I. Description

Summary

Digital breast tomosynthesis uses modified digital mammography equipment to obtain additional radiographic data that are used to reconstruct cross-sectional “slices” of breast tissue. Tomosynthesis may improve the accuracy of digital mammography by reducing problems caused by overlapping tissue. Tomosynthesis typically involves additional imaging time and radiation exposure, although recent improvements may change this.

Screening

Norse and Italian screening studies published in 2013 provide the strongest evidence available to date on the use of mammography plus digital breast tomosynthesis versus mammography alone for screening women for breast cancer. This evidence suggests that use of mammography plus breast tomosynthesis may modestly increase the number of cancers detected, with a large decrease in the number of women who undergo unnecessary recalls or biopsies. For example, in interim analysis of the Norse screening trial, the ratio of cancer detection rates per 1000 screens for mammography plus breast tomosynthesis versus mammography alone was 1.27 (98.5% confidence interval [CI], 1.06 to 1.53; p=0.001). The ratio of false-positive rates for mammography plus breast tomosynthesis versus mammography alone was 0.85 (98.5% CI, 0.76 to 0.96; p<0.001). Even if adding breast tomosynthesis simply maintained the same sensitivity as mammography, a decline in the false-positive rate would reduce the substantial number of unnecessary diagnostic workups in the United States and spare women the psychological stress these engender.

Additional studies generally have supported these findings, with no observed differences in test performance across subgroups defined by age or breast density. However, all studies were nonrandomized. Lack of long-term follow-up prevents assessment of false-negative results and full assessment of test performance. Further, overall impacts on health outcomes are unknown. Long-term effects of additional radiation exposure also are unknown. For these reasons, digital breast tomosynthesis is considered investigational. A trial that randomizes women to digital mammography with or without tomosynthesis, or performs both screening methods in the same woman, is required to demonstrate that improvements in screening are due to tomosynthesis and
not to confounding variables (eg, patient characteristics or radiologist experience in tomosynthesis interpretation).

The configuration of mammography and breast tomosynthesis used in these studies roughly doubled the radiation dose of mammography alone, but exposure was still lower than the guideline established in the Mammography Standards and Quality Act. On May 20, 2013, the U.S. Food and Drug Administration (FDA) approved new tomosynthesis software from Hologic that creates a 2-dimensional (2D) image from tomosynthesis images (C-View), eliminating the need for a separate mammogram. This approach reduces the radiation dose of the combination. Two studies reported comparable performance with digital mammography plus breast tomosynthesis, which reduces radiation exposure. Results warrant replication.

Diagnosis

The potential of digital breast tomosynthesis, as an addition to diagnostic mammography (such as spot views), is primarily to reduce the number of women who undergo biopsy by screening out some fraction of women who have false-positive results. The body of evidence on breast tomosynthesis to evaluate women who are recalled for a diagnostic workup after a suspicious finding on screening mammography is weaker than that on adding breast tomosynthesis to mammography for screening. Confounding this analysis is the fact that diagnostic mammography is not the only imaging modality used during the diagnostic workup. Ultrasound is also commonly used and less often, magnetic resonance imaging.

Consequently, study designs are more complicated in terms of how they incorporate ultrasound into the comparison between diagnostic mammography and breast tomosynthesis. A different research design is needed to assess the incremental value of tomosynthesis compared with currently used diagnostic tests. Additionally, some studies focused on 1 type of finding (eg, masses versus calcification). These studies do not provide data on the accuracy of breast tomosynthesis for the full range of findings.

II. Policy

Digital breast tomosynthesis is not covered in the screening or diagnosis of breast cancer because it is not known to be effective in improving health outcomes when compared to conventional breast imaging technologies.

III. Administrative Guidelines

A. Member Agreement of Financial Responsibility

The patient must be informed of the financial implications of choosing to have the breast tomosynthesis and must acknowledge that the procedure is not covered by signing the Member Agreement of Financial Responsibility prior to the service. If the aforementioned criteria is met, modifier GA should be appended to the digital breast tomosynthesis. When the modifier is GA billed, HMSA will process the claim to indicate member responsibility for this procedure.
The Member Agreement of Financial Responsibility needs to be kept on file by the servicing provider. To view, please see Agreement of Financial Responsibility for Digital Breast Tomosynthesis

B. Applicable codes:

<table>
<thead>
<tr>
<th>CPT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>77061</td>
<td>Digital breast tomosynthesis; unilateral</td>
</tr>
<tr>
<td>77062</td>
<td>Digital breast tomosynthesis; bilateral</td>
</tr>
<tr>
<td>77063</td>
<td>Screening digital breast tomosynthesis, bilateral</td>
</tr>
<tr>
<td>G0279</td>
<td>Diagnostic digital breast tomosynthesis, unilateral or bilateral</td>
</tr>
</tbody>
</table>

