



Meld je aan met de QR-code



# Practopics

Praktische topics voor de huisarts

Of klik op de link in de Q&A rechtsboven.





# Practopics

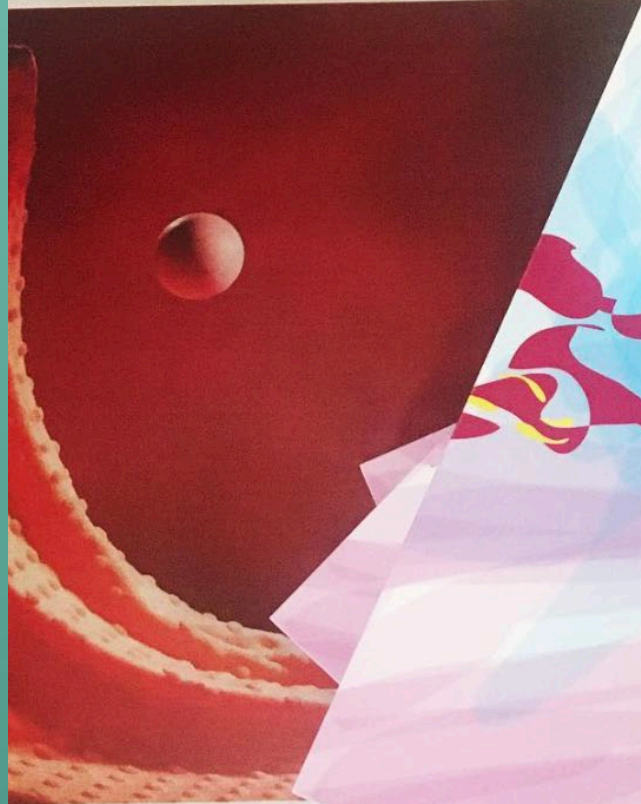
Praktische topics voor de huisarts



# **Computers “denken” anders dan mensen: AI in de gynaecologie**

**Celine Blank MD PhD**

**Gynaecoloog – Fellow Fertiliteitscentrum en Endometriosecentrum ZAS Augustinus**



# UTERINE AND EMBRYO QUALITY FEATURES AND MODELS TO PREDICT SUCCESSFUL IVF TREATMENT



■ Gynaecologie ivf

## Baarmoedergolven onthullen de kans op zwangerschap

Dat er golfpatronen in de baarmoeder zijn, was allang bekend. Celine Blank leert ze te meten. Dat kan bijdragen tot meer succes bij ivf.

Door Ellen de Visser Foto Van Santen & Bolleurs



Als dat idee klopt, zegt haar promotor Dick Schoot, dan zou daarmee een deel van de onvruchtbaarheidsproblemen kunnen worden verklaard. Het succespercentage van een ivf-behandeling is slechts 30 procent. De leeftijd van de vrouw speelt een rol en ook de kwaliteit van het embryo dat wordt teruggeplaatst, maar die verklaringen zijn niet afdoende, zegt Schoot, gynaecoloog in het Catharina Ziekenhuis en hoogleraar aan de Universiteit Gent.

... bij alle ... aan het terug- ... embryo, een echo kan wor- ... om zo het patroon van hun ... edergolven in kaart te brengen. ... cht dat patroon niet goed zijn, dan zijn er twee mogelijkheden, legt ze uit: het embryo invriezen en wachten tot de golven wél goed zijn, of medicijnen geven die de golven de goede kant op sturen. Te denken valt aan middelen die weeën remmen of juist opweken. 'De vraag is alleen hoe die inwerken bij een vrouw die niet zwanger is. Daar moet eerst onderzoek naar worden gedaan.'

Misschien blijkt straks dat het bij vruchtbaarheidsbehandelingen een goed idee is om even te wachten met het terugplaatsen van een embryo totdat de hormoonhuishouding van vrouwen weer normaal is, oppert Blank. 'Vrouwen krijgen hormonen om veel eicellen te laten rijpen en dat heeft ook effect op de baarmoeder, dus op het golfpatroon. Als je wacht totdat de normale cyclus terugkeert, komen de golven misschien tot rust.'

Eind vorig jaar kreeg de Eindhovense onderzoeksgroep een Europese prijs van vakgenoten, en dat voelt als een erkenning voor een onderwerp dat onder gynaecologen nog altijd weinig bekend is, zegt Blank. Nu melden zich de eerste buitenlandse collega's die willen samenwerken. Ze zegt: 'Onvruchtbaarheid is zo'n groot probleem, al kunnen we het succespercentage van vruchtbaarheidsbehandelingen met onze inzet maar een paar procent verbeteren.'

Wat is er zo wild aan?

Waarom zou het kunnen kloppen?

Wat sprekt de theorie tegen?

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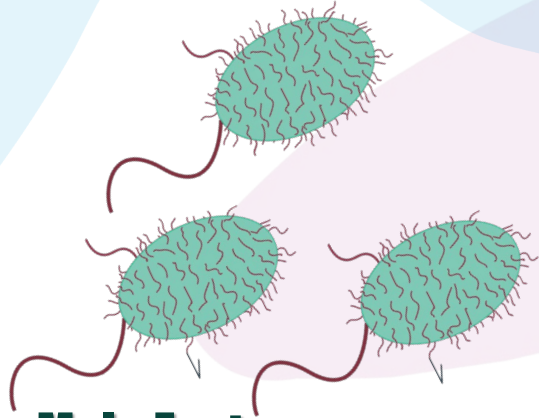
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**= ± 20 %**

