




## Research article

## Overview of different reimbursement strategies among contrast-enhanced mammography (CEM) expert centers on a global level – A survey study

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**Abbreviations:** CEM, Contrast-enhanced mammography; CPT, Current Procedural Terminology; DBT, Digital breast tomosynthesis; EUSOBI, European Society of Breast Imaging; FDA, Food and Drug Administration; FFD, Full field digital mammography; MRI, Magnetic Resonance Imaging.

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## ABSTRACT

**Objectives:** To perform an international survey among global expert breast radiologists regarding contrast-enhanced mammography (CEM) on the topic of reimbursement strategies.

**Methods:** An online questionnaire on CEM reimbursement strategies was distributed to 29 selected global expert breast radiologists regarding CEM. Hospital information, CEM implementation, estimated costs, reimbursement availability, registration and declaration codes, as well as personal opinions on CEM reimbursement, were collected. Replies were analyzed using descriptive and non-parametric statistics.

**Results:** Twenty out of 29 global expert breast radiologists regarding CEM responded to this survey. All respondents had implemented CEM at their hospitals between 2011 and 2024 and offered CEM for clinical/diagnostic indications, CEM price ranges were lower than MRI at all but two sites.

Sixty percent of hospitals (12/20) reported receiving reimbursement for CEM. The remaining 40% declared not receiving reimbursement, citing reasons such as coverage by department budget, lack of dedicated billing code, or absence of reimbursement by the national healthcare system and/or insurance providers. Among the 12 hospitals receiving reimbursement, 67% (8/12) obtained full reimbursement for all components of CEM, and 75% (9/12) for all indications. Reimbursement sources varied by hospital type, with public and university hospitals mainly publicly funded, and private hospitals relying on insurance or patient payments.

Most respondents (75%, 15/20) reported that no dedicated national reimbursement code for CEM currently exists. Of these respondents, 53% (8/15) used the FFDM code. Most hospitals lacked separate codes for the contrast medium (60%, 9/15) or its intravenous injection (93.3%, 14/15). Among hospitals without a national code, 73% (11/15) were aware of efforts to establish one.

Although nearly half of the participants (45%, 9/20) faced reimbursement challenges, 65% (13/20) stated that reimbursement strategies did not affect their CEM adoption.

**Conclusion:** Substantial heterogeneity in CEM reimbursement strategies exist, with most hospitals securing full coverage through alternative strategies until dedicated national reimbursement codes are established.

## 1. Introduction

Contrast-enhanced mammography (CEM), an imaging technique that uses iodinated contrast medium to allow the visualization of breast lesions and assess tumor neovascularity [1–8], was introduced commercially in 2011 [1,2]. Since then, its popularity has grown exponentially, as evidenced by the increasing numbers of CEM devices, examinations, and published studies [1].

Although CEM has demonstrated diagnostic performance comparable to MRI for various indications [2,3,9–11] and has been reported as being preferred by patients [12], its clinical implementation has sometimes been hindered by a range of factors such as a perceived lack of clinical need and the widespread availability of the more familiar technique of breast MRI [9] and were highlighted in a survey conducted by the European Society of Breast Imaging (EUSOBI) in 2024 [13]. These issues [13] have been addressed in recent years, but economic considerations remain an ongoing topic of debate.

The potential of CEM to serve as a realistic cost-effective alternative to breast MRI [14,15] has been described. Nevertheless, the principal economic barrier to its adoption is the absence of specific reimbursement for CEM [13] in many healthcare systems. To overcome this issue, various strategies have been implemented.

For example, in the USA, the lack of a dedicated CPT (Current Procedural Terminology) code—a code used to track and bill for medical services [16,17]—for CEM [9] has prompted institutions to explore alternative billing strategies. A common approach involves billing for a standard full-field digital mammography examination and separately billing for the intravenous contrast medium and its injection, which may not always be reimbursed [9,15].

Insurance coverage for CEM varies widely, depending on individual insurance plans and regional or national strategies, as some insurers may classify CEM as investigational or experimental, potentially impacting reimbursement. Given these economic challenges, obtaining information on CEM reimbursement at a global level among expert centers is warranted to guide policy development and support new adopters of this technique.

This study aims to review reimbursement strategies at leading CEM centers in Europe, North America, South America, Oceania, and Asia, providing guidance for healthcare institutions considering the

implementation of this technique.

## 2. Materials and methods

Medical ethics committee approval was not necessary for the present study. Two board-certified radiologists with 3 and 5 years of clinical experience in CEM (J.A.S. and T.V.N.) developed the first draft of the questionnaire that was then reviewed and approved by consensus with two board-certified radiologists with clinical experience in CEM (P.B. and R.A.S.).