IV. Background

Conventional mammography produces 2D images of the breast. Overlapping tissue on a 2D image can mask suspicious lesions or make benign tissue appear suspicious, particularly in women with dense breast tissue. As a result, women may be recalled for additional mammographic spot views. Inaccurate results may lead to unnecessary biopsies and emotional stress, or to a potential delay in diagnosis. Spot views often are used to evaluate microcalcifications, opacities, or architectural distortions; to distinguish masses from overlapping tissue; and to view possible findings close to the chest wall or in the retroareola area behind the nipple. The National Cancer Institute reports that approximately 20% of cancers are missed at mammography screening. Average recall rates are approximately 10%, with an average cancer detection rate of 4.7 per 1000 screening mammography examinations. The Mammography Quality Standards Act audit guidelines anticipate 2 to 10 cancers detected per 1000 screening mammograms. Interval cancers, which are detected between screenings, tend to have poorer prognoses.

Digital breast tomosynthesis was developed to improve the accuracy of mammography by capturing 3-dimensional (3D) images of the breast, further clarifying areas of overlapping tissue. Developers proposed that its use would result in increased sensitivity and specificity, as well as fewer recalls due to inconclusive results. Digital breast tomosynthesis produces a 3D image by taking multiple low-dose images per view along an arc over the breast. During breast tomosynthesis, the compressed breast remains stationary while the x-ray tube moves approximately 1° for each image in a 15° to 50° arc, acquiring 11 to 49 images. These images are projected as cross-sectional “slices” of the breast, with each slice typically 1-mm thick. Adding breast tomosynthesis takes about 10 seconds per view. In 1 study in a research setting, mean time (SD) for interpretation of results was 1.22 (1.15) minutes for digital mammography and 2.39 (1.65) minutes for combined digital mammography and breast tomosynthesis.

With conventional 2D mammography, breast compression helps decrease tissue overlap and improve visibility. By reducing problems with overlapping tissue, compression with breast tomosynthesis may be reduced by up to 50%. This change could result in improved patient satisfaction.

A machine equipped with breast tomosynthesis can perform 2D digital mammography, 3D digital mammography, or a combination of both 2D and 3D mammography during a single compression.
Radiation exposure from tomosynthesis is roughly equivalent to mammography. Therefore, adding tomosynthesis to mammography doubles the radiation dose, although it still is below the maximum allowable dose established in the U.S. Mammography Quality Standards Act.

Studies typically compare 1-view (i.e., mediolateral oblique [MLO] view), or more commonly, 2-view (MLO plus craniocaudal view) breast tomosynthesis alone or combined with standard 2D mammography with standard 2D mammography alone. A 2014 TEC Assessment (updated in 2015) focused on 2-view tomosynthesis. The FDA Radiological Devices Panel, which reviewed this new modality in 2011, recommended that 2-view breast tomosynthesis is preferable to 1-view tomosynthesis (both used in combination with full-field digital mammography).

In May 2013, FDA approved new tomosynthesis software that permits creation of 2D images (called C-View) from images obtained during tomosynthesis. As a result, 2D mammography may become unnecessary, thereby lowering radiation dose. In other words, only the tomosynthesis procedure will be needed, and both 2D and 3D images will be created. It is too early to gauge how traditional mammography plus tomosynthesis compares with C-View plus tomosynthesis.

V. Rationale

Primary outcomes to be examined include the number of cancers detected and the number of unnecessary recalls and biopsies. Improvement in sensitivity and specificity of testing is an intermediate outcome that will impact ultimate health outcomes, but is not by itself sufficient to establish that outcomes are improved. If the sensitivity of breast cancer detection is improved by tomosynthesis, then the number of cases detected will increase. If the specificity of cancer detection is improved, then the number of recalls and biopsies for patients without cancer will decrease. If tomosynthesis is performed during screening, the number of unnecessary recalls may decline, along with attendant anxiety and inconvenience for the patient. If tomosynthesis is performed as part of the diagnostic workup, after a woman is recalled for questionable findings during screening, then a lower false-positive rate could prevent unnecessary biopsies.