**Unexplained**



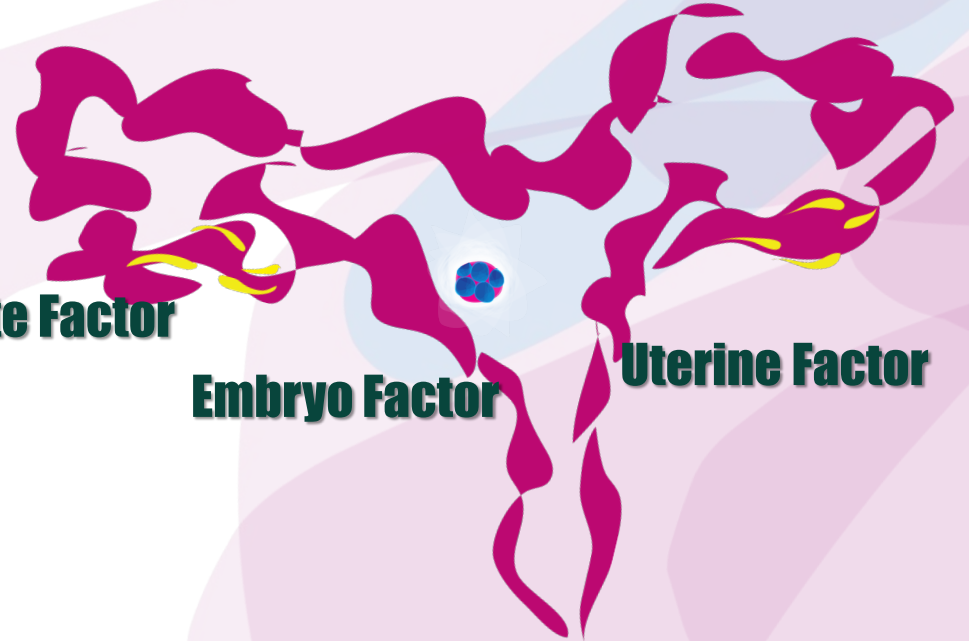
**Male Factor**

**Oocyte Factor**

**Embryo Factor**

**Pelvic Factor**

**Uterine Factor**



# IVF

**Laboratory Phase**

**Follicle Stimulation**

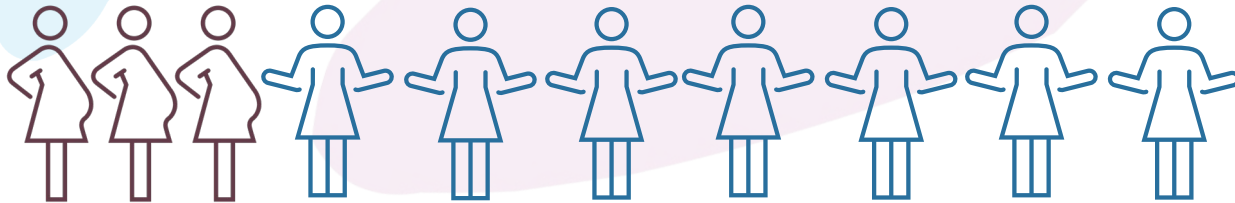
**Implantation**

**Embryo Transfer**

**Oocyte aspiration**

## THE PROBLEM

Overall success rate per  
IVF cycle remains around  
20-30 %







**Leeftijd ♀ 26 jaar**

**Leeftijd ♂ 32 jaar**

**G1 P0 A1**

**Indicatie: onverklaarde subfertiliteit**

**Semen motiliteit:**

**Progressief bewegelijke zaadcellen 2%**

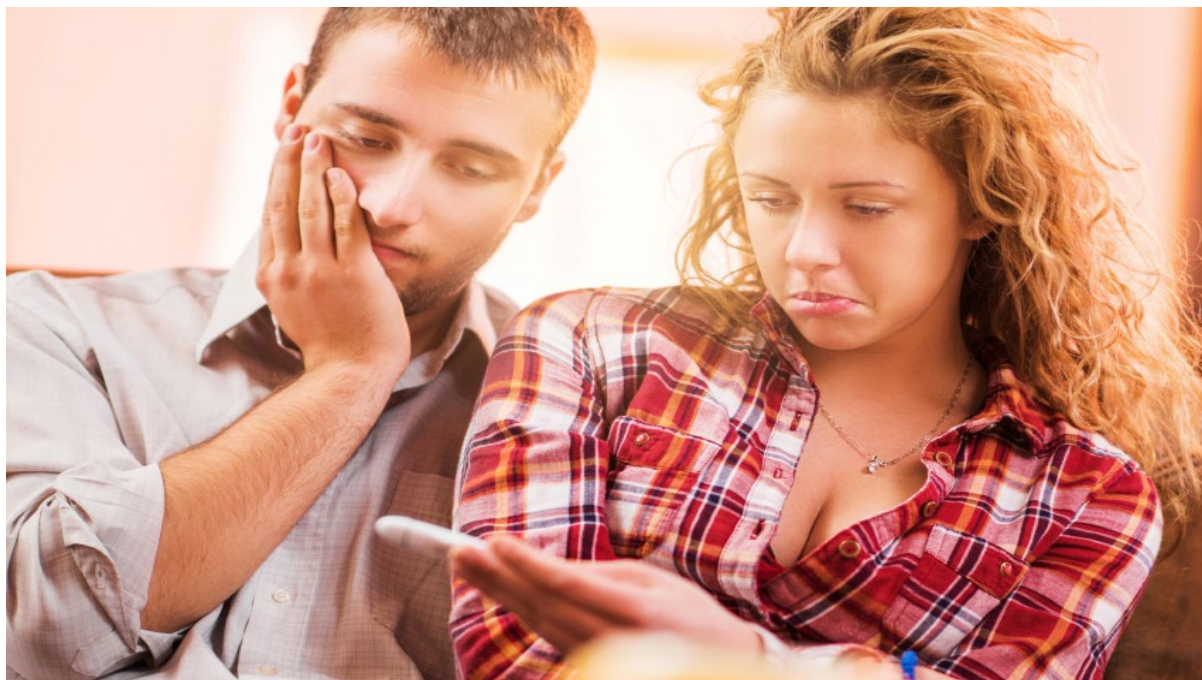
**Bewegelijke zaadcellen 54%**

**Downregulatie: short-agonist protocol**

**Ovarian stimulation: 225IE Menopur**

**Embryo-karakteristieken:**

# Verwachte zwangerschapskans?



10 - 30%

30 - 50%

50 - 80%

Leeftijd ♀ 26 jaar, ♂ 32 jaar, G1 P0 A1, onverklaarde subfertiliteit

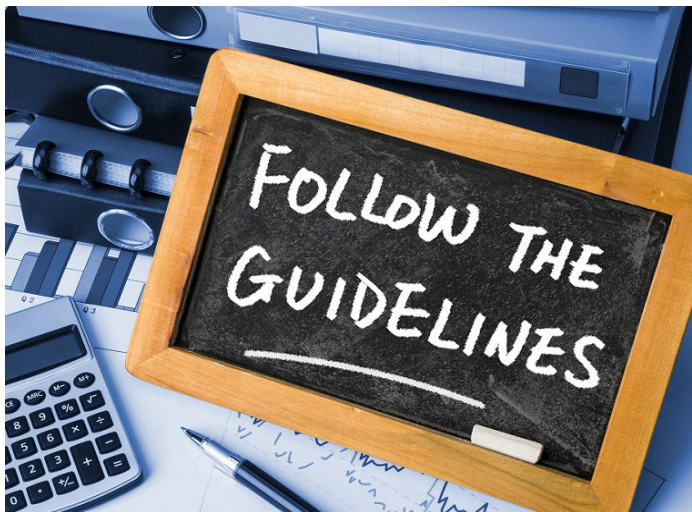
Semen motiliteit:

WHO - A: 2 % WHO - B: 56 %, WHO - C: 32 % WHO - D: 10 %

Short-agonist protocol

Ovarian stimulation: 225IE Menopur

Embryo-karakteristieken: D3: vacuolen -, D5: 3CA



# Klassieke predictie modellen

Univariate logistische regressie analyse



Significante variabelen



Multivariate logistische regressie analyse



Multivariate logistische regressie model

# Ons onderzoek

Retrospectief onderzoek 2015-2017 IVF/ICSI database UZ Gent

1052 verse single embryo transfer cycli geïnccludeerd

Klinische gegevens (n= 39) van koppel  
Morfologische embryo gegevens (n=20)

Uitkomst: voorspelling doorgaande zwangerschap



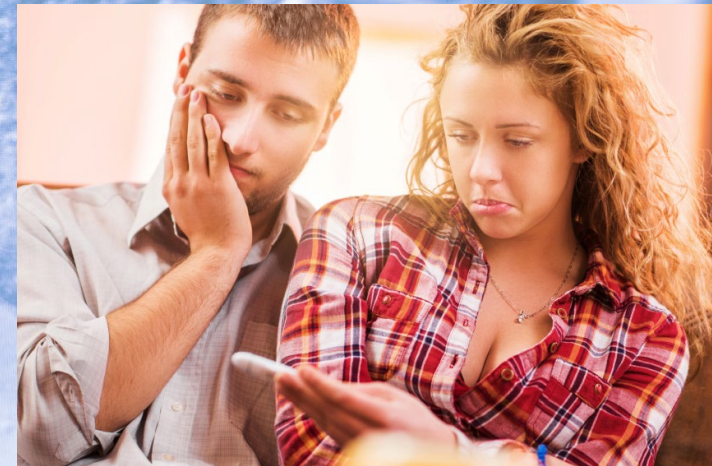
# Multivariate logistisch regressie model

$$Y = 0.99 + (\text{Age}^{\circ} * -0.07) + (\text{Parity}^{\circ} * 0.75) + (\text{Indication: Unexplained causes}^{\circ} * 0.62) + (\text{Vacuole D3}^{\circ} * 1.21) + (\text{Cell stage D5: Compaction}^{\circ} * -1.19) + (\text{Cell stage D5: Blast 1}^{\circ} * -1.56) + (\text{Cell stage D5: Blast 2}^{\circ} * -0.50) + (\text{Cell stage D5: Blast 3}^{\circ} * -0.14) + (\text{Cell stage D5: Blast 5}^{\circ} * -0.24) + (\text{ICM-B}^{\circ} * -0.02) + (\text{ICM-C}^{\circ} * -0.96) \quad (\circ \text{present}=1; \text{absent}=0)$$

