# Standardized structured breast MRI report: a technical note

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## ABSTRACT

*Currently, the American College of Radiology (ACR) Breast Imaging Reporting and Data System (BI-RADS) 5th Edition lexicon is widely used for the interpretation of breast lesions on magnetic resonance imaging (MRI). It is known worldwide and should be used by all radiologists who specialize in breast imaging. However, it is not always easy to interpret the specific imaging features of the BI-RADS ACR categories. In addition, other systematic methods can improve the diagnostic accuracy of breast MRI, such as the Kaiser score, a widely used clinical decision aid based on the BI-RADS lexicon, which has a high diagnostic accuracy in classifying mass and non-mass breast lesions. The MRI report should be concise, clear and provide important details about the breast lesions. This technical note aims to provide a standardized structured report template using the ACR BI-RADS 5th Edition lexicon and Kaiser score to increase clarity and completeness.*

*Keywords: Breast magnetic resonance imaging. Breast Imaging Reporting and Data System. Kaiser score. Breast cancer. MRI lexicon.*

## INTRODUCTION

A tree-shaped evaluation of breast magnetic resonance imaging (MRI) findings to differentiate benign from malignant imaging findings was first described in 1997 by Nuñez et al.[1] with a model based on architectural features of breast lesions. Another approach was proposed in 2002 by the Göttingen group with 5 criteria to define and evaluate a category for contrast-enhanced MRI[2] that mimics the categories used in mammography[3]. In 2003, the American College of Radiology (ACR) included a chapter in the fourth edition of the Breast Imaging Reporting and Data System (BI-RADS) describing breast MRI with a lexicon and categories for mass and non-mass breast lesions. This chapter was updated in the 5th edition of 2013[4]. On the other hand, the Kaiser score diagnostic criteria align with the BI-RADS lexicon for MRI were published in 2013. The Kaiser score has proven its value in aiding radiologists in clinical decision making and in differentiating between benign and malignant enhanced lesions on breast MRI[5]. The Kaiser score has shown a high specificity

for lesion detection of 87.4% and a positive predictive value of 94%[6-8]. This technical note aims to provide a standardized structured reporting template using the BI-RADS 5th Edition lexicon and the Kaiser score to increase clarity and completeness.

## RECOMMENDATIONS FOR A STANDARDIZED STRUCTURED BREAST MRI REPORT

The BI-RADS 5th Edition provides a standardized lexicon for the interpretation and classification of breast MRI lesions[4,9-14]. The lexicon contains appropriate terms for enhancement features and a standardized classification of breast lesions. A general description of breast composition includes the amount of fibroglandular tissue and parenchymal enhancement in the background. The description of the findings includes focus, mass, non-mass lesion, abnormal enhancement descriptors, intramammary lymph nodes, skin lesions, associated features (non-enhancing findings and fat-containing lesions), location, size and kinetic curve, and the presence of implants.

The Kaiser score, on the other hand, combines criteria from the BI-RADS lexicon and other findings into a flowchart with 11 criteria for categorizing mass and non-mass breast lesions[6,7]. The Kaiser score has been validated and there is a freely available online calculator at https://school-of-radiology.com/kaiser-score[8]. The higher values of the Kaiser score reflect the increasing likelihood of malignancy and, together with the clinical context, aid in individual decision-making and are useful for therapeutic decision-making and prognosis[6,7,15-17].

## STANDARDIZED STRUCTURED BREAST MRI REPORT

We propose a standardized template for a structured breast MRI report, which is divided into several sections that are filled in with patient information in a specific order (Table 1) (Supplementary material, Table 1).

The first section is the simplest and shortest and includes the full name of the imaging examination and whether it is simple (unenhanced) or contrasted breast MRI.

The second section states the reason for the examination: screening, diagnosis, staging, complementary, treatment evaluation and/or follow-up of breast cancer.

The third section contains information about the patient's medical history, such as family and/or personal history. If breast cancer has been recently diagnosed, the histopathologic diagnosis and the date and location of previous imaging examinations should be included.

