

# Patterns of breast cancer radiotherapy practices among Saudi radiation oncologists

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## ABSTRACT

**الأهداف:** التعرف على أنماط ممارسة العلاج الإشعاعي لأورام الثدي بين أطباء الأورام بالإشعاع في المملكة العربية السعودية.

**المنهجية:** تم إنشاء استبيان يتكون من 27 سؤالاً علمياً و6 أسئلة ديموغرافية في عام 2019 من قبل عضو هيئة التدريس بجامعة الملك عبد العزيز بجدة، المملكة العربية السعودية، وتم توزيعه على أطباء الأورام بالإشعاع في المملكة العربية السعودية بين فبراير إلى أبريل عام 2019 م.

**النتائج:** وردت 24 ردًا. فيما يتعلق بعلاج جدار الصدر بعد استئصال الثدي، اقترح 100% ممن أجابوا الاستبيان العلاج الإشعاعي بعد استئصال الثدي (PMRT) لمرض T3N1 أو T4، بينما اقترح 87.5% للمرضى من الدرجة T2N1، و83.3% للمرضى من الدرجة T3N0. في المقابل، لم يكن هنالك توافق في الآراء بشأن تحديد المنطقة المراد علاجها وتخطيط العلاج ومعايير التغطية للغدد الليمفاوية الثديية الداخلية.

**الخلاصة:** ظهرت اختلافات في ممارسة العلاج الإشعاعي للثدي في المملكة العربية السعودية بسبب عدم وجود أدلة سريرية ومبادئ توجيهية وطنية، إضافة إلى الاختلافات المحتملة في تخصيص الموارد الصحية. يوصى بتخصيص الموارد وإنشاء مبادئ توجيهية وطنية لتقليل من هذا التباين والسماح بتبادل البيانات وتطوير التعاون البحثي الوطني.

**Objectives:** To identify practice patterns among radiation oncologists in Saudi Arabia.

**Methods:** A questionnaire comprising 27 scientific questions and 6 demographic questions was created in 2019 by a faculty member at King Abdulaziz University, Jeddah, Saudi Arabia, and distributed among radiation oncologists in Saudi Arabia between February and April 2019.

**Results:** Twenty-four responses were received. Regarding chest wall treatment after mastectomy, 100% of the respondents offered postmastectomy radiotherapy (PMRT) for tumor stage 3 node 1 (T3N1) or T4 disease, while 87.5% offered PMRT for T2N1, and 83.3% offered PMRT for T3N0 disease. In contrast, there was a lack of consensus regarding treatment planning and coverage criteria for internal mammary lymph nodes and contouring.

**Conclusion:** Variations in breast radiotherapy practices in Saudi Arabia exist due to the lack of clinical evidence and national guidelines, as well as potential variations in health resources allocation. Resource allocations and the establishment of national guidelines are recommended to decrease this variation and allow for data exchange and the development of national research collaborations.

**Keywords:** radiotherapy, breast, Saudi Arabia, practice

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Breast cancer is the most common cancer among women worldwide as well as in Saudi Arabia.<sup>1,2</sup> In the latest cancer registry report in 2015, the median age at diagnosis was <50 years and the age-adjusted incidence was 22.7/100,000 in the female population, and they are both most likely to increase.<sup>2</sup> There is a paucity of data describing the stage-adjusted incidence and prevalence of different molecular subtypes of breast cancer among Saudi nationals.

A combination of surgery, hormonal therapy, chemotherapy, immunotherapy, and/or radiotherapy is used for the management of breast cancer. Adjuvant radiotherapy after lumpectomy is equivalent to mastectomy for early-stage breast cancer and improves the survival outcome of the patients.<sup>3</sup> Even after mastectomy, adjuvant locoregional radiotherapy is correlated with improved local control and survival in high-risk patients.<sup>4</sup>

The indications, dosage, and treatment volumes of adjuvant locoregional radiotherapy such as adjuvant radiotherapy in node stage 1 (N1) or high-risk node-negative disease, the use of hypofractionated radiotherapy after mastectomy with or without reconstructive surgery or when treating the regional lymphatics, and the inclusion of the internal mammary (InM) chain of lymphatics in the treated volume after lumpectomy or mastectomy have been the subject of much controversy.<sup>5,6</sup>

There are also variations in the treatment planning process itself. The exact definitions of the target volumes, the use of advanced techniques, and others differ between centers and radiation oncologists.<sup>7</sup> Those disparities may also be influenced by the availability of resources.

