# Vacuum-assisted breast biopsy versus core needle biopsy: A Systematic Review and Meta-Analysis

# ELECTRONIC SUPPLEMENTARY MATERIAL

## S1: Search strategies PubMed and Cochrane Library

### Search strategy - PubMed

((((("vacuum" OR "vacuum assisted" OR "vacuum-assisted" OR "ATEC*" OR "Brevera*" OR "Eviva*" OR "Celero*" OR "Mammotome*" OR "Elite*" OR "Revolve*" OR "EnCor*" OR "EnCor Enspire*" OR "EnCor Ultra*" OR "Vacora*" OR "EleVation*") AND ("breast biops*" OR "biops*" OR "core biops*" OR "excision" OR "device" OR "biopsy device" OR "suction biops*" OR "aspiration biops*")) OR "VAB" OR "VABB" OR "VAE" OR "VACNB" OR "VACB" OR "VALCB" OR "DVA") AND ((("core needle" OR "core-needle" OR "needle core" OR "core" OR "large core" OR "large-core" OR "percutaneous" OR "percutaneous core" OR "spring-loaded" OR "spring loaded" OR "spring-activated" OR "spring activated" OR "automated gun" OR "Sertera*" OR "EvoCore*" OR "Magnum*" OR "Mission*" OR "HistoCore*" OR "MaxCore*" OR "Max-Core*" OR "Monopty*" OR "Marquee*") AND ("biops*" OR "breast biops*")) OR "NCB" OR "CNB" OR "CB" OR "CCNB" OR "ACNB" OR "Biopsy, Large-Core Needle"[MeSH Terms] OR "core-biopsy" OR (("fine-needle" OR "fine needle") AND ("aspiration" OR "aspiration cytology" OR "aspiration biops*")) OR "Biopsy, Fine-Needle"[Mesh] OR "FNA" OR "BFNA" OR "FNAC" OR "FNAB" OR "Chiba*")) AND ("diagnostic management" OR "diagnostic performance" OR "diagnostic accuracy" OR "diagnostic yield" OR "accuracy" OR "sensitivity" OR "true positive rate" OR "true-positive rate" OR "TPR" OR "true positives" OR "true-positives" OR "sensitivity and specificity"[MeSH Terms] OR "sensitivity" OR "true negative rate" OR "true-negative rate" OR "TNR" OR "true negatives" OR "true-negatives" OR "false positive rate" OR "false-positive rate" OR "FPR" OR "false positives" OR "false-positives" OR "false negative rate" OR "false-negative rate" OR "FNR" OR "false negatives" OR "false-negatives" OR "positive predictive value" OR "PPV" OR "positive predictive" OR "positive test" OR "predictive value of tests"[MeSH Terms] OR "negative predictive value" OR "NPV" OR "negative predictive" OR "negative test" OR "area under curve"[MeSH Terms] OR "area under curves"[MeSH Terms] OR "area under the curve" OR "AUC" OR "receiver operat*" OR "underestimation rate*" OR "underestimate rate*" OR "cancer underestimation" OR "diagnostic underestimation" OR "diagnostic upgrade" OR "histologic upgrade" OR "upgrade rate*" OR "understaging" OR "upstaging" OR "disconcordance" OR "disconcordance rate*" OR "concordance" OR "concordance rate*" OR "agreement rate*" OR "underestimation" OR "upgrade" OR "upgrade risk" OR "rate of upgrade" OR "under-evaluation*" OR "under evaluation*" OR "missed cancer" OR (("ductal carcinoma in situ" OR "DCIS" OR "atypical ductal hyperplasia" OR "ADH") AND ("underestimation rate*" OR "underestimat*" OR "upgrade rate" OR "upgrade")) OR "repeat biopsy rate*" OR "biopsy failure rate*" OR "rebiopsy rate*" OR "repeat biops*" OR "calcification retrieval rate*" OR "calcification retrieval" OR "microcalcification retrieval rate*" OR "microcalcification retrieval" OR "retrieval failure" OR "success rate*" OR "complication*" OR "hematoma" OR "bleeding*" OR "infection*" OR "pain" OR "bruising" OR "workflow" OR "efficac*" OR "time under compression" OR "time" OR "minute*" OR ("time" AND "compression") OR "mortality" OR "died" OR "dead" OR "deceased" OR "morbidity" OR "quality of life" OR "quality of life"[MeSH Terms] OR "QoL" OR "QOL" OR "HRQOL" OR "HRQoL" OR "Quality-Adjusted Life Years"[Mesh] OR "Cost-Effectiveness Analysis"[Mesh] OR "Economic Factors"[Mesh] OR "cost-effectiveness*" OR "econom*" OR "Costs and Cost Analysis"[Mesh] OR "Cost-Benefit Analysis"[Mesh] OR "cost*") AND hasabstract[text] AND English[lang] AND ("1995/01/01"[PDAT] : "3000/12/31"[PDAT])

