Time Trends and Geographic Variation in Use of Minimally Invasive Breast Biopsy

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BACKGROUND: Current guidelines recommend minimally invasive breast biopsy (MIBB) as the gold standard for the diagnosis of breast lesions. The purpose of this study was to describe geographic patterns and time trends in the use of MIBB in Texas.

METHODS: We used 100% Texas Medicare claims data (2000−2008) to identify women older than 66 years of age who underwent breast biopsy. Biopsies were classified as open or MIBB. Time trends, racial/ethnic variation, and geographic variation in the use of biopsy techniques were examined.

RESULTS: A total of 87,165 breast biopsies were performed on 75,518 breast masses in 67,582 women; 65.8% of the initial biopsies were MIBB. Radiologists performed 70.3% and surgeons performed 26.2% of MIBB. Surgeons performed 94.2% of open biopsies. Hispanic women were less likely to undergo MIBB (55.9%) compared with white (66.6%) and black (68.9%) women ($p < 0.0001$). Women undergoing MIBB were also more likely to live in metropolitan areas and have higher income and educational levels ($p < 0.0001$). The rate of MIBB increased from 44.4% in 2001 to 79.1% in 2008 ($p < 0.0001$). There are clear geographic patterns in MIBB use, with highest use near major cities. Although rates are increasing overall, rates of improvement in the use of MIBB vary considerably across geographic regions and remain persistently low in more rural areas.

CONCLUSIONS: Despite an increase in the use of MIBB over time, MIBB use was consistently lower than recommended. We must identify specific barriers in rural areas to effectively change practice and achieve the statewide goal of 90% MIBB. (J Am Coll Surg 2013;216:814−827. © 2013 by the American College of Surgeons)

During the past decade, improvements in both early detection and treatment have led to steady declines in breast cancer mortality rates.[1,2] For both suspicious lesions found on mammography and palpable breast masses, biopsy is essential to establishing a diagnosis of breast cancer and allowing timely treatment. Historically, open surgical biopsies, such as incisional and excisional biopsies, were performed for definitive diagnosis.

Disclosure Information: Nothing to disclose.

Supported by grants from the National Institutes of Health (1K07CA130983-01A1 and T32 DK007639), Clinical and Translational Science Award UL1TR000071, and the Cancer Prevention Research Institute of Texas (RP101207).

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Presented at the Southern Surgical Association 124th Annual Meeting, Palm Beach, FL, December 2012.

Received December 7, 2012; Accepted December 7, 2012.

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Minimally invasive breast biopsy (MIBB) includes fine-needle aspiration (FNA) and core-needle biopsies with or without image guidance and/or vacuum assistance. Minimally invasive breast biopsy is as accurate as open biopsy for the diagnosis of malignancy, particularly when combined with image guidance and vacuum assistance.[3-5] Additionally, MIBB allows for preoperative multidisciplinary consultation.[4] As the use of MIBB has increased, there has been a concomitant decrease in the number of surgical procedures, decreased time between diagnosis and definitive treatment, improved resource use, and decreased overall costs compared with open biopsy.[4,6-11] Lastly, improved cosmetic outcomes and better pain control with MIBB might lead to improved patient satisfaction.[12]

In 2001, 2005, and 2009, expert consensus panels consisting of an international, interdisciplinary group of physicians specializing in the diagnosis and treatment of breast disease endorsed MIBB as the new gold standard diagnostic modality for breast masses.[4,13,14] The American Society of Breast Surgeons, the American College of Radiology, and the National Cancer Center Network

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ISSN 1072-7515/12/$36.00
http://dx.doi.org/10.1016/j.jamcollsurg.2012.12.007

Abbreviations and Acronyms

FNA = fine-needle aspiration
HSA = hospital service area
MIBB = minimally invasive breast biopsy
MSA = metropolitan statistical area
NCCN = National Cancer Center Network

(NCCN) have since followed suit in this recommendation.[15-17] Although open biopsies might still be required or preferred in certain situations, the 2009 Consensus Statement and NCCN have set target rates of <5% to 10% for these more invasive procedures.[4,17]

Despite the benefits associated with MIBB, both single-institution and population-based studies have reported that rates of open biopsy are as high as 20% to 30%, exceeding current recommendations.[4,6,18-22] The purpose of our study was to use 100% Medicare claims data to describe trends in the use of MIBB in Texas from 2001 to 2008, concurrent with the consensus statements. Specifically, we examined geographic and racial/ethnic variation in overall use and rates of adoption of MIBB as the preferred modality over time. Our hypothesis was that MIBB would be similarly underused in Texas, as reported in other population-based studies.[6,10,19,21,22] Our goal was to better understand the geographic, racial/ethnic, and socioeconomic patterns and trends in the use of MIBB to determine barriers to achieving the goal of >90% MIBB rates.

METHODS

The study was determined to be exempt from review by the University of Texas Medical Branch IRB.

Data source

We used the claims and enrollment data for 100% of Medicare beneficiaries in Texas for the period 2000 to 2008. The Denominator File provided demographic and enrollment information for each beneficiary, including beneficiary unique identifier, state and county codes, ZIP code, date of birth, date of death, sex, race, age, monthly entitlement indicators (Part A/B/both), and reasons for entitlement. The Part D Denominator File (2006—2008) was used to obtain an enhanced race/ethnicity designation based on first and last name algorithms.[23] Beneficiaries who did not have Part D data available (n = 4,533) were assigned race based on the Medicare enrollment race variable. We used the outpatient Standard Analytic File, which contains claims submitted by institutional outpatient providers, and the Carrier Standard Analytic File, which contains claims submitted by noninstitutional providers (physicians), to identify outpatient facility services and physician services. Line Health Care Financing Administration Provider Specialty Codes, which link the types of providers and suppliers who are eligible to apply for enrollment in the Medicare program with the appropriate Health Care Provider Taxonomy Codes, were used to identify provider specialty. Inpatient hospital admissions and claims data were obtained from the Medicare Provider Analysis and Review files. US Census data for the year 2000 provided ZIP code level education and population estimates. The ZIP code level income was obtained from the 2006 ZIP Code Tabulation Area population estimations produced by the Dartmouth Atlas of Health Care.