According to the health transformation strategy of the Saudi Vision 2030, which aims to improve the quality of services, the performance of healthcare organizations, and the delivery of safe, effective, patient-centered care,<sup>8</sup> it is important to identify these variations in practices and the issues regarding possible resource allocation. This survey aimed to identify the patterns of practices in radiotherapy for breast cancer among Saudi radiation oncologists.

**Methods.** In this cross-sectional study, conducted between February and April 2019, a questionnaire was distributed using official e-mail listings in the Saudi Council for Health Specialties, Jeddah, Saudi Arabia to all of the 120 registered radiation oncologists without applying any exclusion criteria, a link to the survey was also shared through the Saudi assembly of radiation oncologists. Date of birth or e-mail registration was used to confirm a single response from each radiation oncologist. Respondents to the questionnaire were asked to select “yes,” indicating their consent to share their responses for research and publication purposes. The ethics board at our institution, Ref Number 63-19, approved this study and it was carried out according to principles of Helsinki Declaration.

The questionnaire, with 27 scientific and 6 demographic questions, was created using Google forms. The questions covered 6 subjects in radiotherapy for breast cancer: ductal carcinoma in situ (DCIS),

hypofractionation, postmastectomy radiotherapy (PMRT), regional nodal irradiation (RNI), radiotherapy planning, and deep inspirational breath-hold (DIBH) techniques. These questions were selected by the author and represent controversial areas that are frequently discussed at the department and national meetings.

**Statistical analyses.** Simple descriptive statistical analyses were performed using IBM SPSS statistics for Windows, version 26 (IBM Corp, Armonk, NY, USA) to analyze the responses in terms of medians and standard deviations.

### **Results. Characteristics of the survey participants.**

Twenty-four (21.4%) radiation oncologists responded to the questionnaire. The participants were 6 (25%) women and 18 (75%) men. Of the respondents, 9 (37.5%) had 1-3 years work experience and 7 (29.2%) had  $\geq 10$  years of work experience. Most respondents (38%) were affiliated with the Ministry of Health, followed by the Ministry of Education (29%). The majority of the respondents (83%) underwent training in North America. Twenty-two respondents (92%) treated breast cancer patients in their practice.

**Analysis of the survey responses.** Regarding DCIS, 14 (58.3%) respondents chose a 2-mm margin as the minimum acceptable margin without re-excision, whereas 7 (29.2%) responded that anything except a positive margin was acceptable. Fifteen (62%) respondents would provide boost radiation if the margin was less than 2 mm. Other indications for boost radiation included young age (33%), high-grade tumor (25%), and positive/inoperable positive margins (12.5%). Only one respondent chose to boost for all patients with DCIS. The above data is not tabulated.

Of the 24 radiation oncologists surveyed, 6 (25%) always used hypofractionated regimens. The most common reasons for not using hypofractionation were immediate reconstruction (45.8%), InM radiation (25%) and nodal irradiation (16.7%). The dose used was 40 Gy/15 F, although the responses were divided regarding the dose of boost radiation. More than half of the respondents would follow the exact same constraints as conventional fractionation. **Table 1** shows the detailed responses of the participants.

All respondents indicated that they would offer PMRT for tumor stage 3 (T3) N1 or T4 disease, 87.5% for T2N1 disease, 83.3% for T3N0 disease, and 54.2% for high-risk N0 disease. Other reasons to offer PMRT were positive margins and a T2 larger than 4 cm. If PMRT was indicated, 58.3% of the responders would treat the chest wall only if N0 disease was detected, whereas 20.8% would treat the chest wall and regional

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**Table 1** - Features of hypofractionation regimens.

