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

Danske kræftforskningsdage

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Retrospective Simulation Studies

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

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, 327 interval cancers and 2107 false positives

Preliminary simulation study:

AI only (<u>no</u> 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.

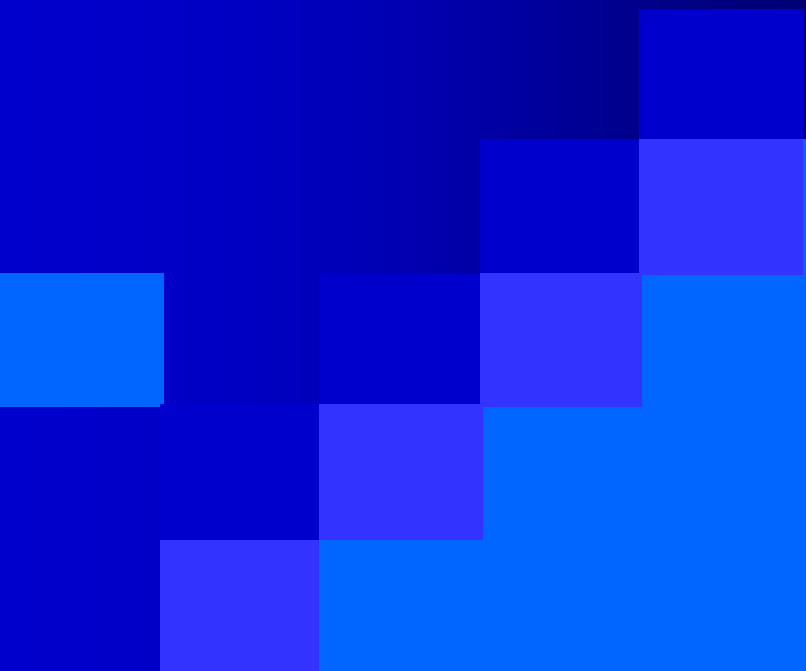# Retrospective simulation studies

Main simulation 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.
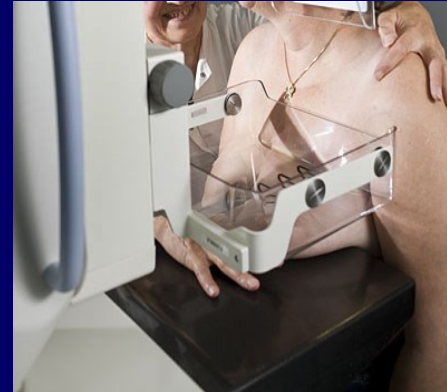
Implementation of AI in Capital Mammography Screening Programme in Denmark

Main goal has been to reduce radiologist workload keeping quality indicators stable

Screening mammography

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

Time consumption

- 6-10 minutes in the examination room at the screening clinics (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 examin...**

Time consumption
6-10 minutes in the
Centralized double
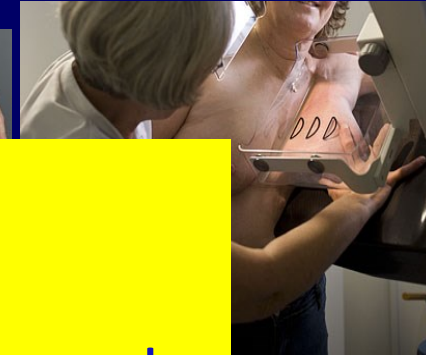
...s are working)

Hard competion but..

