BMC Public Health

RESEARCH

Open Access

Barriers and facilitators of the implementation of mammography screening in the Brazilian public health system: scoping review

Danila Cristina Paquier Sala[1*], Oswaldo Yoshimi Tanaka[2], Reginaldo Adalberto Luz[3], Alexandre Pazetto Balsanelli[1], Sonia Isoyama Venancio[4], Marília Cristina Prado Louvison[2] and Ana A. Baumann[5]

Abstract

Background There are high incidence and mortality rates of breast cancer in Brazil. Brazilian's social and economic disparities, along with complexities of its health system pose challenges to the appropriate implementation of mammography screening as a public policy for the population. In 2015, the Ministry of Health updated the recommendations for the early detection of breast cancer, which had, until then, been based on specialists' consensus, maintaining biennial screening mammography for women aged 50–69 years. However, the screening coverage did not exceed 25% of the expected number of exams for the Brazilian population who use the public health system. The objective of this study was to analyze barriers and facilitators (determinants) of opportunistic mammography screening in the Brazilian public health system.

Methods We conducted a scoping review to examine the extent to which guidelines have been implemented from 2015 to 2025, excluding those that (1) did not include the population aged 50 to 69 years, (2) did not discuss mammographic screening in the Brazilian public health system, (3) included populations with cancer or at high risk of cancer. Results were coded into the domains of the Consolidated Framework for Implementation Research (CFIR).

Results In the 85 articles selected, we coded 74 determinants, 50 referring to barriers and 24 to facilitators. The barriers were related to the outer setting 18(24.3%), inner setting 11(14.9%), characteristics of individuals 9(12.2%), process 6(8.1%), and intervention characteristics 6(8.1%). The facilitators were related to the outer setting 14(18.9%), inner setting 5(6.8%), intervention characteristics 3(4.1%) and individual characteristics 2(2.7%).

Conclusion Using CFIR helps understand the multiple interrelated factors that affect the implementation of opportunistic mammographic screening in the Brazilian public health system. Our results can provide initial data for further studies that aim to improve and organize the implementation of mammography screening in Brazil.

Keywords Breast neoplasms, Mass screening, Mammography, Brazil, Implementation science

*Correspondence:
Danila Cristina Paquier Sala
danilapaquiersala@gmail.com
[1]Paulista School of Nursing, Federal University of São Paulo, São Paulo, Brazil
[2]Faculty of Public Health, University of São Paulo, São Paulo, Brazil
[3]Santa Casa de São Paulo, School of Medical Sciences, São Paulo, Brazil
[4]Ministry of Health, Secretary of Primary Health Care, General Coordination of Child Health and Breastfeeding, Brasília, Brazil
[5]Washington University School of Medicine, Saint Louis, MO, USA

Introduction

Among cancer types, breast cancer has the highest incidence and is the leading cause of death [1]. The trend is for these numbers to increase by up to 50% in the coming decades in Latin America and the Caribbean [2]. In Brazil, the estimates are worrisome given that, although the incidence rate is stable, it has remained high [3], and the mortality rate has increased, especially in the Northeast and North regions [4, 5].

One of the strategies that can reduce mortality is mammography screening. While beneficial, mammography screening can also be harmful when performed too frequently and outside the target age group [6]. When balancing the potential harms and benefits of mammography, scholars recommend offering this exam to women aged between 50 and 69 years, ensuring follow-up of abnormal results and monitoring the quality of each step leading to diagnosis and treatment [7, 8].

Mammography was introduced in Brazil in the 1990s as a public policy, and opportunistic mammography screening was structured in the 2000s, guided by recommendations from a 2004 national consensus among specialists [9]. This publication built upon a decade-old recommendation and marked a pivotal moment in breast cancer care. In 2015, these guidelines were reviewed, updated, and officially established as evidence-based interventions by the Ministry of Health [10]. This update was based on an extensive and in-depth systematic review, evaluating the strength of the evidence while weighing the risks and benefits of each intervention. The recommendations maintained and reinforced biennial screening for women aged 50 to 69 while excluding clinical breast examinations by health professionals and breast self-examinations as screening methods. This revision underscores the evidence-based nature of mammography screening as a crucial initiative within the Unified Health System [Sistema Único de Saúde (SUS)], a universal and equitable healthcare system instituted in 1990 as a fundamental right to health.

Primary Health Care (PHC) serves as the entry point to the SUS in Brazil [11] covering approximately 83.94% of the population (available from https://egestorab.saude.gov.br, accessed on January 28, 2025). Through PHC, women aged 50 to 69 years can receive a mammogram every two years. This test is performed at radiography facilities or specialized outpatient clinics. If the result is normal and the patient has no clinical breast abnormalities, she continues to be monitored by PHC. However, if there is any suspicion of cancer, she is referred for further investigation, diagnosis, and treatment at the public oncology services closest to her residence. In Brazil, this process is referred to as "the care pathways of the health network for chronic conditions". The care pathways outline a set of criteria that guide the next steps in the continuum of cancer care within the SUS (Available from https://linhasdecuidado.saude.gov.br/portal/ accessed on January 28, 2025). Thus, the PHC-managed care pathways, which aim to ensure comprehensive breast cancer care, could facilitate the implementation of the evidence-based screening guideline [10].

Even with the implementation of the care pathways, full coverage of mammography screening remains unmet. The SUS coverage of mammography screening in the female population is gradually increasing, but it has not exceeded 25% of the expected number of exams and remains far from the 70% target recommended by the World Health Organization (WHO) [12, 13]. A better understanding of the factors that influence implementation can help explain low coverage rates and support improvements in public policies and services to better organize the screening and expand access in Brazil [14]. The Consolidated Framework for Implementation Research (CFIR) is particularly well-suited for this analysis, as it offers a structured approach to examine factors at various levels, including inner and outer settings, individual and intervention characteristics, and the implementation process itself [15]. By enabling the systematic exploration of barriers and facilitators, the CFIR provides a detailed understanding of how these elements interact to shape implementation outcomes.