The fourth section contains information on the sequences and techniques used, including post-processing.

The fifth section contains a general description starting with the breast composition: the amount of fibroglandular tissue, parenchymal enhancement in the background, and whether implants and/or artifacts are present.

The sixth section is one of the most important. Here the features of the visualized lesions are described. At this point, we proposed add the features described in the BI-RADS lexicon and the features taken into account in the Kaiser score, whether they are mass and/or non-mass lesions. This paragraph should include the affected side, the location (quadrant) of the breast lesion, the radius and the distance to the nipple. Mass features include shape, margin, root sign (yes/no), enhancement, kinetic curve, size measured in the three axes, and ipsilateral edema (yes/no). The non-mass features include enhancement, distribution, margins (circumscribed or not), root sign (yes/no), kinetic curve, size measured in three axes and ipsilateral edema (yes/no).

The seventh section describes the distribution pattern: unifocal pattern, a multifocal pattern, a multicentric uniquadrant, or a multicentric multiquadrant[18]. The distribution pattern is only specified for malignant lesions. A digital blank template of breast MRI diagrams for reporting distribution patterns is provided (Supplementary material, Table 2).

The eighth section describes other associated features such as non-enhancing findings and fat-containing lesions and types of findings such as cysts, lipomas, hemangiomas, benign solid nodules, scars, benign skin lesions, or tissue marker clips.

The ninth and tenth sections contain information on other soft tissue findings, including the skin, nipple, and nipple-areola complex[19]. For example, the skin may show edema, thickening, tumor involvement, invasion, and/or retraction. The nipple and nipple-areola complex may have tumor involvement, invasion, and/or retraction.

The eleventh section describes the axillary nodes in three levels and the internal mammary chain; in the case of abnormal lymph nodes, the number and the levels in which they are located.

The twelfth section contains further abnormalities that are relevant to the clinical context, such as metastases.

**Table 1.** Standardized structured breast MRI report template

| Description | Patient information |
|---|---|
| Date and place: | |
| Name of the patient: | |
| Name of the referring physician: | |
| 1. Name of the imaging examination. | |
| 2. Indication: screening, diagnosis, staging, complementary examination, evaluation of treatment or follow-up of breast cancer. | |
| 3. Medical history: family and/or personal. If there is a history of breast cancer, indicate the histopathologic diagnosis and the date and location of previous examinations. | |
| 4. Examination technique: indicate the sequences performed and the techniques used for post-processing. | |
| 5. General description of breast composition: indicate the amount of fibroglandular tissue and parenchymal enhancement in the background. | |
| 6. Description of imaging findings including the ACR BI-RADS lexicon and features assessed by the Kaiser score, applies to each lesion(s) identified: <u>Mass:</u> location (side, radius by clock time), distance from nipple, morphology, shape, margin, root sign (yes/no), enhancement, type of kinetic curve, size measured in the three axes, and ipsilateral edema (yes/no). <u>Non-mass:</u> location (radius by clock time), distance from nipple, enhancement, distribution, margin (circumscribed or not), root sign (yes/no), type of kinetic curve and size measured on three axes and ipsilateral edema (yes/no). | |
| 7. Distribution pattern (only indicated for malignant lesions): unifocal pattern, multifocal pattern, multicentric uniquadrant pattern, or multicentric multiquadrant pattern. | |
| 8. Description of other associated features: non-enhancing findings and fat-containing lesions and types of findings, such as cysts, lipomas, hemangiomas, benign solid nodules, scars, benign skin lesions, or tissue marker clips. | |
| 9. Description of the skin: edema, thickening, tumor involvement, invasion, and/or retraction. | |
| 10. Description of the nipple and nipple-areola complex: tumor involvement, invasion, and/or retraction. | |
| 11. Description of the axillary lymph nodes, three levels and the internal mammary chain: in the case of abnormal lymph nodes, indicate the number and levels in which they are located. | |
| 12. Description of other abnormalities relevant to the clinical context, e.g., metastases. | |
| 13. Conclusion: the most important information from the breast MRI examination is summarized. | |
| 14. Kaiser score[a,b] | |
| 15. BI-RADS: add the category based on findings, including recommendations. | |
| 16. Name, signature, and license number of the radiologist who performed the breast MRI. | |

[a]Baltzer PA et al.[8]; [b]https://school-of-radiology.com/kaiser-score/[8].