The questionnaire included 31 questions divided into seven sections: hospital information, CEM implementation, costs, reimbursement availability, registration code, reimbursement/billing (declaration) code, and personal opinions on CEM reimbursement (**Supplementary material**). This survey incorporated conditional logic (branching questions), ensuring that participants were directed to the relevant set of questions based on their previous responses, while skipping those that did not apply to them.

The survey was made available on Google Forms (Google LLC) from February 14 to March 7, 2025. On the first day, a direct invitation email was sent to 29 selected hospitals/institutions with expertise in CEM, distributed across Europe, North America, South America, Oceania, and Asia. A reminder email was sent on March 4, 2025. Descriptive and non-parametric statistical methods were used to provide the results of the survey.

## 3. Results

### 3.1. Hospital information

In total, 20 out of the 29 invited expert breast radiologists from different hospitals responded to the survey. These hospitals are located across Europe (Austria [(1), France (1), Italy (2), the Netherlands (2), Spain (1), UK (2)), North America (Canada (1), USA (2)), South America (Argentina (2), Brazil (2), Chile (1)), Oceania (Australia (2)), and (Western) Asia (Turkey (1)), based on the UN geo-scheme [9].

Two participants (10%) reported that their country lacked a national healthcare system.

The hospitals represented vary in type: 6 (30%) are public and

university-affiliated, 5 (25 %) private, 4 (20 %) public, 3 (15 %) university-affiliated, 1 (5 %) private and university-affiliated, and 1 (5 %) combined public, private, and university-affiliated.

### 3.2. CEM implementation

The year in which hospitals began offering CEM differed widely across the surveyed sites. The earliest adoption was in 2011 (1/20, 5 %), followed by three hospitals in 2013 (3/20, 15 %). The highest number of hospitals started offering CEM in 2018 (4/20, 20 %), while the most recent implementations occurred in 2024 (2/20, 10 %) (Fig. 1).

Participants were asked to identify the indications for CEM use at their centers from four categories: clinical/diagnostic purposes, screening recalls, supplemental screening, and research. All hospitals (20/20, 100 %) use CEM for clinical indications, 18 (90 %) use it for research, 13 (65 %) for screening recalls, and 9 (45 %) for supplemental screening. Notably, 6 hospitals (30 %) use CEM for all four indications.

### 3.3. Costs

Participants were asked to estimate the cost of a CEM procedure at their hospital using five options: four price ranges (<100€, 100–200€, 200–300€, >300€) and “I do not know.” Two participants (10 %) were unaware of the cost. Seven (35 %) reported a price below 100€, another seven (35 %) selected 100–200€, three (15 %) indicated 200–300€, and one (5 %) reported a cost over 300€ (Fig. 2a).

Participants were asked to estimate the cost of contrast-enhanced breast MRI using thirteen options: eleven price ranges (<100€ to >1000€), plus “MRI not performed” and “I do not know.” One participant (5 %) reported MRI was not available, and another (5 %) did not know the cost. Four (20 %) selected 100–200€, three (15 %) chose 200–300€, four (20 %) selected 300–400€, and three (15 %) chose 400–500€. The remaining four (20 %) indicated price ranges exceeding 500€. A more detailed analysis is presented in Fig. 2b.

In all but two cases, the price range of a breast MRI was higher than that of a CEM. In most instances (6/18, 30 %), the price difference between CEM and MRI corresponded to a two-range gap (100–300 & 101–300€). Notably, in three (3/18, 15 %) cases, the difference was equal or exceeded six price ranges (>500€ difference between CEM and MRI), with the largest observed difference being eight ranges—equating to a cost disparity of 701–900€ (Fig. 3).

### 3.4. Reimbursement availability

When asked regarding reimbursement of CEM costs, 12 out of 20 participants (60 %) responded yes. The remaining 8 (40 %) who reported no reimbursement provided the following reasons:

- 2 (25 %) stated that CEM costs were already covered within the department’s budget.
- 2 (25 %) cited the absence of a specific reimbursement/billing code for CEM.
- 4 (50 %) mentioned that CEM was not reimbursed by the national healthcare system and/or insurance providers.

### 3.5. Components reimbursed

Among the 12 (60 %) participants who reported CEM reimbursement at their hospital, respondents specified which components were covered by selecting one or more of the following options: Mammography (including FFDM or DBT), contrast medium, intravenous contrast injection, or all the above

A total of 8/12 (67 %) hospitals receive reimbursement for all components. Among the 4/12 (33 %) that do not, 2/12 (17 %) are reimbursed only for mammography, 1/12 (8 %) for mammography and contrast medium, and 1/12 (8 %) for mammography and intravenous contrast injection (Fig. 4).