The aim of this study is to provide a systematic and critical synthesis of the factors that can support public policies and to identify gaps that require further research to improve the implementation of mammography screening in the Brazilian public health system, guided by the CFIR. Specifically, the study analyzes the barriers and facilitators related to the implementation of opportunistic mammography screening for breast cancer in Brazil through a scoping review.

Method

We conducted a scoping review in five steps: (1) identification of the guiding research question; (2) identification of relevant studies; (3) selection of studies; (4) data mapping; and (5) synthesis and coding [16].

We conducted a deductive analysis, coding the determinants (barriers and facilitators) mapped by the review using a theoretical instrument from implementation science [17, 18]. To organize the data, we used one of the implementation science determinant frameworks: the Consolidated Framework for Implementation Research (CFIR) [15]. This framework has been used in other reviews for other contexts (e.g., e-health and medication review implementations) [19, 20]. Using CFIR allows for the transferability and comparability of findings of this review with other reviews and studies examining the factors that affect the implementation of breast screening. The framework comprises 39 constructs across five

domains: (1) characteristics of the intervention, (2) inner setting, (3) outer setting, (4) characteristics of individuals and (5) process. Using CFIR to guide the organization of our data enables us to capture multilevel factors that determine mammography screening in SUS [21].

Step 1. Identification of the research question

We used the Population, Concept, Context (PCC) strategy, with components described in Table 1 [22], to guide the definition of the research question. The guiding question of the research is: "What are the barriers and facilitators for the implementation of opportunistic mammography screening in the Brazilian public health system?" The review had a registered protocol at the OSF platform [23].

Step 2. Identification of relevant studies

The research included all articles published from January 2015 to January 2025, with the purpose of analyzing data ten years after the publication of the first evidence-based guideline in 2015 and, consequently, analyzing its implementation in Brazilian territory. Although the updated 2015 recommendations did not alter opportunistic screening model in Brazil, nor the age and frequency of mammography, they represent a fundamental milestone for the implementation of evidence-based practices in breast cancer control. The guideline synthesizes actions and responsibilities for managers, professionals, and the population across the country's complex healthcare network.

We searched the electronic libraries and database of Latin American and Caribbean Literature on Health Sciences (Lilacs), Scientific Electronic Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE - PubMed), Web of Science, Scopus and EMBASE. No language restrictions were applied. The searches were conducted on January 31, 2025. The keywords and search strings used are listed in Table 2.

Step 3. Selection of studies

Studies were eligible for inclusion if they met the following criteria: peer-reviewed articles; published between January 2015 and January 2025; focused on mammography screening within the Brazilian public health system (SUS); included women aged 50 to 69 years; and employed qualitative, quantitative, mixed-methods designs, or were literature reviews. We excluded protocol studies, editorials, letters, and articles that: did not address mammographic screening in the SUS; did not include the target age group (50–69 years); or focused on populations with breast cancer or at high risk of the disease.

Duplicate detection, study selection, and article organization were managed using Rayyan® software. Screening and selection were conducted independently by the first author (DCPS). In cases of uncertainty, inclusion decisions were discussed with a second reviewer (OYT). The selection flow is illustrated in Fig. 1. When full-text articles were not directly accessible, the corresponding authors were contacted via email.

Step 4. Charting the data

For the collection and mapping of the selected data, a structured instrument was used containing information on:

- Name of the main author;
- Year of publication of the article;
- Purpose of the study;
- Method characteristics: design, population, study site, sample number and outcome variable;
- Outcomes.
  - Studies investigating barriers and facilitators of biennial screening (following SUS guidelines).
  - Studies investigating barriers and facilitators for any screening periodicity, including opportunistic, annual, or irregular screening.
  - Studies investigating barriers and facilitators without specifying screening frequency.

This process was conducted without the use of automation tools.

Step 5. Collating, summarizing, and synthesizing results

Data from the included studies were summarized as follows. First, DCPS coded for the determinants of the implementation of mammography screening in the Brazilian public system and classified them as barriers or facilitators. For example, factors that made implementation difficult, such as no access to mammography, were classified as barriers. Factors that helped with the implementation of mammography screening, such as access to mammography, were classified as facilitators (see Additional file 1).

Second, DCPS and RAL coded these barriers and facilitators according to CFIR domains. To ensure consistency in the coding stage, statistical analysis of inter-observer

Table 1 Components related to the review question, according to the population, concept and context strategy

Population	Women aged 50–69, healthcare professionals, primary and specialized healthcare
Concept	Implementation of evidence-based mammography screening
Context	Brazilian public health system; Unified Health System (SUS); Brazil

Table 2 Distribution of articles identified in the search in January 2015 up to January 2025