# Multivariate logistisch regressie model

$$Y = 0.99 + (\text{Age} = 26 * - 0.07) + (\text{Parity} = 0 * 0.75) + \\ (\text{Indication: Unexplained causes} = 1 (\text{yes}) * 0.62) + \\ (\text{Vacuole D3} = 0 (\text{no}) * 1.21) + (\text{Cell stage D5: Blast } 3^{\circ} * - \\ 0.14) + (\text{ICM-C} = 1 (\text{yes}) * - 0.96) = -1.31$$

Predicted Pregnancy probability =  $1/e(-1.3) = 27\%$



# Amsterdam gaat illegale Airbnb's

RESEARCH | OPEN ACCESS

Classification of caesarean section and normal vaginal del using foetal heart rate signals and advanced machine lear algorithms

Paul Fergus, Abir Hussain, Dhiya Al-Jumaily, De-Shuang Huang and Nizar Bouguila

BioMedical Engir  
Received: 11 Feb

## Big data persoonsgerichte zorg, verkeerde conclusies snel getrokken

23 oktober 2017 | Nieuws

CLEATION AND CLEAVAGE TIME | Wang<sup>a</sup>, H. Lin

D. L. K  
Medicin  
Gyn, Ne

## Big data in de zorg, hoe werkt dat?

• Orig

31-08-2016, 14:03 BINNENLAND

# Hoe big data onze eetgewoontes kan t 'big data' veranderen

HOME

Kristel van Teeffelen – 22:12, 12 april 201

## Big data gebruikt om sterfte aan bloedvergiftiging terug te dringen

31-08-2016, 06:09 BINNENLAND

## ata Big Brother dreigt te n China - én hier

g: hoe hou je

## Van der Aalst:



European Heart Journal (2017) 38, 500–507  
doi:10.1093/eurheartj/ehw188

CLINICAL RESEARCH  
Coronary artery disease

Machine learning for prediction of all-cause mortality in patients with suspected coronary artery disease: a 5-year multicentre prospective registry analysis



**big data medicine**  
Zoekterm

+ Vergelijken

Wereldwijd ▼ 2004 - heden ▼ Alle categorieën ▼ Google Zoeken ▼

Interesse in de loop der tijd ?



