



Experience with introduction of AI in Breast Cancer Screening in Capital Region of Denmark

DBCWG Representative's Meeting 2023

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Retrospective Simulation Study



A collaboration between Capital Mammography Screening Programme, Institutes at University of Copenhagen (Computerscience and Public Health) and a professor from Radboud University, NL

Two retrospective simulation studies based on

- Results of Double blind readings by experienced full time breast radiologist of 114.421 consecutive womens screening exams versus AI
- Sampling period January 2014 - December 2015. 2 year follow up.
- 791 screen detected cancers and 327 interval cancers. 2107 false positives

Preliminary study:

AI only (no radiologist readings) with a sensitivity matched to experienced breast radiologists sensitivity

- 100% work load reduction
- Lower specificity than the radiologist (94.9% versus 98.1%)
- Signifikant rise in FP; 276,5% rise - 5825 women compared to 2107

"An Artificial-Intelligence-based Mammography Screening Protocol for Breast Cancer: Outcome and Radiologist Workload". Radiology 2022.

Retrospective simulation study



Main study:

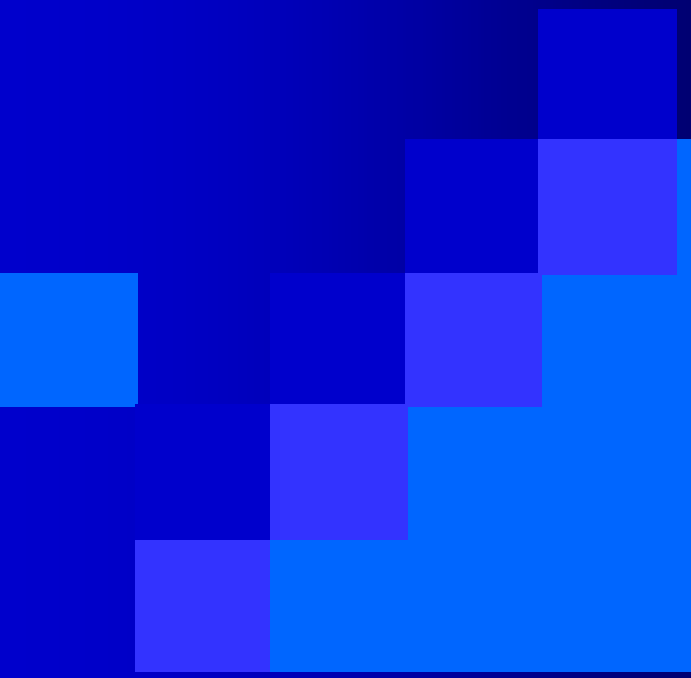
- AI [★]only reader on the lowest risk group (<5 on a risk score on a scale from 1-10)
- Double blind readings by experienced breast radiologists (risk score ≥ 5 - 9,989)
- Direct recall of women with a risk score on ≥ 9.989

Results

- Sensitivity: AI 69.7% versus breast radiologist 70.8%
- Specificity: AI 98.6% versus breast radiologist 98.1%
- Numbers of false positive reduced with 25%

★Transpara version 1.7.0

"An Artificial-Intelligence-based Mammography Screening Protocol for Breast Cancer: Outcome and Radiologist Workload". Radiology 2022.