Screening

The 2015 TEC Assessment identified studies that addressed the use of mammography with or without digital breast tomosynthesis for screening. These studies are summarized in Table 1. The Assessment concluded:

“Current evidence on use of breast tomosynthesis plus mammography versus mammography alone for screening is insufficient to permit conclusions regarding the effect on health outcomes of adding breast tomosynthesis. Most available studies are retrospective and many did not use adequate reference standards. Also, most subjects did not serve as their own controls. The risk of bias for most of the studies was high. In addition, there is substantial variation across studies concerning (1) the magnitude of the impact of adding tomosynthesis on recall rates, and (2) whether any increases in cancer detection rates are statistically significant. Variations may be due to inadequate sample sizes, and the effect of other factors such as whether the screening is the initial or repeat examination. Adding tomosynthesis to mammography may also increase overdetection and entails greater radiation exposure.
Therefore, the available evidence does not permit conclusions regarding the effect of the tomosynthesis on health outcomes.”

Prospective Studies

The strongest evidence for using mammography and breast tomosynthesis for screening women for breast cancer comes from interim results of a large 2013 trial in Norway. The sample comprised 12,621 women with 121 cancers detected on routine screening. Cancer detection rate was 6.1 per 1000 screenings for mammography alone and 8.0 per 1000 screenings for mammography plus digital breast tomosynthesis. Cancers missed by digital breast tomosynthesis were missed due to reading errors, either detection or interpretation. After adjusting for reader differences, the ratio of cancer detection rates for mammography plus breast tomosynthesis versus mammography alone was 1.27 (98.5% confidence interval [CI], 1.06 to 1.53; p=0.001). The authors did not ascertain any improvement in detecting ductal carcinoma in situ by adding breast tomosynthesis, ie, additional cancers detected were mostly invasive. The false-positive rate was 61.1 per 1000 screenings for mammography alone and 53.1 per 1000 screenings for mammography plus breast tomosynthesis. A reduction in the false-positive rate would decrease the number of women recalled after screening for additional imaging or biopsy. In Norway, as in much of Europe, women are screened every other year, and 2 readers independently interpret the images, which differs from usual practice in the U.S. After adjusting for differences across readers, the ratio of false-positive rates for mammography plus breast tomosynthesis versus mammography alone was 0.85 (98.5% CI, 0.76 to 0.96; p<0.001). For this interim analysis, only limited data were available about interval cancers so “conventional absolute sensitivity and specificity” could not be estimated. Additional information will be available when the trial (NCT01248546) is completed (estimated study completion date, September 2015).

The second study (STORM) examined comparative cancer detection for traditional mammography with or without breast tomosynthesis in a general Italian, asymptomatic screening population of 7292 women. The reference standard was pathology for women undergoing biopsies; women with negative results on both mammography and breast tomosynthesis were not followed up, so neither sensitivity nor specificity could be calculated. Mammography plus breast tomosynthesis revealed all 59 cancers; 20 (34%) were missed by traditional mammography (p<0.001). Incremental cancer detection by using both modalities was 2.7 cancers per 1000 screens (95% confidence interval [CI], 1.7 to 4.2). There were 395 false-positive results: 181 were false-positive using either mammography or both imaging modalities together; an additional 141 occurred using mammography only; and 73 occurred using mammography and breast tomosynthesis combined (p<0.001). In preplanned analyses, combined results of mammography and digital breast tomosynthesis yielded more cancers in both age groups (<60 vs ≥60 years) and breast density categories (1 [least dense] and 2 vs 3 and 4 [most dense]).

Both of these studies were considered to have a medium risk of bias using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS)-2 tool. In both studies, follow-up of women with negative imaging findings was insufficient.
Another study compared results of mammography alone versus breast tomosynthesis plus mammography among 997 patients with mixed indications: 780 women were undergoing routine screening, and 217 were scheduled for biopsy. Two retrospective reader studies were conducted. Some of these results were included in the submission to the U.S. Food and Drug Administration (FDA) for premarketing application (PMA) approval of Hologic’s Selenia Dimensions tomosynthesis system. Readers were trained in interpreting tomosynthesis images, and training was augmented between the first and second reader studies to emphasize how to read certain lesions that were often misinterpreted in the first reader study. In both reader studies, the area under the receiver operating characteristic curve (ROC) for mammography plus breast tomosynthesis was greater than for mammography alone; the difference for the second study was 6.8% (95% CI, 4.1% to 9.5%; p<0.001). For noncancer cases, adding breast tomosynthesis to mammography changed the mean recall rate across readers for study 2 from 48.8% (SD=12.3%; 95% CI, 28.2% to 69.1%) to 30.1% (SD=7.6%; 95% CI, 19.8% to 41.3%) for the combined modalities. Almost all of the improvement among readers was attributable to noncalcification cases, including masses, asymmetries, and architectural distortions. Risk of bias was considered high due to: substantial patient dropout (16%); use of an investigational tomosynthesis system during the early part of the study; enrichment of the screening sample by inclusion of the biopsy cases.