Survey questions and response(s)	n (%)
<i>The following is a reason not to hypofractionate*</i>	
Nodal irradiation, with or without InM radiation	4 (16.7)
DCIS	3 (12.5)
Postmastectomy	2 (8.3)
InM radiation	6 (25)
Immediate reconstruction	11 (45.8)
Skin involvement	3 (12.5)
None	6 (25)
Other	2 (8.3)
<i>Dose (Gy/F)</i>	
42.4/16	5 (20.8)
40/15	18 (75)
Other	1 (4.2)
<i>Boost dose (Gy/F)</i>	
2.00	12 (50)
2.5	12 (50)
<i>Organs at risk constraints</i>	
I use the exact same constraints as conventional fractionation	13 (54.2)
I change the dose parameters based on the EQD2 calculation	6 (25)
I follow a certain institutional or trial protocol	5 (20.8)

\*Multiple responses allowed. InM: internal mammary, DCIS: ductal carcinoma in situ, EQD2: equivalent dose in 2 Gy fraction

lymphatics in all PMRT patients. Additionally, 45% of the responders would treat the regional lymph nodes for T4 disease.

The most common practice (58%) indicated for bolus placement was “always placing it,” although for only half the course, whereas 2 (8.3%) respondents indicated that they would place the bolus every day for the duration of the course and only have it removed if there was skin intolerance. The most common indication (54.2%) for boost radiation after mastectomy was close or positive margins, and 5 (20.8%) participants responded that they would never use boost radiation. Other reasons were, to improve coverage, inflammatory breast cancer, positive but not close margins, skin or dermal lymphatic invasion, and a thin chest wall. **Table 2** shows the details of PMRT.

Fifteen (62.5%) respondents would modify the whole-breast field to treat the regional lymph nodes for any N1 disease. In the case of patients with N1 disease, this percentage increased to 66.7% if there were high-risk features, 75% if an extracapsular extension was present, and 79.2% if there was inadequate axillary dissection. After a mastectomy; however, 13 (54.2%) respondents would treat the regional lymph nodes for any N1 disease, which increased to 58.3% for N1 disease with high-risk features, 70.8% for extracapsular

**Table 2** - Features of postmastectomy radiotherapy.

Survey questions and response(s)	n (%)
<i>The following is an indication for PMRT in my practice*</i>	
T3N0	20 (83.3)
T3N1	24 (100)
T4N any	24 (100)
T1-T2N1	21 (87.5)
High-risk node negative	13 (54.2)
Other	2 (8.3)
<i>PMRT volumes*</i>	
Chest wall only unless its N+	14 (58.3)
Chest wall and regional nodes always	5 (20.8)
Chest wall and regional nodes for any T4	11 (45.8)
Chest wall +/- regional nodes for high-risk node negative	9 (37.5)
<i>Bolus placement</i>	
Always, every day, removed only for skin intolerance	2 (8.3)
Always, half of the course	14 (58.3)
For T4 only, everyday	1 (4.2)
For T4 only, half of the course	6 (25)
Other	1 (4.2)
<i>The following is an indication for scar boost after mastectomy</i>	
Close or positive margin	13 (54.2)
I boost all patients	1 (4.2)
None	5 (20.8)

\*Multiple responses allowed PMRT: postmastectomy radiotherapy.  
T: tumor, N: node

extensions, and 75% for inadequate axillary dissections. Twenty-one (87.5%) respondents would treat the regional lymph nodes for N2 disease after both lumpectomy and mastectomy. After lumpectomy, 3 (12.5%) respondents would treat the regional lymph nodes for T3N0 disease without high-risk features and 11 (45.8%) would treat for T3N0 disease with high-risk features. After mastectomy, 5 (20.8%) respondents would treat the regional lymph nodes for T3N0 disease without high-risk features and 15 (62.5%) would treat for T3N0 disease with high-risk features. The majority of the respondents (95.8%) would treat the InM lymph nodes if they were radiologically positive, 2 (8.3%) would treat them whenever the regional lymph nodes were treated, and only one (4.2%) respondent would treat them for right-sided tumors. Fourteen (58.3%) respondents treated InM if the tumor was N1 disease and medially located or involved more than 50% of the axillary nodes. **Table 3** shows the regional nodal radiation responses.