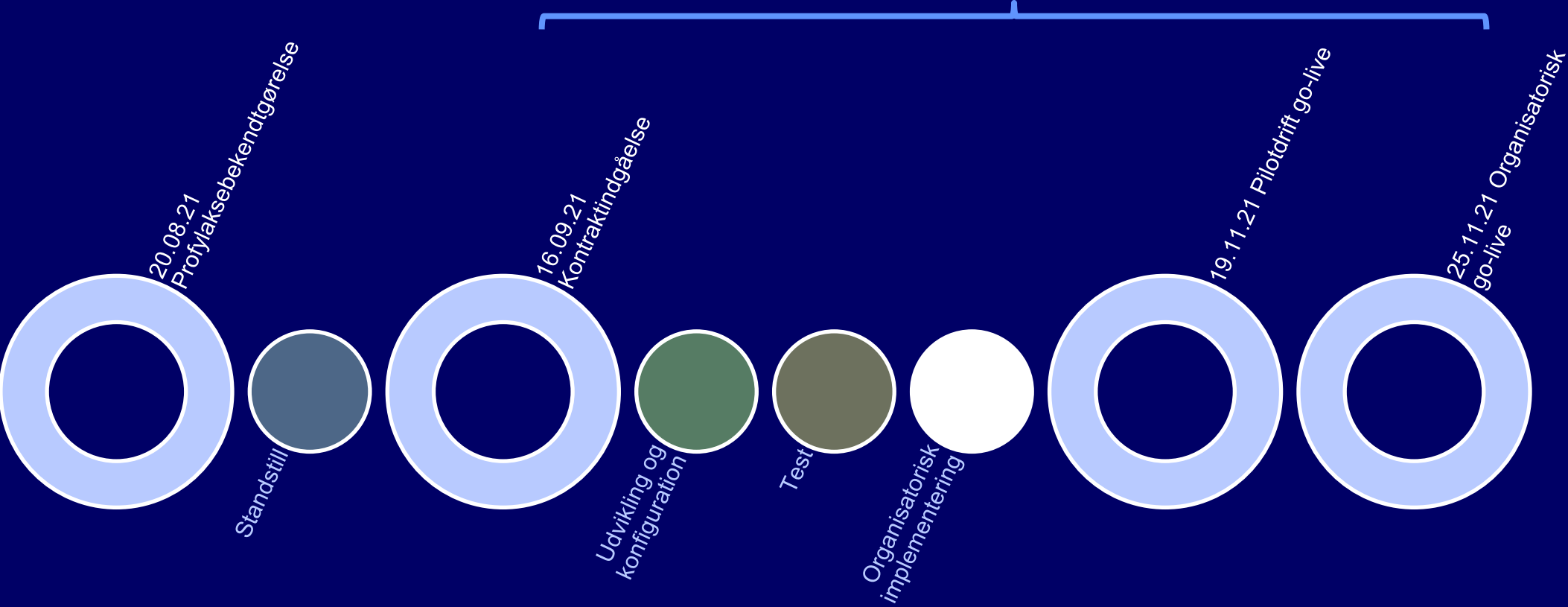


Implementation of AI in Capital Mammography Screening Programme in Denmark

Main goal is to reduce radiologist workload
keeping quality indicators stable

Procurement and implementation completed in a compressed process of 3 months – in a strong collaboration between CIMT, Human Bytes / Transpara and clinical staff from the Breast Cancer Screening Program in RegionH

2 months



Screening mammography

- 2 standardized views: CC + MLO
- No clinical examination or UL



Time consumption

- *6-10 minutes in the examination room at the screening clinic (radiographers)*
- *1-3 min. x 2/ exam (when the systems are working) centralized double blind readings (two radiologists)*

Screening mammography

- 2 standardized views: CC + MLO
- No clinical examination or UL



Hard competition but:
Target group in DK ≥ 700.000 Q
aged 50-69 år; 219.000 Q
i RegionH

*Time consumed
6-10 minutes*

Centralized

Extended offer to breast cancer
treated women aged 70-79
years;
8100 Q in Capital Region

clinic

when the systems are working)



