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Review Article

Active surveillance for low-grade ductal carcinoma in situ: A mixed-methods systematic review of patient, clinician, and health-system perspectives

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ABSTRACT

Background: Low-grade ductal carcinoma in situ (DCIS) is increasingly detected through breast screening, raising concerns about overtreatment. Active surveillance (AS) has emerged as an alternative to immediate surgery. We synthesized patient, clinician, and health-system perspectives relevant to AS adoption.
Methods: We conducted a mixed-methods systematic review (MMSR) following PRISMA, integrating quantitative, qualitative, and mixed-methods studies using a convergent integrated synthesis approach (PROSPERO CRD420250656621). PubMed, Embase, and the Cochrane Library were searched from 2000 to 2025. Risk of bias (RoB) was assessed using standardized tools.
Results: Fourteen studies were included. Patient preferences varied widely and were influenced by anxiety, terminology, perceived risk, and trust. Clinicians highlighted concerns about progression risk, pathology variability, medicolegal exposure, and limited long-term evidence. Institutional readiness was constrained by gaps in surveillance pathways, risk-stratification tools, and implementation support. Overall RoB was low to moderate.
Conclusion: Adoption of AS for low-grade DCIS depends not only on clinical evidence but also on psychological, communication, and organizational factors that shape decision-making across patients, clinicians, and health systems.

1. Introduction

Ductal carcinoma in situ (DCIS) is a non-invasive breast lesion characterized by malignant epithelial proliferation confined to the ductal system without stromal invasion across the basement membrane.[1] With the expansion of population-based mammographic screening, detection rates of DCIS, particularly asymptomatic, screen-detected lesions, have risen sharply, intensifying long-standing concerns regarding overdiagnosis and overtreatment.[2]

Current guidelines recommend surgical excision for most DCIS cases, typically via breast-conserving surgery with adjuvant radiotherapy or mastectomy for more extensive disease.[3] Although these approaches provide excellent oncologic control, they also carry risks of physical morbidity, psychological distress, and long-term impact on body image. At the same time, emerging evidence suggests that many small, low-risk DCIS lesions may follow a biologically indolent course. Long-term observational data have shown that a subset of low-grade lesions typically does not progress to invasive cancer even after decades of follow-up.[4] This divergence between biological behavior and standard treatment has prompted global efforts to re-examine the necessity of immediate surgery for all patients with low-risk DCIS.

Active surveillance (AS), which is commonly defined as structured clinical and radiological monitoring with selective intervention upon evidence of progression,[5] has therefore emerged as a potential

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alternative for carefully selected low-risk patients. Ongoing international trials including COMET (USA), LORD (Europe), LORIS (UK), and LORETTA (Japan) aim to evaluate the safety, acceptability, and patient-reported outcomes of AS in comparison to upfront surgical treatment [5–8]. Early findings suggest that AS may be safe for selected patients; however, long-term oncological outcomes are still underway, and widespread implementation remains controversial.

Despite burgeoning scientific interest, the adoption of AS in routine practice remains limited. Clinicians have voiced concerns about tumor progression, medicolegal liability due to its out-of-standard practice, and inherent variability in pathological grading.[9–11] Patients, conversely, may experience anxiety related to uncertainty, misconceptions about DCIS biology, or difficulty reconciling a cancer diagnosis with non-intervention [12–14]. Institutional factors, including guideline conservatism, capacity to deliver close surveillance, and absence of cost-effectiveness evidence, further complicate real-world implementation.[15,16]

These complexities justify why a mixed-methods systematic review (MMSR) is necessary. Quantitative studies describe patterns of preference, proportions favoring AS, and measurable determinants (e.g., risk tolerance, quality-of-life utilities), but they cannot explain why these preferences arise or how patients and clinicians negotiate uncertainty. Qualitative studies, in contrast, provide rich accounts of lived experience, communication barriers, emotional responses, and contextual influences, that is, insights critical for designing acceptable and feasible AS pathways. Policymaking and clinical guideline development for AS require both types of evidence (measurable trends and interpretive understanding). Synthesizing these complementary data streams would provide a more complete picture of the barriers and facilitators influencing AS uptake across patients, clinicians, and health systems.

Therefore, we conducted a MMSR to synthesize quantitative, qualitative, and mixed-methods evidence on patient, clinician, and health-system perspectives toward AS for low-risk DCIS. Our aim was to identify convergent and divergent determinants of AS acceptability and to generate relevant insights to support shared decision-making and real-world pathway design.