Database	Search strategy	*N*
SciELO	(((((((Mammography) OR (Mammogram))) AND ((Screening) OR (Mass Screening) OR (Early Detection of Cancer))) AND ((Breast Neoplasms) OR (Breast Cancer))))) AND (Brazil*) AND Filters: from 2015–2025	71
Lilacs	((mammography OR mammogram)) AND ((screening OR mass screening OR early detection of cancer)) AND ((breast cancer) OR (breast neoplasms)) AND (brazil*) AND db: ("LILACS") AND (year_cluster: [2015 TO 2025]) AND instance:"lilacsplus"	84
MEDLINE/ PubMed	(("mammography"[MeSH Terms] OR "mammography"[All Fields] OR "mammographies"[All Fields] OR "mammography s"[All Fields] OR ("mammography"[MeSH Terms] OR "mammography"[All Fields] OR "mammogram"[All Fields] OR "mammograms"[All Fields])) AND ("diagnosis"[MeSH Subheading] OR "diagnosis"[All Fields] OR "screening"[All Fields] OR "mass screening"[MeSH Terms] OR ("mass"[All Fields] AND "screening"[All Fields]) OR "mass screening"[All Fields] OR "early detection of cancer"[MeSH Terms] OR ("early"[All Fields] AND "detection"[All Fields] AND "cancer"[All Fields]) OR "early detection of cancer"[All Fields] OR "screen"[All Fields] OR "screenings"[All Fields] OR "screened"[All Fields] OR "screens"[All Fields] OR ("mass screening"[MeSH Terms] OR ("mass"[All Fields] AND "screening"[All Fields]) OR "mass screening"[All Fields]) OR ("early detection of cancer"[MeSH Terms] OR ("early"[All Fields] AND "detection"[All Fields] AND "cancer"[All Fields]) OR "early detection of cancer"[All Fields])) AND ("breast neoplasms"[MeSH Terms] OR ("breast"[All Fields] AND "neoplasms"[All Fields]) OR "breast neoplasms"[All Fields] OR ("breast"[All Fields] AND "cancer"[All Fields]) OR "breast cancer"[All Fields] OR ("breast neoplasms"[MeSH Terms] OR ("breast"[All Fields] AND "neoplasms"[All Fields]) OR "breast neoplasms"[All Fields])) AND ("brazil*"[All Fields] OR "brasil*"[All Fields] OR "unified health system"[Title/Abstract] OR "sus"[All Fields])) AND (2015:2025[pdat])	274
Web of Science	("breast cancer" OR "ca breast" OR "breast gland cancer" OR "breast gland neoplasm" OR "breast malignancies" OR "breast malignancy" OR "breast tumor malignant" OR "cancer in the mammary gland" OR "cancer of the breast" OR "cancer of the mammary gland" OR "cancer, breast" OR "malignancies of the breast" OR "malignancy of the breast" OR "malignant breast neoplasm" OR "malignant breast tumor" OR "malignant neoplasm of the breast" OR "malignant tumor of the breast" OR "mamma cancer" OR "mammary cancer" OR "mammary gland cancer" OR "mammary gland malignancy" OR "mammary malignancies" OR "mammary malignancy") AND ("mammography" OR "mamilloscopy" OR "mammilloscopy" OR "mammo-graphy" OR "mammogram" OR "mastography) AND "screening" OR "multiple screening" OR "prescreening" OR "screening method" OR "screening procedure" OR "screening program" OR "screening programme" OR "screening project") AND ("brazil" OR "federative republic of brazil" OR "united states of brazil" OR "brazilian" OR "brazilians")	176
Scopus	("breast cancer" OR "ca breast" OR "breast gland cancer" OR "breast gland neoplasm" OR "breast malignancies" OR "breast malignancy" OR "breast tumor malignant" OR "cancer in the mammary gland" OR "cancer of the breast" OR "cancer of the mammary gland" OR "cancer, breast" OR "malignancies of the breast" OR "malignancy of the breast" OR "malignant breast neoplasm" OR "malignant breast tumor" OR "malignant neoplasm of the breast" OR "malignant tumor of the breast" OR "mamma cancer" OR "mammary cancer" OR "mammary gland cancer" OR "mammary gland malignancy" OR "mammary malignancies" OR "mammary malignancy") AND ("mammography" OR "mamilloscopy" OR "mammilloscopy" OR "mammo-graphy" OR "mammogram" OR "mastography) AND "screening" OR "multiple screening" OR "prescreening" OR "screening method" OR "screening procedure" OR "screening program" OR "screening programme" OR "screening project") AND ("brazil" OR "federative republic of brazil" OR "united states of brazil" OR "brazilian" OR "brazilians")	143
EMBASE	(('breast cancer'/exp OR 'ca breast':ti, ab, kw OR 'breast cancer':ti, ab, kw OR 'breast gland cancer':ti, ab, kw OR 'breast gland neoplasm':ti, ab, kw OR 'breast malignancies':ti, ab, kw OR 'breast malignancy':ti, ab, kw OR 'breast tumor malignant':ti, ab, kw OR 'cancer in the mammary gland':ti, ab, kw OR 'cancer of the breast':ti, ab, kw OR 'cancer of the mammary gland':ti, ab, kw OR 'cancer, breast':ti, ab, kw OR 'malignancies of the breast':ti, ab, kw OR 'malignancy of the breast':ti, ab, kw OR 'malignant breast neoplasm':ti, ab, kw OR 'malignant breast tumor':ti, ab, kw OR 'malignant neoplasm of the breast':ti, ab, kw OR 'malignant tumor of the breast':ti, ab, kw OR 'mamma cancer':ti, ab, kw OR 'mammary cancer':ti, ab, kw OR 'mammary gland cancer':ti, ab, kw OR 'mammary gland malignancy':ti, ab, kw OR 'mammary malignancies':ti, ab, kw OR 'mammary malignancy':ti, ab, kw) AND ('brazil'/exp OR 'brazil':ti, ab, kw OR 'federative republic of brazil':ti, ab, kw OR 'united states of brazil':ti, ab, kw) OR 'brazilian'/exp OR 'brazilian':ti, ab, kw OR 'brazilians':ti, ab, kw) AND ('mammography'/exp OR 'mamilloscopy':ti, ab, kw OR 'mammilloscopy':ti, ab, kw OR 'mammo-graphy':ti, ab, kw OR 'mammogram':ti, ab, kw OR 'mammography':ti, ab, kw OR 'mastography':ti, ab, kw) AND ('screening'/exp OR 'multiple screening':ti, ab, kw OR 'prescreening':ti, ab, kw OR 'project, screening':ti, ab, kw OR 'screening':ti, ab, kw OR 'screening method':ti, ab, kw OR 'screening procedure':ti, ab, kw OR 'screening program':ti, ab, kw OR 'screening programme':ti, ab, kw OR 'screening project':ti, ab, kw) AND [2015–2025]/py AND [embase]/lim	111
Total		859

reliability between team members was calculated as the percentage of agreement and using the Cohen's Kappa statistical test. The statistical package used was the R program psych, version 4.1.3 [24]. The agreement analysis was performed in the first moment for only 25% of the determinants (barriers and facilitators). Inconsistencies were discussed between two members of the team (DCPS and RAL) to clarify conflicting interpretations and promote familiarization with the data, dialogue, and optimization of the analysis. At the end of the first round, 100% of the determinants were coded. Then, in the second round, with a third researcher (AB), fluent in Portuguese and English, we refined the coding, analyzed the codes and resolved inconsistencies from the first round, resulting in the Cohen's Kappa value of 0.92, corresponding to almost perfect agreement (95% CI = 0.84 -1.00) between the team members. This process was conducted without the use of automation tools.