### 3.6. Indications reimbursed

Among the 12 participants whose hospitals get reimbursement for CEM, only 3/12 (25 %) stated that not all the indications for which they use CEM are covered:

- In one institution, CEM is used for clinical/diagnostic, screening recalls, and research indications. However, only clinical/diagnostic indications are reimbursed.
- In the other two, CEM is also used for the same three indications, but only research purposes are not covered.

### 3.7. Source of reimbursement

The source of CEM reimbursement varies considerably. In most

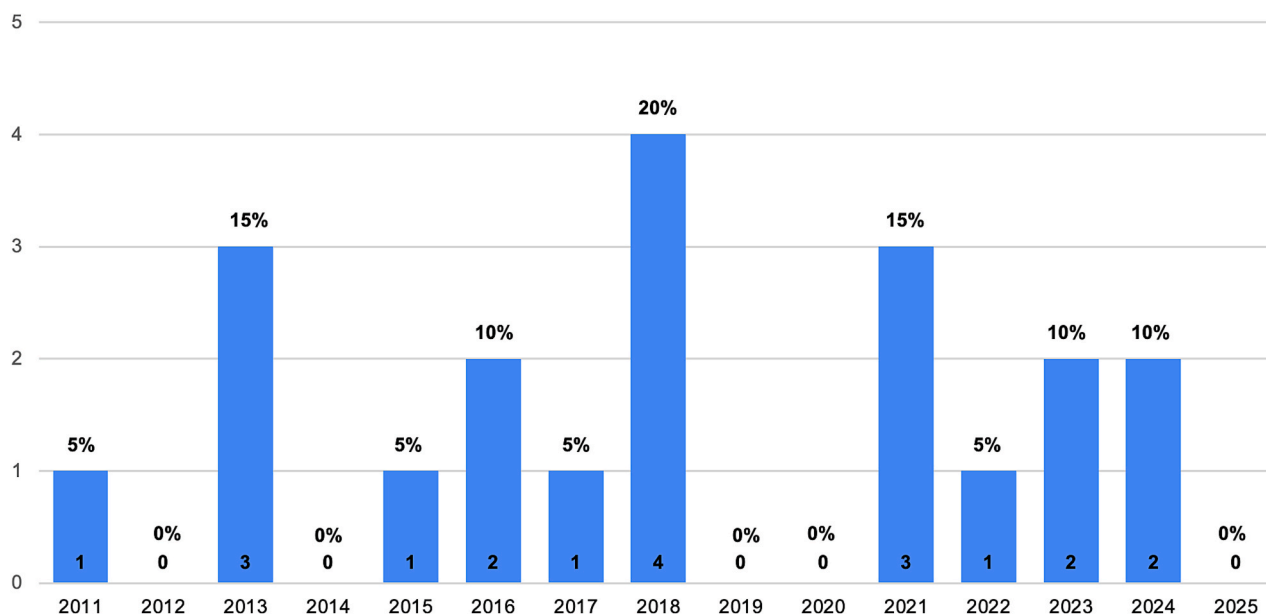


Fig. 1. Year in which CEM started being offered at the different surveyed institutions.