Study cohort

We used Medicare claims and enrollment data for all minimally invasive and open breast biopsies performed between 2001 and 2008 using CPT codes. The CPT codes are shown in Table 1 and the cohort selection is summarized in Figure 1. During the time period, a woman might have had more than one breast mass and/or more than one biopsy on the same mass. Therefore, we considered each unique breast mass an episode of care. This was done to identify the first biopsy received for evaluation of a suspicious lesion and is the unit of analysis for the study. An episode consists of one or more biopsies occurring on the same breast within 6 months of the first biopsy. A biopsy performed on the opposite breast or any biopsy performed more than 6 months after the first biopsy was defined as a separate episode. The final cohort included 75,518 episodes (87,165 total biopsies) and 67,582 patients (Fig. 1, Table 2).

Study outcomes

We examined the first biopsy for each episode of care. Biopsies were classified as either MIBB or open biopsy. CPT codes were used to identify each biopsy type (Table 1). Minimally invasive breast biopsy included FNA and core-needle biopsies. CPT codes 10021 and 10022 identify FNA done for any reason. Therefore, to identify FNAs done specifically for breast lesions, we chose only those associated with a diagnosis of breast mass, benign or malignant (ICD-9 diagnosis codes 174.0 to 174.9, 217, 233.0, 238.3, 239.3, 610.0 to 610.9, 611.0 to 611.9). The use of image-guidance and vacuum-assistance technologies in MIBB was also examined (Table 1). Open surgical procedures included incisional and excisional biopsies.

Study variables

Age was categorized as 66 to 74 years and 75+ years. Race categories included white, black, Hispanic, and other. Median income and education levels (percentage

Table 1. Initial Biopsy Modality (n = 75,518)

CPT code	Procedure	Percent within each modality (MIBB or open)
MIBB		n = 49,653 (65.8% of first biopsies)
FNA*		
10021	Fine-needle aspiration; not using imaging guidance	3.8
10022	Fine-needle aspiration; using imaging guidance	4.1
Core biopsy		
19100	Breast biopsy; percutaneous, needle core, not using imaging guidance	9.1
19102	Breast biopsy; percutaneous, needle core, using imaging guidance	37.3
19103	Biopsy of breast; percutaneous, automated vacuum assisted or rotating biopsy device, using imaging guidance	45.7
Open		n = 25,865 (34.2% of first biopsies)
19101	Breast biopsy; open, incisional	9.1
19120	Excision of cyst, fibroadenoma, or other benign or malignant tumor, aberrant breast tissue, duct lesion, nipple or areolar lesion, open, one or more lesions	44.1
19125	Excision of breast lesion identified by preoperative placement of radiological marker, open; single lesion	46.8

*CPT codes 10021 and 10022 identify fine-needle aspiration done for any reason. To identify those done specifically for breast lesions, we chose only those associated with a diagnosis of breast mass, benign or malignant (ICD-9 codes: 174.0−174.9, 217, 233.0, 238.3, 239.3, 610.0−610.9, 611.0−611.9).
FNA, fine-needle aspiration; MIBB, minimally invasive breast biopsy.

of individuals with <12 years of education) at the ZIP code level were stratified into quartiles.

Metropolitan statistical area (MSA) is a classification given to regions with a core area containing a substantial population nucleus with adjacent surrounding communities that have a high degree of economic and social integration with the core area. Defined by the US Office of Management and Budget, an MSA contains a core urban area population of ≥50,000. There are 25 MSAs in Texas. Metropolitan statistical areas were categorized as small (<250,000 population), medium (250,000 to 1 million population), and large (≥1 million population). The remaining people lived in micropolitan service areas, metropolitan divisions, or combined statistical areas with a core population of ≤10,000.[24]

To evaluate geographic variation in the use of MIBB, we used the hospital service areas (HSAs), which are local health care markets for hospital care. The Dartmouth Atlas Research Group defines HSAs by aggregating Medicare claims records at the ZIP code level to determine service areas where a hospital or group of hospitals provides a preponderance of care.[25] There are 208 HSAs in Texas.

We examined the specialty of physicians performing the initial biopsy. We also identified the specialty of the first physician that a woman saw for a diagnosis of breast mass. In 40,560 of the 75,518 episodes, we were able to identify a physician visit for a diagnosis of breast mass in the 6 months before the biopsy claim. In the remaining patients, the breast biopsy claim was not preceded by a physician visit for breast mass. We speculate that the latter group had a higher percentage of biopsies done for abnormalities on screening mammography and, therefore, no previous visit for breast mass. When a physician visit was identified, provider specialty was classified using Line Health Care Financing Administration Provider Specialty Codes: radiologist (codes 30, 47, 94), surgeon (02, 24, 33, 49, 77, 91), internal medicine/primary care physician (01, 08, 11, 38, 50, 97), obstetrics and gynecology (09, 15, 16), oncologist (excluding surgical oncologist, 83, 90, 92), or other (all remaining codes, mid-level providers in "other" category). Code 47 was for "independent diagnostic testing facility" and was included in the radiologist group, and 49 was for ambulatory surgery center and was included in the surgeon group. Women with a diagnosis of breast cancer or ductal carcinoma in situ (ICD-9 codes 233.0 or 174) in the year after the initial biopsy were classified as having breast cancer.