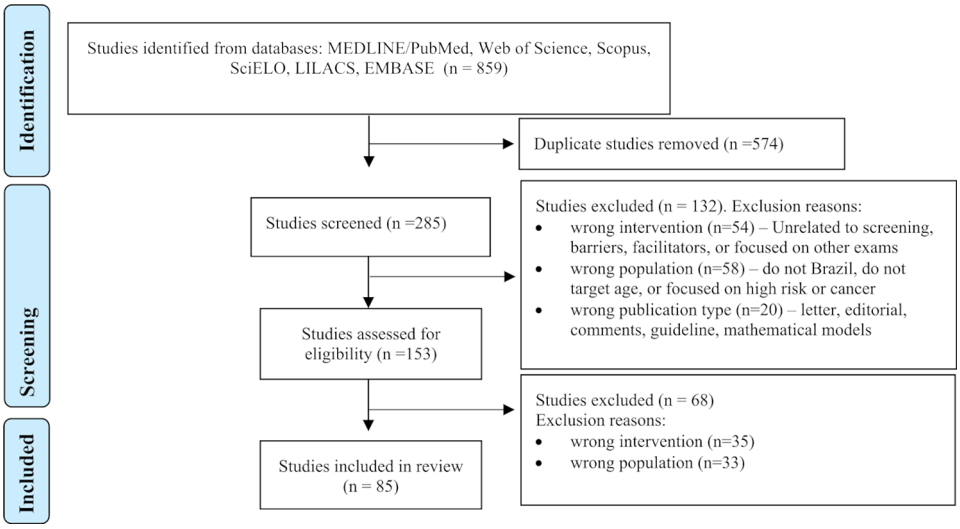

Fig. 1 Diagram of the article selection process, according to PRISMA-ScR recommendation, from January 2015 to January 2025

Table 3 Distribution of included articles according to research method

Type of studies	*n*	%
Quantitative		
Cross-sectional	44	51.8
Ecological	17	20.0
Time-series	6	7.1
Cohort	2	2.4
Pre-post	1	1.2
Qualitative	6	7.1
Systematic Review	5	5.9
Mixed Method	4	4.7
Total	85	100

Table 4 Distribution of included articles according to Brazilian geographic scope

Geographic scope	*N*	%
National level	51	60.0
Local level	24	28.2
State level	8	9.4
Total	**85**	**100.0**

Results

A total of 859 studies were identified, with 85 included in the final selection (Fig. 1). The characteristics of the included studies are detailed in Additional File 1. Table 3 shows the methodological heterogeneity of the studies, with a predominance of a quantitative approach (82.3%).

Table 4 presents the geographic scope of the included studies. Most studies had a national focus.

The data collated, summarized, and synthesized resulted in the identification of 74 determinants that were coded, 50 of which are barriers and 24 facilitators. Figure 2 shows the absolute frequency of the determinants coded by CFIR's domains, comparing barriers and facilitators. The barriers were related to the outer setting ($n = 18$; 24,3%), inner setting ($n = 11$;14,9%), characteristics of individuals ($n = 9$; 12,2%), process ($n = 6$; 8,1%) and intervention characteristics ($n = 6$; 8,1%). The facilitators were related to the outer setting ($n = 14$; 18,9%), inner setting ($n = 5$; 6,8%), intervention characteristics ($n = 3$; 4,1%), individual characteristics ($n = 2$; 2,7%). There were no determinants related to the process domain.

In Tables 5, 6, 7, 8 and 9, we describe in detail the barriers and facilitators according to CFIR domains. Table 5 shows the barriers and facilitators in the Outer Setting domain.

In terms of *patient needs and resources*, Black race/color/ethnicity women are less likely to have access to mammography [25–28, 103]. Low socioeconomic status of women [25, 26, 28–36, 103], low level of education of women [28–30, 33, 34, 36–42, 103], having social benefit [31], being in prison [34], having lack of financial resources or social support [43], women who have a chronic health problem [32] increase the chances of never having a mammogram or face more barriers to access it. On the other hand, mammography is more easily obtained for White women [27, 30, 47, 48], with good or high socioeconomic status [25, 26, 45, 48], good or high level of education [26, 28, 47–49] and family support [50]. An increasing number of women aged 50–69 have gained better access to screening; however, older women have faced more barriers [38, 45, 46].

A women's place of residence may influence her access to mammography. Not residing in the South or Southeast region [26, 36, 38] or residing in municipalities with more than 500,000 inhabitants, or at home with 6 or more people [26] were barriers to mammography. However, living in the capital, the Southeast region, or in municipalities