ACR: American College of Radiology; BI-RADS: Breast Imaging Reporting and Data System; MRI: magnetic resonance imaging.

Note: If your facility allows you to store important breast MRI images in the system, you should do so; the attending physicians will be grateful.

**Table 2.** Example of a standardized structured breast MRI report for a benign lesion (Figure 1)

| Description | Patient information: example |
|---|---|
| Date and place: | |
| Name of the patient: | |
| Name of the referring physician: | |
| 1. Name of the imaging examination. | Contrast-enhanced breast MRI |
| 2. Indication: screening, diagnosis, staging, complementary examination, evaluation of treatment or follow-up of breast cancer. | Diagnostic |
| 3. Medical history: family and/or personal. If there is a history of breast cancer, indicate the histopathologic diagnosis and the date and location of previous imaging examinations. | 25-year-old female patient with a palpable lump in both breasts. She has a positive familial risk factor for breast cancer (her sister was diagnosed at the age of 26). |
| 4. Examination technique: indicate the sequences performed and the techniques used for post-processing. | T1-weighted SE, T2 FS, DWI, ADC, T1 GE with FS, T1 DCE with Gd, T1 DCE with Gd and subtraction, kinetic curve, PEI values, MIP and coronal T2 FSE sequences were performed. |
| 5. General description of breast composition: indicate the amount of fibroglandular tissue and parenchymal enhancement in the background. | The breast composition is almost entirely fat, with mild and symmetrical background parenchyma enhancement. |
| 6. Description of imaging findings including the ACR BI-RADS lexicon and features assessed by Kaiser score, applies to each lesion(s) identified: Mass: location (side, radius by clock time), distance from nipple, morphology, shape, margin, root sign (yes/no), enhancement, type of kinetic curve, size measured in the three axes, and ipsilateral edema (yes/no). Non-mass: location (radius by clock time), distance from nipple, enhancement, distribution, margin (circumscribed or not), root sign (yes/no), type of kinetic curve and size measured on three axes and ipsilateral edema (yes/no). | In the right breast, the main mass is located in the upper inner quadrant, in the radius at 11:00, 6 cm from the nipple; it is oval, circumscribed, without root sign and shows enhancement with dark internal septations without edema. Type 2 kinetic plateau curve. The mass measures 3.2 cm in anteroposterior diameter x 3.4 cm in craniocaudal diameter x 2.0 cm in transverse diameter. Multiple oval, circumscribed masses in both breasts with the same features described. |
| 7. Distribution pattern (only indicated for malignant lesions): unifocal pattern, multifocal pattern, multicentric uniquadrant, or multicentric multiquadrant pattern. | Not applicable. |
| 8. Description of other types of findings: cyst, lipoma, hemangioma, benign solid mass, scar, benign skin lesion, tissue marker clip, non-enhancing findings and whether implants are present. | None |
| 9. Description of the skin: edema, thickening, tumor involvement, invasion and/or retraction. | None |
| 10. Description of the nipple and nipple-areola complex: tumor involvement, invasion and/or retraction. | None |
| 11. Description of the axillary lymph nodes, three levels and the internal mammary chain: in the case of abnormal lymph nodes, indicate the number and levels in which they are located. | None |
| 12. Description of other abnormalities relevant to the clinical context, e.g., metastases. | None |
| 13. Conclusion: the most important information from the breast MRI examination is summarized. | Multiple oval and circumscribed masses in both breasts contain benign features. |
| 14. Kaiser score[a,b] | 2 |
| 15. BI-RADS: add the category based on findings, including recommendations. | Category BI-RADS 2 Benign -Essentially 0% likelihood of malignancy Recommendations: consider clinical monitoring and, depending on the clinical findings, performing a breast ultrasound. |
| 16. Name, signature, and license number of the radiologist who performed the breast MRI. | |

[a]Baltzer PA et al.[8]; [b]https://school-of-radiology.com/kaiser-score/[8].