Opmerking

Interesse per regio ?



# Using Cost a

Could the IVF  
process? Learn  
the way ART is



Redactie

*Ultrasound quantification of tissue strain and perfusion  
From technical advancement to clinical*

Elicit Recent Library

Find papers

Ask a research question

- Extract data from PDFs
- List of concepts
- Start a systematic review RESEARCH PRO

Recent

- Uterine Contraction Dynamics 10:07am today

## Ontwikkeling van de optimale beleid van gynaecologische translationeel onderzoek: de (Tumour Analysis) en ander

Type	Onderzoeksproject
Projectcode	3M240331
Periode	1 oktober 2024 - 30 september 2025
Kerndomein(en)	Human health
Discipline(s)	03021203 Gynaecologie 03061203 Gynaecologie 03022402 Kankerdiagnose 03062402 Kankerdiagnose 03021204 Verloskunde 03061204 Verloskunde 03021899 Medische beeldvorming en therapie niet elders geclassificeerd

Connie O. Rees

Gynaeco

juni 2024

*Yizhou Huang*

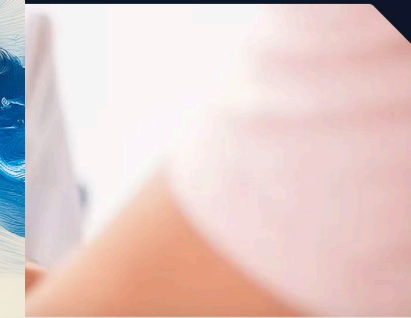
Onderzo

(LUMC) hebben een AI-model ontwikkeld dat het risico op de terugkeer van baarmoederkanker nauwkeurig kan voorspellen.

Deel deze pagina



sperma



**Big data**  
(verbanden) ↔ **Artificial  
Intelligence**



**Machine learning**  
(voorspellen resultaat)



**Supervised Unsupervised**

*Image:  
McKinsey*

# Machine learning

> gegevens (data) → uitkomst

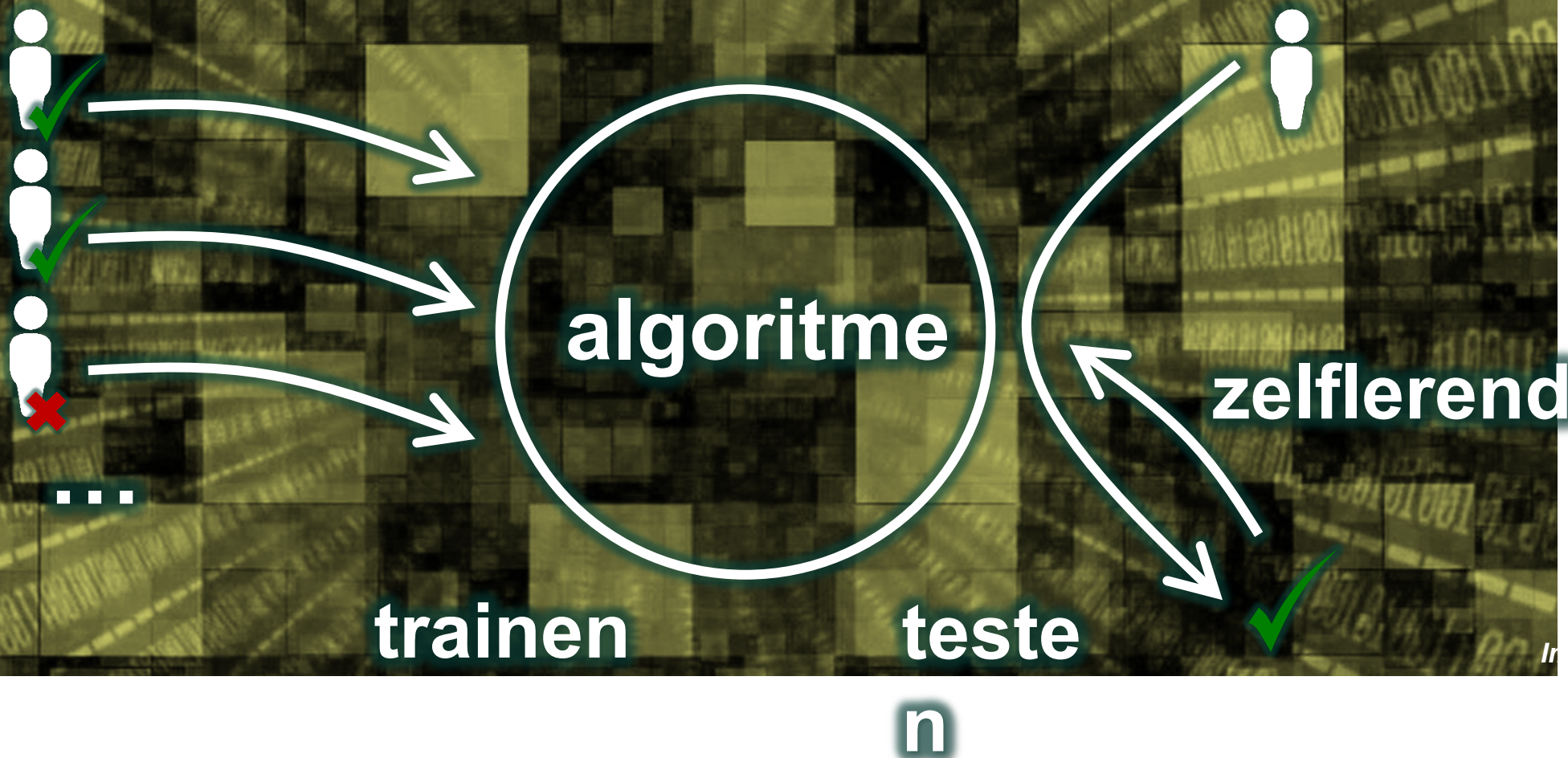
> verzekeringsgegevens + declaratiegedrag → fraude?