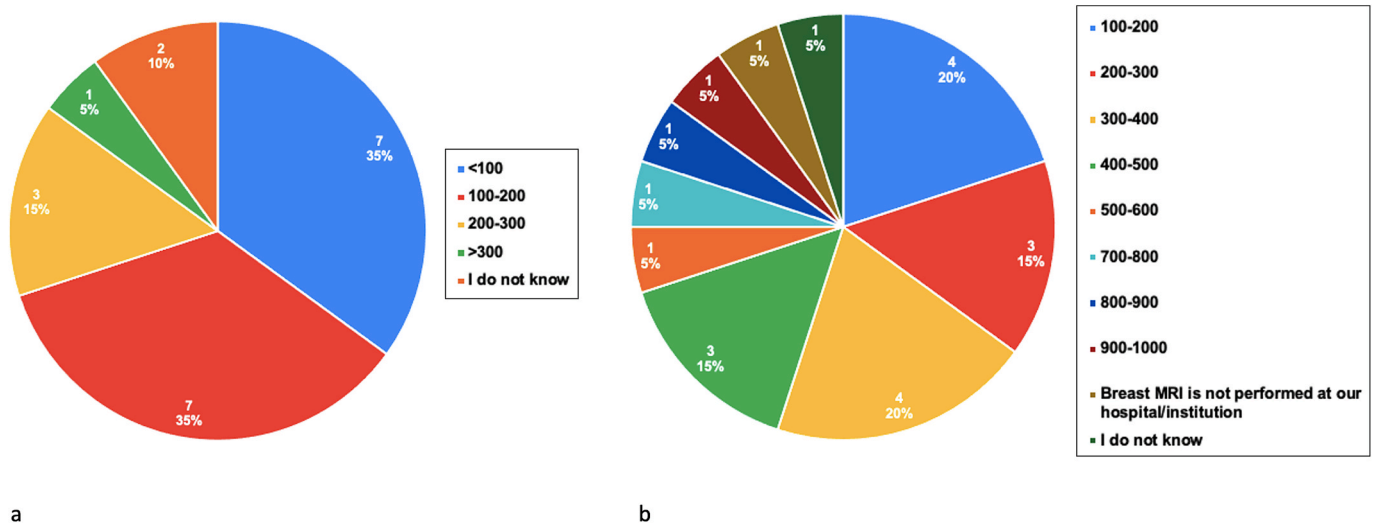


Fig. 2. Price ranges distribution for CEM (a) and breast MRI (b).

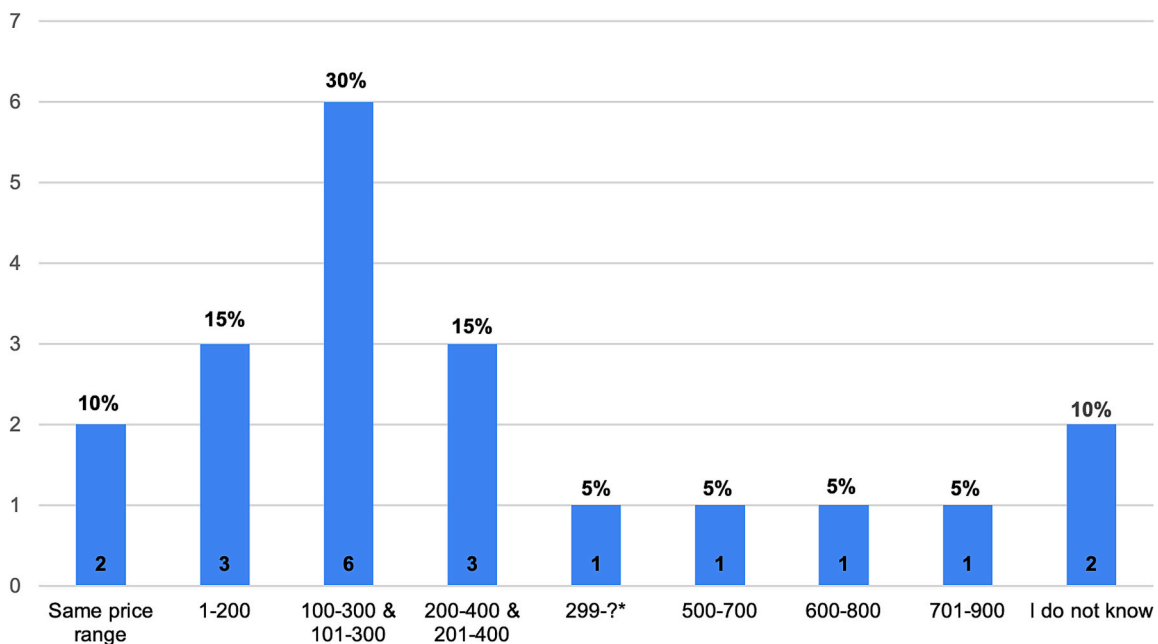


Fig. 3. Differences in price ranges (range gaps) between MRI and CEM. \* The “?” symbol indicates that the maximum difference between price ranges cannot be determined. As the estimated price range of CEM is > 300€, and that of MRI is 500–600€, only the minimum difference can be calculated.

public and university-affiliated hospitals (8/12), the primary source of reimbursement is the public healthcare system. However, in some cases, additional funding comes from research grants, patients’ insurance, or direct patient payments. Notably, one public and university-affiliated hospital does not receive reimbursement from the national healthcare system; instead, costs are covered through patients’ insurance and research grants.

In private hospitals (4/12), CEM reimbursement is primarily funded by patients’ insurance and/or direct patient payments, although one of these institutions also receives public healthcare funding.

### 3.8. Registration code

More than half of the hospitals (12/20, 60 %) use the same code for the registration and reimbursement/billing (declaration) of CEM.

Among the 8/20 (40 %) hospitals using separate codes, only one (12.5 %) uses a national registration code for CEM. The remaining seven

(87.5 %) use these alternatives: 3 (42.9 %) use the FFDM code, 2 (28.6 %) use the DBT code, and 2 (28.6 %) rely on an internal CEM code (Fig. 5a).