## Search strategy – Cochrane Library

#1 (("vacuum" OR "vacuum assisted" OR "vacuum-assisted" OR "ATEC" OR "Brevera" OR "Eviva" OR "Celero" OR "Mammotome" OR "Elite" OR "Revolve" OR "EnCor" OR "EnCor Enspire" OR "EnCor Ultra" OR "Vacora" OR "EleVation") AND ("breast biopsy" OR "breast biopsies" OR "biopsy" OR "biopsies" OR "core biopsy" OR "core biopsies" OR "excision" OR "device" OR "biopsy device" OR "suction biopsy" OR "suction biopsies" OR "aspiration biopsy" OR "aspiration biopsies")) OR “VAB” OR “VABB” OR “VAE” OR “VACNB” OR “VACB” OR “VALCB” OR "DVA"

#2 MeSH descriptor: [Biopsy, Large-Core Needle] explode all trees

#3 MeSH descriptor: [Biopsy, Fine-Needle] explode all trees

#4 (("core needle" OR "core-needle" OR "needle core" OR "core" OR "large core" OR "large-core" OR "percutaneous" OR "percutaneous core" OR "spring-loaded" OR "spring loaded" OR "spring-activated" OR "spring activated" OR "automated gun" OR "Sertera" OR "EvoCore" OR "Magnum" OR "Mission" OR "HistoCore" OR "MaxCore" OR "Max-Core" OR "Monopty" OR "Marquee") AND ("biopsy" OR "biopsies" OR "breast biopsy" OR "breast biopsies")) OR "NCB" OR "CNB" OR "CB" OR "CCNB" OR "ACNB" OR "core-biopsy" OR (("fine-needle" OR "fine needle") AND ("aspiration" OR "aspiration cytology" OR "aspiration biopsy" OR "aspiration biopsies")) OR "FNA" OR "BFNA" OR "FNAC" OR "FNAB" OR "Chiba" OR #2 OR #3

#5 MeSH descriptor: [Sensitivity and Specificity] explode all trees

#6 MeSH descriptor: [Area Under Curve] explode all trees

#7 MeSH descriptor: [Predictive Value of Tests] explode all trees

#8 "diagnostic management" OR "diagnostic performance" OR "diagnostic accuracy" OR "diagnostic yield" OR "accuracy" OR "sensitivity" OR "true positive rate" OR "true-positive rate" OR "TPR" OR "true positives" OR "true-positives" OR "sensitivity" OR "true negative rate" OR "true-negative rate" OR "TNR" OR "true negatives" OR "true-negatives" OR "false positive rate" OR "false-positive rate" OR "FPR" OR "false positives" OR "false-positives" OR "false negative rate" OR "false-negative rate" OR "FNR" OR "false negatives" OR "false-negatives" OR "positive predictive value" OR "PPV" OR "positive predictive" OR "positive test" OR "negative predictive value" OR "NPV" OR "negative predictive" OR "negative test" OR "area under the curve" OR "AUC" OR "receiver operator" OR #5 OR #6 OR #7

#9 "underestimation rate" OR "underestimation rates" OR "underestimate rate" OR "underestimate rates" OR "cancer underestimation" OR "diagnostic underestimation" OR "diagnostic upgrade" OR "histologic upgrade" OR "upgrade rate" OR "upgrade rates" OR "understaging" OR "upstaging" OR "disconcordance" OR "disconcordance rate" OR "disconcordance rates" OR "concordance" OR "concordance rate" OR "concordance rates" OR "agreement rate" OR "agreement rates" OR "underestimation" OR "upgrade" OR "upgrade risk" OR "rate of upgrade" OR "under-evaluation" OR "under evaluation" OR "missed cancer" OR (("ductal carcinoma in situ" OR "DCIS" OR "atypical ductal hyperplasia" OR "ADH") AND ("underestimation rate" OR "underestimation rates" OR "underestimate" OR "underestimation" OR "upgrade rate" OR "upgrade"))

#10 "repeat biopsy rate" OR "repeat biopsy rates" OR "biopsy failure rate" OR "biopsy failure rates" OR "rebiopsy rate" OR "rebiopsy rates" OR "repeat biopsy" OR "repeat biopsies"

#11 "calcification retrieval rate" OR "calcification retrieval rates" OR "calcification retrieval" OR "microcalcification retrieval rate" OR "microcalcification retrieval rates" OR "microcalcification retrieval" OR "retrieval failure" OR "success rate" OR "success rates"

#12 "complication" OR "complications" OR "hematoma" OR "bleeding" OR "infection" OR "infections" OR "pain" OR "bruising"

#13 "workflow" OR "efficacy" OR "time under compression" OR "time" OR "minute" OR "minutes" OR ("time" AND "compression")

#14 MeSH descriptor: [Quality of Life] explode all trees

#15 MeSH descriptor: [Quality-Adjusted Life Years] explode all trees

#16 "mortality" OR "died" OR "dead" OR "deceased" OR "morbidity" OR "quality of life" OR "QoL" OR "QOL" OR "HRQOL" OR "HRQoL" OR #14 OR #15

#17 MeSH descriptor: [Cost-Effectiveness Analysis] explode all trees

#18 MeSH descriptor: [Economic Factors] explode all trees

#19 MeSH descriptor: [Costs and Cost Analysis] explode all trees

#20 MeSH descriptor: [Cost-Benefit Analysis] explode all trees

#21 "cost-effectiveness" OR "economic" OR "cost" OR "costs" OR #17 OR #18 OR #19 OR #20