> woordgebruik e-mail + gegevens afzender → spam?

> klinische gegevens + embryo-eigenschappen → zwanger?

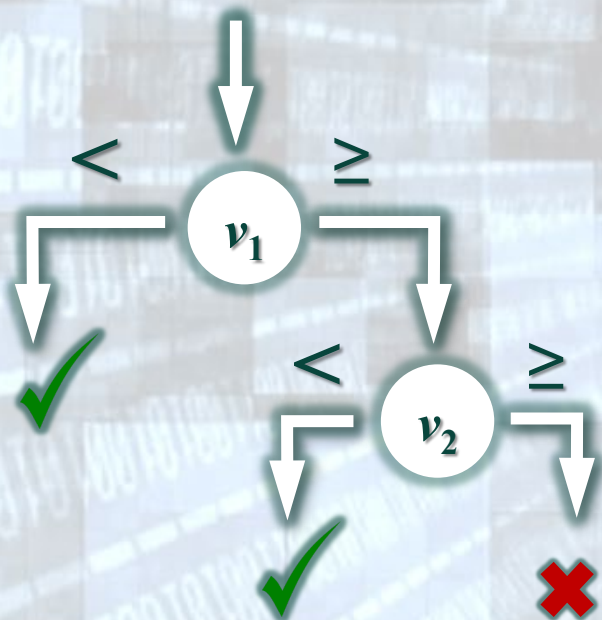
Image:  
McKinsey

# Machine learning (supervised)

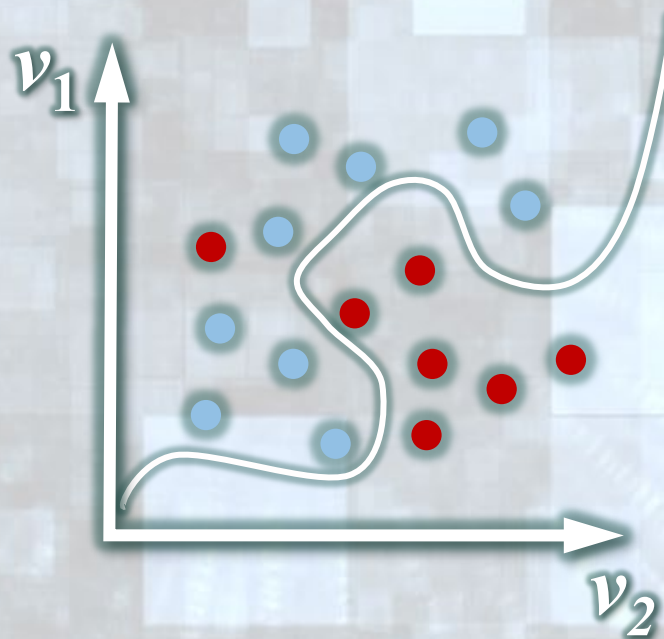


# Verschillende algoritmes

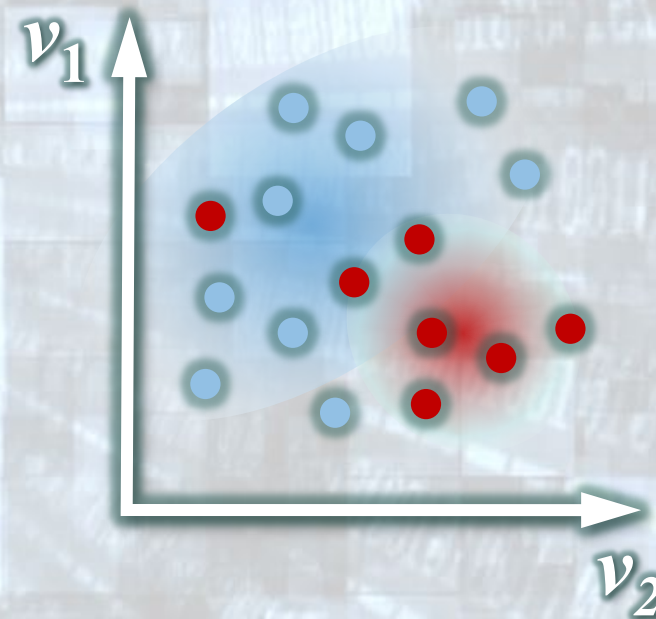
## Beslisboom *Decision Tree*



## Support Vector Machine



## Gaussian Mixture Models





**Computers “denken”  
anders dan mensen**

# Hoe computers “denken”



persoon

“Have you eaten?”

“I haven’t eaten — I don’t really have an appetite.”



Baby

Q

BBC News: “Chinese chatbots shut down after anti-government posts”, 03 August 2017



# Hoe computers “denken”



persoon

“Long live the Communist Party!”