2. Methods

2.1. Study design and setting

This review followed a MMSR design to integrate both quantitative and qualitative evidence examining patient, clinician, and institutional perspectives on AS for low-risk DCIS. As aforementioned, a mixed-methods approach was selected due to the multidimensional nature of AS decision-making, which is shaped not only by measurable determinants—such as risk tolerance and treatment preferences—but also by contextual, emotional, and interpretive factors that cannot be captured by quantitative designs alone [9,10,12,13]. A convergent integrated synthesis allowed quantitative and qualitative findings to be analyzed jointly to identify areas of convergence, divergence, and complementarity.

For the literature search and study selection process, we also referenced the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[17] The protocol was also prospectively registered in PROSPERO (registration number CRD420250656621).

2.2. Search strategy

A comprehensive search of three electronic databases (PubMed, Embase, and the Cochrane Library) was conducted for studies published from January 1, 2000 to July 30, 2024. The search strategy was developed in collaboration with a medical librarian and included controlled vocabulary (e.g., MeSH/Emtree terms) and keywords covering the following major concepts, "ductal carcinoma in situ" OR "DCIS", "low-risk" OR "low-grade", "active surveillance" OR "active monitoring", "patient perspective" OR "physician perspective" OR "attitudes", and "decision-making" OR "treatment preference". Search strings were adapted for each database to account for indexing differences. No language restrictions were applied at the search stage, though only human studies were included. Additional records were identified through manual searching of reference lists from eligible studies. The full search strategy for all databases is provided in Supplementary Table S1.

2.3. Eligibility criteria

Studies were eligible if they met all of the following criteria:

- Population/participants: Patients diagnosed with low-grade or low-risk DCIS; and/or clinicians involved in DCIS diagnosis or management (e.g., breast surgeons, oncologists, radiologists, breast care nurses); and/or health-system or institutional stakeholders relevant to DCIS management pathways.
- Phenomenon of interest: AS or active monitoring for low-risk DCIS, including attitudes, acceptability, willingness to recommend/choose, perceived barriers/facilitators, or decision-making.
- Outcomes of interest: Patient perspectives (e.g., preferences, anxiety, risk perception, decisional conflict, trust, quality of life); and/or clinician perspectives (e.g., comfort offering AS, perceived progression risk, medicolegal concerns); and/or system/institutional perspectives (e.g., pathway readiness, follow-up infrastructure, guideline considerations).
- Study design: Quantitative, qualitative, or mixed-methods primary research.

In contrast, studies were excluded if they: (i) focused exclusively on high-grade DCIS or invasive breast cancer; (ii) did not address AS as a management approach; or (iii) were editorials, commentaries, conference abstracts, or grey literature without extractable primary data. Grey literature refers to research and reports not formally published in peer-reviewed journals (e.g., policy reports, dissertations, organizational reports, preprints, and conference proceedings).

2.4. Study selection

All records were imported into Covidence for de-duplication and screening. A two-stage screening process was conducted, whereby title and abstract screening were performed independently by three reviewers (D.H.X.P., C.L.Y.T., and Y.N.). Full-text screening conducted for all potentially eligible studies. Discrepancies were resolved through discussion with a fourth reviewer/senior author (S.S.N.G. or Q.X.N.). Reasons for exclusion at the full-text stage were documented. The study selection process is depicted in a PRISMA flow diagram (Fig. 1).

2.5. Data extraction

A standardized extraction form was piloted and finalized before use. Extracted items included study characteristics (authors, year, country, design), participant characteristics, quantitative outcomes (e.g., preference distributions, risk tolerance, psychosocial measures), qualitative themes (e.g., emotional responses, communication issues, expectations), and institutional or system-level findings, where available. Two reviewers (D.H.X.P. and C.L.Y.T.) independently extracted data. Disagreements were resolved through consensus with the senior reviewer (S.S.N.G.).