#22 #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #16 OR #21

#23 #1 AND #4 AND #22

#24 #1 AND #4 AND #22 with Cochrane Library publication date Between Jan 1995 and Dec 2024

**S2. PRISMA-DTA checklist**

| Section/topic | # | PRISMA-DTA Checklist Item | Reported on page # |
|---|---|---|---|
| **TITLE / ABSTRACT** | | | |
| Title | 1 | Identify the report as a systematic review (+/- meta-analysis) of diagnostic test accuracy (DTA) studies. | Title |
| Abstract | 2 | Abstract: See PRISMA-DTA for abstracts. | 1 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 3 - 4 |
| Clinical role of index test | D1 | State the scientific and clinical background, including the intended use and clinical role of the index test, and if applicable, the rationale for minimally acceptable test accuracy (or minimum difference in accuracy for comparative design). | 3 |
| Objectives | 4 | Provide an explicit statement of question(s) being addressed in terms of participants, index test(s), and target condition(s). | 4 |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | 5 |
| Eligibility criteria | 6 | Specify study characteristics (participants, setting, index test(s), reference standard(s), target condition(s), and study design) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 5 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5 |
| Search | 8 | Present full search strategies for all electronic databases and other sources searched, including any limits used, such that they could be repeated. | ESM, S1 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 5 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 5-6 |
| Definitions for data extraction | 11 | Provide definitions used in data extraction and classifications of target condition(s), index test(s), reference standard(s) and other characteristics (e.g. study design, clinical setting). | 6 |
| Risk of bias and applicability | 12 | Describe methods used for assessing risk of bias in individual studies and concerns regarding the applicability to the review question. | 6 |
| Diagnostic accuracy measures | 13 | State the principal diagnostic accuracy measure(s) reported (e.g. sensitivity, specificity) and state the unit of assessment (e.g. per-patient, per-lesion). | 6 |
| Synthesis of results | 14 | Describe methods of handling data, combining results of studies and describing variability between studies. This could include, but is not limited to: a) handling of multiple definitions of target condition. b) handling of multiple thresholds of test positivity, c) handling | 6-8 |

| | | | |
|---|---|---|---|
| | | multiple index test readers, d) handling of indeterminate test results, e) grouping and comparing tests, f) handling of different reference standards | |
| Meta-analysis | D2 | Report the statistical methods used for meta-analyses, if performed. | 7 |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 7 |
| **RESULTS** | | | |
| Study selection | 17 | Provide numbers of studies screened, assessed for eligibility, included in the review (and included in meta-analysis, if applicable) with reasons for exclusions at each stage, ideally with a flow diagram. | 9 |
| Study characteristics | 18 | For each included study provide citations and present key characteristics including: a) participant characteristics (presentation, prior testing), b) clinical setting, c) study design, d) target condition definition, e) index test, f) reference standard, g) sample size, h) funding sources | 9 |
| Risk of bias and applicability | 19 | Present evaluation of risk of bias and concerns regarding applicability for each study. | 9 |
| Results of individual studies | 20 | For each analysis in each study (e.g. unique combination of index test, reference standard, and positivity threshold) report 2x2 data (TP, FP, FN, TN) with estimates of diagnostic accuracy and confidence intervals, ideally with a forest or receiver operator characteristic (ROC) plot. | 9-12 |
| Synthesis of results | 21 | Describe test accuracy, including variability; if meta-analysis was done, include results and confidence intervals. | 9-12 |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression; analysis of index test: failure rates, proportion of inconclusive results, adverse events). | 9-12 |
| **DISCUSSION** | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence. | 13 |
| Limitations | 25 | Discuss limitations from included studies (e.g. risk of bias and concerns regarding applicability) and from the review process (e.g. incomplete retrieval of identified research). | 14-15 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence. Discuss implications for future research and clinical practice (e.g. the intended use and clinical role of the index test). | 15-16 |
| **FUNDING** | | | |
| Funding | 27 | For the systematic review, describe the sources of funding and other support and the role of the funders. | Discloure paragraph |

*Adapted From:* McInnes MDF, Moher D, Thombs BD, McGrath TA, Bossuyt PM, The PRISMA-DTA Group (2018). Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies: The PRISMA-DTA Statement. JAMA. 2018 Jan 23;319(4):388-396. doi: 10.1001/jama.2017.19163.

**S3. Extraction sheet according to checklist of the data extraction for complex meta-analysis (DECiMAL)**

This supplemental material S3 is provided as a separate MS Excel file.