Mammograms analyzed by Transpara AI

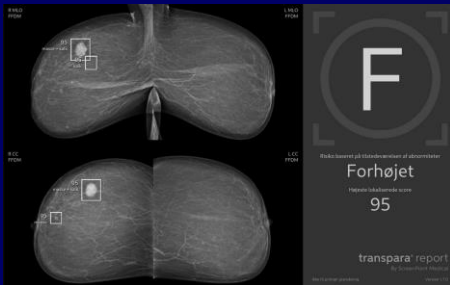
Local regional score

Selection of highest regional score

Stratification into **risk categories on a scale from 1-100**

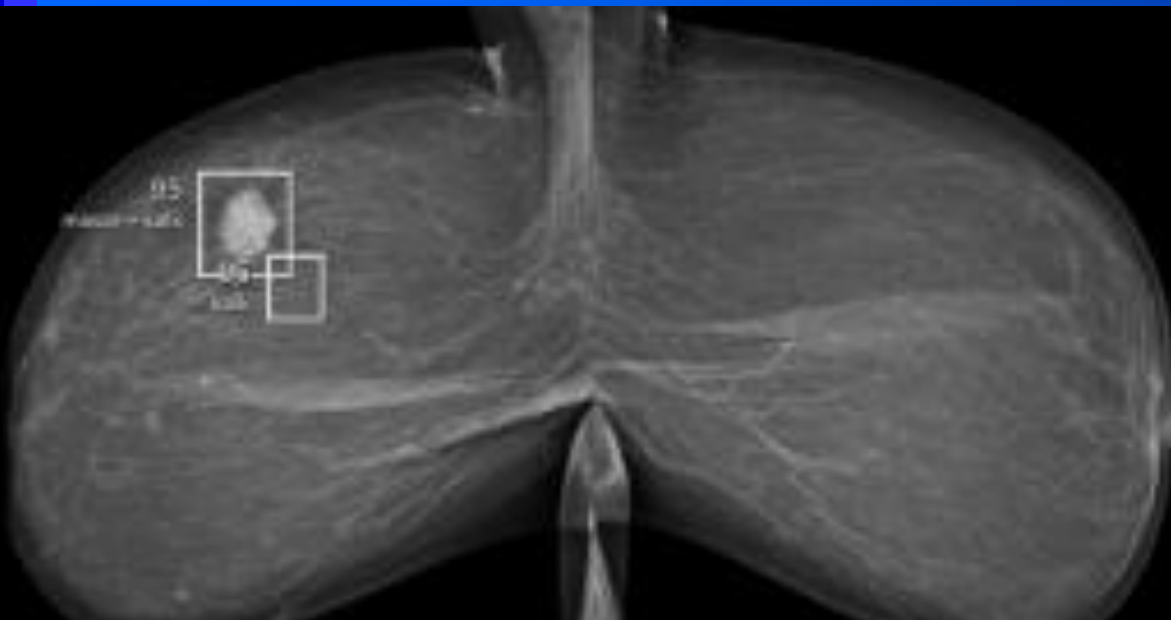
Shown in PACS

(in the end of the exam)