2.6. Risk of bias assessment

Risk of bias was evaluated at the study level using the following tools: Cochrane Risk of Bias Tool[18] for randomized, controlled trials (RCTs), Newcastle–Ottawa Scale (NOS)[19] for observational studies (cohort, cross-sectional), ROBVALU tool for values and preferences research,[20] and the Critical Appraisal Skills Programme (CASP)

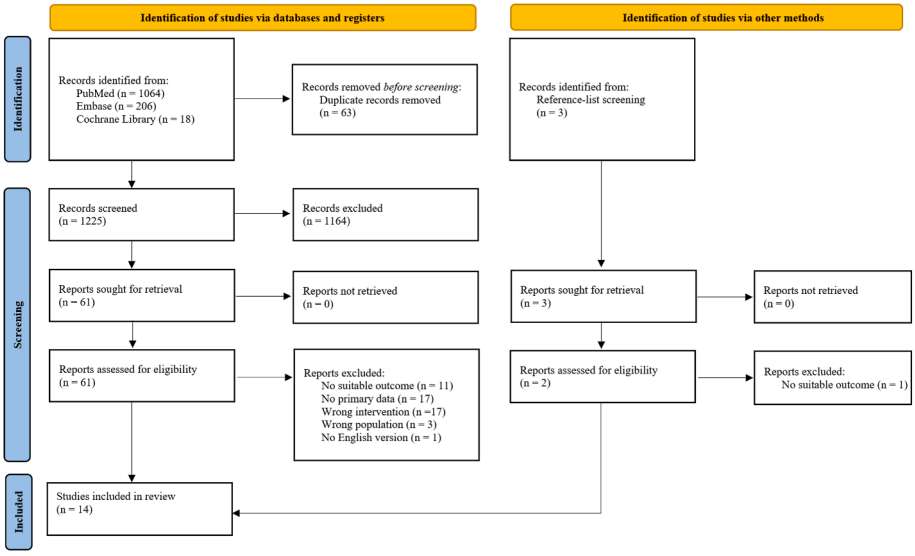

Fig. 1. PRISMA flowchart showing the study selection process.

checklist[21] for qualitative studies. Two reviewers (D.H.X.P. and C.L.Y.T.) performed independent assessments; disagreements were resolved by a third reviewer (Q.X.N.).

2.7. Data synthesis and integration

Given the methodological heterogeneity across included studies, a narrative synthesis was conducted. As per Joanna Briggs Institute guidance,[22] convergent integrated approach was used for mixed-methods synthesis, whereby the quantitative evidence (e.g., proportions choosing AS, utility scores, risk trade-offs) was summarized descriptively and qualitative findings (e.g., fear of progression, trust in clinicians, terminology effects) were thematically analyzed and mapped to decision-making constructs. Both strands were then brought together to identify convergent, divergent, and complementary insights regarding patient, clinician, and institutional perspectives on AS after rigorous team discussions. Our review team members brought expertise from medicine, surgery, public health and the social sciences. This integrative approach allowed us to synthesize measurable determinants with experiential and contextual evidence to inform real-world implementation of AS for low-risk DCIS.

3. Results

3.1. Study selection

The database search identified 1288 records. After removal of duplicates, 1225 titles and abstracts were screened. Sixty-one articles underwent full-text review, of which 47 were excluded for not meeting eligibility criteria. Two additional records were identified through reference-list screening and met inclusion criteria. Finally, 14 studies were included in the review (Fig. 1).

3.2. Study characteristics

Across the 14 included studies [6,11,23–34], methodological approaches varied widely, including discrete choice experiments, cross-sectional surveys, rating scale utilities, semi-structured interviews, and web-based qualitative surveys. Patient sample sizes ranged from 172 to 1832, while clinician studies included between 17 and 979 participants. Most patient-based quantitative studies focused specifically on screen-detected low-risk DCIS, reflecting the populations targeted by ongoing AS trials such as LORD[6] and LORIS.[7] The four qualitative studies contributed rich contextual insight into psychological responses, clinician dilemmas, and perceptions of terminology. The majority of studies (n = 11) examined patient attitudes [6,11,23–30,32], while four examined clinician perspectives[23,31,33,34]; one study included both groups.[23] A summary of study characteristics is shown in Table 1.

3.3. Risk of bias assessment

Most quantitative studies demonstrated acceptable methodological quality, with low to moderate risk of bias [6,23–31,34]. Common limitations included non-probability sampling, limited adjustment for confounders, and cross-sectional design. Qualitative studies met core CASP criteria but showed variability in reporting reflexivity and positionality. Overall, no study presented a risk of bias serious enough to preclude inclusion. A detailed breakdown is presented in Supplementary Table S2.