Regarding radiotherapy planning, 21 (87.5%) respondents would always contour the chest wall/breast

and 23 (95.8%) would contour the lymph nodes. However, 9 (37.5%) respondents did not follow the nodal contours and used the standard field borders. Most of the respondents (83.3%) followed the Radiation Therapy Oncology Group atlas for contouring and 12 (50%) added a 5-mm margin for the nodal planning target volume (PTV). Seven (29%) respondents would add PTV only for IMRT but not for 3D treatment. Internal mammary PTV responses varied, with 6 (25%) respondents adding 3-5 mm but trimming from the lung and heart, 5 (20.8) adding 5 mm all around, and

5 (20.8) adding 3-5 mm with IMRT only and without trimming. The definition of acceptable coverage for InM PTV was 80% for 7 (29.2%) respondents, 90% for 8 (33.3%), and 95% for 4 (16.7%) respondents. Four (16.7%) respondents were only interested in clinical target volume (CTV) coverage. More than half of the respondents would prefer InM CTV to be covered by 90% of the prescription dose. The most common technique to treat InM was with modified wide tangents whenever possible at 87.5%, followed by volumetric modulated arc therapy (VMAT) at 54.2%. When asked for the extent of RNI after axillary dissection, 16 respondents (68.7%) would treat the undissected axilla only with a small supraclavicular field (MA20 small field), 2 (8.3%) would treat all axillary levels for any N1 disease, 14 (58.3%) would treat all levels for extracapsular extension, and 17 (70.8%) would treat for inadequate dissection. For N2 disease, 10 (41.7%) would treat the dissected axilla only in cases of inadequate dissection or extensive nodal involvement and 13 (54.2%) would always treat the full axilla. **Table 4** shows the radiotherapy planning responses.

Ten (41.7%) respondents would use DIBH techniques for all left-sided tumor patients, 8 (33.3%) for treating InM on the left side, and 11 (45%) when heart constraints were not acceptable. Six (25%) radiation oncologists did not use DIBH techniques because of unavailability. Eleven (45.8%) respondents used DIBH techniques with 3D treatment and 5 (20.8%) with both 3D and VMAT/IMRT. **Table 5** shows the features of DIBH.

**Discussion.** Breast cancer is the most common cancer among Saudi women, and the incidence rate of breast cancer continues to rise.<sup>9,10</sup> Radiotherapy plays a major role in the management of breast cancer. However, there are worldwide variations in the practice of radiotherapy as well as in Saudi Arabia, perhaps because of the different training backgrounds of radiation oncologists.<sup>7</sup>

Ductal carcinoma in situ is not a common diagnosis in Saudi Arabia; however, national efforts to raise awareness regarding the early detection of breast cancer and improvements in health care accessibility are expected to increase the rate of DCIS diagnoses. Breast conservative surgery with adjuvant radiotherapy is the standard of care for DCIS.<sup>11</sup> Although the management of DCIS closely follows that of early breast cancer, there are a few differences. The Society of Surgical Oncology, American Society for Radiation Oncology and American Society of Clinical Oncology published a joint consensus guideline on the margins for breast-conserving surgery

**Table 3** - Features of regional nodal irradiation (RNI).

Survey questions and response(s)	n (%)
<i>The following is an indication for RNI after BCS and ALND*</i>	
Any N1	15 (62.5)
Macrometastatic N1	14 (58.3)
N1 with high-risk features	16 (66.7)
N1 with inadequate axillary dissection	19 (79.2)
N1 with extracapsular extension	18 (75)
N2	21 (87.5)
Any T3N0	3 (12.5)
T3N0 with high-risk features	11 (45.8)
T2N0 with high-risk features	4 (16.7)
Nx	10 (41.7)
<i>The following is an indication for RNI after MRM*</i>	
Any N1	13 (54.2)
Macrometastatic N1	13 (54.2)
N1 with high-risk features	14 (58.3)
N1 with inadequate axillary dissection	18 (75)
N1 with extracapsular extension	17 (70.8)
N2	21 (87.5)
Any T3N0	5 (20.8)
T3N0 with high-risk features	15 (62.5)
T2N0 with high-risk features	2 (8.3)
Nx	8 (33.3)
<i>The following is an indication for InM LN radiation*</i>	
Radiologically positive InM node	23 (95.8)
N1 and medially located tumor	14 (58.3)
N0 and medially located tumor with certain high-risk features	3 (12.5)
When 50% or more of the axilla is positive	14 (58.3)
Whenever RNI is indicated for right-sided tumors only	1 (4.2)
Whenever RNI is indicated	2 (8.3)
<i>The definition of adequate LN dissection is</i>	
8 or more	3 (12.5)
10 or more	20 (83.3)
15 or more	1 (4.2)