ACR: American College of Radiology; ADC: apparent diffusion coefficient; BI-RADS: Breast Imaging Reporting and Data System; DCE: dynamic contrast-enhanced; DWI: diffusion-weighted imaging; FS: fat suppressed; FSE: fast spin echo; Gd: gadolinium; GE: gradient echo; MIP: maximum intensity projection; MRI: magnetic resonance imaging; PEI: positive enhancement integral; SE: spin echo.

Note: If your facility allows you to store important breast MRI images in the system, you should do so; the attending physicians will be grateful.
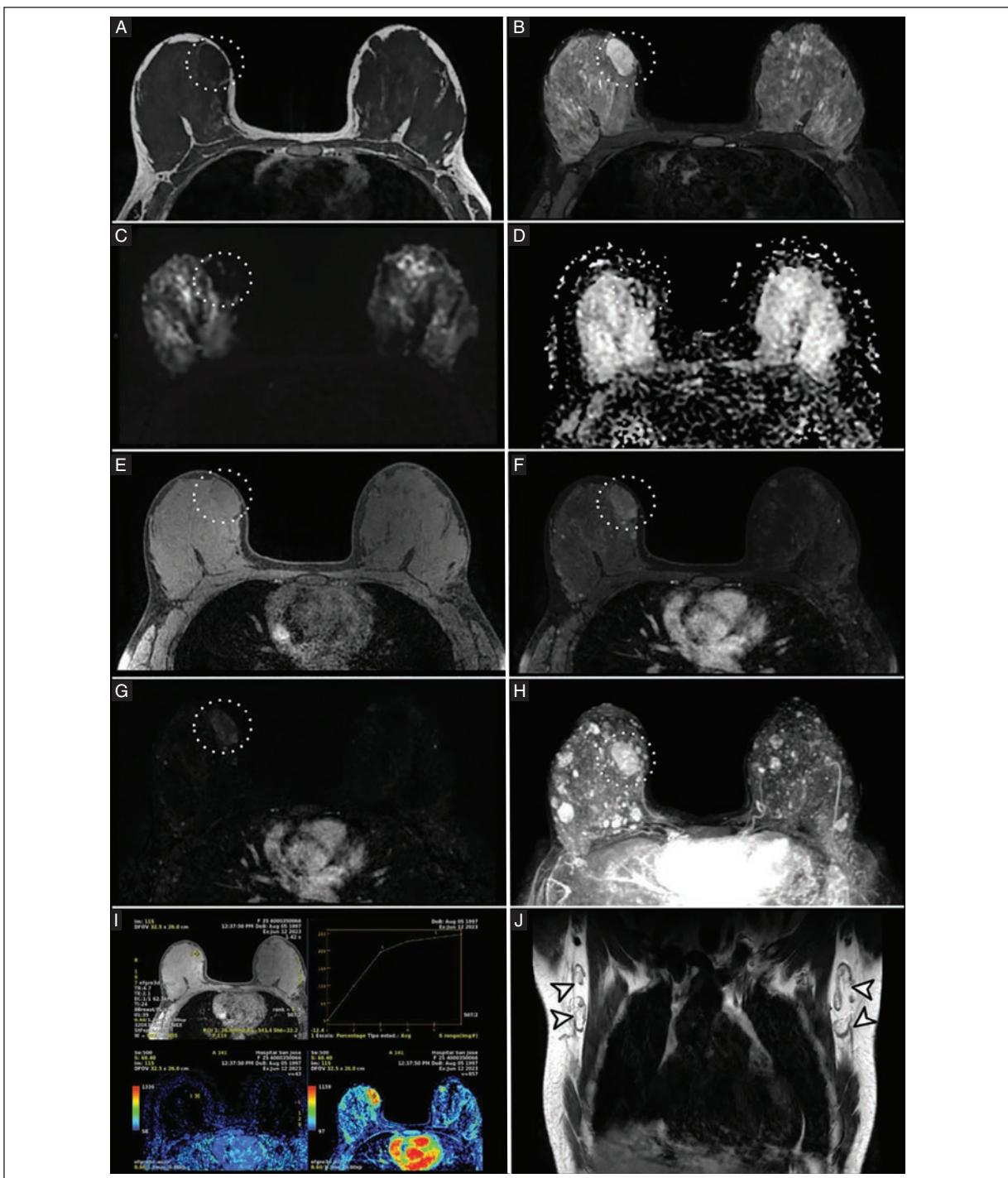
**Figure 1.** Breast MRI lesion in a 25-year-old woman with a palpable mass and a histopathologic diagnosis of fibroadenoma. **A:** T1 weighted SE shows a hypointense oval circumscribed mass in the upper inner quadrant of the right breast (dotted circle). **B:** T2 FS with hyperintense oval circumscribed mass in the upper inner quadrant of the right breast (dashed circle). **C:** DWI sequence and **D:** ADC without restriction in the topography of the lesion (dotted circles). **E:** T1 GE with FS shows an isointense oval circumscribed mass in the upper inner quadrant of the right breast (dotted circle). **F:** T1 DCE with Gd and **G:** T1 DCE with Gd with subtraction with the lesion of interest in the right breast showing enhancement with dark internal septations (dotted circles). **H:** MIP with multiple oval and circumscribed masses in both breasts. Some show enhancement with dark internal septations, others show homogeneous uptake. The largest mass is 3.4 cm in size and is located in the inner upper quadrant of the right breast (dotted circle). **I:** PEI with correlation of time-signal intensity curves performed on the main lesion shows a type II plateau curve. **J:** coronal T2 FSE with normal lymph nodes in the axillary level (white arrowheads).  This mass corresponds to a Kaiser score of 2, BI-RADS category 2.