3.4. Synthesis of findings

3.4.1. Patient perspectives

Across the 11 studies examining patient views, preferences for AS varied substantially by country and clinical context. In three large Dutch studies involving women eligible for the LORD trial, 76–81% of patients chose AS over conventional surgery.[6,23,28] In contrast, a Hong Kong cohort reported overwhelming preference for surgical excision, with only 1 of 112 patients opting for AS.[29]

In terms of patient-dependent factors, age effects were inconsistent. One study reported older women were more likely to choose surgery, whereas three others found no age association with management preference. Cancer worries and tolerance for uncertainty demonstrated mixed associations: two studies found higher worry predicted preference for surgery,[25,30] whereas others found no relationship.[6,28] Patients with prior breast cancer, abnormal mammograms, or biopsies consistently displayed lower interest in AS, reflecting heightened perceived vulnerability.[11,26,29]

Knowledge gaps played a notable role. In Engelhardt et al., 66% of women had low DCIS knowledge, with misconceptions about AS safety and future invasive cancer risk. Women with lower knowledge were paradoxically more likely to select AS, possibly due to underestimation of risk.

In terms of disease-dependent factors, tumour size and grade were not consistently associated with treatment preference across studies. However, cancer progression risk strongly influenced valuations in rating-scale and utility studies. Chapman et al. found that cancer risk

Table 1
Characteristics and key findings of included studies.

Author, Year	Country/Setting	Study Design	Population & Sample Size	Study Objectives/Aims	Key Findings Relevant to AS
Byng, 2021[23]	Netherlands	Discrete choice experiment	172 low-risk DCIS patients; 30 oncologists	Treatment preferences and factors influencing decision-making	Majority of patients preferred AS; treatment invasiveness more influential than absolute cancer risk; physicians prioritised 10-year invasive cancer risk more strongly than patients.
Hwang, 2021[5]	USA	Cross-sectional survey with time–trade-off utility modelling	665 women with DCIS/ ADH/LCIS	Quality-of-life valuation of AS vs surgery	Patients valued physical function highest; older women willing to trade more survival years to avoid adverse health states; low uptake of AS despite favorable utilities.
Geerts, 2016[25]	Netherlands	Discrete choice experiment	216 women (screen-eligible general population)	Determinants of preferences for AS vs surgery	High cancer worry drove preference for surgery; low worry associated with greater acceptance of AS; disfigurement from surgery strongly influenced decisions.
McCaffery, 2015[27]	Australia	Randomised experimental survey	269 women	Effect of terminology ("abnormal cells" vs "pre-invasive cancer")	Terminology significantly affected concern and preference; neutral language increased willingness to consider non-surgical options.
Engelhardt, 2024[28]	Netherlands	Cross-sectional survey (LORD trial participants)	376 low-risk DCIS patients	Knowledge, perceptions, and management choice	77% chose AS; low DCIS knowledge associated with preference for AS; misconceptions about AS safety prevalent.
Schmitz, 2023[6]	Netherlands	Cross-sectional survey (LORD trial participants)	377 low-risk DCIS patients	Motivations for choosing AS vs surgery	76% preferred AS; drivers included avoidance of side effects, trust in follow-up, and desire to avoid overtreatment; surgery chosen due to anxiety and desire for certainty.
Bromley, 2019[26]	Australia	Cross-sectional interview with utility elicitation	172 women (mixed breast cancer histories)	Preferences and utilities for AS vs surgery	AS rated closest to perfect health; surgery associated with lower utilities; fear of recurrence influenced choice of surgery.
Co, 2021[29]	Hong Kong	Structured interviews	1000 women attending breast clinic	Perceptions of AS and preferred management	Only 10.9% chose AS; older age and malignant history strongly predicted preference for surgery; fear of lifelong anxiety prominent.
Chapman, 2021[30]	USA	Discrete choice experiment	194 women attending imaging centre	Influence of non-oncologic attributes on decisions	Many willing to accept modest risk increases to avoid mastectomy or chronic pain; breast appearance and pain were major determinants.
Poli, 2023[31]	USA	National physician survey	979 breast specialists	Clinician opinions on observing DCIS	<50% believed evidence for AS was adequate; major barriers included progression risk, risk of upstaging, patient unwillingness, and medico-legal concerns.
Rosenberg, 2022[32]	USA	Qualitative open-ended survey	1832 DCIS patients	Experiences, emotions, and concerns	High uncertainty and psychological burden; confusion about DCIS nature; treatment decisions strongly influenced by fear of recurrence.
Nickel, 2020[33]	Australia & New Zealand	Qualitative interviews	26 clinicians	Professional views on AS	Many believe DCIS requires active treatment; AS considered acceptable only with strong evidence; communication challenges highlighted.
Mathelin, 2022[34]	International (Senologic Society)	Cross-sectional clinician survey	22 clinicians (multidisciplinary)	Global management attitudes and future directions	Mixed receptivity: 27% supportive of AS, 27% opposed; clinicians identified patient subgroups suitable for AS (elderly, low-grade).
Nickel, 2015[11]	Australia	Qualitative interviews	26 women	How terminology affects management preference	Neutral terminology reduced anxiety; many preferred monitoring when cancer-related wording was avoided.