Target group in DK ≥700.000 Q aged 50-69 år; 220.000 Q
i RegionH

Extended offer to breast cancer treated women aged 70-79 years;
8150 Q in Capital Region
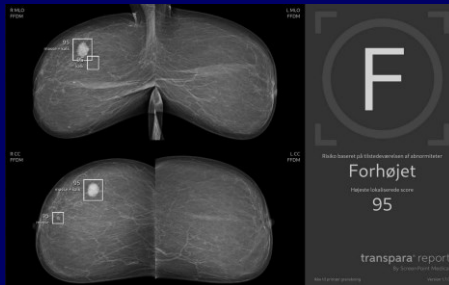
Mammograms analyzed by Transpara AI

Local regional score

Selection of highest regional score

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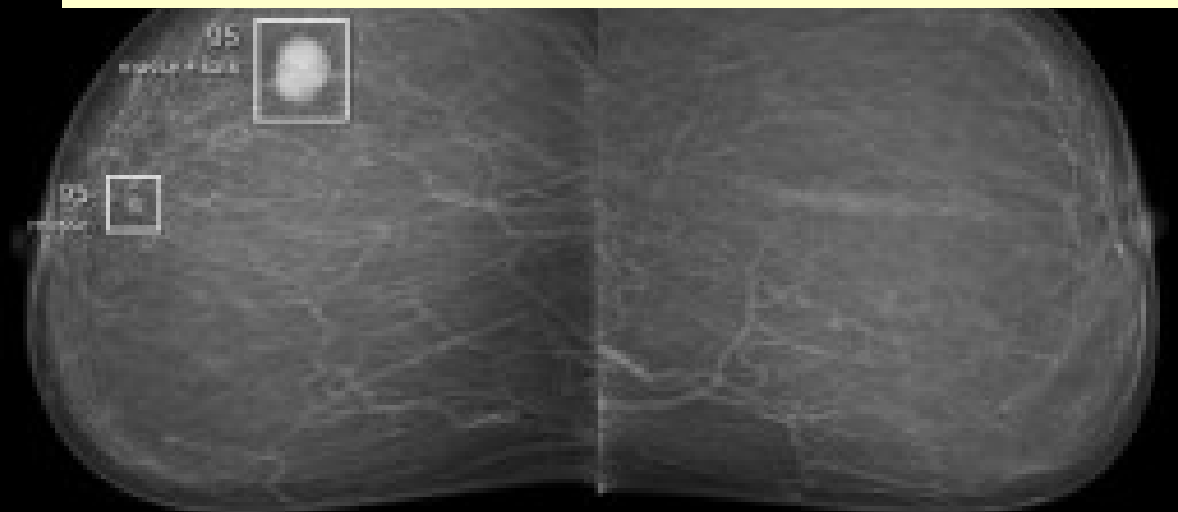
Shown in PACS

(in the end of the exam)

Highest regional score decides the final risk score

Relation between scores

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

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**	
50 - 60	Samlet frekvens for kræft i dette interval svarer til screeningen af befolkningen (6/1000)	9
43 - 49		8
39 - 42	**Lav**	7
36 - 38	- > 99,9% normale test[*] - Fund vist med markør ≥ 36	6
≤ 35		≤ 5

≥ 70%

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

Workflow in Capital Region DK
AI+Single or double reading?

Women with **low risk score**

from 3/5 2022 all with score ≤ 42 (<36 from 18/11 2021-3/5 2022)

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

Consensus list in case of disagreement
Allways 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

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2 a. Participation (%invited)	76%	82%	84%	83%	83%	84%
b. Coverage (% target)						%
4. Recall rate						,4%
False-positive rate						,8%
Detection rate (IC+DC						61%
5. Interval cancer rate (Interval IC / Interval IC+ scree detected < 12 / 12-24 months a						%
6. Invasive % (IC / IC+DCIS						5%
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
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Even a small increase in recall rate decrease the benefit!

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

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

Conclusion

- Background for implementation: Very promising results in our large retrospective simulations study

- Prospective results:

  - AI is a valuable tool for risk stratification on basis of analysis of the mammograms

    (≥ 70 % stratified as low risk)

  - Substantial wokload reduction in readings for breast radiologists (≥35%)

  - ≥ 20% reduction in recalls

  - Early quality indicators shows at least as good results as previously

Thank you for your attention!