Statistical analysis

Descriptive statistics were used to examine the overall use of MIBB and open biopsies during an episode, MIBB as the initial biopsy of an episode, type of MIBB technique, and the use of image guidance and vacuum assistance. Chi-square tests were used to compare use of MIBB and open biopsy by patient characteristics (ie, age, race/ethnicity, cancer diagnosis, quartiles of income, quartiles of education,

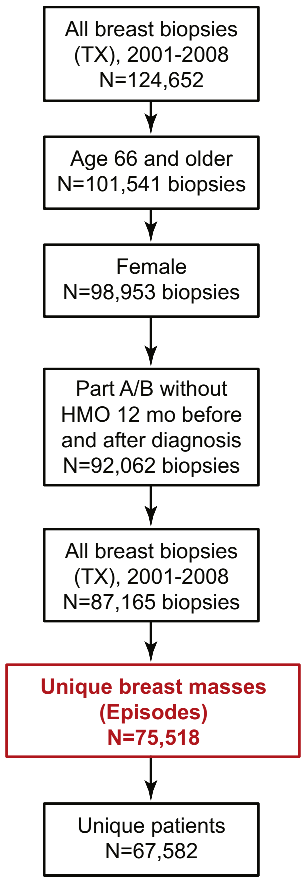

Figure 1. Cohort selection. Biopsies were categorized into unique episodes of care to identify the first biopsy received for evaluation of a suspicious lesion, and to establish the unit of analysis for the study. An episode consists of one or more biopsies occurring on the same breast within 6 months of the first biopsy. A biopsy performed on the opposite breast or any biopsy performed >6 months after the first biopsy was defined as a separate episode. The final cohort included 75,518 episodes (87,165 total biopsies) and 67,582 patients. The episode (or unique breast mass) is the unit of analysis.

and size of MSA where treatment was received). To determine independent predictors of receipt of MIBB, we used generalized mixed linear models with general estimating equations for parameter estimation. This was done to account for multiple episodes resulting in clusters of correlated data from each subject. Significant 2-way interactions between variables were included in the final model. A Cochran-Armitage test for trend was used to examine time trends in the use of MIBB techniques and MIBB use by race/ethnicity and socioeconomic status. Geographic variation in the use of MIBB as the initial biopsy of an episode was examined across HSAs in Texas, both for the overall study period and for 2001 to 2004 vs 2005 to 2008.

All analyses were performed with SAS version 9.2 (SAS Inc.). Statistical significance was accepted at the $p < 0.05$ level.

RESULTS

Distribution of patients, episodes, and biopsies

A total of 75,518 episodes of care (unique breast masses) were identified in 67,582 women between 2001 and 2008. Across episodes, a total of 87,165 biopsies were performed. The number of overall biopsies performed in Texas ranged from a minimum of 9,831 biopsies in 2001 to a maximum of 11,964 in 2003, with no clear time trend. Most patients (89.6%) had only 1 episode during the study period, 9.2% of patients had 2 episodes, and 1.2% had ≥3 episodes. Only 1 biopsy was performed in 86.4% of episodes, 2 biopsies in 12.1%, and ≥3 biopsies in 1.6% of episodes. At the time of the defined episodes, the mean age was 74.3 ± 6.3 years. For the 75,518 episodes, 56.8% of patients in the overall cohort were 66 to 74 years old, and 80.9% were white, 7.9% were black, and 10.2% were Hispanic. Most patients lived in MSAs with a population >1 million (51.3%); 11.3% lived in MSAs with a population of 250,000 to 1 million; 16.7% lived in MSAs with 10,000 to 250,000 population; and 20.7% in nonmetropolitan service areas with a population <10,000.

Overall use of minimally invasive breast biopsy techniques

Within the 75,518 episodes, 43,684 episodes had MIBB only (57.8%), 25,576 had open biopsy only (33.8%), and 6,258 had both (8.3%). In patients who had both, MIBB was done as the first modality in 95.4%. For the first biopsy of each episode, 49,653 were MIBB (65.8%) and 25,865 (34.2%) were open (Table 1). Among MIBB, core-needle biopsy (including non—image-guided, image-guided, and vacuum-assisted) was used in 92.1% of women (Table 1). Fine-needle aspiration, both with and without image guidance, was used least often during the study period. Image guidance (FNA, core, or vacuum-assisted) was used in 87.1% of minimally invasive biopsies and vacuum assistance in 45.7% (Table 1).