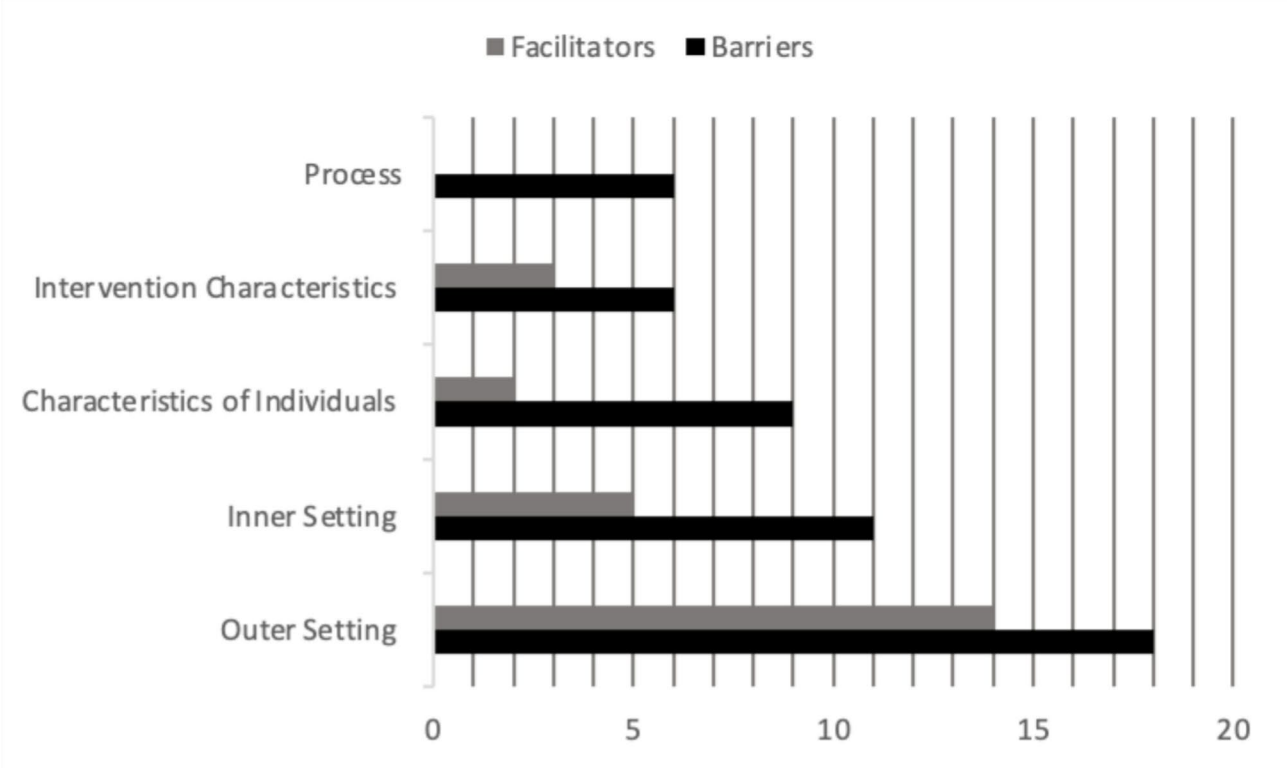

Fig. 2 Number of barriers and facilitators by CFIR's domains

Table 5 Barriers and facilitators of the implementation of mammography screening in the Brazilian public health system according to outer setting domain

Outer Setting	Barriers	Facilitators
Patient needs and resources	• Black race/color/ethnicity [25–28,103] • Lower socioeconomic status [25, 26, 28–36, 103] • Lower education level [28–30, 33, 34, 36–42, 103] • Receiving social benefits [31] • Lack of financial/social support [43] • Chronic health conditions [32] • Women in prison [44] • Older women [38, 45, 46, 103]	• White race/color/ethnicity [27, 30, 47, 48] • High socioeconomic status [25, 26, 45, 48] • Higher education level [26, 28, 47–49] • Accessibility/Family support [50]
	• Living crowded households or cities [26, 36, 38, 103] • Regions with low HDI* and high GINI index* [5, 32, 51, 52]	• Living in South, Southeast or smaller cities [26, 38] • Regions with high HDI*, GDP and low GINI* [32, 53, 54]
Cosmopolitanism	• Communication difficulties between patient and professional [43, 55]	• *No studies identified*
External policies and incentives	• Conflicting screening recommendations and laws [56–58] • Private provider interests dominating planning [57–60] • Covid-19 pandemic [27, 28, 60–75] • Disputes over funding between public/private [56, 76] • Not having private health insurance [28, 34, 36, 38, 47, 103]	• Convergent screening guidelines and laws [10, 76, 77] • Primary Health Care, especially Family Health Center as access point [29, 31, 78–81] • Navigation programs and community health workers [37, 43, 81] • Having private health insurance [45, 47–50]

*Abbreviations: HDI–Human Development Index, GDP-Gross Domestic Product, GINI: Gini coefficient, INCA–National Cancer Institute

with less than 500,000 habitants decrease the barriers for mammography screening [26, 38, 103].

Regions with lower Human Development Index (HDI) and higher GINI index lead to unequal distribution of resources and low coverage of mammography in Brazilian regions [5, 32, 51, 52]. Regions with higher HDI, GDP and lower GINI coefficient lead to unequal distribution of resources and greater coverage of mammography in Brazilian regions [32, 53, 54].

Table 6 Determinants of the implementation of mammography screening in the Brazilian public health system according to inner setting domain

Inner setting	Barriers	Facilitators
Structural characteristics	• Absenteeism [82] • High turnover in team [56] • Disorganization in services [56, 82].	*No studies identified*
Compatibility	• Lower organizational tradition in use of evidence-based practices [28, 56, 82–85] • Lower adherence/ awareness of professionals to evidence-based practices[32, 80, 86–93]	*No studies identified*
Readiness for implementation	• Unsatisfactory work capacity and team interaction in Primary Health Care [82].	*No studies identified*
Available Resources	• Lower capacity to produce mammograms per device [52, 72, 78, 83, 94–96] • Lower number of radiologists [52, 83, 94, 95] • Long distances or lack of specialized services [51, 81, 90, 91] • Long waiting periods for scheduling and exams [76, 82, 85, 92] • Higher number of mammography machines in the private system [95] • Insufficient financial resources [56] • Primary Health Care services with insufficient physical and human resources [26, 36, 38, 47, 50, 103]	• Sufficient number of mammography machines [72, 94, 95, 97] • Public funding for mammography services targeting the appropriate age group [83] • Access to physicians [37, 55, 79, 81, 82] • Educational initiatives to train the PHC team [50, 81, 82]
Access to knowledge and information	• Information systems do not provide complete or real-time data for monitoring and planning [56, 59, 82, 87, 98].	*No studies identified*

Table 7 Determinants of the implementation of mammography screening in the Brazilian public health system according to characteristics of individuals domain