**Retrospective Studies**

All retrospective studies had a high or unknown risk of bias using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) –2 tool.

One of 3 related articles on this study reported that the recall rate among noncancer cases was 0.42 (95% CI, 0.38 to 0.45) for digital mammography alone and 0.28 (95% CI, 0.25 to 0.31) for digital mammography plus breast tomosynthesis (p<0.001). Analogous rates for cancer cases were 0.88 (95% CI, 0.84 to 0.91) for digital mammography alone and 0.93 (95% CI, 0.90 to 0.96) for digital mammography plus breast tomosynthesis. Sensitivity of digital mammography alone was 60% and increased to 72% when breast tomosynthesis was added (p=0.034, but authors noted the small number of positive findings). These articles did not describe the sample, the time between digital mammography and breast tomosynthesis, or how the reference standard was verified. Therefore, risk of bias is unknown.

Other studies consistently showed improved breast cancer detection rates (sensitivity) with addition of tomosynthesis to digital mammography. Improvements were not always statistically significant or statistical significance was not reported.

**Table 1. Studies of Digital Breast Tomosynthesis for Breast Cancer Screening**

<table>
<thead>
<tr>
<th>Study</th>
<th>No. Cancers/No. Patients</th>
<th>Recalls/1000 Screens 95% (CI)</th>
<th>PPV for Recalls</th>
<th>Cancers Dedected/1000 Screens (95% CI)</th>
<th>PPV for Biopsies 95 % CI</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Diagnostics 1</th>
<th>Diagnostics 2</th>
<th>P value</th>
<th>Other Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skaane (2013)</td>
<td>121/12,621</td>
<td>NR</td>
<td>28.6%</td>
<td>6.1</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NR</td>
<td>29.1%</td>
<td>8.0</td>
<td>0.001</td>
</tr>
<tr>
<td>Storm</td>
<td>59/7292</td>
<td>45</td>
<td>11%</td>
<td>5.3</td>
<td>(3.8 to 7.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>19%</td>
<td>8.1</td>
<td>(6.2 to 10.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Rafferty Study 1</td>
<td>51/997</td>
<td></td>
<td></td>
<td>NR</td>
<td>NR</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Rafferty Study 2</td>
<td></td>
<td></td>
<td></td>
<td>NR</td>
<td>NR</td>
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<td></td>
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<td>NR</td>
<td>NR</td>
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<tr>
<td>Good Gur</td>
<td>35/125</td>
<td></td>
<td></td>
<td>NR</td>
<td>NR</td>
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<td></td>
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<td>NR</td>
<td>NR</td>
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<tr>
<td>Destounis</td>
<td>105/17,955</td>
<td>114</td>
<td>42</td>
<td>NR</td>
<td>3.8</td>
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<tr>
<td></td>
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<td></td>
<td>5.7</td>
<td>NR</td>
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<tr>
<td>Durand</td>
<td>321/59,617</td>
<td>123(117 to 130)</td>
<td>78(73 to 84)</td>
<td>NR</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.9</td>
<td>NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Greenberg</td>
<td>71/13,158</td>
<td>55 (138-175)</td>
<td></td>
<td>4.9</td>
<td>(4.2 to 5.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.5%</td>
<td>(18.9 to 24.5)</td>
</tr>
</tbody>
</table>
The 2015 TEC Assessment reviewed a large reading study conducted in the U.K. National Health Service. Because the study included a mix of screening and diagnostic patients, case selection bias limits extrapolation of the results to a screening population. The Tomosynthesis with digital Mammography (TOMMY) trial (ISRCTN73467396) compared the performance of mammography plus tomosynthesis with mammography alone among women at moderate-to-high risk for breast cancer undergoing screening (n=1040 including 2 cancers) and women who had been recalled for a diagnostic workup after having a screening mammogram (n=6020 including 1158 cancers). After enrollment, these women had a mammogram and tomosynthesis; a synthesized mammogram (C-View) was also reconstructed from the tomosynthesis results. Comparisons were mammography alone versus mammography plus tomosynthesis versus synthetic mammogram plus tomosynthesis. The reference standard was pathology results for women who had a biopsy; the report did not note follow-up for other subjects. Sensitivity was 87% (95% CI, 85 to 89) for mammography only, 89% (95% CI, 25 to 91) for mammography plus tomosynthesis, and 88% (95% CI, 86 to 90) for C-View images plus tomosynthesis. None of these differences was statistically significant. Specificity was
58% (95% CI, 27.56 to 60) for mammography alone, 69% (95% CI, 67 to 71) for mammography plus tomosynthesis, and 71% (95% CI, 69 to 73) for C-View images plus tomosynthesis. Specificity for each of the combined modalities was statistically greater compared with mammography alone (p<0.001). This result also held for all age and breast density groups. When breast density was divided into 2 groups (more or less than 50% density), sensitivity for women with greater breast density was improved with mammography plus tomosynthesis compared with mammography alone (93% vs 86%; p=0.03).