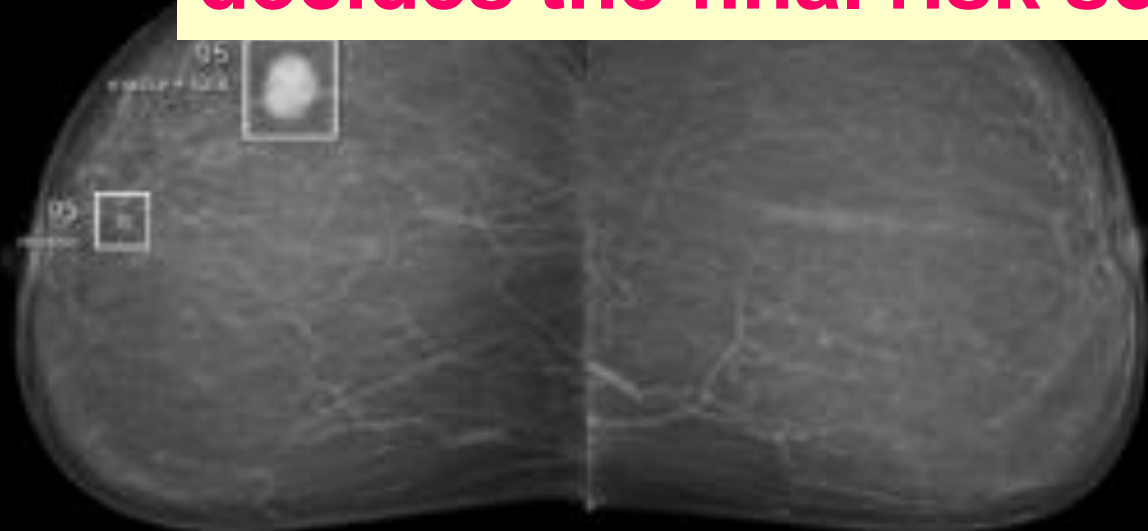
R MLO
FFDM

L MLO
FFDM



**Highest regional score
decides the final risk score**

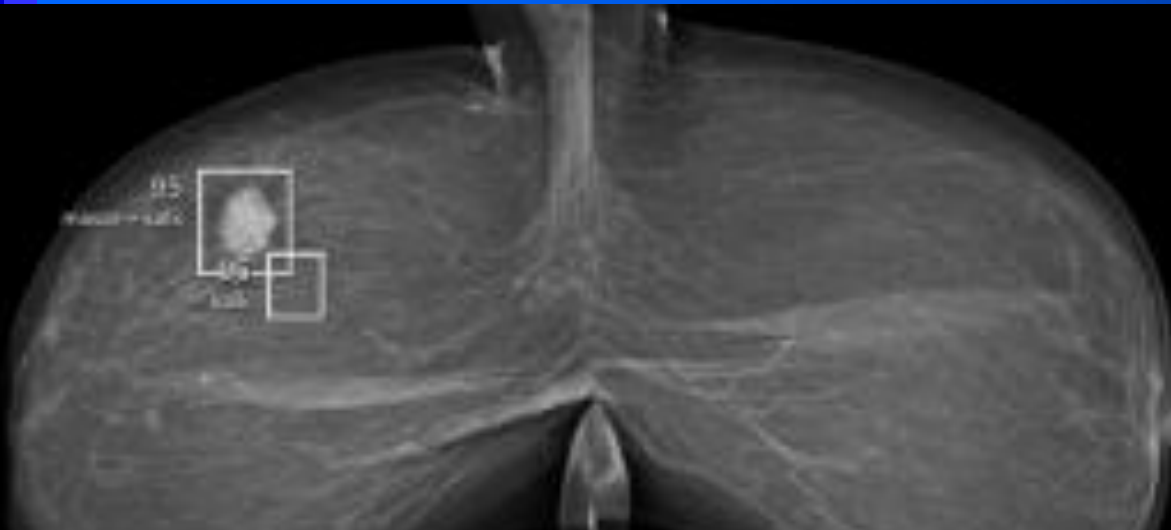
R CC
FFDM



A graphic representing a 'transpara' report. At the top, a large white letter 'F' is centered within a circular frame. Below this, the text reads: 'Risiko baseret på Estados analyse af abnormiteter' (Risk based on Estados analysis of abnormalities), followed by 'Forhøjet' (Elevated) in a large font, and 'Højeste lokaliserede score' (Highest localized score) above the number '95'. At the bottom, it says 'transpara® report' and 'By ScreenPoint Medical'. There are also small text elements at the very bottom: '© 2015 ScreenPoint Medical' on the left and 'Version 1.1.0' on the right.

R MLO
FFDM

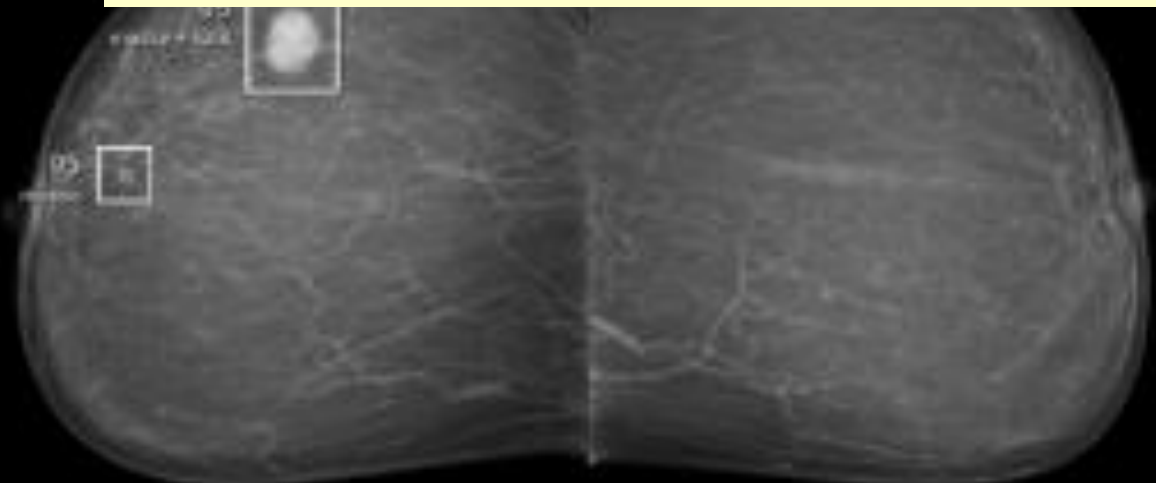
L MLO
FFDM



AI has no previous exams to compare with- but the radiologists have them!