**S4: Results of the sensitivity analyses for comparing any imaging-guided VABB to any imaging-guided CNB**

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | favor |
|---|---|---|---|---|---|
| **ADH underestimation rate (VABB vs CNB)** | | | | | |
| All studies included | 22 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Badan 2016 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Bae 2015 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Berg 2001 | 21 | 0.64 | 0.56, 0.73 | <0.01 | VABB |
| Bertani 2020 | 21 | 0.63 | 0.55, 0.71 | <0.01 | VABB |
| Burbank 1997 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Darling 2000 | 21 | 0.64 | 0.56, 0.73 | <0.01 | VABB |
| Huang 2011 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Jackman 1997 | 21 | 0.65 | 0.57, 0.74 | <0.01 | VABB |
| Kil 2008 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Ko 2008 | 21 | 0.62 | 0.55, 0.71 | <0.01 | VABB |
| Liberman 2001 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Londero 2011 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Oktay 2023 | 21 | 0.62 | 0.54, 0.72 | <0.01 | VABB |
| Park 2022 | 21 | 0.65 | 0.57, 0.64 | <0.01 | VABB |
| Rageth 2019 | 21 | 0.64 | 0.55, 0.74 | <0.01 | VABB |
| Seely 2017 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Seo 2017 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Tothova 2013 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Willers 2023 | 21 | 0.62 | 0.54, 0.71 | <0.01 | VABB |
| Zannis 1998 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |
| Zhang 2023 | 21 | 0.57 | 0.48, 0.67 | <0.01 | VABB |
| Zhao 2003 | 21 | 0.63 | 0.55, 0.72 | <0.01 | VABB |

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | favor |
|---|---|---|---|---|---|
| **DCIS underestimation rate (VABB vs CNB)** | | | | | |
| All studies included | 27 | 0.47 | 0.39, 0.58 | <0.01 | VABB |
| Badan 2016 | 26 | 0.47 | 0.38, 0.58 | <0.01 | VABB |
| Bae 2015 | 26 | 0.48 | 0.39, 0.60 | <0.01 | VABB |
| Bundred 2016 | 26 | 0.47 | 0.38, 0.58 | <0.01 | VABB |
| Burbank 1997 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Darling 2000 | 26 | 0.47 | 0.38, 0.58 | <0.01 | VABB |
| Dória 2018 | 26 | 0.45 | 0.37, 0.56 | <0.01 | VABB |
| Elsharkawy 2020 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Hsieh 2023 | 26 | 0.50 | 0.41, 0.60 | <0.01 | VABB |
| Huang 2011 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Jackman 2001 | 26 | 0.46 | 0.37, 0.58 | <0.01 | VABB |
| Kim 2012 | 26 | 0.46 | 0.37, 0.58 | <0.01 | VABB |
| Lee 2013 | 26 | 0.51 | 0.42, 0.61 | <0.01 | VABB |
| Liberman 2001 | 26 | 0.46 | 0.37, 0.57 | <0.01 | VABB |
| Mannu 2019 | 26 | 0.46 | 0.37, 0.57 | <0.01 | VABB |
| Marques 2019 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Seely 2017 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Seo 2017 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Sheng 2020 | 26 | 0.46 | 0.37, 0.56 | <0.01 | VABB |
| Sim 2015 | 26 | 0.45 | 0.37, 0.56 | <0.01 | VABB |
| Suh 2012 | 26 | 0.48 | 0.39, 0.60 | <0.01 | VABB |
| Szynglarewicz 2015 | 26 | 0.47 | 0.38, 0.58 | <0.01 | VABB |
| Tothova 2013 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Won 1999 | 26 | 0.47 | 0.38, 0.58 | <0.01 | VABB |
| Yashima 2023 | 26 | 0.46 | 0.37, 0.57 | <0.01 | VABB |
| Zannis 1998 | 26 | 0.48 | 0.39, 0.59 | <0.01 | VABB |
| Zhang 2023 | 26 | 0.48 | 0.38, 0.59 | <0.01 | VABB |
| Zou 2019 | 26 | 0.50 | 0.41, 0.60 | <0.01 | VABB |

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | favor |
|---|---|---|---|---|---|
| **Repeat biopsy rate (VABB vs CNB)** | | | | | |
| All studies included | 10 | 0.78 | 0.69, 0.88 | <0.01 | VABB |
| Bundred 2016 | 9 | 0.77 | 0.71, 0.83 | <0.01 | VABB |
| Cho 2005 | 9 | 0.80 | 0.69, 0.93 | <0.01 | VABB |
| **Grady 2017** | **9** | **0.83** | **0.66, 1.05** | **0.13** | **VABB** |
| Liberman 2000 | 9 | 0.79 | 0.67, 0.92 | <0.01 | VABB |
| Philpotts 1999 | 9 | 0.79 | 0.71, 0.87 | <0.01 | VABB |
| Philpotts 2003 | 9 | 0.76 | 0.71, 0.82 | <0.01 | VABB |
| Poole 2015 | 9 | 0.77 | 0.69, 0.86 | <0.01 | VABB |
| Velanovich V 1999 | 9 | 0.78 | 0.67, 0.90 | <0.01 | VABB |
| Yashima 2023 | 9 | 0.79 | 0.69, 0.91 | <0.01 | VABB |