Zuley et al (2014) compared diagnostic accuracy of synthesized 2D mammography and digital mammography, both alone and in combination with 3D breast tomosynthesis. Area under ROC was 0.894 and 0.889 for synthesized and digital mammography, respectively; with the addition of 3D tomosynthesis, values increased to 0.916 and 0.939, respectively. In the second half of the Skaane et al (2014) study (after improvements to 2D image processing were made), there was no statistical difference in cancer detection rates, positive predictive values (PPV), and false-positive rates (noncancer recall rates) between synthesized and digital mammography (both in combination with tomosynthesis). Mean glandular radiation dose for a single mammographic view was 45% less in the synthesized mammography group compared with the digital mammography group (mean, 1.58 mGy vs 3.53 mGy, respectively).

Section Summary

These studies provided some evidence that adding breast tomosynthesis to mammography may increase accuracy (and possibly sensitivity) of screening while reducing the number of women who are recalled unnecessarily. However, the available studies have methodologic limitations. Several studies did not have adequate follow-up of women with negative screening results; 1 larger study provided interim results. Other studies were retrospective case reviews; patients had mixed or unclear indications for screening. More recently, prospective and large retrospective studies have reported cancer detection rates with reduced false recall rates. This evidence is from nonrandomized designs with a lack of long-term follow-up to assess false negative results. Therefore, performance of digital breast tomosynthesis in the screening setting cannot be determined with certainty. Two studies of synthesized 2D mammography showed comparable diagnostic performance with digital mammography and lower radiation exposure. Replication of these findings is warranted.

Diagnosis

Lei et al (2014) conducted a systematic review with meta-analysis of 7 studies (total number of patients, 2014; total number of lesions, 2666) that compared digital breast tomosynthesis with digital mammography in patients with Breast Imaging-Reporting and Data System (BI-RADS) 2 or higher breast lesions. All studies were rated high quality using the QUADAS tool. As shown in Table 2, compared with histologic diagnosis, performance of both imaging modalities was approximately similar; PPVs were low (57% for breast tomosynthesis and 50% for digital mammography), and negative predictive values (NPV) were high. Statistical heterogeneity in these analyses was considerable (I2=»90%). Studies used both 1-view (n=4) and 2-view (n=3) breast tomosynthesis. Pooled sensitivity and specificity for only 1-view breast tomosynthesis studies were 81% and 77%, respectively; for 2-view studies, pooled sensitivity and specificity were 97% and 79% respectively.
Table 2. Side-by-Side Comparison of Digital Breast Tomosynthesis and Digital Mammography

<table>
<thead>
<tr>
<th></th>
<th>Digital Breast Tomosynthesis, Pooled Estimate (95% CI)</th>
<th>Digital Mammography, Pooled Estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>90% (87 to 92)</td>
<td>89% (86 to 91)</td>
</tr>
<tr>
<td>Specificity</td>
<td>79% (77 to 81)</td>
<td>72% (70 to 74)</td>
</tr>
<tr>
<td>PPV(^a)</td>
<td>57% (53 to 61)</td>
<td>50% (46 to 53)</td>
</tr>
<tr>
<td>NPV(^a)</td>
<td>96% (95 to 97)</td>
<td>95% (94 to 97)</td>
</tr>
<tr>
<td>DOR</td>
<td>26.04 (8.70 to 77.95)</td>
<td>16.24 (5.61 to 47.04)</td>
</tr>
<tr>
<td>LR+</td>
<td>3.50 (2.31 to 5.30)</td>
<td>2.83 (1.77 to 4.52)</td>
</tr>
<tr>
<td>LR−</td>
<td>0.15 (0.06 to 0.36)</td>
<td>0.18 (0.09 to 0.38)</td>
</tr>
<tr>
<td>AUC</td>
<td>0.867</td>
<td>0.856</td>
</tr>
</tbody>
</table>

AUC: area under the summary receiver operating characteristic curve; CI: confidence interval; DOR: diagnostic odds ratio (ratio of the odds of positivity in cases to the odds of positivity in controls = [LR+] ÷ [LR−]); LR+: positive likelihood ratio (ratio of the probability of positivity in cases to the probability of positivity in controls = sensitivity ÷ [1-specificity]); LR−: negative likelihood ratio (ratio of the probability of a negative result in cases to the probability of a negative result in controls = [1-sensitivity] ÷ specificity); NPV: negative predictive value; PPV: positive predictive value.

