changes in facility availability, radiologist practice patterns, and screening guidelines themselves (eg, the conversion from analog to digital mammography; the introduction of digital breast tomosynthesis; changing guidelines from the United States Preventive Services Task Force (19), as well as from the American Cancer Society (20) and the American College of Radiology (21)). Therefore, to better understand the role of supply-side factors in impacting screening mammography, the aim of this study was to assess, at the US county level, the association between Medicare beneficiary screening mammography rates and the local availability of mammography facilities and mammography-interpreting radiologists.

METHODS

This retrospective study was Health Insurance Portability and Accountability Act compliant and did not require institutional review board approval given that it did not entail use of private identifiable information.

Federal law mandates that all mammography facilities be Mammography Quality Standards Act certified (22). A comprehensive list of such mammography facilities (certified either by the United States Food and Drug Administration or by the Certifying States) was obtained (23). Such facilities must meet specific quality standards in terms of equipment, staff, and practices in accordance with the Mammography Quality Standards Act and subsequent amendments (23). This publicly available list is periodically updated as information is received from certifying bodies. The list contains each facility's zip code, from which corresponding counties were derived using data from the United States Census Bureau (24,25). The corresponding counties were identified, and the number of mammography facilities was aggregated by county.

The Physician and Other Supplier Public Use File for 2015 was accessed from the Centers for Medicare & Medicaid Services (26) and used to identify radiologists submitting claims for screening mammograms (HCPCS code G0202), hereafter designated as mammogram-interpreting radiologists. For this purpose, radiologists were defined as those providers with a listed specialty of diagnostic radiology, nuclear medicine, or interventional radiology. As with facilities, radiologists' listed place of service zip code was used to identify their corresponding counties and then aggregate the number of mammogram-interpreting radiologists by county. In addition, a list of all radiologists nationally subspecialized in breast imaging (defined as over half of the radiologist's work relative value units involving breast imaging) was created using previously described methodology (27,28) and then aggregated at the county level.

Next, the Centers for Medicare & Medicaid Services Geographic Variation Public Use File was used to obtain each US county's number of fee-for-service (FFS) Medicare beneficiaries (29). Then, counties' total number of facilities, mammogram-interpreting radiologists, and breast imaging subspecialists were normalized by these total FFS beneficiary counts to determine facility and radiologist supply per 100,000 Medicare beneficiaries at each county level. In addition, as a surrogate of potential beneficiary travel distance, each county's land area was determined using data provided by the United States Census Bureau (30) and used to determine counties number of facilities per 100,000 square miles.

Finally, the publicly available University of Wisconsin County Health Rankings data set (31) was used to determine each county's screening mammography rate in 2014. Screening rates in this data set reflect receipt of a mammogram within a 2-year interval among female Medicare FFS beneficiaries aged 67–69 years.

Counties with incomplete data were excluded from the linked data sets, and analysis was then performed for the remaining counties with complete data availability. Spearman correlations were determined between county-level screening mammography rates and a range of variables related to facility and radiologist supply and interpreted as follows: ≤0.20, minimal correlation; 0.21–0.40, weak correlation; 0.41–0.60, moderate correlation; 0.61–0.80, strong correlation; ≥0.81, almost perfect correlation. In addition, multivariable linear regressions using counties' screening rate as the dependent variable were performed combining the measures of facility and radiologist supply within individual models. Results are two-sided and considered statistically significant at $P < .001$ given the large sample sizes and numerous comparisons. Analysis was performed using MedCalc (MedCalc software, Ostend, Belgium).

RESULTS

A total of 3137 counties were identified in the 2015 Centers for Medicare & Medicaid Services Geographic Variation Public Use File. Among these counties, counties were excluded for the following reasons: number of FFS beneficiaries not listed (n = 5), county not identified in the County Health Rankings file (n = 4), and screening mammography rate not reported in the County Health Rankings file (n = 93). These exclusions provided a final study sample of 3035 counties with complete data.