R CC
FFDM

L CC
FFDM



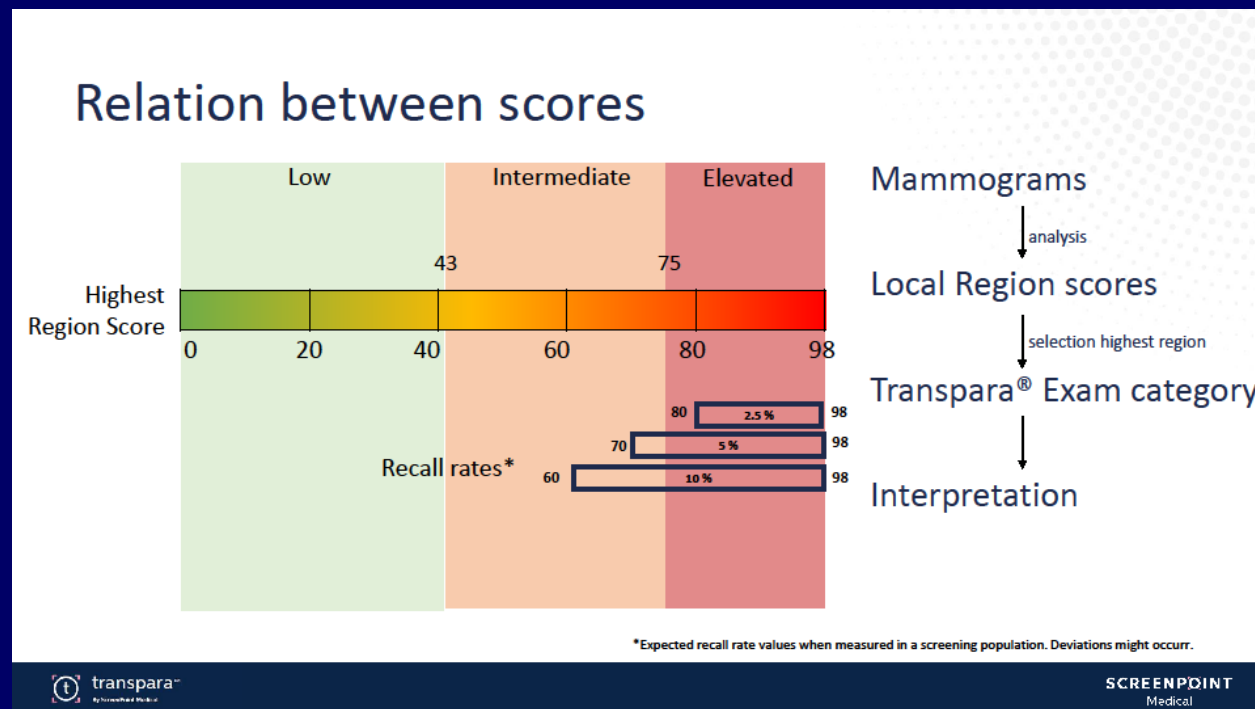
An AI report interface for the mammogram. At the top, a large white letter 'F' is centered within a circular frame. Below this, the text reads: 'Result baseret på tilstedeværelsen af abnormiteter' (Result based on the presence of abnormalities). The word 'Forhøjet' (Elevated) is displayed in a large font. Below it, the text says 'Højeste lokaliserings score' (Highest localization score) followed by the number '95'. At the bottom, it says 'transpara® report' and 'By ScreenPoint Medical'. There are also some small, faint text elements at the very bottom of the interface.