ADC: apparent diffusion coefficient; BI-RADS: Breast Imaging Reporting and Data System; DCE: dynamic contrast-enhanced; DWI: diffusion-weighted images; FS: fat suppressed; FSE: fast spin echo; GE: gradient echo; Gd: gadolinium; MIP: maximum intensity projection; MRI: magnetic resonance imaging; PEI: positive enhancement integral; SE: spin echo.

**Table 3.** Example of a standardized structured breast MRI report for a malignant breast lesion (Figure 2)

| Description | Patient information: example |
|---|---|
| Date and place: | |
| Name of the patient: | |
| Name of the referring physician: | |
| 1. Name of the imaging examination. | Contrast-enhanced breast MRI |
| 2. Indication: screening, diagnosis, staging, complementary examination, evaluation of treatment or follow-up of breast cancer. | Diagnostic |
| 3. Medical history: family and/or personal. If there is a history of breast cancer, indicate the histopathologic diagnosis and the date and location of previous imaging examinations. | 34-year-old female patient with a palpable lump in the right breast. She has a positive family history of breast cancer (her sister was diagnosed at the age of 40). |
| 4. Examination technique: indicate the sequences performed and the techniques used for post-processing. | T1 weighted SE, T2 FS, DWI, ADC, T1 GE with FS, T1 DCE with Gd, T1 DCE with Gd and subtraction, kinetic curve, PEI values, MIP and coronal T2 FSE sequences were performed. |
| 5. General description of breast composition: indicate the amount of fibroglandular tissue and parenchymal enhancement in the background. | The breast composition is heterogeneous fibroglandular tissue with minimal and symmetrical background parenchyma enhancement. |
| 6. Description of imaging findings including the ACR BI-RADS lexicon and features assessed by Kaiser score, applies to each lesion(s) identified: <br> <u>Mass:</u> location (side, radius by clock time), distance from nipple, morphology, shape, margin, root sign (yes/no), enhancement, type of kinetic curve, size measured in the three axes, and ipsilateral edema (yes/no). <br> <u>Non-mass:</u> location (radius by clock time), distance from nipple, enhancement, distribution, margin (circumscribed or not), root sign (yes/no), type of kinetic curve and size measured on three axes and ipsilateral edema (yes/no). | There are three masses in the right breast: mass #1 is located in the upper outer quadrant at 10:00, 5 cm from the nipple, is irregular in morphology and margin, without root sign, with heterogeneous enhancement and has a late plateau phase (kinetic curve type 2). It measures 4.3 cm in anteroposterior diameter, 3.1 cm in craniocaudal diameter, and 2.4 cm in transverse diameter. Mass #2 is located in the upper inner quadrant, at 2:00 of the clock, 4 cm from the nipple, and is irregular in morphology and margin, with root sign, heterogeneous enhancement and a late plateau phase (kinetic curve type 2). It measures 2.7 cm in anteroposterior diameter, 4.5 cm in craniocaudal diameter and 2.7 cm in transverse diameter. Mass #3 is located in the lower inner quadrant at 8:00 of the clock, 2 cm from the nipples and is irregular in morphology