\*Multiple responses allowed, CTV: clinical target volume, IMRT: intensity modulated radiotherapy, LN: lymph node, RTOG: Radiation Therapy Oncology Group, PTV: planning target volume, ESTRO: European Society for Radiotherapy and Oncology, InM: internal mammary, VMAT: volumetric modulated arc therapy, SC: supraclavicular, ECE: extracapsular extension, T: tumor, N: node

**Table 4** - Features of radiotherapy planning (N=24).

Survey question	Response	n (%)
I contour chest wall/breast	Always	21 (87.5)
	Never	1 (4.2)
	Only when treating with IMRT	2 (8.3)
I contour nodal CTV	Always	23 (95.8)
	Never	0 (0)
	Only when treating with IMRT	1 (4.2)
If nodal CTV was contoured*	I adjust the field border/ shielding accordingly	16 (66.7)
	I follow the standard field borders and use the contours for reference only	9 (37.5)
	I don't contour nodal CTV anyway	0 (0)
	Other	0 (0)
My LN CTV follows	RTOG atlas	20 (83.3)
	ESTRO atlas	2 (8.3)
	Other	2 (8.3)
My LN PTV	Is 3 mm	3 (12.5)
	Is 5 mm	12 (50)
	Is equal to my CTV	2 (8.3)
	Is technique dependent, I add 3-5 mm when using IMRT but not with 3D	7 (29.2)
	Other	0 (0)
InM PTV	Is equal to my CTV	2 (8.3)
	5 mm all around	5 (20.8)
	3 mm all around	3 (12.5)
	3 or 5 mm, but trimmed from lung/heart	6 (25)
	Is technique dependent, I add 3-5 mm when using IMRT but not with 3D, and I DO NOT trim from lung or heart	5 (20.8)
	Is technique dependent, I add 3-5 mm when using IMRT but not with 3D, and I DO trim from lung or heart	3 (12.5)
	Other	0 (0)
	Other	0 (0)
Acceptable InM PTV coverage is	80% of prescription	7 (29.2)
	90% of prescription	8 (33.3)
	95% of prescription	4 (16.7)
	I only care about CTV coverage	4 (16.7)
Acceptable InM CTV coverage	80% of prescription	6 (25)
	90% of prescription	13 (54.2)
	95% of prescription	5 (20.8)
Technique used when treating InM*	Modified wide tangents whenever possible	21 (87.5)
	Direct electron field matching photon tangents whenever possible	4 (16.7)
	Step and shoot IMRT	6 (25)
	VMAT	13 (54.2)
	Tomotherapy	4 (16.7)
	Other	0 (0)
RNI after axillary dissection*	For any N1 I treat as per MA20 (small SC field encompassing axilla 3-SC)	16 (66.7)
	For N1+ ECE I treat the full axilla+SC+/-InM	14 (58.3)
	For any N1 I treat the full axilla+SC+/-InM	2 (8.3)
	For N1+ inadequate dissection I treat the full axilla+SC+/-InM	17 (70.8)
	For N2 I always treat the dissected axilla +SC+/- InM (large MA20 SC field)	13 (54.2)
For N2 I treat the dissected axilla only in cases of inadequate dissection or extensive nodal involvement	10 (41.7)	