accounted for 53% of variance in treatment preference 30, whereas Byng et al. showed progression risk was comparatively less influential among women who already favoured AS.[23]

As for treatment-dependent factors, quality-of-life implications were central. Surgical and radiotherapy options were associated with anticipated or experienced pain, sensory disturbance, disfigurement, and functional limitations. Conversely, AS was seen as preserving physical quality of life but imposing ongoing emotional burden due to uncertainty. Patients willing to choose AS generally accepted shorter surveillance intervals (4–6 months), reflecting desire for reassurance.

With regard to potential physician-dependent factors, communication and terminology significantly shaped patient perceptions. Studies showed that labelling DCIS as "abnormal cells" lowered anxiety, whereas "pre-invasive breast cancer" heightened concern. Shared decision-making, trust in clinicians, and clinician encouragement increased likelihood of choosing AS; conversely, clinician discouragement, even subtle, shifted patients toward surgery.

3.4.2. Physician perspectives

Four studies provided clinician insights, encompassing 1057 healthcare professionals across multiple regions.[23,31,33,34] Across settings, clinician support for AS was cautious and heterogeneous. Notably, fewer than half of surveyed clinicians in the US believed that evidence supporting observation of DCIS was moderate or strong.[31] Most expressed greatest comfort offering AS to women with low-grade lesions, older age, comorbidities, or smaller tumour size. Nearly all clinicians were uncomfortable recommending AS for high-grade DCIS.

Key barriers to AS adoption included perceived high risk of disease progression, fear of upstaging at excision, concerns about medicolegal exposure, limited patient willingness, and deviation from established norms. In one US survey, 76.5% described recruitment into AS trials as "somewhat to very difficult." Some clinicians felt that explaining AS to patients was challenging due to entrenched cultural expectations of active cancer treatment.[31]

In terms of future outlook for AS, clinicians anticipated that stronger trial evidence could shift practice norms.[33] In an international clinician survey (Senologic International Society survey), respondents anticipated future de-escalation trends including reduced surgery and radiotherapy and increased use of risk stratification tools to support surveillance-based pathways.[34]

3.4.3. Healthcare system and institutional perspectives

Evidence relating to institutional or health system perspectives was limited. No included study provided cost-effectiveness evaluations. One survey done in the US reported that 68.3% of physicians did not view lack of institutional support as a barrier to trial participation, though

31.7% cited institutional uncertainty or reluctance as at least a minor factor.

Across studies, the absence of standardised surveillance protocols, lack of clear guidelines, and the need for intensive follow-up infrastructure were recurrent themes. Quality-adjusted life-year studies indicated that guideline-concordant care (GCC) may yield lower quality of life than AS due to pain, infection risk, and functional limitations, but such modelling has not yet been translated into policy or implementation frameworks.

3.5. Integrated mixed-methods interpretation

Integrating the quantitative and qualitative evidence yielded a cohesive understanding of how patients, clinicians, and health systems perceive and approach AS for low-risk DCIS. Across the included studies, DCIS emerged as a diagnosis marked by inherent uncertainty.[31,33] Patients frequently described confusion about the biological behaviour of DCIS, often struggling to reconcile the label of "cancer" with the possibility of non-intervention,[11,32] while clinicians expressed hesitancy, stemming from concerns about disease progression and the limitations of current prognostic tools.[31,33] This ambiguity shaped decision-making across both groups and contributed to the persistence of conventional treatment norms.

Anxiety and the desire for certainty further influenced preferences, with many patients gravitating toward surgery as a means of reducing perceived risk, even when aware of its associated morbidity [25,26,30]. Fear of progression, uncertainty about surveillance intervals, and apprehension about living with untreated disease were recurring themes, while clinicians similarly favoured intervention to mitigate medicolegal risk and alleviate patient anxiety.[23,31] These overlapping emotional drivers often overshadowed objective risk assessments, reinforcing a default inclination toward excision.