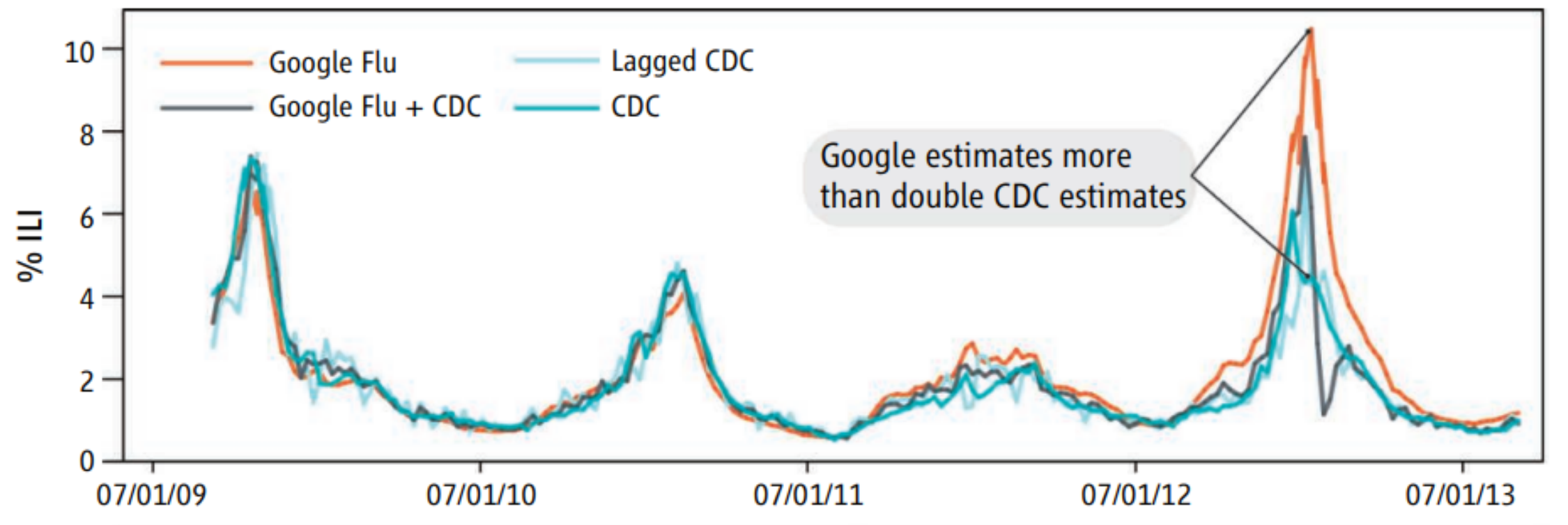
“Do you think that such a corrupt and incompetent political regime can live forever?”



Baby  
Q

BBC News: “Chinese chatbots shut down after anti-government posts”, 03 August 2017

# Hoe computers “denken”



Lazar (2015) The Parable of Google Flu: Traps in Big Data Analysis

# Valkuilen

- > Genoeg (onafhankelijke) data?
- > ‘*Black box*’ –fenomeen
- > Wat zijn de limieten voor toepassing?