Characteristics of individuals	Barriers	Facilitators
Knowledge and beliefs about the intervention	• Practice of defensive medicine [83] • Not performing clinical breast exam or cervical cytology [34, 38] • Lack of awareness about secondary prevention of breast cancer [99] • Lack of shared decision-making [55] • Inappropriate requests for exams [56] • Belief that the exam is not important [34, 47] • Not engaging in healthy style [38, 100] • Fear related to the exam or diagnosis [43, 79]	• Women who practice a healthy lifestyle [39, 49] • Educational initiatives [48, 55, 105]
Individual identification with the organization	• Discrimination against patients [38]	*No studies identified*
Other Personal Attributes	• Negative self-assessment of health [38, 39] • Not having a partner [26, 33, 34, 38, 39]	• Having a partner [48, 49]

In terms of *cosmopolitanism*, Gioia et al., (2019) reported that 58% of women reported barriers related to bad communication with the medical team [43].

In terms of *External policies and incentives*, some laws and policies within Brazil's public health system present contradictions. Brazil's public health system ensures access to mammography for all women, regardless of whether they are symptomatic or not. However, the screening program guidelines explicitly recommend the exam for women aged 50 to 69 years [10]. On the other hand, Federal Law nº 11.664/2008 guarantees the right to mammography starting at age 40 [57], which creates a conflict with the guidelines that prioritize women aged 50 to 69 as the target population. This law was instituted by the legislature and supported/influenced by specialists from medical societies [60]. Conversely, when there is alignment between different institutions, such as the Ministry of Health, the National Cancer Institute, and the Brazilian College of Radiology, through national guidelines for quality control of imaging services, these policies act as facilitators for screening implementation [10, 76, 77].

The COVID-19 pandemic also acted as a significant barrier to mammography screening in Brazil. Studies reported reductions of up to 42.9% in screening rates during 2020, with persistent declines in 2021. Contributing factors included movement restrictions, reorganization of health services, fear of infection, and limited availability of appointments, particularly in underserved

Table 8 Determinants of the implementation of mammography screening in the Brazilian public health system according to intervention characteristics domain

Intervention characteristics	Barriers	Facilitators
Evidence strength and quality	• Lack of national studies on the risks of mammography screening [57]	*No studies identified*
Relative Advantage	• Perception of controversies regarding the benefits of mammography screening [10, 57, 58, 83, 101]	*No studies identified*
Adaptability	*No studies identified*	• Use of mobile mammography units [29, 46] • Support for decision-making (managers, professionals, population) [10, 58, 83] • Flexibility in screening coverage targets [81, 82].
Complexity	• Negative perceptions of organized screening program management [83] • Long wait times to receive mammography results or result loss [47, 82, 85] • Difficulties understanding healthcare system flows [43]	*No studies identified*
Design quality and packaging	• Lower quality of imaging services and mammographic reports [77, 102]	• Good quality of mammography services [46]

Table 9 Determinants of the implementation of mammography screening in the Brazilian public health system according to process domain

Process	Barriers	Facilitators
Planning	• Lack of planning and monitoring of the mammography screening program [59, 82, 87]	*No studies identified*
Engagement	*No studies identified*	• Engagement of the Primary Health Care team [82]
Opinion Leaders	• Greater influence of specialists (gynecology, mastology, radiology) [55, 56] • Lower influence of universities [56, 57]	*No studies identified*
External Change Agents	• Advocacy for mammography and educational campaigns during Pink October [57, 83, 104]	*No studies identified*
Executing	• Low compliance with Primary Health Care screening program recommendations [84] • Lower mammographic coverage in the target population [12, 46, 47, 52, 54, 82, 91, 93, 94, 96, 97, 106, 107]	*No studies identified*

regions. The impact was more pronounced among socioeconomically vulnerable women [27, 28, 61–75].

Another relevant aspect in the implementation process of mammography screening in Brazil is the influence of the private health sector's interests on the oncologic public services [57–60]. Landim et al. (2019), highlight that the planning and structuring of diagnostic clinics adhere to market logic, with a tendency to concentrate in more populous areas [59]. This dynamic leads to the creation of healthcare gaps, representing a barrier to the implementation of the mammographic screening.

One facilitator in mammography screening is the role of Primary Health Care (PHC) as the initial point of access for patients to obtain a mammogram and to be referred to specialized oncology hospitals within the public health system. Studies have found that in places with higher PHC coverage, access to mammography is higher [29, 31, 78–81]. The Family Health Strategy, one of the Brazilian PHC models, has shown potential in addressing this issue. The strategy involves home visits or patient navigators, by community health workers [37, 43, 81], which has resulted in increased coverage among the target population [43].

Table 6 shows the barriers and facilitators in the Inner Setting domain.

In terms of *Structural characteristics*, absenteeism [82] and high turnover, as well as the disorganization of health services [56, 82], mainly in PHC, can be barriers. In terms of *Compatibility*, no long-term use of guidelines [28, 56, 82–85], low adherence and awareness of professionals to evidence-based practices [80, 86–90]can be barriers. In terms of *Readiness for implementation*, the unsatisfactory capacity and team interaction in PHC [82], hinder the implementation of mammography screening.

As it relates to *Available Resources*, the papers from our sample indicate that there are insufficient financial resources for mammography services [56]. This includes PHC services with insufficient or inappropriate physical structure [26, 38, 47, 50], lack of access to consultations for requesting and evaluating the mammogram [52, 72, 83, 94–96], low number of mammography machines or low capacity to produce mammograms per device [52, 72, 83, 94–96] and low number of radiologists [52, 83, 94, 95]. Of the total number of mammogram devices in the health public system, 53% are in the private sector [95]. Long distances and long waiting periods are also barriers to care [52, 76, 82, 83, 85, 94, 95].