Adoption of AS also varied considerably across cultural and healthcare contexts. Dutch and Australian cohorts demonstrated greater acceptance of surveillance,[6,11,23,26] likely reflecting established national breast-screening programmes, strong risk communication practices, and cultural comfort with watchful waiting. Conversely, studies from Asian settings showed a clear preference for surgical excision, driven by cultural norms, high value placed on decisiveness in cancer care, and strong trust in surgeon-led recommendations. At the system level, readiness for widespread implementation of AS remains limited. Across settings, clinicians cited insufficient long-term trial evidence, lack of institutional infrastructure to support close monitoring, and unclear medicolegal frameworks as major barriers. Without validated risk-stratification tools, standardised follow-up protocols, and supportive organisational structures, AS is perceived as challenging to deliver safely and consistently. These findings highlight the complex interplay between biological uncertainty, emotional drivers, cultural norms, and system-level constraints that currently shape the evolution and feasibility of AS for low-risk DCIS.

4. Discussion

This MMSR synthesized quantitative and qualitative evidence on patient, clinician, and institutional perspectives toward AS for low-risk DCIS. Across 14 included studies, four overarching insights emerged: (1) DCIS is widely perceived as a confusing and ambiguously defined condition; (2) treatment decision-making reflects a dynamic negotiation between anxiety, desire for certainty, and trust; (3) real-world readiness for AS remains low and varies across cultural and healthcare contexts; and (4) significant system-level gaps, including infrastructure, risk-stratification tools, and medico-legal frameworks, continue to impede adoption in routine clinical practice.

Across studies, patients consistently described DCIS as an entity that is simultaneously "not cancer" and yet managed as cancer. Confusion regarding its natural history, prognosis, and significance was a recurring theme, contributing to anxiety and difficulty conceptualizing AS as a legitimate option. This diagnostic ambiguity mirrors longstanding debates in the scientific community regarding the biological heterogeneity of DCIS and the extent to which all lesions carry malignant potential. While prior observational data indicate that some low-grade lesions may behave indolently,[35,36] such nuance is challenging to communicate and often poorly understood by patients and clinicians alike. In particular, terminology powerfully shaped emotional and cognitive responses. As shown in both quantitative and qualitative data, framing DCIS using less cancer-laden language reduced anxiety and increased openness to AS, whereas the term "pre-cancer" heightened perceived urgency for intervention. These linguistic effects are important considerations for clinician-patient communication as they emphasize biological risk rather than categorical labels.

Unsurprisingly, anxiety, risk perception, and tolerance for uncertainty emerged as major determinants of treatment preference. Some patients viewed AS as a pathway that might preserve quality of life, avoid unnecessary surgery, and prevent disfigurement; others perceived it as emotionally burdensome due to ongoing vigilance and the fear of missing progression. Where invasive disease was feared, even small perceived risks prompted preference for mastectomy (even bilateral mastectomy) for psychological closure. Clinicians, meanwhile, valued certainty, systematic control, and medicolegal safety. Existing DCIS risk stratification approaches include clinicopathologic nomograms and multigene assays designed to estimate recurrence or progression risk[37,38]; however, their utility in selecting patients for non-operative management remains uncertain in part due to limited prospective validation, variable discrimination, and questions regarding generalizability and interpretability. For most clinicians, the risk of progression remained the single most influential factor guiding management. This divergence, that is, patients holding subjective preferences and often prioritizing avoidance of morbidity and clinicians prioritizing oncologic certainty, has been documented in breast oncology [39–41] and highlights a fundamental tension at the heart of AS decision-making. Effective shared decision-making must therefore scaffold both the cognitive (risk estimates, surveillance intervals) and emotional (fear, reassurance, perceived vulnerability) dimensions of choice.

Considerable geographic variation was evident. Dutch studies reported that most AS-eligible patients favoured surveillance,[6,23,25,28] while in Asian settings, surgical management remained overwhelmingly preferred.[29] Cultural values relating to cancer stigma, medical authority, trust, and acceptable levels of risk tolerance likely shape these differences. Similarly, clinician perspectives varied widely. While some clinicians expressed cautious optimism that AS could become standard for selected patients once trial data mature, others rejected AS outright due to insufficient evidence, concerns about institutional support, or perceived patient unwillingness. Such heterogeneity complicates guideline harmonization and underscores the importance of contextual, culturally sensitive implementation planning.