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | favor |
|---|---|---|---|---|---|
| **Concordance rate (VABB vs CNB)** | | | | | |
| All studies included | 12 | 1.07 | 1.04, 1.11 | <0.01 | VABB |
| Brenner 2000 | 11 | 1.08 | 1.04, 1.12 | <0.01 | VABB |
| Bundred 2016 | 11 | 1.08 | 1.04, 1.12 | <0.01 | VABB |
| Elsharkawy 2020 | 11 | 1.08 | 1.04, 1.12 | <0.01 | VABB |
| Huang 2011 | 11 | 1.07 | 1.03, 1.11 | <0.01 | VABB |
| Middleton 2003 | 11 | 1.07 | 1.04, 1.11 | <0.01 | VABB |
| Povoski 2011 | 11 | 1.05 | 1.03, 1.08 | <0.01 | VABB |
| Seely 2017 | 11 | 1.07 | 1.03, 1.11 | <0.01 | VABB |
| Soo 1999 | 11 | 1.07 | 1.04, 1.11 | <0.01 | VABB |
| Won 1999 | 11 | 1.07 | 1.03, 1.11 | <0.01 | VABB |
| Zannis 1998 | 11 | 1.07 | 1.03, 1.11 | <0.01 | VABB |
| Zhang 2023 | 11 | 1.08 | 1.04, 1.13 | <0.01 | VABB |
| Zou 2019 | 11 | 1.08 | 1.03, 1.13 | <0.01 | VABB |

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | favor |
|---|---|---|---|---|---|
| **Calcification retrieval rate (VABB vs CNB)** | | | | | |
| All studies included | 9 | 1.11 | 1.06, 1.16 | <0.01 | VABB |
| Bae 2015 | 8 | 1.11 | 1.06, 1.17 | <0.01 | VABB |
| Berg 2001 | 8 | 1.12 | 1.07, 1.17 | <0.01 | VABB |
| Bundred 2016 | 8 | 1.12 | 1.06, 1.17 | <0.01 | VABB |
| Huang 2011 | 8 | 1.09 | 1.05, 1.13 | <0.01 | VABB |
| Jackman 2006 | 8 | 1.10 | 1.05, 1.15 | <0.01 | VABB |
| Liberman L 2001 | 8 | 1.12 | 1.06, 1.17 | <0.01 | VABB |
| Meyer JE 1997 | 8 | 1.11 | 1.05, 1.17 | <0.01 | VABB |
| Philpotts 1999 | 8 | 1.12 | 1.06, 1.17 | <0.01 | VABB |
| Reynolds 1998 | 8 | 1.10 | 1.06, 1.16 | <0.01 | VABB |

| All studies included / Removing each study | N | Pooled Risk Ratio | Random 95% CI | p-value | Favor |
|---|---|---|---|---|---|
| **False-negative rate (VABB vs CNB)** | | | | | |
| All studies included | 10 | 0.67 | 0.43, 1.04 | 0.07 | VABB |
| Becker 2006 | 9 | 0.64 | 0.39, 1.05 | 0.08 | VABB |
| Ciatto 2007 | 9 | 0.72 | 0.43, 1.22 | 0.23 | VABB |
| Fuentes 2019 | 9 | 0.66 | 0.41, 1.05 | 0.08 | VABB |
| Huang 2011 | 9 | 0.70 | 0.44, 1.11 | 0.13 | VABB |
| Lacambra 2012 | 9 | 0.66 | 0.41, 1.06 | 0.08 | VABB |
| **La Forgia 2020** | **9** | **0.57** | **0.41, 0.79** | **<0.01** | **VABB** |
| Shin 2008 | 9 | 0.69 | 0.44, 1.09 | 0.11 | VABB |
| Tian 2024 | 9 | 0.71 | 0.46, 1.09 | 0.12 | VABB |
| Tothova 2013 | 9 | 0.69 | 0.43, 1.11 | 0.13 | VABB |
| Zhang 2023 | 9 | 0.66 | 0.36, 1.21 | 0.18 | VABB |

## S5: Results comparing X-ray guided VABB to any imaging-guided CNB

*(a) Summary of results comparing* X-ray *guided VABB to any imaging-guided CNB: ADH underestimation rate, DCIS underestimation rate, repeat biopsy rate, concordance rate, calcification retrieval rate, and false negative rate*

| | *No. studies* | *Risk ratio (95% CI) using REM, p-value* | *favor* |
|---|---|---|---|
| ADH underestimation rate | 15 | 0.53 (0.42-0.66), p<.01 | VABB |
| DCIS underestimation rate | 13 | 0.42 (0.30-0.60), p<.01 | VABB |
| Repeat biopsy rate | 3 | 0.94 (0.68-1.29), p=.69 | - |
| Concordance rate | 7 | 1.08 (0.99-1.17), p=.07 | - |
| Calcification retrieval rate | 9 | 1.09 (1.02-1.15), p<.01 | VABB |
| False negative rate | 2 | 0.30 (0.08-1.17), p=.08 | - |

*(b) Summary of results comparing* X-ray *guided VABB to any imaging-guided CNB: sensitivity and specificity*