Of these seven hospitals, 4 (57.1 %) use a separate code for contrast medium registration (Fig. 5b), while only 2 (28.6 %) use a separate code for the intravenous injection of contrast medium (Fig. 5c).

Of the seven participants without a national registration code, five (71.4 %) were aware of efforts to establish one in their country, state or region.

### 3.9. Reimbursement/billing (declaration) code

All 20 participants were asked about the reimbursement/billing code for CEM. Only 5 (25 %) reported having a dedicated national declaration code, while the remaining 15 (75 %) use alternative solutions. Most of these (8/15, 53.3 %) use an FFDM code. Others reported using a CEM internal code (2/15, 13.3 %), a DBT code (1/15), a generic

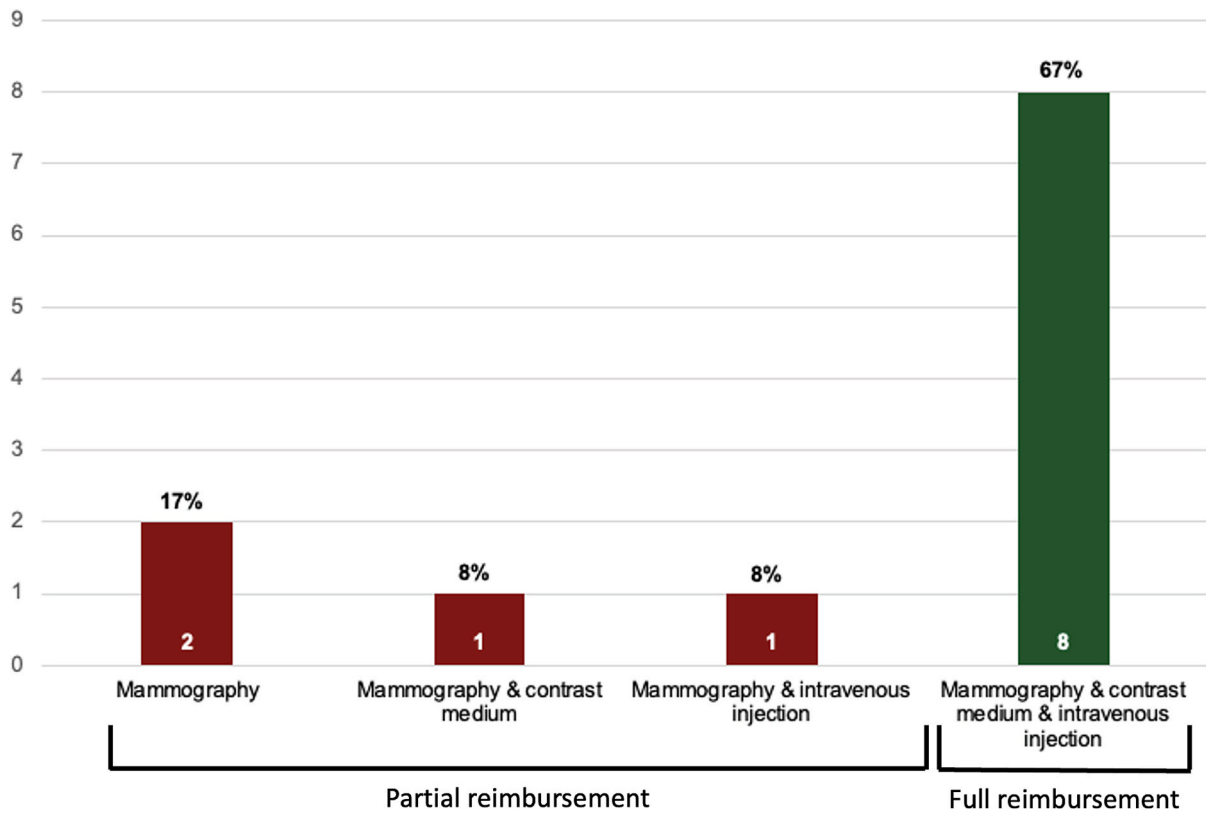


Fig. 4. Reimbursement of CEM components.

Registration code



Fig. 5. Registration code scheme for CEM. This figure illustrates how countries without a specific registration code for CEM manage its registration: (a) Registration codes used for CEM, (b) Use of a registration code for the contrast medium, (c) Use of a registration code for the intravenous injection of contrast medium.

