Original Article

Supplier-Induced Demand in Diagnostic MRI of Primary Breast Cancer

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Abstract

Background and Purpose: Supplier-induced demand (SID) refers to the concept that healthcare providers may deliver services to patients that are not medically necessary. An estimation of the extent to which this event has occurred can be insightful for policymaking and guiding health systems. This study aimed to investigate the extent to which SID presents itself during diagnostic MRI (magnetic resonance imaging) for primary breast cancer.

Materials and Methods: In this cross-sectional study, data were obtained using questionnaires from a random sample of 310 cases. To identify patients who were candidates for undergoing a necessary diagnostic MRI, we employed the international clinical guidelines with the confirmation of our expert panelists. With their assistance, a comprehensive index was created to screen those who were affected by SID.

Results: Of the respondents, 94.1% had undergone an unnecessary diagnostic MRI and, thus, were likely affected by SID, which indicated the lack of sovereignty of clinical guidelines in the prescription of MRI diagnosis imaging.

Discussion: This study supported the SID hypothesis and the unnecessary demand for diagnostic MRI in primary breast cancer. In addition, our evidence indicated that excessive costs were imposed; these can positively influence policymakers' decisions regarding healthcare management.

Keyword: Supplier-induced demand; primary breast cancer; diagnostic MRI; physician-induced demand

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1. Introduction

Supplier-induced demand (SID) pertains to the concept that healthcare providers can manipulate their patients' demand by using their discretionary power to provide additional services mostly due to information and knowledge asymmetries (1). This practice increases the cost of public resources and out-of-pocket expenditures; therefore, it should be put under more scrutiny by policymakers and managers who aim to build equitable and cost-effective healthcare services (2, 3). Reinhardt indicated that the issue of demands induced by the physician (as the supplier) goes straight to the heart of perhaps the most significant controversy in contemporary health policies (4). From a policymaking perspective, SID can have two significant negative impacts. First, it increases health expenditures and puts pressure on the general budget; second, it decreases the efficiency of the healthcare system since national resources are not allocated to appropriate and necessary care (1). Paying attention to the issue of SID, especially in important care situations, such as cancer management, will optimize the management of healthcare services. Breast cancer is one of the most common and concerning health problems among women. Breast cancer, with a relative frequency of 24.2%, is the most commonly diagnosed type of cancer among women worldwide, and it ranks fifth in deaths related to cancer (5). With a relative frequency of 26%, breast cancer is the most common cancer among Iranian women, constituting 12% of all cancer types in both sexes, ranking a shared sixth position in cancer deaths among women (6). Hence, the management of breast cancer is of special interest to public health directors not only because of

health issues but also due to economic and social reasons.

Regarding the complexity of cancer, the information and knowledge asymmetries between patients and physicians are significant. This makes SID an accessible and tangible issue. Moreover, the increasing costs of patient management, especially regarding breast cancer patients, reveal the importance of monitoring and assessing healthcare services according to SID. The relevant literature yielded no studies on the estimation of SID in the diagnosis of primary breast cancer, which indicates that proper attention has not been paid to this economic issue. Although there are several studies about overutilization and overdiagnosis in breast cancer imaging (7, 8), there was found no study that specifically included the SID issue and the diagnosis of primary breast cancer via MRI. Therefore, considering the breast cancer status in the world and the importance of SID in health policies and healthcare management, combined with a lack of related studies, there is an increasing need for research on this topic. Results of studies in the United States and the Netherlands suggest that, generally, about 30–40% of patients do not receive healthcare services according to present scientific evidence, and about 20–25% of healthcare provided is not necessary (9). In the primary diagnosis of breast cancer, the rule of triple assessment is important to more effectively manage cases, which is based on history taking, clinical examinations, imaging procedures, and tissue diagnosis confirmation (10, 11). Regarding imaging, we use mammograms as the initial imaging technique for all cases that are candidates for surgery because of its effect on selecting the type of surgery (12). Among them, MRI

(magnetic resonance imaging) has very limited indications but is associated with high expenses and social difficulties because of its cost, accessibility, and availability.