Description of the cohort and rates of biopsy use by patient characteristics

In a bivariate analysis, age was not a predictor of MIBB. The percentage of patients undergoing MIBB was lower in Hispanic women (55.9%) compared with white (66.6%) and black women (68.9%; $p < 0.0001$). Women living in areas with higher income, higher education levels, and in the most populous MSAs were likely to undergo MIBB ($p < 0.0001$ for all). Patients who had an ultimate diagnosis of breast cancer were more likely to have undergone MIBB compared with those who did

Table 2. Use of Minimally Invasive Breast Biopsy as First Biopsy within an Episode by Patient Characteristics

Patient characteristics	MIBB	Open biopsy	p Value
All episodes, n (%)	49,653 (65.8)	25,865 (34.2)	
Age, y, mean ± SD	74.3 ± 6.3	74.2 ± 6.2	
Age, y, group, n (%)			0.34
66−74	28,138 (65.6)	14,752 (34.4)	
75+	21,515 (65.9)	11,113 (34.1)	
Race/ethnicity, n (%)			<0.0001
White	40,710 (66.6)	20,416 (33.4)	
Black	4,095 (69.0)	1,842 (31.0)	
Hispanic	4,285 (55.9)	3,386 (44.1)	
Other	534 (72.5)	202 (27.5)	
Breast cancer diagnosis after biopsy, n (%)			<0.0001
Yes	26,077 (69.1)	11,650 (30.9)	
No	23,576 (62.4)	14,215 (37.6)	
Quartile of median income (lowest to highest), n (%)			<0.0001
Q1	11,169 (58.5)	7,915 (41.5)	
Q2	11,992 (63.3)	6,964 (36.7)	
Q3	12,535 (66.1)	6,438 (33.9)	
Q4	13,949 (75.4)	4,543 (24.6)	
Quartile of education (lowest to highest), n (%)			<0.0001
Q1	10,988 (59.4)	7,503 (40.6)	
Q2	11,341 (62.5)	6,812 (37.5)	
Q3	12,142 (67.5)	5,845 (32.5)	
Q4	13,208 (74.7)	4,474 (25.3)	
Size of MSA, n (%)			<0.0001
≥1 million	28,510 (73.6)	10,233 (26.4)	
250,000 to <1 million	4,406 (51.5)	4,155 (48.5)	
>10,000 to <250,000	7,946 (63.2)	4,633 (36.8)	
≤10,000	8,791 (56.2)	6844 (43.8)	

MIBB, minimally invasive breast biopsy; MSA, metropolitan statistical area.

not have a cancer diagnosis (69.1% vs 62.4%; $p < 0.0001$). In 375 women who had an ultimate diagnosis of breast cancer, the initial open biopsy appeared to be the definitive procedure, as these women had no other breast operation.

In a multivariate model, the same factors independently predicted receipt of MIBB (Table 3). As education and income were highly correlated, only education was included in the final model. There was a significant interaction between race/ethnicity and MSA, as well as race/ethnicity and education.

Time trends in the use of minimally invasive breast biopsy

The rate of MIBB as the initial biopsy in an episode of care increased every year, from 44.4% in 2001 to 79.1% in 2008 ($p < 0.0001$; Fig. 2). Increasing year of diagnosis was an independent predictor of MIBB use (odds ratio = 1.22 per increasing year; 95% CI, 1.21−1.23; Table 3). This was largely due to increases in the use of core-needle biopsy from 44.4% of all biopsies in 2001 to 74.2% in 2008. Fine-needle aspiration use was relatively stable and <7% across the time period. The use of image guidance with MIBB increased from 72.5% to 94.1% and the use of vacuum assistance increased from 40.0% to 54.6% between 2001 and 2008 ($p < 0.0001$ for both trends).

The rate of MIBB increased over time for each racial/ethnic group ($p < 0.0001$ for all; Fig. 3A), but the disparity between Hispanic women and other racial/ethnic groups remained throughout the study period. Likewise, the use of MIBB increased over time across the income (Fig. 3B) and education (Fig. 3C) quartiles, but disparities persisted. In no racial, education, or income group did MIBB rates exceed the recommended 90%, even at the end of the time period.

Table 3. Multivariate Model: Factors Predicting Receipt of Minimally Invasive Breast Biopsy*

Factor (reference group)	Odds ratio	95% CI
Year of diagnosis (per year)	1.22	1.21–1.23
Age (per year)	1.00	0.99–1.00
Race/ethnicity		
White (Hispanic)	1.25	1.18–1.32
Black (Hispanic)	1.38	1.28–1.50
Other (Hispanic)	1.35	1.12–1.61
Breast cancer diagnosis after biopsy (benign)	1.32	1.27–1.36
Education quartile (compared with lowest Q1)		
Quartile 2 (Q1)	1.07	1.02–1.12
Quartile 3 (Q1)	1.17	1.12–1.23
Quartile 4 (Q1)	1.45	1.37–1.52
Size of MSA		
≥1 million (≤10,000)	1.92	1.83–2.01
250,000 to <1 million (≤10,000)	0.85	0.80–0.91
>10,000 to <250,000 (≤10,000)	1.24	1.17–1.31

*Main effects shown in this Table. Interactions between race/ethnicity and MSA, and MSA and education were significant and are included in the model.
MSA, metropolitan statistical area.

Geographic analysis

For the time period of our study, Figure 4A illustrates the use of MIBB as the initial biopsy in an episode of care in Texas by HSAs. There was a wide range of MIBB use across HSAs, ranging from 20.6% to 89.1%. Hospital service areas, including major metropolitan areas (Houston, Austin, San Antonio, Dallas) and/or major medical centers (Lubbock, Midland, Odessa, Waco) had the highest rates of MIBB use during the study period. Given the disparities in MIBB that we found in Hispanic women, we also show a map of the Hispanic population as a percent of the total population by county in Texas[26] to visually correlate Hispanic density with receipt of MIBB (Fig. 4B). There were 37,132 episodes in HSAs, with >70% MIBB rates (Fig. 4A). In these higher-use HSAs, Hispanic disparities still existed, with Hispanic women undergoing MIBB 73.4% of the time, compared with 77.1%, 77.7%, and 79.5% for whites, blacks, and other racial/ethnic groups, respectively ($p < 0.0001$).