Registration code

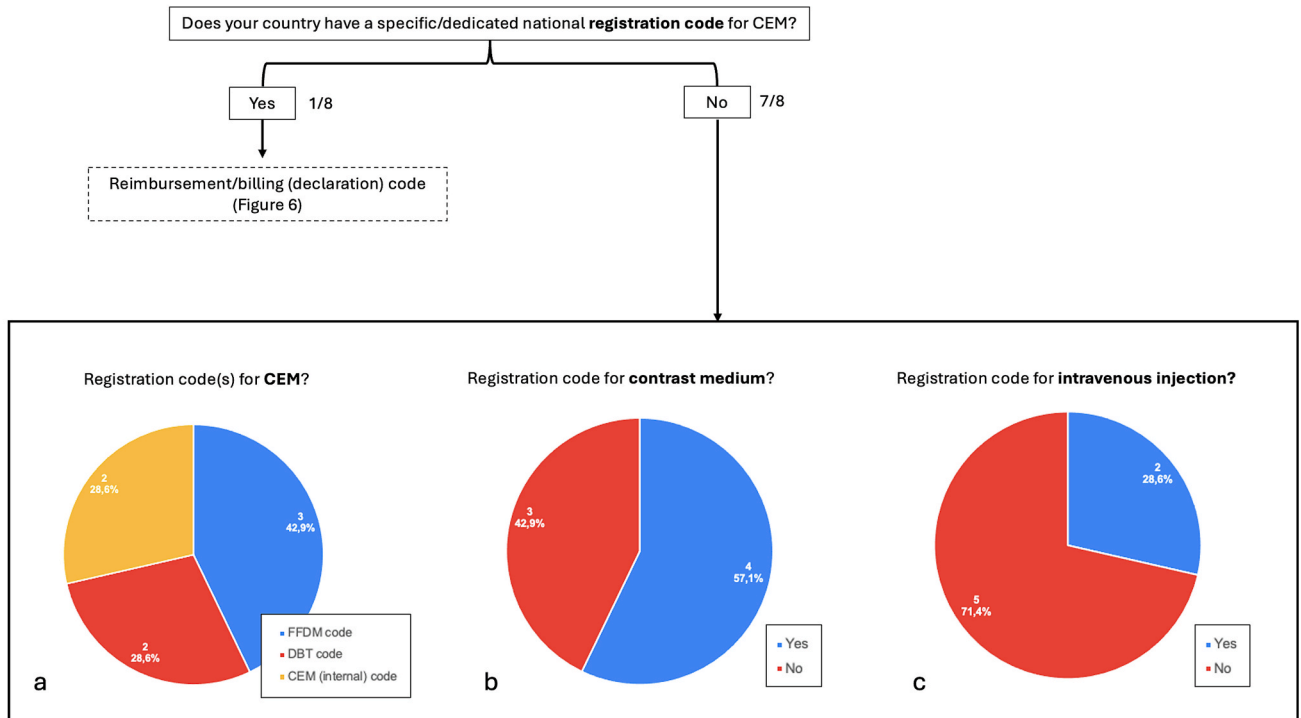


Fig. 6. Reimbursement/billing code scheme for CEM. This figure illustrates how countries without a specific reimbursement/billing code for CEM manage its declaration: (a) Declaration codes used for CEM, (b) Use of a declaration code for the contrast medium, (c) Use of a declaration code for the intravenous injection of contrast medium.

mammography code (1/15), a diagnostic mammography code (1/15), or both FFDM and DBT codes (1/15). One hospital (1/15) did not report any specific code, explaining that imaging procedures are covered under “Activity-Based Funding” (Fig. 6a).

Among these 15 hospitals, most do not use separate registration codes for the contrast medium (9/15, 60 %) (Fig. 6b) nor for its intravenous injection (14/15, 93.3 %) (Fig. 6c).

3.10. Personal opinions on CEM reimbursement

3.10.1. Influence of reimbursement strategy in CEM adoption

When questioned whether reimbursement strategies have influenced CEM adoption, 65 % (13/20) of participants said no. The remaining 35 % (7/20) reported the lack of coverage by public healthcare systems and private insurers as the main barrier to its adoption.

3.10.2. Challenges faced in CEM reimbursement

Nearly half of participants (9/20, 45 %) declared having faced challenges with CEM reimbursement at their hospitals. These included:

- Lack of reimbursement for some or all components of the CEM procedure.
- Uncertainty about appropriate billing for the procedure’s complexity.
- Absence of a reimbursement/billing codes for all or certain CEM indications.
- Delays in obtaining regional or national approval for the technique.
- Limited interest from insurance providers.

3.10.3. Reluctance to introduce CEM

When asked about the reluctance to adopt CEM in other hospitals. Nearly all participants (19/20, 95 %) believed some institutions are hesitant due to the perception that reimbursement is not feasible. Additionally, most respondents (15/20, 75 %) felt that the belief in

significantly higher MRI reimbursement also contributes to this reluctance.