# Random forest

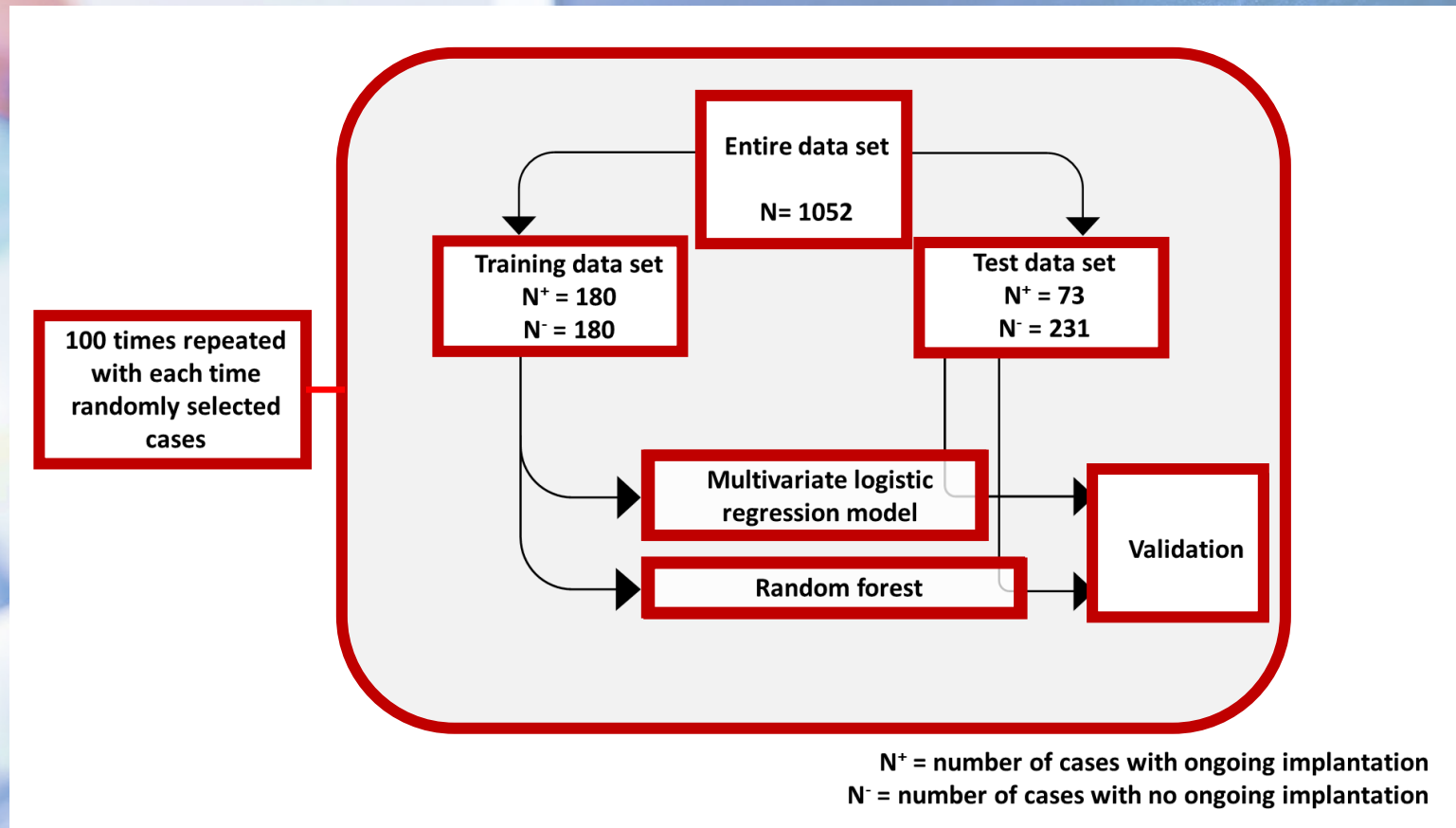
**Categorische variabelen**

**Inclusie cases ondanks missing values**

**Inter-connecties tussen variabelen**

**Makkelijke interpretatie in de kliniek**

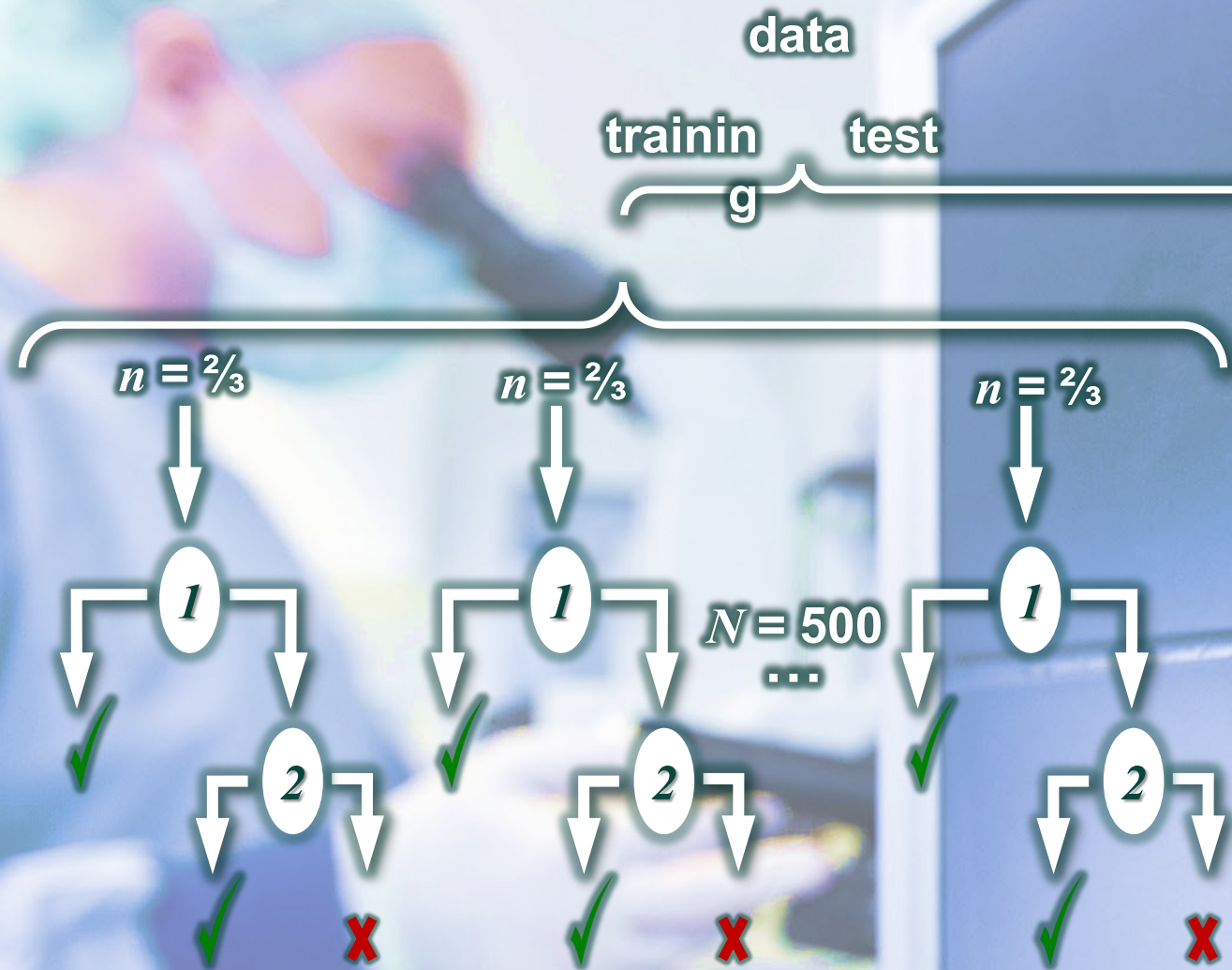