Across institutional perspectives, three challenges were particularly salient. First, the absence of standardized surveillance pathways, including defined roles, imaging intervals, triggers for intervention, and mechanisms for communicating results. Second, the lack of validated risk-stratification tools capable of reliably identifying truly low-risk lesions. Finally, medicolegal concerns related to deviation from current standard of care. Although only a minority of clinicians cited inadequate institutional support as a "major barrier," a sizable proportion identified it as a minor but meaningful constraint; collective ambivalence can be as obstructive as explicit opposition. Furthermore, the absence of cost-effectiveness data represents an important evidence gap for implementation planning and future guideline development, particularly given the longitudinal imaging and follow-up resources required for surveillance-based pathways.

Within this context, vacuum-assisted excision (VAE) or other image-guided, minimally invasive excision techniques may represent one potential "middle ground" between standard surgery and AS approaches

for selected patients. Although not the primary focus of most included studies, the concerns they highlight about underestimation of invasive components, medicolegal risk, and patient anxiety, align with the appeal of an approach that removes or debulks the lesion through an outpatient procedure, reduces the need for theatre-based surgery, and still permits careful histological assessment and margin evaluation.[42] For low-grade, small-volume DCIS, de-escalation to VAE followed by close radiological surveillance may be more acceptable to both patients and clinicians in the immediate term than a wholesale shift to non-excisional surveillance. VAE provides a larger tissue sample than core biopsy, enabling more extensive histological assessment and potentially reducing undersampling,[42] although it does not provide definitive surgical margin assessment comparable to formal excision. It may support safe follow-up within a controlled framework. In this stepwise model, AS sits at the far end of a spectrum of de-escalation, becoming more credible as diagnostic accuracy, prognostic tools, and long-term trial data strengthen confidence in truly non-operative strategies. Nevertheless, de-escalation is not limited to VAE, and patient acceptability may differ substantially depending on preferences for awake procedures, tolerance for repeated biopsies, and desire for definitive excision under anesthesia. Other non-surgical or less invasive strategies—including endocrine therapy as risk reduction, focal ablation approaches (e.g., cryoablation[43]), and radiotherapy de-escalation in selected patients—may also play complementary roles in future individualized management pathways.

AS represents a broader conceptual shift that extends beyond procedural de-escalation and is best understood as a continuum rather than an 'all-or-nothing' alternative, with most systems likely to adopt staged implementation. AS is not necessarily equivalent to "no treatment," as some protocols incorporate endocrine therapy as a non-surgical risk-reduction strategy, which may shape both oncologic outcomes and patient acceptability.[5,44] As evidence from international trials, including COMET, LORD, LORIS, and LORETTA, continues to mature [5–8], this continuum can be recalibrated, with AS potentially transitioning from a protocolized or investigational strategy toward a standard-care option for clearly defined subgroups where safety and patient-reported outcomes are favorable.

Notably, based on recent trial updates, the LORETTA (JCOG1505) single-arm confirmatory study of tamoxifen monotherapy without surgery in ER-positive, low-risk DCIS was reportedly stopped early after interim analysis suggested that the 5-year cumulative incidence of ipsilateral invasive cancer exceeded a predefined acceptability threshold.[45] This contrasts with COMET's early findings,[5] which have generally supported the short-term feasibility of active monitoring (with or without endocrine therapy) in carefully selected patients, albeit with longer-term invasive cancer outcomes still awaited. These signals suggest that "no surgery" strategies may be highly sensitive to patient selection, underlying biology, and the intensity and fidelity of surveillance, and reinforce the need for robust risk stratification and shared decision-making before broad implementation.

Regardless of where a system currently sits on this spectrum, implementation of de-escalatory strategies will require several core components. First, clear risk communication and shared decision-making support are essential to help patients understand DCIS heterogeneity, the rationale for de-escalation, and the trade-offs between surgical morbidity and the psychological burden of surveillance, while avoiding overly alarming terminology. Standardized educational and decision-support tools (e.g., scripts, visual risk communication aids, and decision templates) may improve consistency in counselling and explicitly address uncertainty, surveillance intensity, and triggers for intervention.[46,47] Second, clinician training in communicating probabilistic risk and documenting preference-sensitive decisions is important to build confidence and mitigate medicolegal concerns. Third, multidisciplinary pathways should define eligibility criteria for standard surgery, minimally invasive approaches (e.g., VAE), or AS; specify imaging schedules; and establish clear thresholds for re-biopsy or conversion to surgery, with roles clarified across radiology, surgery, oncology, pathology, and nursing. Finally, psychosocial support structures, such as nurse-led navigation or psycho-oncology services, may benefit patients who experience ongoing uncertainty during surveillance-based management.