\(^a\) Calculated by author.

The 2014 TEC Assessment identified 6 studies that addressed the use of breast tomosynthesis in the diagnostic setting, ie, when there are suspicious findings on screening mammography or when the woman is symptomatic. Studies vary considerably in types of suspicious mammographic findings (eg, calcifications vs noncalcifications); patient sample; and comparators to breast tomosynthesis (eg, 2-view mammography, mammographic spot views, ultrasound). One study had a medium risk of bias; the remainder, a high risk of bias using the QUADAS-2 tool. These studies are summarized next.

In a study of 158 women consecutively recalled after screening mammography, breast tomosynthesis was evaluated as a possible triage tool to reduce the number of false-positive results. Results of diagnostic assessment (including ultrasound and needle biopsy when performed) were used as the reference standard. Breast tomosynthesis eliminated 102 (65%) of 158 recalls, all of which were unnecessary (ie, false-positive results on mammography). No cancers were missed on breast tomosynthesis. Performance of breast tomosynthesis did not vary by breast density or age group, but reduction in recalls was greater for asymmetric densities and distortions, and nodular opacities with regular margins. As noted by the authors, the observed decline in recall rates after breast tomosynthesis exceeded that observed in blinded comparisons of digital mammography and breast tomosynthesis.

Another study compared the performance of mammographic spot views versus tomosynthesis among 52 consecutive recalled women with a BI-RADS rating on initial screening of 0 (which means “Need Additional Imaging Evaluation and/or Prior Mammograms for Comparison”). Women with
calcifications were excluded. The study was designed as a noninferiority analysis of area under the ROC curve, sensitivity, and specificity, with a noninferiority margin of delta of 0.05, so that if breast tomosynthesis were noninferior to mammographic spot views, breast tomosynthesis could be performed right after screening mammography to avoid a recall. Sensitivity and specificity were extremely high for both modalities, and there was no statistically significant difference between them.

A third study compared diagnostic mammography to breast tomosynthesis among women with abnormalities on screening mammography with no calcifications in a “simulated clinical setting.” Breast tomosynthesis rating was based on both readers’ ratings and their confidence that no additional studies were needed, as well as ultrasound results in some cases. The reference standard was either results of the entire clinical workup, including biopsy if performed, or follow-up for women not undergoing biopsy (86% of the entire sample). There was no statistically significant difference between diagnostic mammography and breast tomosynthesis in sensitivity or specificity.

Two of the these 3 studies found no difference in sensitivity and specificity between breast tomosynthesis and a clinical workup comprising diagnostic mammographic images or a more comprehensive diagnostic work-up. The third study examined the use of breast tomosynthesis to triage women recalled after screening and substantially reduced the recall rate.

Another study evaluated 738 women with 759 lesions recalled after screening with film mammography. This unblinded study assessed the incremental value of breast tomosynthesis added to film and digital mammography. The reference standard comprised pathology results or follow-up for 18 to 36 months. The addition of breast tomosynthesis to film and digital mammography increased the area under the ROC curve from 0.895 (95% CI, 0.871 to 0.919) to 0.967 (95% CI, 0.957 to 0.977; p=0.001). Complete sensitivity (ie, counting ratings of 3-5 as positive) increased from 39.7% for digital mammography to 58.3% when breast tomosynthesis was added; confidence intervals or p values were not reported. Specificity increased from 51% to 74.2% when breast tomosynthesis was added to digital mammography. The difference in areas under the ROC curve after the addition of breast tomosynthesis was statistically significant for soft tissue lesions, but not for microcalcifications.

One study compared diagnostic mammography images with dual-view breast tomosynthesis in 217 lesions (72 [33%] malignant) among 182 women. This retrospective study included women who had undergone diagnostic mammography and breast tomosynthesis. The sample included women with clinical symptoms such as a palpable lump, or findings on mammography, ultrasound, or magnetic resonance imaging (MRI). Women with only calcifications were excluded. Area under the ROC curve was 0.83 (95% CI, 0.77 to 0.83; range across readers 0.74-0.87) for diagnostic mammography, and 0.87 (95% CI, 0.82 to 0.92; range across readers, 0.80-0.92) for tomosynthesis (p<0.001).

Authors of the Norse screening trial wrote about their initial experience with digital breast tomosynthesis in a clinical setting. The study sample comprised 129 women with a palpable lump (23%) or abnormal findings on screening mammography (42%), and women undergoing surveillance after prior biopsy or breast conservation surgery (35%). Twenty-five cancers were
diagnosed, including 18 invasive cancers, 5 ductal carcinomas in situ (DCIS), and 2 other cancers. Thirty-eight percent of the women had dense breasts (BI-RADS density categories of 3 or 4). Of the 50 women in the reader study, 23 had cancer, 5 of which were DCIS. All 3 readers missed 2 of the DCIS cases. Two cancers were detected in women with dense breasts, increasing cancer detection by 8%.