In major cities with percentages of Hispanic patients above the national average of 16.3%, rates of MIBB were as high as major cities with smaller relative Hispanic populations. Despite similar racial/ethnic makeup, rates of MIBB in border counties varied considerably by HSA, consistent with previous documented geographic variation in health care use.[27] For example, the HSA, including McAllen, known for high per-capita Medicare spending, had <40% MIBB rates, and El Paso, known for low spending, had >70% MIBB rates, despite a similar proportion of Hispanic patients.

Figure 5A and 5B illustrates the change in MIBB use over time (2001 to 2004 vs 2005 to 2008). Between the 2 time periods shown, there was an overall increase in the use of MIBB. However, rates of improvement in MIBB were variable, with the majority of areas around large cities improving to >70%, but inconsistent improvement in rural areas. For example, rates of MIBB remained at <40% in McAllen and Harlingen,

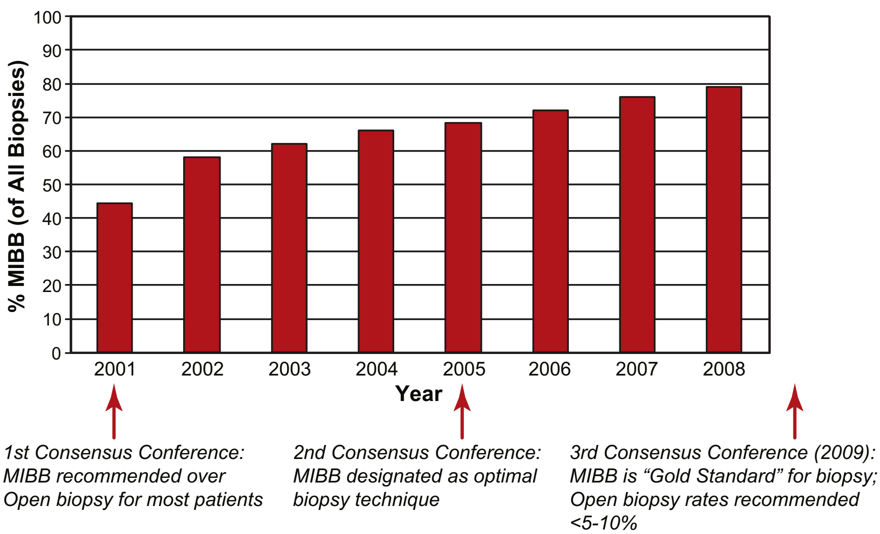

Figure 2. The percent of all initial biopsies performed as minimally invasive breast biopsy (MIBB) by year in Texas ($p < 0.0001$). The timeline for major consensus recommendations for MIBB shown along the x-axis.

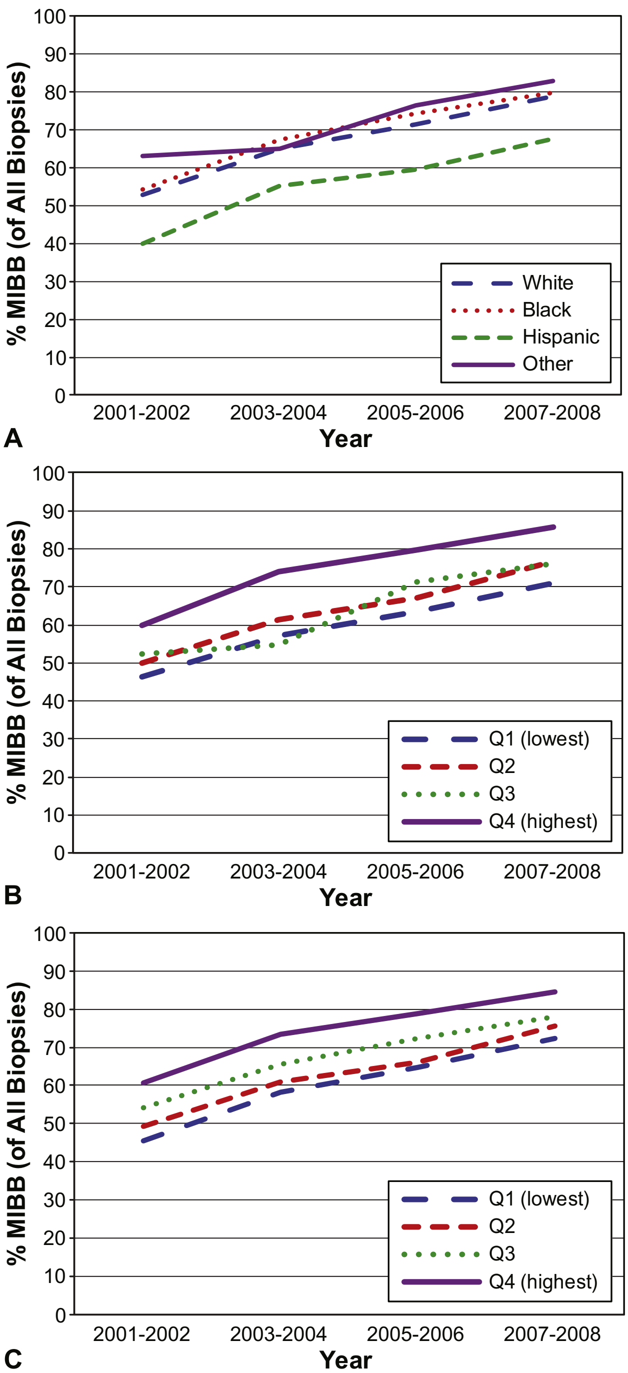

Figure 3. The percent of all initial biopsies performed as minimally invasive breast biopsy (MIBB) by (A) race and year, (B) income and year, and (C) education and year ($p < 0.0001$ for all trends).

but increased in Brownsville (immediately adjacent to McAllen) and El Paso during the time period. In 2001 to 2004, only 0.5% of HSAs met the 90% MIBB benchmark. This improved to only 4.8% in 2005 to 2008.