\*Multiple responses allowed. CTV: clinical target volume, IMRT: intensity modulated radiotherapy, LN: lymph node, RTOG: Radiation Therapy Oncology Group, PTV: planning target volume, ESTRO: European Society for Radiotherapy and Oncology, InM: internal mammary, VMAT: volumetric modulated arc therapy, RNI: regional nodal irradiation, SC: supraclavicular, ECE: extracapsular extension

**Table 5** - Features of DIBH techniques.

Survey questions and response(s)	n (%)
<i>I use DIBH technique(s)</i>	
With 3D	11(45)
With IMRT/VMAT	1 (4.2)
With both	5 (20.8)
I do not use it	7 (29.2)
<i>I use DIBH technique(s)*</i>	
For all left-sided patients	10 (41.7)
When treating InM on the left side	8 (33.3)
When heart constraints are not acceptable	11(45.8)
At our department we have a protocol for screening patients who could benefit from it	2 (8.3)
I do not use it because it is not available at our center	6 (25)
Other	1 (4.2)
<i>If you chose other above, please specify</i>	
Any side with InMN, also if liver is located high in chest and occasionally with right side SCV field if very young patient	
<i>I do not use DIBH technique(s) because*</i>	
The accessories are not available at my center, I would love to acquire them	7 (53.8)
It takes a long time in the machine; we cannot afford it	3 (23.1)
I am satisfied with my treatment without it	5 (38.5)
No reason, just never thought of using it	1 (7.7)

\*Multiple responses allowed. DIBH: deep inspirational breath hold, IMRT: intensity modulated radiotherapy, VMAT: volumetric modulated arc therapy, InM: internal mammary, InMN: internal mammary nodes, SCV: supraclavicular

with whole-breast irradiation in DCIS, indicating 2 mm as the minimum acceptable margin. However, clinical judgment is required to decide on the necessity and suitability of re-excision.<sup>12</sup> Boost radiotherapy to the surgical bed is not widely adopted for DCIS because trials on the role of boost radiotherapy largely focus on invasive cancer.<sup>7</sup> Nevertheless, there is an evidence to suggest an improvement in local control with the use of tumor bed boost radiotherapy in DCIS.<sup>13</sup>

Hypofractionation at a dose of 40/15 or 42.5/16 is the standard of care after breast conservative surgery.<sup>14</sup> However, the use of hypofractionation for locoregional treatment as well as in the setting of PMRT with or without immediate reconstruction is controversial.<sup>7</sup> The Danish and Canadian postmastectomy landmark trials that revealed survival advantage following the addition of adjuvant radiation after mastectomy have actually delivered hypofractionated regimens.<sup>15,16</sup> In the United Kingdom (UK), it is standard practice to offer hypofractionated radiotherapy to all patients in the adjuvant setting.<sup>17</sup> The Canadians are currently recruiting for a phase 3 randomized trial of standard

versus hypofractionated radiotherapy after mastectomy with or without reconstruction.<sup>18</sup> The Study of Radiation Fractionation on Patient Outcomes After Breast REConstruction (FABREC) is a phase 2 trial that is recruiting and investigating whether hypofractionated radiotherapy to the chest wall and the regional lymph nodes is superior to standard fractionation in the reconstructed breast.<sup>19</sup> Wang et al<sup>20</sup> found hypofractionated radiotherapy to be non-inferior to standard fractionation in the setting of T3-T4 or N2 disease.

The benefits of PMRT are controversial; nevertheless, there is a strong consensus among Saudi radiation oncologists regarding using PMRT. Postmastectomy radiotherapy is indicated for advanced primary or nodal disease.<sup>16</sup> However, the value of PMRT for N1 disease or high-risk nodal negative disease is in question, particularly in the better systemic therapy setting.<sup>6,21</sup> Two randomized phase 3 trials are underway to clarify the value of PMRT: the UK Selective Use of Postoperative Radiotherapy After Mastectomy (SUPREMO) trial, which is looking for the role of PMRT in high-risk node-negative patients and N disease<sup>22</sup> and the Tailor RT trial, a Canadian trial investigating the predictive value of low-risk oncotype DX recurrence scores in N1 patients.<sup>23</sup> The use of a bolus with PMRT is another vague area with conflicting evidence. Some departments use a bolus for all patients, whereas others use it only in patients with skin involvement. Daily bolus on alternate days or half the bolus on consecutive days are 2 different practices.<sup>7</sup> Some authors reported a higher risk of recurrence when a bolus is not used, whereas others demonstrated similar local control with the routine omission of the bolus when no skin involvement was observed.<sup>24,25</sup> Variations in the bolus placement practice are, therefore, expected.