and margin, without root sign, heterogeneous enhancement and a late plateau phase (kinetic type 2 curve). It measures 4.6 cm in anteroposterior diameter, 4.0 cm in craniocaudal diameter, and 4.0 cm in transverse diameter. There is ipsilateral edema. They show diffusion restriction with a very low ADC value between 0.480 and 0.633 x $10^{-3}$ mm$^2$/s. <br> In addition, further small irregular hyperenhanced masses are observed in both upper quadrants. These findings are associated with diffuse subcutaneous prepectoral edema and pectoral edema. |
| 7. Distribution pattern (only indicated for malignant lesions): unifocal pattern, multifocal pattern, multicentric uniquadrant, or multicentric multiquadrant pattern. | Multicentric multiquadrant pattern. |
| 8. Description of other associated features: cyst, lipoma, hemangioma, benign solid mass, scar, benign skin lesion, tissue marker clip, non-enhancing findings and whether implants are present. | None |
| 9. Description of the skin: edema, thickening, tumor involvement, invasion, and retraction. | There is thickening of the skin. |
| 10. Description of the nipple and nipple-areola complex: tumor involvement, invasion, and retraction. | Thickening of the nipple-areola complex. |
| 11. Description of the axillary lymph nodes, three levels and the internal mammary chain: in case of abnormal lymph nodes, indicate the number and levels in which they are located. | Three abnormal lymph nodes with cortical thickening of up to 7 mm at level I are observed in the right axillary region. |

*(Continued)*

Table 3. Example of a standardized structured breast MRI report for a malignant breast lesion (Figure 2) *(continuation)*

| Description | Patient information: example |
|---|---|
| 12. Description of other abnormalities relevant to the clinical context, e.g., as metastases. | No other relevant abnormalities were found in the anatomical structures. |
| 13. Conclusion: the most important information from the breast MRI examination is summarized. | Highly suggestive of a malignancy in the right breast, multicentric multiquadrant pattern with ipsilateral lymph node involvement. It is also associated with diffuse thickening and edema of the skin and nipple-areola complex. |
| 14. Kaiser score[a,b] | 10 |
| 15. BI-RADS: add the category based on findings, including recommendations. | Category BI-RADS 5<br>Highly suggestive of malignancy, ≥ 95% likelihood of malignancy.<br>A breast biopsy is recommended. |
| 16. Name, signature, and license number of the radiologist who performed the breast MRI. | |

[a]Baltzer PA et al.[8]; [b]https://school-of-radiology.com/kaiser-score/[8].
ADC: apparent diffusion coefficient; ACR: American College of Radiology; BI-RADS: Breast Imaging Reporting and Data System; DCE: dynamic contrast-enhanced; DWI: diffusion-weighted imaging; FS: fat suppressed; FSE: fast spin echo; Gd: gadolinium; GE: gradient echo; MIP: maximum intensity projection; MRI: magnetic resonance imaging; PEI: positive enhancement integral; SE: spin echo.
Note: If your facility allows you to store important breast MRI images in the system, you should do so; the attending physicians will be grateful.