Provider patterns

For the first biopsy in each episode, 35,380 (49.5%) were performed by surgeons and 35,238 (47.0%) by radiologists, with the remaining biopsies done by a variety of specialists, including gynecologists, oncologists, and primary care physicians. Of the 49,653 MIBBs, 70.3% were performed by radiologists and 26.2% by surgeons. Surgeons performed 94.2% of the 25,865 open biopsies during the study period ($p < 0.0001$), with others being done by internists/primary care physicians (2.2%), radiologists (2.1%), and a variety of other physicians. In 40,560 of 75,518 episodes, there was a documented physician visit for a primary diagnosis of breast mass before first biopsy (Table 4). Episodes for which we documented a visit before first breast biopsy had a lower rate of MIBB (52.6%) than episodes for which we could not document a pre-biopsy visit (81.0%; $p < 0.0001$). For episodes with a documented pre-biopsy visit, the first physician seen for a breast mass was a surgeon in 46.1%, internist/primary care physician in 35.3%, nonsurgical oncologist in 9.4%, gynecologist in 6.9%, and other in 2.3%. Women with breast masses who presented to oncologists were the most likely to undergo MIBB (66.7%; $p < 0.0001$) as the first diagnostic procedure, compared with OB/GYN (58.6%), internal medicine/primary care (58.4%), or surgery (44.1%; $p < 0.0001$).

DISCUSSION

Our study is the first to examine MIBB rates in Texas and to describe associated geographic patterns that will enable us to better understand the barriers to achieving the 2009 Consensus Statement target of >90% MIBB rates for patients presenting with palpable breast masses and/or suspicious mammographic abnormalities.[4] In Texas, between 2001 and 2008, only 65.8% of all initial biopsies for new breast lesions were MIBB. The largest increase in MIBB rates occurred in the first 2 years (2001 to 2002), which corresponded with the issuing of the 2001 consensus statement advocating the use of MIBB. Despite the increase in MIBB over time, in 2008, only 79% of women underwent MIBB as the initial biopsy procedure for newly diagnosed breast mass or mammographic abnormality. Racial/socioeconomic disparities persisted, with Hispanics and patients with lower socioeconomic status being less likely to undergo a MIBB. Even in the later time period, only 4.8% of 208 HSAs in Texas met the 90% MIBB target rate.

The geographic patterns identified in our study might be the next step in understanding the barriers to achieving higher rates of MIBB. Texas has the largest rural population in the United States,[28,29] the greatest

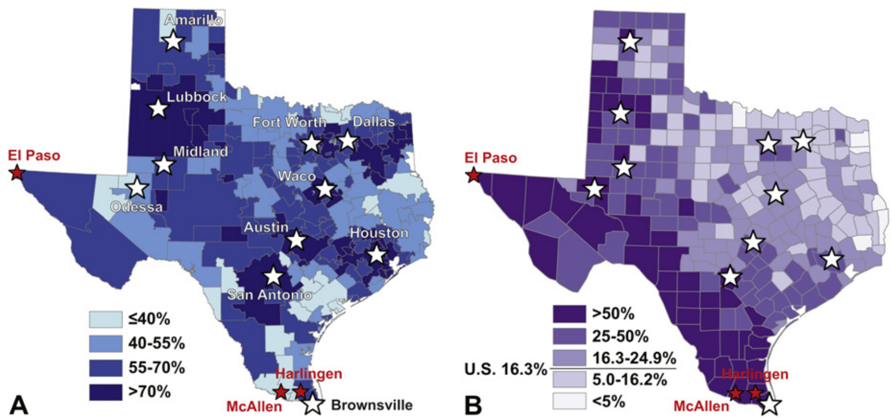

Figure 4. (A) The percent use of minimally invasive breast biopsy (MIBB) in Texas from 2001 to 2008 by hospital service area. (B) The Hispanic population as a percent of the total population by county in Texas. The national mean percent Hispanic population is 16.3%.

number of uninsured patients,[30] no ethnic majority, and the largest Hispanic population in the country.[26] Hospital service areas, including major metropolitan areas (Houston, Austin, San Antonio, Dallas) and/or major medical centers (Lubbock, Midland, Odessa, Waco), which have been shown to be associated with higher MIBB rates,[6,22] had the highest rates of MIBB during the study period. Rural areas might have limited access to MIBB technology, poor physician–patient education about changing standards of care, reduced access to health care in general, greater proportion of minority patients,[10,22] and patients with lower socioeconomic status.[31]

Although rates of MIBB increased in Hispanic patients over time, disparities persisted, with Hispanic women being less likely than white or black women to undergo MIBB. Even in HSAs with >70% MIBB use, Hispanic patients were less likely to get MIBB. This might represent differential access to care, and different patient preferences and tumor/imaging characteristics in Hispanic women. Although our study population represents a uniformly insured patient population, differential access can still be problematic. Similar to other disease processes, it is possible that Hispanic women cluster within physicians that are less likely to perform screening[32] or refer for MIBB. In addition, especially in rural areas, these women might be less likely to receive regular primary care or screening mammography and might present at a later stage with palpable masses, where open biopsy might be more appropriate. The underuse of MIBB in Hispanics across HSAs likely contributes to the failure to achieve >90% MIBB rates. However, this is not the entire explanation because MIBB in other racial groups is still <90%, even in the HSAs achieving >70% MIBB rates.