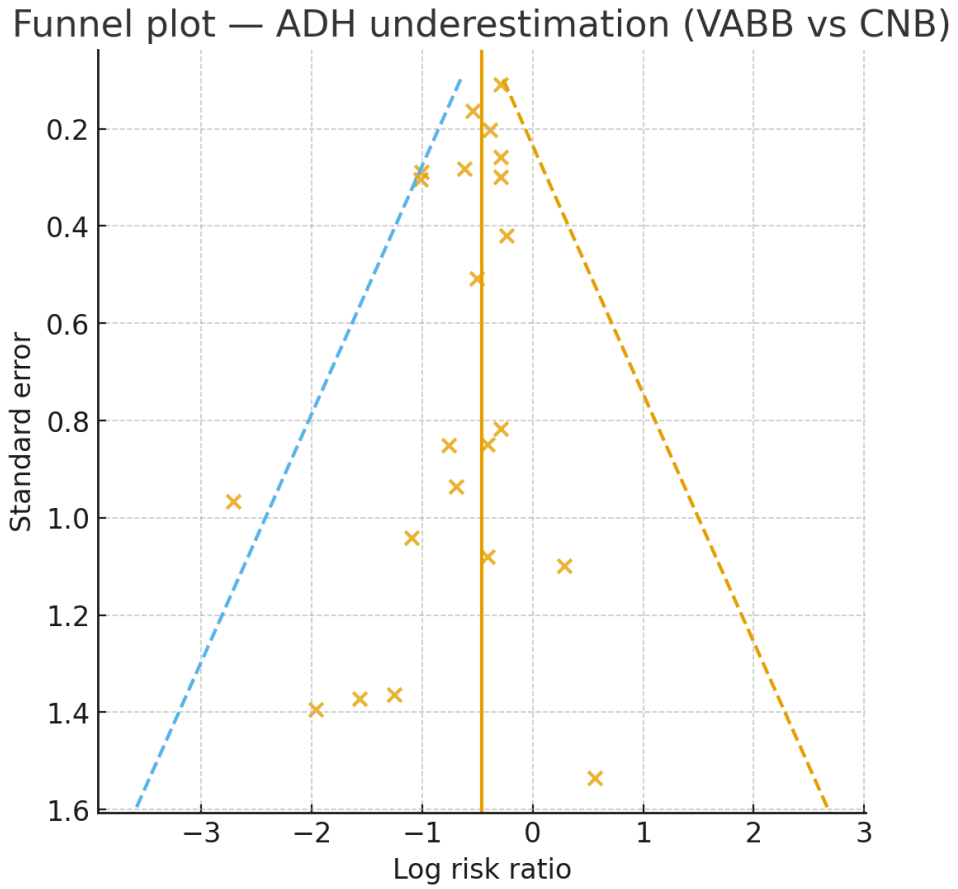
| | *No. studies* | *Pooled values (95% CI) using REM* |
|---|---|---|
| Sensitivity | 2 | xVABB: 0.91 (0.80-1.00)<br>xCNB: 0.68 (0.56-0.80) |
| Specificity | 2 | xVABB: 1.00 (0.97-1.00)<br>xCNB: 1.00 (0.99-1.00) |

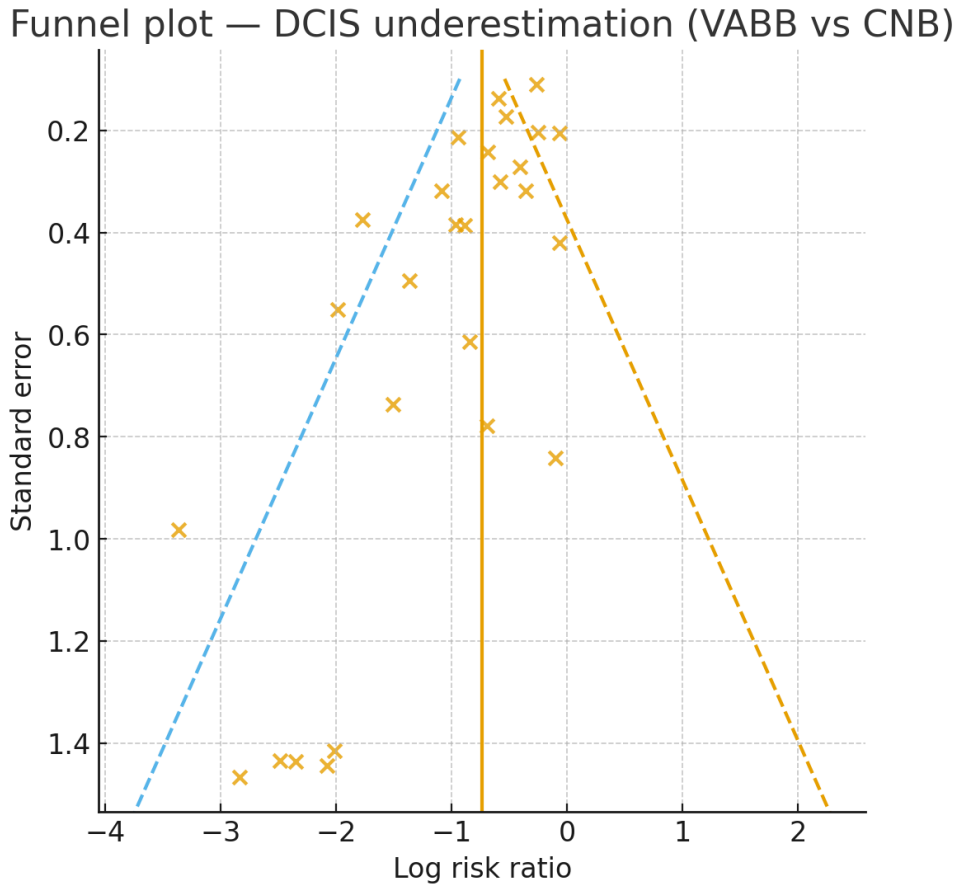
***ADH**: atypical ductal hyperplasia; **DCIS**: ductal carcinoma in-situ; **REM**: random effects model; **VABB**: vacuum-assisted breast biopsy; **CNB**: core needle biopsy; **xVABB**:* X-ray *guided VABB, **xCNB**:* X-ray *guided CNB*