Under certain conditions, MRI can be prescribed to diagnose primary breast cancer. This study estimated the extent to which SID occurred in the diagnostic MRI of primary breast cancer. Also, it aimed to increase the awareness of policymakers, health managers, physicians, other healthcare providers, and patients.

2. Materials and Method

The present research was an analytic-descriptive, cross-sectional, and practical study. Cochran's formula was used to calculate the sample size. Therefore, to achieve the maximum confidence level for an ideal and sufficient sample size, a value of 0.5 was given to p and q, which also gave us the largest sample size. By using an estimator with a 95% level of confidence ($\alpha=0.05$), a sample size of 217.4 was generated. Finally, the sample size was increased to a total of 334 cases over a 15-month period (May 1, 2018 to September 22, 2019). After considering the inclusion and exclusion criteria, 310 random cases were accepted and analyzed.

All of the women in Iran with a definite diagnosis of primary breast cancer who had been referred to the cancer research center (CRC) of Shahid Beheshti University of Medical Sciences for treatment, irrespective of their age and clinical stages of the disease, and those who had not received any prior treatment, were included. Patients who had already started their treatment, patients whose breast cancer had recurred, patients whose MRIs had not been directly ordered by physicians (either upon the patient's request or by direct referral to imaging centers because we try to consider only the consumption caused by the inducement of the suppliers), and patients whose time interval between completing the questionnaires and undergoing an MRI had exceeded six months were excluded. Patients whose breast cancers were diagnosed at the CRC were also excluded.

The questionnaire was designed by the authors and was approved by all the expert panelists, including a breast surgeon, a radiologist, an oncologist, an epidemiologist, a gynecologist, and health economists. Two questioners who had previously been trained and were fully familiar with the subject gathered information, including demographic data and the number of MRIs, along with the breast specialist's opinion regarding the necessity of that.

To determine a benchmark for identifying the necessity of diagnostic MRI for primary breast cancer, we referred to indications listed in the available international clinical guidelines, as demonstrated in Table 1 (no clinical guidelines for the diagnosis of primary breast cancer is currently available in Iran), which were studied and confirmed by expert panelists. All cases were then evaluated by the breast specialist considering the indications mentioned in Table 1 in the clinic during the clinical evaluation and the filling out of the questionnaires.

Table 1. The indications for patients' candidacy to undergo a necessary MRI for primary breast cancer diagnosis

The names of guidelines / Indications	NHS (13)	ESMO (11)	CAR (12)	Gland Surgery (10)	NCCN (14)	Cancer Australia (15)	*Indications used in this study*
Lifetime risk > 25%: **BRCA1/2 mutation** **Chest wall irradiation**	■	■	■		■		■
Suspicion of multifocality/multicentricity	■	■	■	■	■	■	■
Large discrepancies between conventional imaging and clinical examination	■	■	■		■		■
Breast implants			■			■	■

After the collection of data, they were analyzed using SPSS Software (version 25).

3. Results

Out of 310 accepted questionnaires, 51 cases were documented to perform at least one MRI. The results of the numbers of diagnostic MRIs prescribed for patients are shown in Table 2.

Table 2. The numbers of diagnostic MRI in all patients

		Frequency	Percent
The number of MRI prescribed for patients	0	259	83.5
	1	49	15.8
	2	2	.6
	Total	310	100.0

The results of performing or not performing a genetic test to determine the status of BRCA1/2 are shown in Table 3.

Table 3. The presence or absence of hereditary cancer history in the families of patients who underwent MRI (positive or not "BRCA1/2")

	Frequency	Percent
No	51	100.0
Yes	0	0

The opinion of the breast disease specialist regarding the necessity to perform an MRI is shown in Table 4.

Table 4. The opinion of breast disease specialists about the necessity for MRI

		Frequency	Percent
Opinion of speciali	Positive	3	5.9
	Negative	48	94.1
	Total	51	100.0

4. Discussion

From the total number of patients surveyed, 16.4% had an MRI. None of them performed lifetime breast cancer risk more than 25%, such as chest wall irradiation or the BRCA1-2 gene mutation tests. According to the opinion of the breast disease specialist, 94.1% of those who had an MRI did not need one; thus, they were affected by SID. This was an evidence of the SID hypothesis, as well as the issue of information and knowledge asymmetries and their harms.