Relations between scores and recall rates:

$\geq 78-80 = 2.5\%$

$\geq 70 = 5\%$

$\geq 60 = 10\%$



Relation between scores

Højeste lokaliserede score ved undersøgelse	Risiko baseret på tilstedeværelsen af abnormiteter	Transpara Undersøgel sesresultat
≥ 75	Forhøjet - 1 ud af 10 undersøgelser påviser kræft ved screening* - Svarer til en tilbagekaldelsesrate på 4%*	10 Tjek lokaliseret score
61 - 74	Middel Samlet frekvens for kræft i dette interval svarer til screeningen af befolkningen (6/1000)	9
50 - 60		8
43 - 49		7
39 - 42	Lav - > 99,9% normale test* - Fund vist med markør ≥ 36	6
36 - 38		≤ 5
≤ 35		

} ≥ 70%

Capital Region:
Score 78 = recall rate på 2,5%

3th of May 2022 AI first reader of whole low risk group →

18th of November 2021 →

Workflow in Capital Region DK

AI+Single or double reading?

Women with the **low risk score**
from 3/5 2022 all ≤ 42 (<36 from 18/11 2021-3/5 2022)



AI (first reader) + one breast radiologist (second reader)

Consensus list in case of disagreement
Always a radiologist who decide!

Women with **intermediate or high risk score**



Double blind readings as usual by two breast radiologists (with AI assistance)

(no direct recall)

Danish National Mammography Screening program 2008-2020

Performance Indicators

(Danish Quality Database for Mammography Screening)

Performance Indicator (Number)	Invitation round					
	First 2008- 2009/2010	Second 2010-2011/12	Third 2012- 2013/14	Fourth 2014- 2015/16	Fifth 2016-2018	Sixth 2018-2020
2 a. Participation (%invited)	76%	82%	84%	83%	83%	84%
b. Coverage (% target)	75%	75%	77%	76%	79%	79%
4. Recall rate	3%	2,7%	2,7%	2,5%	2,4%	2,4%
False-positive rate	2.0%	2.1%	2.1%	1.9%	1,8%	1,8%
Detection rate (IC+DCIS)	0.93%	0.62%	0.67%	0.61%	0.62%	0,61%
5. Interval cancer rate (Interval IC / Interval IC+ screen detected < 12 / 12-24 months after)	NA	NA	12% 21%	11% 19%	11% 20%	13% 21%
6. Invasive % (IC / IC+DCIS)	87%	86%	86%	86%	87%	85%
7. Lymph node neg %	70%	75%	78%	81%	76%	77%
8. Small tumor ≤1cm %	37%	39%	37%	37%	37%	37%
9. Benign : malign operation ratio	1:6	1:7	1:8	1:9	1:10,5	1:10
10.BCS % (BCS / BCS+ mastectomy)	80%	81%	83%	No longer in use	Not in use	Not in use

http://www.rkkp.dk/siteassets/om-rkkp/de-kliniske-kvalitetsdatabaser/mammografiscreening/dkms-rapport-version-52_51113.pdf

https://www.sundhed.dk/content/cms/78/4678_dkms-rapport-2016-7-version.pdf

https://www.sundhed.dk/content/cms/78/4678_dansk-kvalitetsdatabase-for-mammografi-screening-rapport-2017.pdf

NA: not available

The Danish National Mammography Screening program 2008-2020

Performance Indicators

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4. Recall rate	3%	2,7%	2,7%	2,5%	2,4%	2,4%
False-positive rate						1,8%
Detection rate (IC+DCIS)						0,61%
5. Interval cancer rate (Interval IC / Interval IC+ screen detected < 12 / 12-24 months after)						13% 21%
6. Invasive % (IC / IC+DCIS)						85%
7. Lymph node neg %						77%
8. Small tumor ≤1cm %						37%
9. Benign : malign operation ratio	1:0	1:7	1:0	1:9	1:10,5	1:10
10.BCS % (BCS / BCS+ mastectomy)	80%	81%	83%	No longer in use	Not in use	Not in use

Even a small increase in recall rate would decrease the benefit!