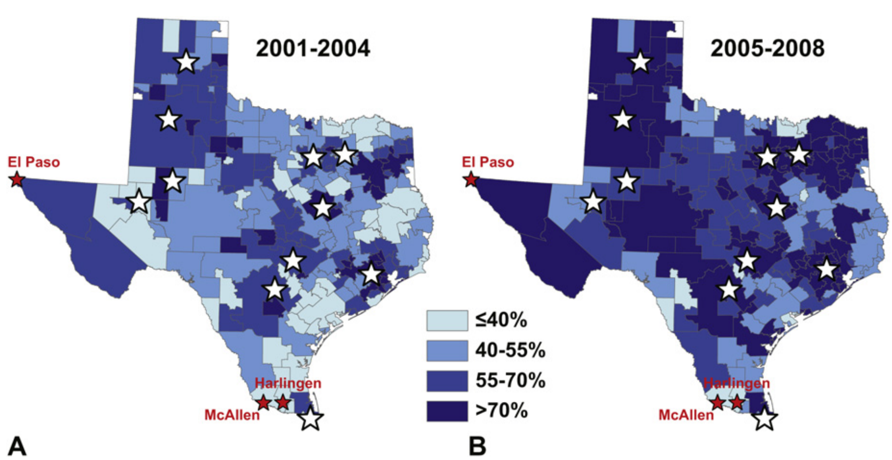

Figure 5. The percent use of minimally invasive breast biopsy (MIBB) in Texas for periods (A) 2001 to 2004 and (B) 2005 to 2008.

Table 4. Biopsy Rates Based on Pre-Biopsy Physician Visit Specialty Type*

	Initial biopsy after physician visit (n = 40,560)*			
	MIBB		Open	
Provider type†	n	%	n	%
Surgeon	8,244	44.1	10,451	55.9
Internal medicine/PCP	8,370	58.4	5,955	41.6
Gynecologist	1,635	58.6	1,157	41.4
Oncologist	2,541	66.7	1,270	33.3

*Women seeing a physician for breast mass before biopsy claim (n = 40,560).
†$p < 0.0001$.
MIBB, minimally invasive breast biopsy; PCP, primary care physician.

The inconsistent improvement in the use of MIBB across geographic regions with similar demographic makeup suggests that, in addition to tumor characteristics (presence of a palpable mass) and patient preference (desire removal of palpable mass), physician preference and practice patterns can contribute to underuse of MIBB. Consistent with previous documented geographic variation in health care use across Texas,[27] HSAs with reported high per capita Medicare spending (McAllen) had the lowest rates of cost-effective MIBB, and areas known for low spending (El Paso) had the highest rates, suggesting that underuse of MIBB might be related to lack of cost-effective health care provision in certain regions.

Although a recent single-institution interdisciplinary breast center reported a 97% rate of MIBB,[12] similar results are not being achieved in the general population. Our findings are consistent with previous population-based studies. A recent Florida population-based study evaluated >172,000 breast biopsies done for benign or malignant disease.[6] Of all biopsies, approximately 30% were done open. Minimally invasive breast biopsy rates increased from 45% in 2003, but still fell short of the recommended 90%. Other population-based studies have focused on breast cancer patients exclusively, and therefore lack the true denominator of all breast biopsies.[10,19,21,22] These studies demonstrate slightly higher biopsy rates, ranging from 61% to 87%. The slightly higher reported rates in these studies are consistent with our observation that patients with an ultimate diagnosis of breast cancer were more likely to have MIBB. Like the Florida study, our study included all biopsies, regardless of diagnosis, allowing us to assess the true denominator (overall breast biopsy use).

Only 54% of our cohort had a documented physician visit for breast mass before the initial biopsy claim. After a pre-biopsy visit, women presenting to oncologists, OB/GYNs, radiologists, or internal medicine/primary care providers with a diagnosis of breast mass were more likely to undergo MIBB than those presenting to surgeons. We suspect that the overall lower MIBB rates in this group occur because these patients were more likely to present with a palpable mass and might desire excision for peace of mind or other reasons we cannot measure. In addition, patients presenting or referred to surgeons might include a greater number of patients or masses with characteristics that favor open biopsy. The patients who did not have a visit before the claim were likely diagnosed with abnormalities on routine screening mammography, where the case for MIBB might be less controversial. However, the differences between specialists suggest different management of the same presentation and might provide specific groups to target for interventions focused on improving MIBB rates, such as those previously proposed in the literature.[18,19]

Our study had several limitations. Our cohort was restricted to female Medicare beneficiaries who were 66 years of age and older in the state of Texas at the time of biopsy. Because of this, our findings might not be applicable to the US population or areas with younger populations. Similar findings of low MIBB rates reported by Gutwein and colleagues and Williams and colleagues, which included women of all ages, suggest that the findings are generalizable to women of all ages.[6,22] Medicare claims data do not contain information on patient preferences, symptoms, or physical examination findings, which can influence the choice of biopsy technique. In addition, because of the nature of the claims data, we were only able to access information through the year 2008. As a result, we were not able to measure the effect the 2009 consensus statement recommendations[4] and NCCN guidelines[17] on MIBB rates.