Measuring the extent of SID in the healthcare market is very difficult, and no agreement exists on how it should be done (1). Mooney clearly stated that, "testing for absolute SID involves the impossible task of observing a perfectly informed patient" (16). Also, there are several definitions for SID, though no definitive and fully accepted definition has so far been there for it (1). Therefore, to create a basis, we considered the definition of Folland et al. They indicated that, "the physician's own efforts to induce patients to buy more care than appears medically necessary" is induced demand (17). Studies implement various approaches to test the existence, nature, and extent of SID. Fuchs indicates that the extent of inducement is sensitive to a benchmark that is used to identify the necessary levels of care (18). In this study, the approach employed to test for SID compared the patterns of MRI for primary breast cancer diagnoses prescribed by physicians with a benchmark originated from the aggregation of the indications mentioned in available international clinical guidelines and the approval of our expert panelists. According to the conceptual model of Labelle (19) (and considering that clinical guidelines take into account the cost-effectiveness and necessity of ordering any prescription), employing these measures is one of the best approaches to test for induced demand (7, 20). The development and implementation of clinical guidelines are promising and effective tools for improving the quality of healthcare. However, for some reasons, many guidelines are not used after dissemination (21).

MRI has an excellent capability for soft tissue imaging, such as breast tissue, with additional tools including convolutional neural network (22), artificial intelligence, or computer added system, which are able to increase the accuracy of MRI diagnosis but do not change the indication for detecting breast malignancy (23, 24). In some specific situations, such as triple-negative breast cancer cases, dynamic contrast-enhanced MRI helps to differentiate it from other forms of breast cancers (25), but clinically, it does not make sense to use it as a routine imaging tool in initial breast cancer diagnosis.

MRI utilizes different images from different tissue structures with different magnetic effects due to the hydrogen atoms in water, fat, and other tissue materials (26).

The specificity of MRI is lower than mammograms, with higher false-positive diagnoses, and it is not able to reduce the local recurrence of cancer(12, 26).

MRI-detected lesions are not significantly more common when compared to ultrasound second look detecting cases; all of the lesions detected by MRI must only be biopsied with MRI guidance, which is another obstacle to using it (27). Research has shown that using MRI in screening programs for specific conditions may detect lesions in lower stages compared to mammogram alone, but is not approved in the initial diagnosis of suspected breast cancer cases (28). Data for the surveillance of second breast cancer events in women with a history of breast cancer with MRI is insufficient and not recommended for routine screening in such cases (29).

The diagnostic MRI of primary breast cancer is a procedure with a long history, with no clinical uncertainty in it, and the guidelines and our experts' panel confirm this claim. Also, for the above reasons, the type and position of the MRI in primary breast cancer diagnosis procedures are such that even if there was a well-informed patient, he/she would most likely have no preference except as stated by available international guidelines. Therefore, by choosing the diagnostic MRI procedure ordered by the physician, we have attempted to become as close as possible to the SID and estimate the overprovision due to physicians' inducement.

Considering that the comprehensive benchmark of this study was applied by breast disease specialists, only 5.9% of patients had at least one of the indications of the study's benchmark. Therefore, the remaining underwent an unnecessary diagnostic MRI, since they did not have any of the indications of the study benchmark

(Table 1). This completed classification estimated how much the patients were affected by SID. Furthermore, it aimed to increase the awareness of policymakers, health managers, physicians, other healthcare providers, and patients.

5. Conclusion

An unnecessary MRI was prescribed for 94.1% of patients as part of their breast cancer diagnoses. These results further supported the SID hypothesis. This research can provide long-term benefits for the general population because, as long as policymakers and executors are aware of the extent of SID, actions could be taken to counteract SID. This will reduce not only the costs of healthcare but also the patients' out-of-pocket payments and harm, thereby increasing social welfare. The general population should, therefore, educate themselves about healthcare services, especially cancer diagnostic imaging (particularly MRI imaging, which is relatively more expensive). This matter is of great importance in breast cancer, as it is the most common type of cancer in women.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

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