Several studies assessing diagnostic digital breast tomosynthesis have been published subsequent to the TEC Assessment. These studies are summarized in Table 3. These studies reported that addition of tomosynthesis to digital mammography increased diagnostic accuracy overall, with improvements in true positive rates (sensitivity) exceeding improvements in true negative rates (specificity). However, PPV remained low (≥50%). Differences in test performance between studies (ie, between Rafferty 2014 and Thibault 2013) are likely due to the difference in technologies studied (2-view digital mammography plus 1-view tomosynthesis vs 1-view digital mammography plus 1-view tomosynthesis, respectively), but also to differences in sample size (310 vs 130, respectively), setting (U.S. vs Europe, respectively), number of readers (15 vs 7, respectively), training (150 cases vs 20 cases, respectively).

Table 3. Studies of Diagnostic Digital Breast Tomosynthesis

<table>
<thead>
<tr>
<th>Study</th>
<th>AUC</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>PPV, %</th>
<th>NPV, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rafferty (2014)(35), N=310</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>0.828</td>
<td>63</td>
<td>86</td>
<td>47</td>
<td>92</td>
</tr>
<tr>
<td>DM + 1-view DBT</td>
<td>0.864a</td>
<td>71a</td>
<td>86</td>
<td>50</td>
<td>94</td>
</tr>
<tr>
<td>DM + 2-view DBT</td>
<td>0.895a</td>
<td>79a</td>
<td>85</td>
<td>50</td>
<td>95</td>
</tr>
<tr>
<td>Gennaro (2013)(37), N=463</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>NR</td>
<td>76</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>1-view (CC) DM + 1-view DBT</td>
<td>NR</td>
<td>79</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Thibault (2013)(36), N=130</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>0.756</td>
<td>73</td>
<td>53</td>
<td>53</td>
<td>74</td>
</tr>
<tr>
<td>1-view (CC) DM + 1-view DBT</td>
<td>0.780</td>
<td>68</td>
<td>64</td>
<td>58</td>
<td>73</td>
</tr>
<tr>
<td>DM + 1-view DBT + US</td>
<td>0.763</td>
<td>81</td>
<td>52</td>
<td>55</td>
<td>79</td>
</tr>
</tbody>
</table>

Note: One-view DBT is MLO unless noted otherwise.

AUC: area under the receiver operating characteristic curve; CC: craniocaudal; DBT: digital breast tomosynthesis; DM: digital mammography (2-view unless noted otherwise); MLO: mediolateral-oblique; NPV: negative predictive value; NR: not reported; PPV: positive predictive value; US, ultrasound.

a Statistically significant difference from DM.
b Statistically significant difference from 1-view DBT

Tagliafico et al (2015) compared digital mammography versus digital mammography plus tomosynthesis in BI-RADS classification of microcalcification clusters at 3 centers in Italy. Six
radiologists evaluated images from 107 women with biopsy-proven microcalcification clusters who had both digital mammography and tomosynthesis images available and minimum follow-up of 12 months. All clusters were visible on both mammography and tomosynthesis, and 41 (38%) were malignant. Of 11 discordant results, 3 were malignant and were incorrectly underclassified as benign (R2) by mammography plus tomosynthesis; 8 (including 1 high-risk lesion) were nonmalignant and were incorrectly classified as malignant (R3 or R4) by mammography alone. Overall sensitivity and specificity were 100% (95% CI, 91 to 100) and 95% (95% CI, 87 to 99), respectively, for mammography, and 91% (95% CI, 79 to 98) and 100% (95% CI, 95 to 100) for mammography plus tomosynthesis. Overall intra- (based on repeated analysis of 50 image sets 2 months later) and interobserver agreement was good (weighted $\kappa$ range, 0.61-0.80) for both mammography and tomosynthesis. The study suggests that tomosynthesis may miss a small proportion of malignant lesions in patients with microcalcification clusters.

Section Summary

This mixed set of articles provides evidence of either a similar diagnostic performance between breast tomosynthesis and other approaches or an advantage for breast tomosynthesis. Mixed patient populations, differences in references standard, use of different imaging tests to compare with breast tomosynthesis, and variations in follow-up make it difficult to draw conclusions from these studies.