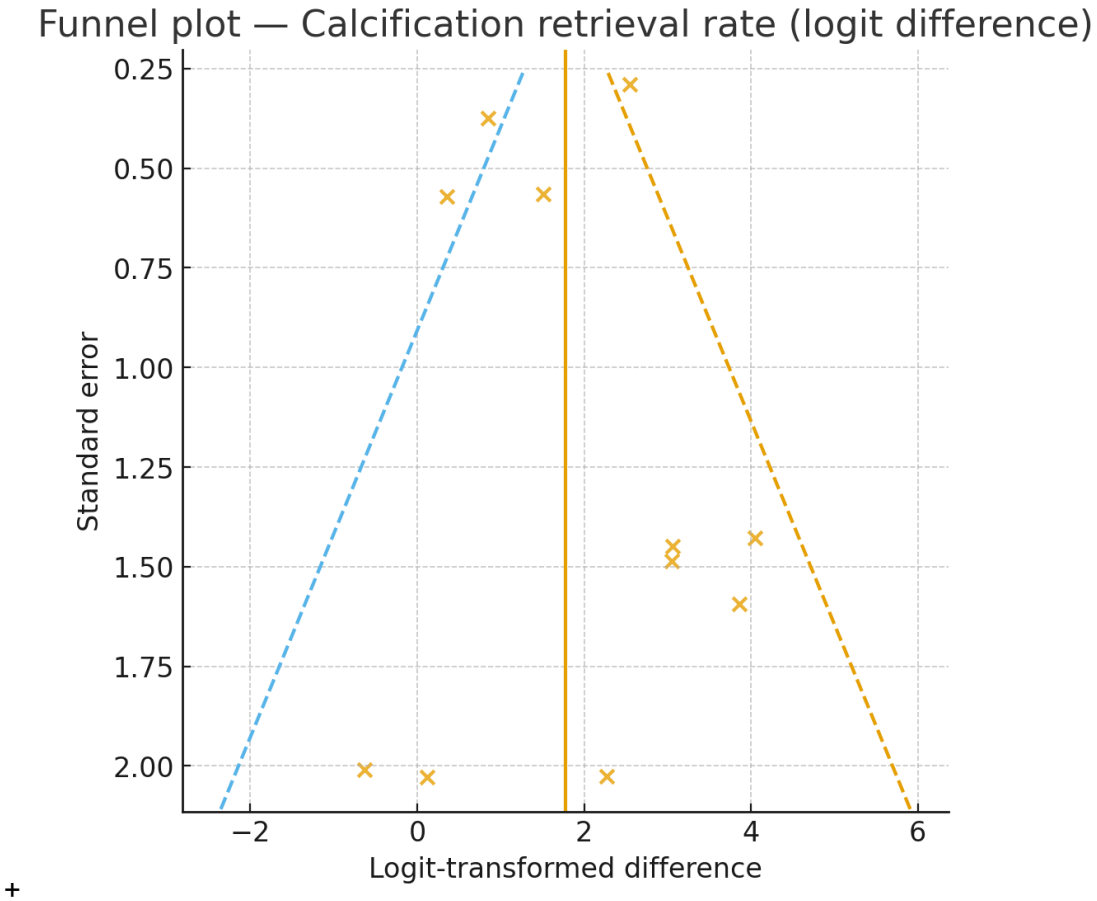
**S6: Detailed study-level QUADAS-2 assessment reporting individual domain-level risk-of-bias and applicability judgments for each included study**

This supplemental material S6 is provided as a separate MS Excel file.