1 diagnostic mammography (incl. clinical examination, UI and evt. needle biopsy) matches = 30-50 single readings

Preliminary data January 2023

Recall rate

- 6.Screening Round (1.July 2018- 31.September 2020):

2,5%

- 7.Screening Round (**Before AI**. Preliminary data for the periode 1st October 2020- 31st of October 2021; 61.330 q)

3.04%

Women with a previous cancer diagnosis was highly prioritized over the normal screening population

- **After AI** (November 2021- 30th of November 2022; 72.532 q):

Recall rate **before** increase of threshold: 2.72%

Recall rate **after** increase of threshold: 2.34%

In total with AI: 2.48%

Recall rate for **low risk**: 0.41% (11 cancers/ 48.722 us= detection rate 0,02%)

Recall rate for **intermediate and high**: 6.72%

Screening with AI as 1st reader (Nov. 2021- 30th November 2022) = 67.17% (48.722 / 72.532 screenings)

Preliminary data January 2023

Recall rate

6. Screening Round (1. July 2018- 31. September 2020):

7. Screening Round (1. October 2020- 31st of October 2021; 61,100 women)

Women with a previous mammogram

After AI (November 2021- November 2022)
Recall rate before AI
Recall rate after AI
In total with AI

Low risk group

- 11 cancers amongst 206 recalled women
- All cancers were new or lesion changed since last exam
- AI has no previous images to compare with

er 2020- 31st of

screening population

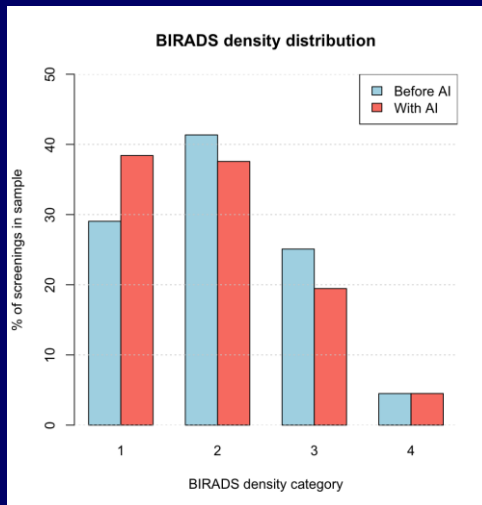
Recall rate for low risk:

6.72% (11 cancers / 206 recalled women = detection rate 0,02%)

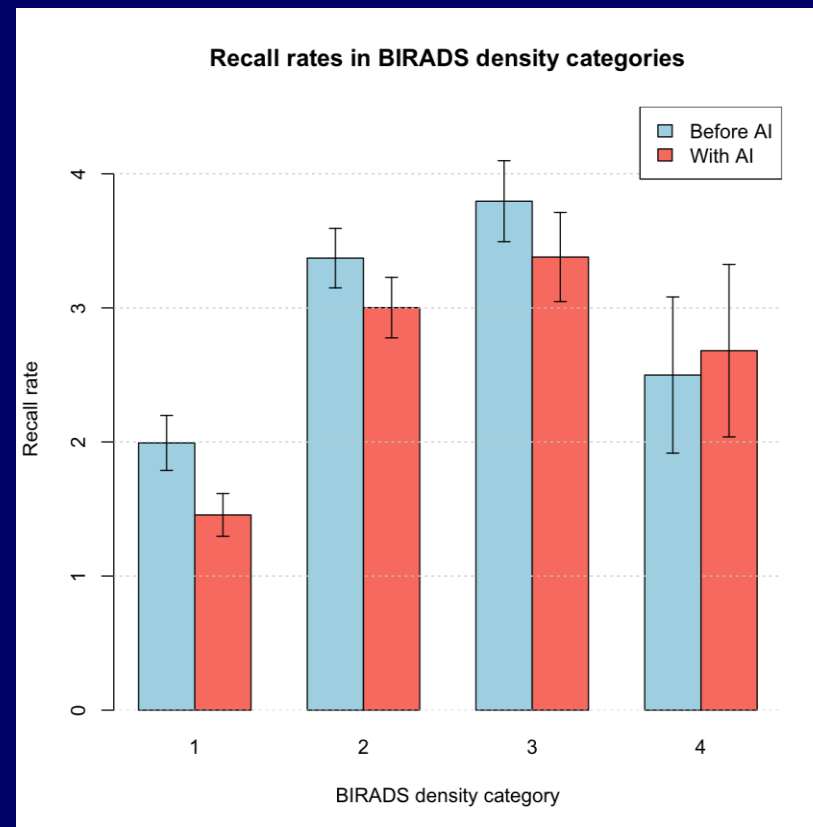
Recall rate for intermediate and high: **6.72%**