Ongoing Research

Digital breast tomosynthesis continues to be an active field of investigation. A search of online site, clinicaltrials.gov, identified 17 active studies of digital breast tomosynthesis. All but 2 studies had sample sizes larger than 100, and 6 studies were larger than 1000 (eg, 15,000 [NCT01091545] and 25,000 [NCT01248546, the study whose interim analysis was reported by Skaane et al (2013)]). A large study with target enrollment of 12,000 was suspended due to funding unavailability (NCT01593384).

Several studies have assessed different breast tomosynthesis equipment, including a study of the Siemens Inspiration Digital Breast Tomosynthesis system (NCT01373671) and 3 completed studies sponsored by GE Healthcare that have not yet been published (NCT NCT00535184, NCT NCT00535327, NCT00535678).

Practice Guidelines and Position Statements

American College of Radiology

ACR does not include digital breast tomosynthesis in its Appropriateness Criteria for screening or diagnostic breast imaging. However, in a joint news release with the Society of Breast Imaging after release of the Norse study interim analysis by Skaane et al (2013), the organizations stated, “While the study results are promising, they do not provide adequate information to define the role of tomosynthesis in clinical practice.” They also noted that while cancer detection was greater with tomosynthesis, it is unknown whether incremental health benefits would be the same during a second round of screening. Furthermore, they noted “how the technology will affect screening accuracy among women of different ages, risk profiles and parenchymal density is uncertain. In
addition, how this technology would affect reader performance among U.S. radiologists with varying practice patterns and expertise is also uncertain. Other questions include whether computer aided detection will provide any further benefit, and if reconstructed images (presumably 2D) can be used, in lieu of standard full field digital images, to reduce radiation dose.”

In an ACR Statement on Breast Tomosynthesis dated November 24, 2014, however, the position had changed:

“A new digital technology, breast tomosynthesis has shown to be an advance over digital mammography, with higher cancer detection rates and fewer patient recalls for additional testing. This is extremely important. The medical community has long sought ways to improve breast cancer screening accuracy. Better sensitivity will likely translate into more lives saved. Lower recall rates result in fewer patients who may experience short-term anxiety awaiting test results. This is important evidence that tomosynthesis will have a positive impact on patient care.…

“As this technology is used in clinical practice, we anticipate that further studies will clarify its impact on long-term clinical outcomes, including reduced mortality. It will also be important to further elucidate which subgroups of women might benefit most from these exams (by age, breast density, frequency of examination, etc.)….

“To be clear: tomosynthesis is no longer investigational. Tomosynthesis has been shown to improve key screening parameters compared to digital mammography.

“While the College encourages more studies to clarify the clinical role(s) of tomosynthesis and its long-term outcomes, it is clear that tomosynthesis represents an advance in breast imaging.”

American College of Obstetricians and Gynecologists

In its 2011 practice bulletin on breast cancer screening, ACOG noted that digital breast tomosynthesis is 1 of several screening techniques that were considered but not recommended for routine screening.

National Comprehensive Cancer Network

According to the National Comprehensive Cancer Network, “Early studies show promise for tomosynthesis mammography. Two large trials showing a combined use of digital mammography and tomosynthesis resulted in improved cancer detection and decreased call back rates; of note, this is double the dose of radiation and is a factor in recommending this modality. Definitive studies are still pending.”

U.S. Preventive Services Task Force

In 2009, USPSTF updated its recommendations for breast cancer screening using film mammography and using methods other than film mammography. USPSTF recommends mammography and digital mammography but does not include digital tomosynthesis. However, the Department of Health and Human Services, in implementing the Affordable Care Act, utilizes USPSTF 2002 recommendations on breast cancer screening. These recommendations do not
include digital breast tomosynthesis. USPSTF is in the process of updating its recommendations for breast cancer screening.

Medicare National Coverage

There is no national coverage determination (NCD). In the absence of an NCD, coverage decisions are left to the discretion of local Medicare carriers.

VI. Important Reminder

The purpose of this Medical Policy is to provide a guide to coverage. This Medical Policy is not intended to dictate to providers how to practice medicine. Nothing in this Medical Policy is intended to discourage or prohibit providing other medical advice or treatment deemed appropriate by the treating physician.

Benefit determinations are subject to applicable member contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control.

This Medical Policy has been developed through consideration of the medical necessity criteria under Hawaii’s Patients’ Bill of Rights and Responsibilities Act (Hawaii Revised Statutes §432E-1.4), generally accepted standards of medical practice and review of medical literature and government approval status. HMSA has determined that services not covered under this Medical Policy will not be medically necessary under Hawaii law in most cases. If a treating physician disagrees with HMSA’s determination as to medical necessity in a given case, the physician may request that HMSA reconsider the application of the medical necessity criteria to the case at issue in light of any supporting documentation.

VII. References