Our study might be limited by failure to correctly identify Hispanic ethnicity. Previous studies demonstrate that large numbers of Hispanic patients are misclassified using Medicare claims enrollment data.[33] However, a new algorithm using first and last names and other available information has been validated by the Centers for Medicare and Medicaid Services and is available in the Part D enrollment data.[23] Part D enrollment information was available and used for 93% of our cohort. We would expect misclassification of Hispanics to bias our results toward the null hypothesis (no difference between racial/ethnic groups). A recent critique of previous studies in the *Journal of the American College of Radiology* questioned the validity of using CPT code 19125 as an open biopsy code, arguing that surgeons might use this code for surgical excisions of benign masses without earlier biopsy for definitive treatment, or for malignant masses that had received earlier biopsy.[34] The authors demonstrated that this would then lead to underestimation of MIBB rates. We hoped to minimize this effect by including CPT code 19120 (which is specific for excisions performed on benign lesions) and by analyzing only the first biopsy of each episode of care to capture only the initial diagnostic procedure performed on a lesion. However, it is still possible that, in some patients, the biopsy procedure was considered the definitive therapy.

CONCLUSIONS

Improvements in MIBB use can lower health care costs and improve patient care and patient satisfaction.[4,6-12] In this statewide, population-based study, we show that MIBB rates in Texas remain well below the NCCN guidelines of >90%, even in large metropolitan areas and despite notable increases over time. This study identifies both Hispanic disparities and geographic variations in practice patterns as potential targets for interventions to improve MIBB rates. Strategies to improve MIBB rates might need to vary by geographic region and underlying cause of the failure to adopt this cost-effective practice. In very rural areas where the primary problem is access to MIBB technology, MIBB rates of >90% might not be feasible. In areas such as major metropolitan areas, where racial disparities drive the failure to meet target rates, interventions need to be aimed at reducing these disparities. Finally, in some instances, physician practice patterns, and not patient characteristics, can drive underuse of MIBB.

Author Contributions

Study conception and design: Zimmermann, Sheffield, Duncan, Han, Cooksley, Townsend, Riall

Acquisition of data: Han, Riall

Analysis and interpretation of data: Zimmermann, Sheffield, Duncan, Han, Cooksley, Townsend, Riall

Drafting of manuscript: Zimmermann, Sheffield, Duncan, Riall

Critical revision: Zimmermann, Sheffield, Han, Duncan, Townsend, Riall

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Discussion

DR KIRBY BLAND (Birmingham, AL): This is a very timely, important, well constructed manuscript. As Dr Riall has reiterated throughout this presentation, temporary guidelines at the National Comprehensive Cancer Network (NCCN)/NIH currently recommend minimally invasive breast biopsy (MIBB) as the "gold standard" for establishing histologic diagnosis of mammographic/ultrasonic or palpable lesions, which is essential to any therapeutic intervention.

I would submit that the concepts presented throughout this manuscript are even deeper in our current legal culture, in which the breast remains the most litigious organ in the body, accounting for more than 20% of medical litigation conducted in the United States.

As noted in conclusions of this presentation, there has been a time trend for increasing applications of MIBB in the state of Texas, which is also true nationally. Regretfully, clinics consistently fall far short of the recommended standards that have been promulgated by many authoritative bodies, including those of the National Cancer Institute/American College of Radiology.

As Dr Riall noted, it is essential that we identify the specific barriers in rural areas that will effectively modify the considerable gap in this disparity of excellence, such that we can achieve an overall goal for MIBB that exceeds 90%. This should be suggested not only in Texas, but nationally as well.

I suggest that the reasons these specific barriers exist are perhaps related to improper insurance coverage and access to MIBB technology in these rural hospitals, with access to stereotactic, ultrasonographic, and MRI-guided biopsies. This is further extended to the CME, and specific efforts for ultrasonographic or stereotactic training to gain the expertise in MIBB.

So it is not surprising that 70% of the MIBB biopsies were performed by mammographically trained radiologists, while only approximately one-quarter of the MIBB techniques were performed by surgeons.

The literature is replete with confirmatory data that the increased use of minimally invasive breast biopsy allows a resulting decrease in the frequency of surgical procedures, a diminution in the interval between diagnosis and the establishment of therapy, and decreased overall costs when compared with open biopsy techniques.

For patients desiring breast conservation, enhanced cosmetic outcome is evident; most importantly, rapid confirmation of the diagnosis for the patient, with the initiation of a therapeutic plan, can be more rapidly implemented with fine needle aspiration (FNA) and/or core stereotactic biopsy. The literature suggests that open biopsy rates are as great as 30% in many states in the US. So, contemporary technology and its availability, with access to all populations, should be the goal of surgeons in this Association who treat breast diseases.

Although there is no clear time trend from the state of Texas from a minimal 9,800-plus MIBBs in 2001, to a maximum of nearly 12,000 in 2003, the denominator is increasing, as it is in most geographic areas in the US. This has to do with the increasing education and trend toward early diagnosis, including the application of MRI, which is a more sensitive technology than either mammogram or ultrasound, and it clearly has brought about a dramatic increase in the open biopsies and MIBB.

You have presented convincing evidence of the increasing application of MIBB in all biopsies, from 42% (2001) to nearly 80% of all biopsies in the year 2008. This followed 3 consensus conferences suggesting that MIBB is recommended over open biopsy and is the optimal biopsy technique, and this technique should be considered the "gold standard" in biopsy.

Although these consensus conferences have recommended that open biopsy rates should be greater than 5% to 10%, I ask, what further can we (the surgical community) initiate to reduce this cohort of more than 20% to ensure considerable improvement in the standard of care?