Facilitators for screening were dual sources of public funding for services that perform mammography (one of which directs the incentive to perform mammography in the age group recommended by the Ministry of Health) [83], having sufficient number of mammography machines considering population coverage potential whitin 60 km of distance between machine and residence [95], and having access to consultations to request the exam [37, 55, 79, 81, 82]. The experience of educational resources training the PHC team also seems to be a facilitator [50, 81, 82]. In terms of *Access to information and knowledge*, the studies indicate that the information systems used for monitoring and planning are heterogeneous and lack integration, often presenting outdated or underreported data. Consequently, they fail to provide real-time information [56, 59, 82, 87, 98].

Table 7 shows the barriers and facilitators in the Characteristics of Individuals domain.

In terms of *Knowledge and beliefs about the intervention*, doctors engaging in defensive medicine practices (ordering excessive tests to avoid lawsuits) [83]and those who do not perform a clinical breast exam or the cervical cytology exam [34, 38]may be barriers for evidence-based mammography screening. Patients not aware of early breast cancer detection practices [99], making inappropriate requests [56], deeming the exam unimportant [34, 47], or fearing cancer [43, 79] tend to receive less screening. Alternatively, patients who adopt a healthy lifestyle (e.g., not smoking, practicing physical activity and consuming fruits and vegetables) seems to have more screening [39, 49].

In terms of *individual identification with the organization*, a factor associated with not having a mammogram in the last two years was patients feeling discriminated against by health professional [38].

In terms of *Other Personal Attributes*, women who negatively assess their health status [38, 39] and those not having a partner [26, 33, 34, 38, 39], present barriers. While having a companion is a facilitator for mammography screening [48, 49].

Table 8 shows barriers and facilitators in the Intervention Characteristics domain.

In terms of *Evidence strength and quality*, there is a lack of national studies on the benefits and risks of mammography on the Brazilian female population [57]. Regarding *Relative Advantage*, there are controversies in the benefit of mammography for breast cancer screening: while the Ministry of Health recommends from age 50 to 69 at biennial intervals, specialist medical societies recommend from the age of 40 at annual intervals [10, 57, 83].

In *Complexity*, the perceptions of difficulties faced, such as disorganized and non-integrated healthcare, without a clear diagnostic and treatment flow, hinders the effectiveness of implementation of a screening program [83]. Patients report difficulties in understanding the service flows to request the exam in PHC and undergo it in specialized care [43], including long periods to receive the result of the mammography exam, or even the loss of results [47, 82, 85].

In terms of *Quality of design and presentation*, studies show the low quality of imaging services and mammographic reports. In the state of Rio de Janeiro, for example, of 16 quality parameters analyzed, only 7 presented more than 70% compliance, the others were below 50% [102]. Araújo et al., 2017 evaluated imaging services with samples from all Brazilian regions and identified that 22.7% of the quality measurements were above the values of reference. Moreover, there was non-compliance in at least 16.7% of the services regarding the classification of the report results; 14% regarding image quality and 5.8% regarding physical structure criteria [77]. Tomazelli et al., 2017, identified a cut-off percentage level of recall of screening mammography of 12.10% [96]. But there is good quality of mammography results regarding the sensitivity and specificity of the exam [46].

In terms of *Adaptability*, providing information about the strength and level of evidence (favorable vs. against; strong vs. weak) facilitates and supports decision-making at the levels of managers, professionals, and population [12, 83]. The use of mobile mammography devices can expand access to mammography [29, 46], and adding flexibility to screening coverage targets, local resources, and establishment of processes for monitoring the program can be key factors in implementing evidence-based screening [81, 82].

Table 9 shows the barriers and facilitators in the Process domain.

In terms of *Planning*, there are a lack of initiatives for planning and monitoring of the screening program in PHC [59, 82, 87]. Additionally, *Opinion Leaders* can be a barrier, as different specialists (gynecology, mastology and radiology) have different recommendations for screening, both regarding the age range of initiation of screening, as well as the interval between mammograms [55, 56].

Concerning *External Change Agents*, the advocacy of mammography can lead to an overuse of mammography, driven by campaigns such as Pink October, which promote the exam without discussing its potential harms [57, 83, 104]. Regarding *Execution*, compliance with PHC screening program recommendations is notably low at 11.8% [84], accompanied by a mammographic coverage rate of the target population from 14.3% to levels still below 70% [12, 46, 47, 52, 54, 82, 91, 93, 94, 97, 106, 107].

Discussion

We aimed to identify the determinants that affect the implementation of opportunistic mammography screening in the Brazilian public health system, so that future studies can develop strategies to address the barriers and optimize the facilitators [108]. Our review identified 74 determinants, expanding the scope of the existing literature on contextual determinants about breast cancer screening [109–112]. Using the CFIR as a reference, it was possible to identify 50 barriers and 24 facilitators from the selected sample.

The wide variety of determinants for implementing evidence-based practices identified in this study is relatively common in the literature [113]. We were able to identify the critical aspects for the implementation of opportunistic mammographic screening in the Brazilian public system, and offer a rich base of information about what, who, and how to modify, adjust, direct, or define resources or strategies to improve and organize the mammographic screening [113]. Furthermore, our results identified barriers and facilitators that are common to other opportunistic- and organized- mammographic screening programs globally, demonstrating the complexity of implementation [114, 115].

The highest frequency of determinants was related to the outer and inner settings, followed by characteristics of individuals and intervention characteristics. We did not find many determinants in the intervention characteristics and process domains. Our findings, therefore, highlight concerns about the complexity of organizing the screening, a similar concern in other countries, such as rural areas in the U.S [112].

In terms of *Outer Setting*, our findings underscore the significance of patient needs and resources as key determinants for breast cancer screening. These determinants include factors such as race, socioeconomic status, and level of education. This importance is acknowledged in the literature and is evident in both low- and middle-income countries, as well as in high-income countries, emphasizing the need to overcome these challenges [112, 116–118]. Conversely, being within the recommended age group (50–69 years) was generally associated with higher screening rates, although older women still faced notable access barriers. Nevertheless, many women outside the target age range continue to undergo screening mammography on a regular basis. Additionally, the COVID-19 pandemic emerged as a relevant external barrier, with several studies reporting a sharp decline in mammography coverage during 2020 and 2021 due to service disruptions, fear of infection, and scheduling difficulties —highlighting the need for targeted policies and financial support [119].