Screening with AI as 1st reader (Nov. 2021-November 2022) = 67.17% (48.722 / 72.532 screenings)

Distribution of Recall Rates in BI-RADS^{*} Density Categories



Density distribution
in the population



Consensus conferences

From 18th of November 2021-> 30th of November 2022

Consensus rate before increase of threshold:

4.24%

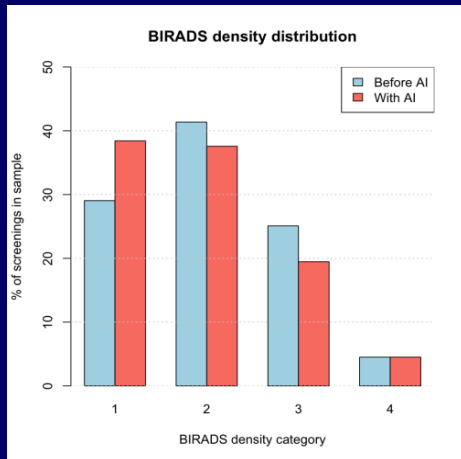
Consensus rate after increase of threshold:

4.22%

Overall consensus rate for low risk: 1.48% (98.52% agreement between AI and radiologists)

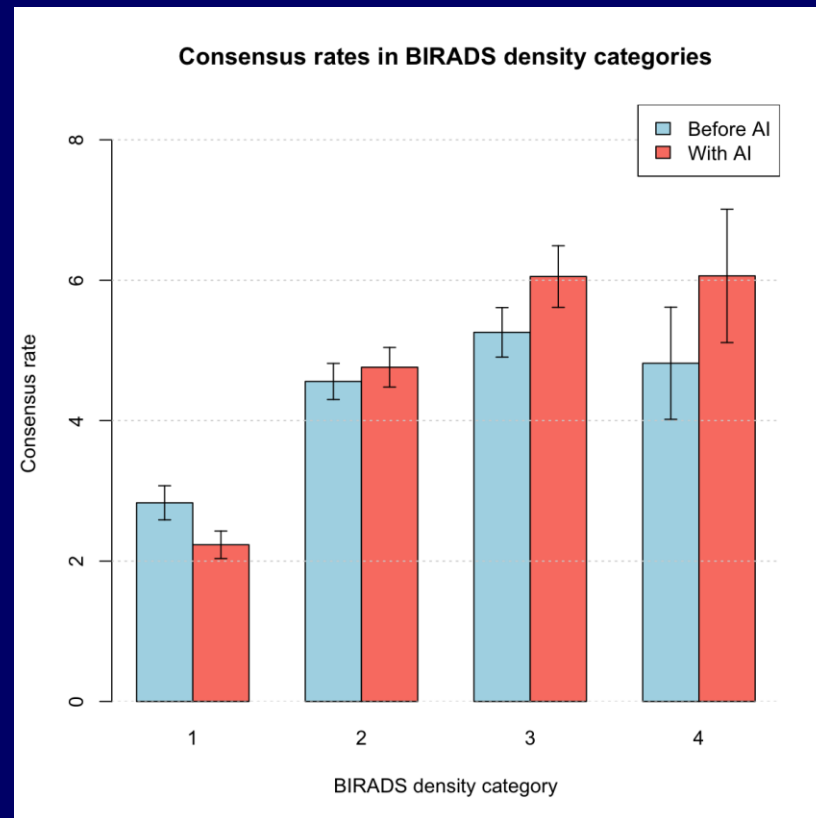
Overall consensus rate for intermediate and high: 9.83% (90.17% agreement between radiologists)

Distribution of Consensus Rates in BI-RADS[×] Density Categories



Density distribution in the population

× 4th Version



Thank you for your attention!