The thirteenth section is the conclusion, which summarizes the most important information about the main breast MRI lesion(s).

The Kaiser score is added in section fourteen. It can be accessed on the virtual platform: https://school-of-radiology.com/kaiser-score[14]. It is easy to use and contains intuitive questions about specific lesion features. When the algorithm is completed, the result of the Kaiser score for a specific case and the corresponding BI-RADS recommendation is displayed.

The BI-RADS categories and recommendations are described in section fifteen[4]: Category 1: Negative – Essentially 0% likelihood of malignancy; Category 2: Benign – Essentially 0% likelihood of malignancy; Category 3: Probably benign – ≥ 0% but ≤ 2% likelihood of malignancy; Category 4: Suspicious – > 2% but < 95% likelihood of malignancy; Category 5: Highly suggestive of malignancy – ≥ 95% likelihood of malignancy; and Category 6: Known biopsy-proven malignancy N/A.

Finally, in section sixteen, the radiologist who interpreted the breast MRI provides name, signature, and license number.

Table 2 describes the standardized structured template for the breast MRI report using the example of a 25-year-old woman with multiple lumps in the breast and a histopathologic diagnosis of benign fibroadenoma (Figure 1).

Table 3 describes the standardized structured breast MRI report template using the example of a 34-year-old woman with a breast mass and a histopathologic diagnosis of no special type (NST) luminal B infiltrating carcinoma (Figure 2).

## CONCLUSION

This evidence-based technical note provides a standardized structured report template using the ACR BI-RADS 5th Edition lexicon and Kaiser score to improve clarity and completeness. A supplemental digital template for the standardized structured breast MRI report and the breast cancer distribution patterns are available for download.

### *Conflicts of interest*

The authors declare that they have no conflicts of interest.