Regarding external policies and incentives, as well as cosmopolitanism, it is important to note that laws and policies formulated by the legislative sphere that contradict the guidelines produced by the executive sphere can be a challenge to implement guidelines. Disagreements regarding the appropriate age to start or end screening are not uncommon; for example, the American Cancer Society suggests initiation at 40, whereas the United States Preventive Services Taskforce recommends starting at 50 [9].

Another barrier relates to the coordination of care, specifically the communication/integration between Primary Health Care and specialized diagnostic and oncology services. For example, a study in the state of Rio de Janeiro revealed the existence of seven different information systems used to coordinate the continuum of the patient care -detailing when, how, and by whom the patient will be cared for. Such a complex structure affects health professionals' knowledge about patients and impairs women's access to early detection of breast cancer and subsequent follow-up care [120]. To address these barriers, which have also been identified by other researchers, the incorporation of the Community Health Workers (CHWs) as patient navigators, appears to support screening efforts. This is exemplified by the Peace of Mind Program developed in the United States for underserved women [121]. In low- and middle-income countries, in addition to the engagement of CHWs, client reminders also seem to be strategies that facilitate the implementation of mammography screening [122, 123].

In terms of *Inner Setting*, we identified several facilitators for breast screening, including financial incentives for mammography at the target age, the number of mammography machines, access to medical appointments, and the engagement and training of healthcare staff. Nevertheless, even in the presence of these facilitators, aspects such as structural characteristics, readiness for implementation and access to knowledge and information were identified as potential barriers. These determinants have also been identified in opportunistic programs implemented in the United States [112, 124–126]. Notably, electronic health records seem critical for the success of patient care [126].

In terms of *characteristics of individuals and intervention characteristics*, our data show similar barriers commonly reported in the literature across various countries, including the U.S., Chile, Iran, Spain, Turkey, and others [108, 112, 127–129]. Regarding patients these barriers encompass women's lack of knowledge, difficulties with scheduling care, financial problems, fear, and lack of social support, as well as information packaging about the intervention.

In terms of the *process*, we found that challenges for screening planning may be linked to low rates of mammography coverage among SUS users, along with potential negative external influences. Relatedly, a review focused on

breast cancer screening through risk stratification highlights the importance of careful planning, positive public engagement, considering the potential negative impact of social media, and echoes healthcare professionals' calls for infrastructure improvements and ongoing assessment processes [130].

A note on "Patient needs and resources" The use of the Consolidated Framework for Implementation Research (CFIR) helped identify numerous interrelated factors that influence the implementation of mammographic screening, highlighting existing crucial gaps for the successful execution of evidence-based screening programs within public health systems. Our team had a lot of in-depth discussion about how to code, however, the constructs outlined in Table 5 under "Patient needs and resources". As the reader can see, we coded constructs related to social determinants of health in this bucket (e.g., socioeconomic status, presence of chronic disease, race). While one could argue that these are individual-level factors, our team conceptualized these constructs through a lens of health rights, incorporating social, economic, and political factors that generate health inequalities [131–133]. This approach underscores the importance of overcoming barriers such as race, socioeconomic status, educational status, and other factors, as societal moderators or mediators, that impede access to mammography screening, suggesting that addressing health inequities requires an understanding of the determinants in the outer setting. An important note is that we used the original CFIR in this study, and since the completion and submission of this paper for review, new versions of the framework have been published [15, 134]. Our edits to the outer context, and other updates of the framework underscore the development of the implementation science field in recognizing the importance of structural, political, and economic factors that affect the access and quality of healthcare for historically underserved populations [135–137], including mammography screening, as shown in this study.

Limitations Although this review provides important knowledge about the barriers and facilitators of opportunistic mammography screening implementation in the Brazilian public health system, some limitations should be noted. We narrowed the search to studies published since 2015, peer-reviewed studies, meaning that significant reports were not included. In addition, we were strict in the inclusion criteria. Some studies that examined screening but did not explore data on mammographic screening in line with Ministry of Health evidence-based recommendations were not included. Furthermore, this review did not include a formal assessment of the methodological quality of the included studies, which limits the ability to weigh the strength of the evidence presented. Finally, the screening and selection process was conducted by a single reviewer. However, this reviewer is a nurse with specialized training in oncology and extensive professional experience across all levels of cancer care — including primary care, mastology outpatient services, and oncology inpatient units. This background enabled a rigorous and contextually grounded screening process, informed by strong clinical experience, policy knowledge, and academic training in oncology and mammography screening.

Conclusion

Our results provide data for further studies that aim to improve the implementation of mammography screening in Brazil in the public health system from opportunistic to organized programs. Using the multilevel analysis of the CFIR to systematize the data, we provide an understanding of multiple interrelated factors that affect mammographic screening for breast cancer in Brazil, a country with a complex healthcare system. These results demonstrate the importance of using implementation science frameworks to inform public policy analysis for breast cancer.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22889-9.

Supplementary Material 1

Acknowledgements
Not applicable.

Author contributions
DCPS, OYT and AB conceived the study and contributed to refining the study concept and methods. DCPS and OYT obtained data. DCPS, RAL and AB prepared and analysed data with substantial contributions input from APB, SIV and MCPL. All authors participated in the interpretation of data. DCPS wrote the first draft, and all authors critically edited it. All authors read and approved the final submitted manuscript and had final responsibility for the decision to submit for publication.

Funding
No funding was available for this study.

Data availability
All data is available from https://osf.io/bxm4p/.
Competing interests.
The authors declare that they have no competing interests.

Declarations

Ethics approval and consent to participate
The Institutional Review Board in Faculty of Public Health of the University of São Paulo doesn't need an approval or consent for review articles.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 30 June 2023 / Accepted: 22 April 2025
Published online: 06 May 2025

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