The majority of postmastectomy trials as well as trials of locoregional irradiation after breast-conserving surgery included comprehensive nodal radiotherapy with the inclusion of the InM chain of lymphatics.<sup>6,16</sup> Nonetheless, indications for RNI and radiation volumes are still controversial. Excluding the dissected axilla (or intentionally not including it) from the radiotherapy field in the adequate axillary dissection setting, the definition of which is debatable, is clearly not a standard practice among responders. Neither is the inclusion of the InM lymph nodes, reflecting worldwide variation in practices.<sup>7</sup> Radiation to the InM chain recently gained interest, particularly with the technique modifications that allow for cardiac and lung dose reduction.<sup>6</sup>

Treatment planning volumes and techniques vary among radiation oncologists not only nationwide, but

worldwide, and is the area with the most variation among respondents in this survey, particularly concerning the InM volumes and coverage criteria. Intensity modulated radiotherapy is an acceptable practice in some centers while standard fields remain in others.<sup>7</sup> Several contouring guidelines have been published.<sup>26,27</sup> However, standard fields do not adequately cover the recommended targets, and the decision to expand the field to cover these targets or acceptance of inadequate coverage should be cautiously individualized. In addition, InM recurrences have been reported outside the recommended contours.<sup>28</sup> There is no consensus regarding the definition of acceptable coverage for the InM lymph nodes, and careful modification of the recommended volume to ensure adequate coverage of the targets should be balanced against the potential toxicity of radiotherapy.<sup>28-30</sup>

The DIBH technique for patients with left-sided breast cancer is widely adopted.<sup>7</sup> Limitations to the routine use of DIBH techniques in certain centers are the cost and significant resource commitment required, and our study responses revealed that 25% of the respondents would not use DIBH techniques because of the lack of availability.<sup>31</sup>

At the time of writing this manuscript, the world had been suffering from the effects of the coronavirus disease (COVID-19) pandemic. Many radiotherapy centers around the world adopted measures to reduce patient and staff exposure to potential infections. Although some measures were not based on level one evidence, the severity of the situation has mandated bold measures. These measures included omitting radiotherapy when deemed of little or no definitive benefit in the adjuvant setting or reducing the number of fractions when deemed acceptable. For breast cancer, in particular, radiotherapy after lumpectomy for node-negative, early-stage, and hormone-positive disease can be omitted.<sup>32</sup> Additionally, an expedited review and publication of the 5-year results of the FAST-forward trial investigating 5 daily fractions of 5.7 Gy in the adjuvant setting coincided with the emerging need for hypofractionation and was quickly adopted, at least for early disease and during the current global pandemic situation.<sup>32,33</sup>

This study is an effort to look into the practice of radiation oncologists in Saudi Arabia. I have addressed almost all of the controversies related to breast radiotherapy. However, I acknowledge the inherent weakness of web-based surveys, such as the lack of accountability and accuracy and the association with a failure to personally explain confusing questions or answer choices. Additionally, the relatively small and underrepresented number of respondents in this

survey may be overcome in the future by expanding the inclusion criteria for the study participants.

In conclusion, radiotherapy practice variations among Saudi radiation oncologists echo international variations in many aspects due to the lack of strong evidence and availability of resources. Resource allocation, particularly for DIBH techniques, and the establishment of national guidelines, are recommended to decrease the disparity in radiotherapy practice and promote the exchange of data and national research collaborations. Prospective follow-up data collection at the national level should be initiated to identify possible dissimilarities in our patient characteristics as well as the potential need for treatment intensification, particularly in areas of international variations.

Future research is required to answer the questions raised and expand the study areas to include radiation oncologists from the Gulf, Arab, and Middle Eastern countries.

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