From a policy and guideline perspective, future recommendations should explicitly distinguish between surgical de-escalation (e.g., avoiding surgery where not clearly indicated, prioritizing breast-conserving surgery or VAE for low-risk lesions) and surveillance de-escalation (e.g., moving from excision plus adjuvant therapy toward protocols where low-risk DCIS may be managed with biopsy ± VAE and structured imaging follow-up). Guidelines will increasingly require validated risk-stratification models that integrate pathology, imaging, molecular markers, and patient characteristics to define thresholds for each step along this continuum. Cost-effectiveness analyses comparing standard surgery, VAE-based de-escalation, and AS in different health systems, particularly those with limited resources, will be essential to inform rational allocation of imaging and follow-up capacity. In settings where cultural norms favor more aggressive treatment, early implementation and adoption efforts should focus on building clinician confidence, ensuring medicolegal clarity, and providing patients with accessible, evidence-based education.

A major strength of this review lies in its mixed-methods design, which enabled the integration of quantitative patterns in preferences and risk trade-offs with qualitative insights into emotions, expectations, and contextual influences. This approach allowed us to understand not only what patients, clinicians, and institutions think about AS, but why, providing a richer foundation for designing patient-centered, stepwise de-escalation pathways that may include VAE and other minimally invasive approaches. However, several limitations warrant consideration. Substantial heterogeneity in study designs, populations, and outcome measures limited comparability and precluded meta-analysis. Many studies relied on hypothetical scenarios or discrete choice experiments rather than real-world clinical decision-making, raising concerns about ecological validity.[11,23,25,26,29,30] Geographic representation was uneven, with most data originating from Western countries [6,11,23–34] and minimal evidence from Asian, Latin American, or low-resource settings[29] where cultural norms and health-system constraints may differ substantially. Institutional perspectives were sparsely examined, leaving significant gaps in understanding organizational readiness, medicolegal considerations, and resource requirements for AS implementation. Finally, while ongoing RCTs including COMET, LORIS, LORD, and LORETTA are expected to clarify long-term oncologic safety [5–8,45], trial outcomes must be interpreted alongside real-world behavioral data on patient adherence, clinician willingness to offer de-escalated options (including VAE and AS), and system-level capacity to support structured surveillance programmes.

5. Conclusions

AS for low-risk DCIS is a meaningful shift in breast cancer care, from a uniform surgical approach towards a more personalized, risk-stratified, and patient-centered model of management. This mixed-methods systematic review demonstrates that the viability of AS hinges not only on accumulating oncologic evidence but, critically, on the psychological, relational, and structural factors that shape how DCIS is perceived and acted upon. Patients must weigh fears of cancer progression against the physical and emotional burdens of overtreatment; clinicians navigate entrenched practice norms, medicolegal concerns, and uncertainty in pathological grading; and health systems confront infrastructural, policy, and workflow limitations that affect real-world implementation. In the near term, a stepwise de-escalation pathway may offer the most pragmatic route toward reducing overtreatment while maintaining safety. Rather than a binary choice between immediate surgery and surveillance alone, de-escalation can be conceptualized as a continuum of strategies—including enhanced diagnostic

confirmation, minimally invasive tissue sampling or lesion-directed procedures, endocrine risk-reduction where appropriate, and structured surveillance with predefined triggers for escalation—tailored to patient preferences, risk tolerance, and local system capacity. If AS is to evolve into a credible and trusted option for appropriately selected patients, healthcare systems must attend to these multidimensional influences, including strengthening communication, improving risk stratification, supporting clinicians, and building institutional pathways that make surveillance both safe and acceptable.

CRediT authorship contribution statement

Daniella Hui Xin Poh: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation. **Cristal Li Yi Tan:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation. **Yaoyi Ng:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Kevin Xiang Zhou:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Qin Xiang Ng:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. **Serene Si Ning Goh:** Writing – review & editing, Supervision, Investigation, Formal analysis, Conceptualization.

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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.

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Appendix A Supplementary data

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