3.10.4. Suggestions for improvement

The final question asked participants to write in suggestions to improve CEM reimbursement. Several key areas were identified, including:

- **Further Research:**
  - Additional studies are needed to demonstrate the cost-effectiveness of CEM compared to breast MRI and to provide high-level evidence for specific clinical indications.
- **Formal Recognition:**
  - CEM should receive official recognition and approval from scientific societies.
- **Improved Coding Practices:**
  - Dedicated national billing codes covering all aspects of the CEM procedure would help standardize and support reimbursement.
- **Reimbursement strategies:**
  - Public healthcare and private insurers should fully cover CEM. In public systems, national reimbursement strategies are preferred over regional ones to ensure broader access.
- **Introduction of a dedicated CEM-guided biopsy billing code:**
  - Two participants highlighted the need for a specific billing code for CEM-guided biopsy.
- **Advocacy and Collaboration:** Radiologists should actively engage with professional societies and other organizations to advocate for CEM reimbursement, as individual efforts alone are often insufficient.

4. Discussion

This is the first international survey aimed to provide an overview of the different reimbursement strategies for CEM across key experts in the field. In recent years, the clinical utilization of CEM has significantly

increased [1,18,19]. Although prior studies have examined barriers to implementation, reimbursement remains a largely overlooked issue [9], contributing to hesitation among some institutions to adopt [13] or expand its use. According to the present study, twenty radiologists from various regions participated, providing information on CEM implementation, costs, reimbursement availability, and coding practices. The results revealed significant variability in reimbursement strategies, with 60 % of hospitals receiving CEM reimbursement and most lacking dedicated national codes. Despite reimbursement challenges reported by nearly half of participants, the majority indicated that these issues did not affect CEM adoption. Overall, the survey highlights the heterogeneity of reimbursement strategies and the use of alternative strategies to secure coverage in the absence of specific national codes.

Findings from this survey indicated that the most common price ranges for CEM were <100€ (~115 USD) (35 %) and 100–200€ (~115–230 USD) (35 %), while for MRI they were 100–200€ (~115–230 USD) (20 %) and 300–400€ (~345–460 USD) (20 %). In all but two cases, breast MRI price ranges were higher than CEM. As previously reported in the literature, CEM is less costly than breast MRI [9,14,15,18]. In most cases (6/18, 30 %), the price difference between the two techniques corresponded to a two-range gap (100–101 to 300€) (~115 to 345 USD). This seems to align with U.S. Medicare rates, which show a reimbursement of USD 161 for CEM (CPT code 77066 for bilateral diagnostic mammography) compared to USD 365 for breast MRI (CPT code 77049), excluding the cost of contrast media [14]. However, due to the current lack of standardized billing practices for CEM, pricing can vary significantly between facilities [14]. For example, Patel et al. [15] reported that the cost of screening MRI can be up to four times higher than that of CEM.

Survey responses showed that 60 % of hospitals receive CEM reimbursement. However, the actual percentage may be higher, as responses from the remaining eight hospitals (40 %) reporting no reimbursement suggest possible misinterpretation of the question. This is not surprising given the complexity of reimbursement systems, which most radiologists are unfamiliar with [20,21]. In two cases, participants reported no reimbursement because CEM costs were covered by the department's budget—an arrangement that implies indirect reimbursement. In two other cases, the absence of a specific reimbursement code was cited, but participants noted that billing is done using a standard mammography code. In one case, the respondent explained that while public patients are not reimbursed, private patients are. Taking these considerations into account, only 3 out of 20 hospitals (15 %) appear to receive no CEM reimbursement.

Among the 12 participants who reported receiving CEM reimbursement, most (67 %) indicated that all components of the procedure are covered. The 2024 EUSOBI survey cited an unavailability of specific reimbursement for CEM of 18.4 % (13), with this lack of reimbursement being more frequently cited by respondents from Southern Europe (13). In our survey, regional analysis showed that the absence of CEM reimbursement was reported more frequently in Europe (38 %) than in South America (25 %), North America (13 %), Asia (13 %), and Oceania (13 %). However, when Europe was further divided into subregions, no significant differences were observed between Northern, Western, and Southern Europe, with each reporting a similar rate of 13 %.

Most participants (15/20, 75 %) reported not having a dedicated national reimbursement code for CEM. In these cases, over half of them (53 %) use an FFDM code, while most do not use separate declaration codes for contrast medium (60 %) nor its intravenous injection (93.3 %). The strategy of combining existing registration codes to bill a new procedure in the absence of a dedicated code has been previously described in the literature. For instance, in the USA, some hospitals address the lack of a dedicated CPT code by combining existing codes for power injection, contrast medium, and diagnostic mammography [22–27].