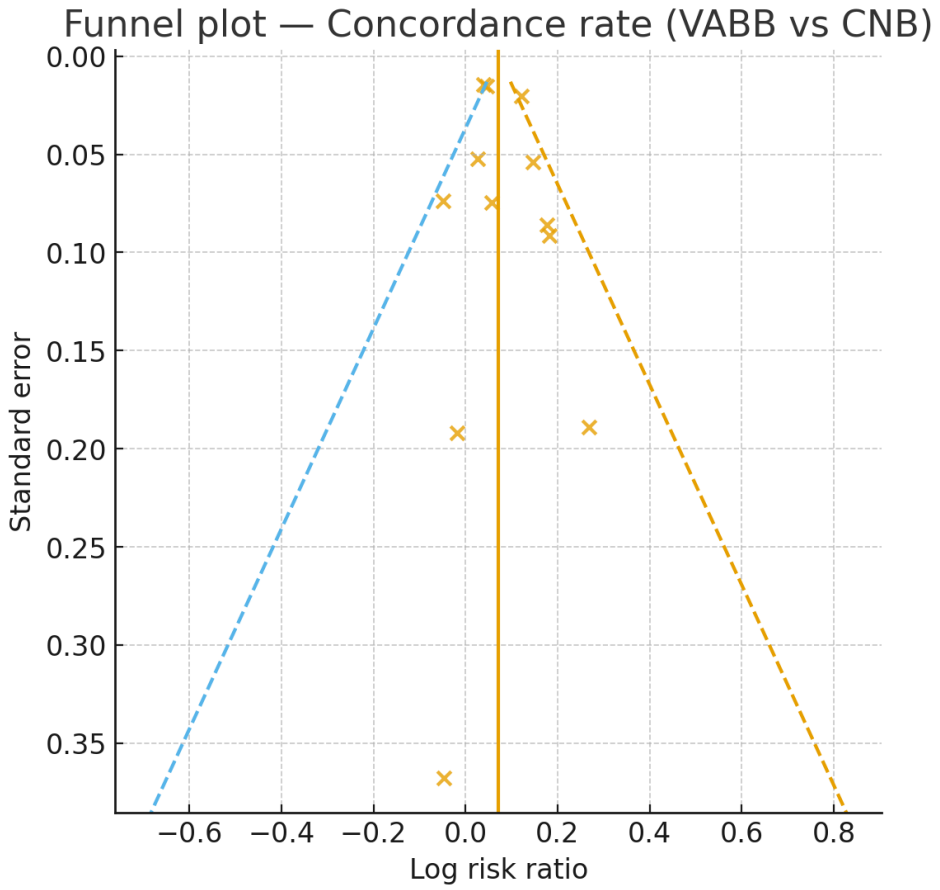
**S7. Funnel plots**

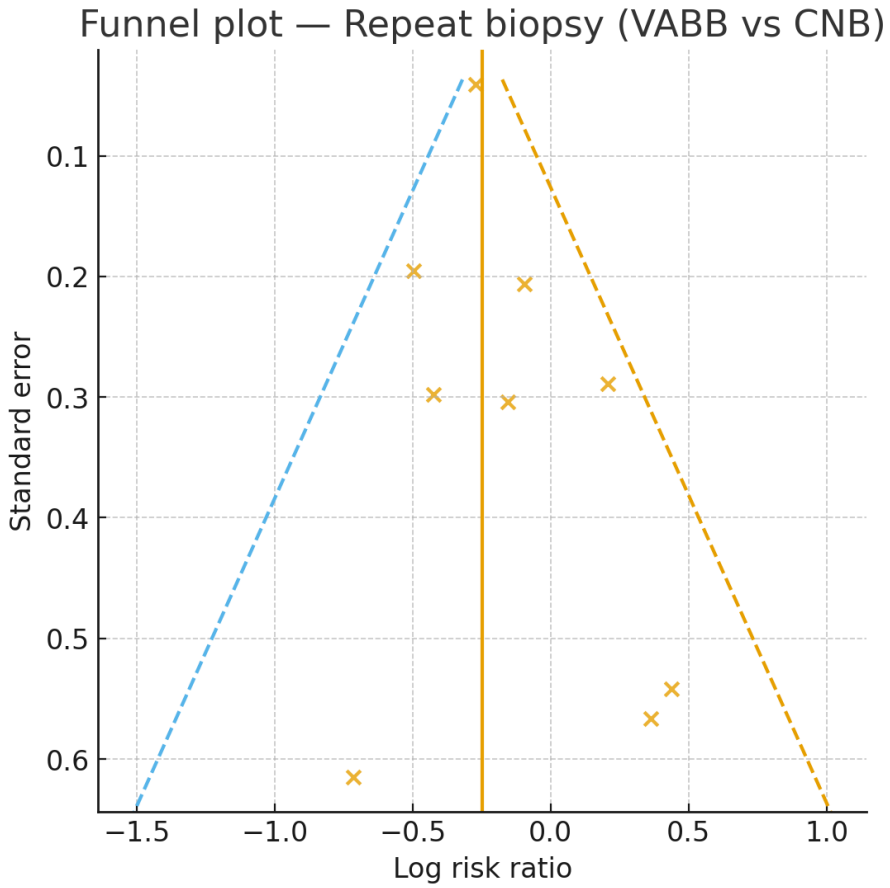



Funnel plot — Calcification retrieval rate (logit difference)
Standard error
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
−2
0
2
4
6
Logit-transformed difference

+


Funnel plot — Concordance rate (VABB vs CNB)
Standard error
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
0.8
Log risk ratio


Funnel plot — Repeat biopsy (VABB vs CNB)
Standard error
0.1
0.2
0.3
0.4
0.5
0.6
−1.5
−1.0
−0.5
0.0
0.5
1.0
Log risk ratio