### *Ethical considerations*

**Protection of humans and animals.** The authors declare that the procedures followed complied with the
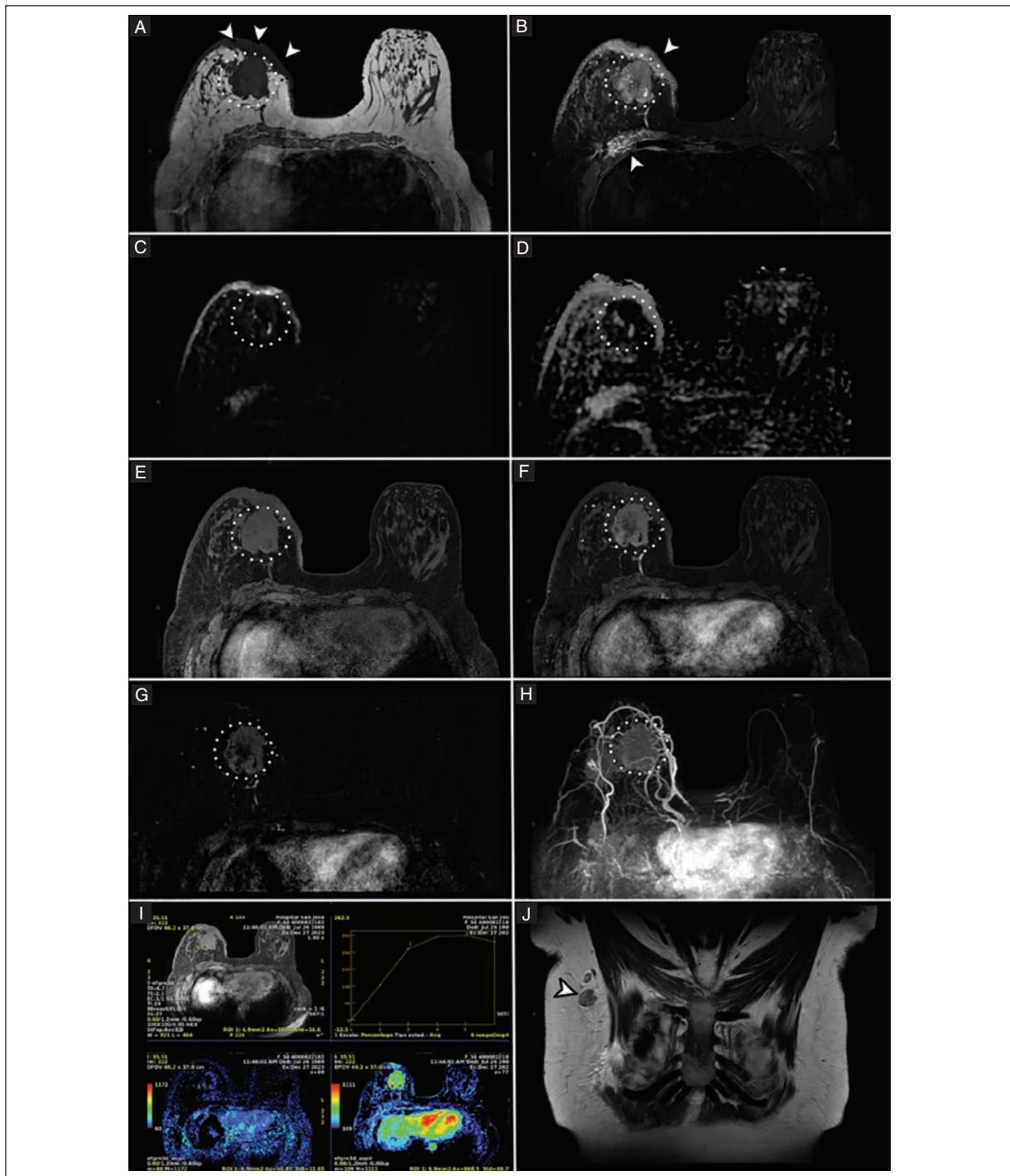
**Figure 2.** Breast MRI lesion in a 34-year-old woman with a palpable lump. The histopathologic diagnosis was NST luminal B infiltrating carcinoma. **A:** T1 weighted SE with scattered fibroglandular tissue. There is an irregular hypointense mass in the inner lower quadrant of the right breast with skin thickening and retraction (white arrowheads). **B:** T2 FS with the same irregular oval mass showing some internal hyperintense areas with associated subcutaneous and prepectoral edema (white arrowheads). **C:** DWI and **D:** ADC with restriction and very low ADC value (dotted circles). **E:** T1 GE with FS shows an irregular mass with subcutaneous edema (dotted circle). **F:** T1 DCE with Gd and **G:** T1 DCE with Gd with subtraction show the irregular oval mass with heterogeneous enhancement (dashed circles). **H:** MIP shows an irregular mass with increased vessels compared to the contralateral side (dashed circle). **I:** PEI with time-signal intensity for the finding of interest showing a type 2 kinetic curve. **J:** coronal T2 FSE with abnormal lymph nodes in axillary level I (white arrowhead). This mass corresponds to a Kaiser score of 10, BI-RADS category 5. Multicentric multiquadrant distribution pattern (not shown).

ADC: apparent diffusion coefficient; BI-RADS: breast imaging reporting and data system; DCE: dynamic contrast-enhanced; DWI: diffusion-weighted images; FS: fat suppressed; FSE: fast spin echo; Gd: gadolinium; GE: gradient echo; MIP: maximum intensity projection; MRI: magnetic resonance imaging; NST: not-special type; PEI: positive enhancement integral; SE: spin echo.

ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki. The procedures were approved by the institutional Ethics Committee.

**Confidentiality, informed consent, and ethical approval.** The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee.

**Declaration on the use of artificial intelligence.** The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

## *Supplementary data*

Supplementary data are available online in the Journal online DOI: 10.24875/JMEXFRI.M25000096. These data are provided by the corresponding author and published online for the reader's benefit. The contents of supplementary data are the sole responsibility of the authors.

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