Standardized billing codes facilitate patient access to new technologies and accurate payment to physicians [17]. However, there is often

an extended period between the emergence of a technique and its recognition as a billable procedure [16]. In practice, delayed reporting of a CPT code can result in loss of revenue [28]. According to this survey, most hospitals were aware of national/regional efforts to establish registration (71.4 %) and declaration (73.3 %) codes for CEM. Participants reporting such initiatives on reimbursement codes were in Australia, Argentina, Brazil, the Netherlands, Spain, and the USA. In the USA, the creation of a CPT code is expected once the FDA (Food and Drug Administration) approves CEM for screening, as it is currently only approved for diagnostic use [9,24,25] and as its clinical use continues to grow [15].

This study has several limitations. The survey targeted a select group of expert centers, which may not reflect the broader healthcare landscape. Geographic representation was limited, with no responses from African or Asian nations other than Turkey. The sample size was small, with only 20 participants. Some questions were subjective, allowing for varying interpretations even within the same healthcare system. In addition, we did not explore in depth the cost to perform the procedure, the cost to the patient, or the exact reimbursement to the facility.

In conclusion, this study represents the first international survey on CEM reimbursement strategies among twenty breast radiologists with expertise in the technique. Although half of the participants reported having faced challenges with reimbursement, these issues have not hindered the adoption of the technique. Furthermore, most hospitals receive full reimbursement for all CEM components. There is a strong need for further initiatives and improved coding practices, including national registration and declaration codes that comprehensively cover all aspects of the technique in both the public and private sectors.

#### CRediT authorship contribution statement

**Javier Azcona Sáenz:** Conceptualization, Data curation, Methodology, Writing – original draft. **Pascal A.T. Baltzer:** Supervision. **Iris Allajbeu:** Supervision, Writing – review & editing. **Allison Rose:** S, upervision, Writing – review & editing. **Erkin Aribal:** Supervision, Writing – review & editing. **Corinne Balleyguier:** Supervision, Writing – review & editing. **Chiara Bellini:** Supervision, Writing – review & editing. **Almir G.V. Bitencourt:** Supervision, Writing – review & editing. **Jonathan J James:** Supervision, Writing – review & editing. **Anat Kornecki:** Supervision, Writing – review & editing. **Marc B.I. Lobbes:** Supervision. **Ruth Helena Morais Bonini:** Supervision, Writing – review & editing. **Bhavika K. Patel:** Supervision, Writing – review & editing. **Federica Pediconi:** Supervision, Writing – review & editing. **Jordana Phillips:** Supervision, Writing – review & editing. **Javier Rodríguez Lucero:** Supervision, Writing – review & editing. **Flavia Beatriz Sarquis:** Supervision, Writing – review & editing. **Donna Blancha Taylor:** Supervision, Writing – review & editing. **Marcela Uchida Silva:** Supervision, Writing – review & editing. **Rodrigo Alcantara Souza:** Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Thiemo J.A. van Nijnatten:** Conceptualization, Investigation, Methodology, Visualization, Writing – original draft.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Outside of the submitted work, Javier Azcona Sáenz reports speaker roles for BD, GE Healthcare and Bayer Healthcare. Pascal A.T. Baltzer serves as Secretary General and Board Member of the EUSOBI, and is a steering group member of the Breast Imaging Working Group of the Deutsche Röntengesellschaft. Iris Allajbeu is a speaker for GE Healthcare and received research funding from Cancer Research UK and the British Center of Research (pending confirmation). Erkin Aribal has received an honorarium from GE Healthcare. Corinne Balleyguier is a speaker for GE Healthcare. Chiara

Bellini is a speaker for Hologic and Giotto. Anat Kornecki reports a research collaboration with GE Healthcare. Marc B.I. Lobbes has received speaker's fees from Hologic Inc. and Tromp Medical B.V., and research funding from Hologic Inc. Bhavika Patel has received unrelated research grants from GRAIL Inc. and Hologic Inc., and is a member of the NCCN Breast Cancer Screening Panel. Federica Pediconi is part of the speakers' bureau for Bayer, Bracco, and IMS Giotto, and serves on the advisory boards of Bayer and Guerbet. Jordana Phillips is a consultant for GE Healthcare and Hologic Inc. Rodrigo Alcantara Souza is a member of the speakers' bureau for BD and GE Healthcare. Thiemo J.A. van Nijnatten has received institutional grant support, participated in medical advisory board meetings, and received speaker honoraria from GE Healthcare and Bayer; he also participates in advisory board meetings for ScreenPoint Medical. All other co-authors declare no conflicts of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejrad.2025.112315>.

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