# Ons onderzoek



# Ons

# onderzoek

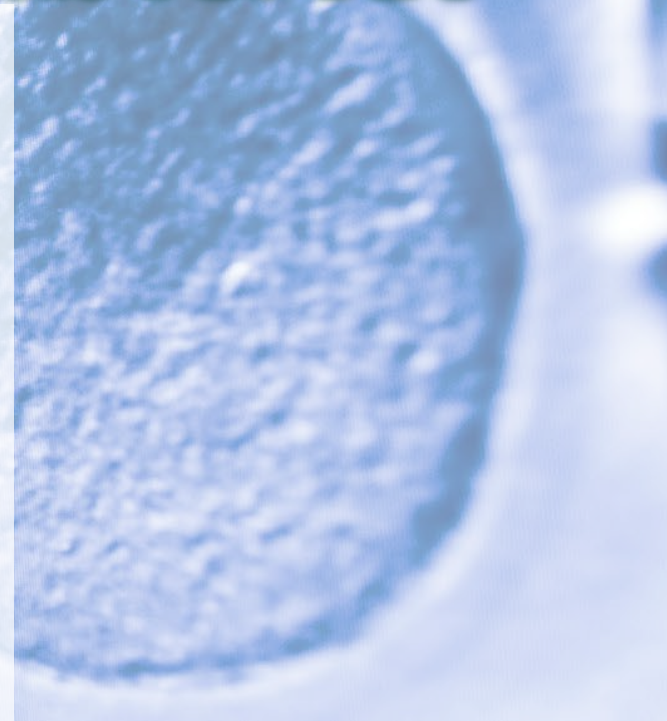
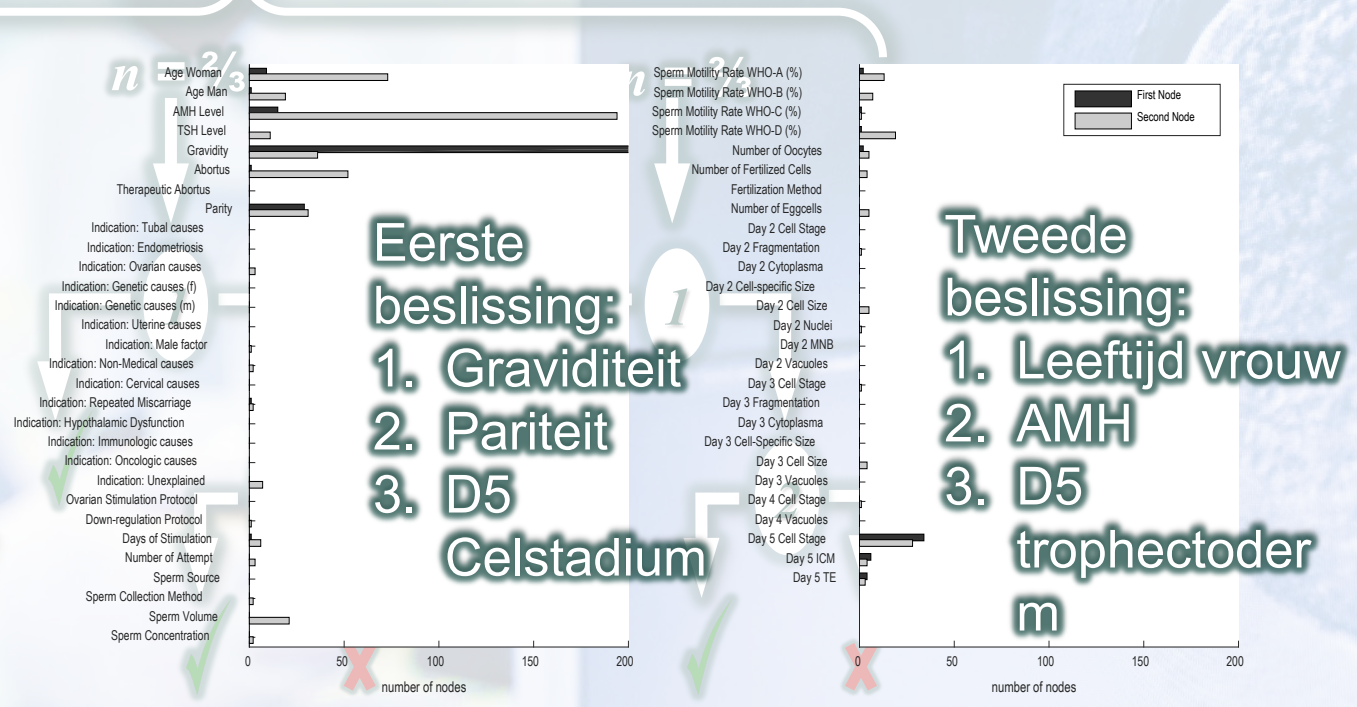
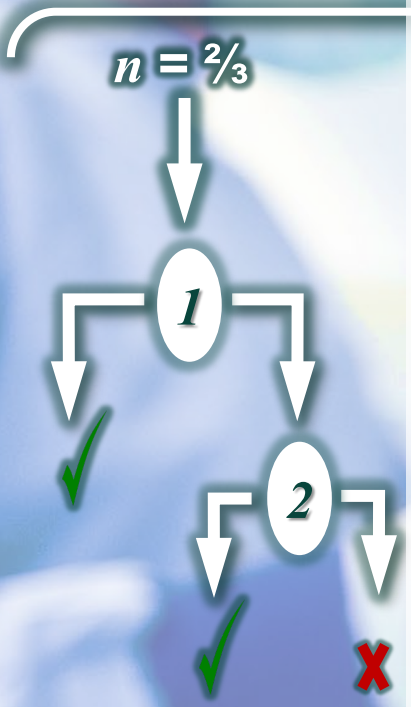
# “random forest”



# Ons

# onderzoek

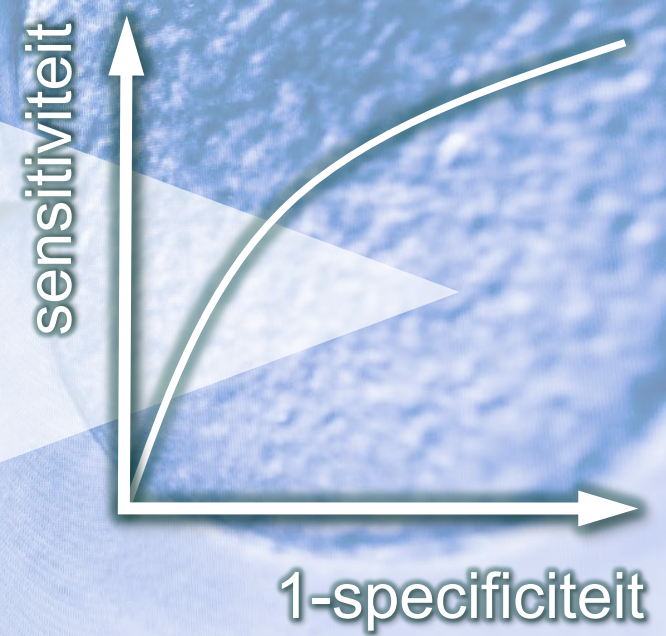
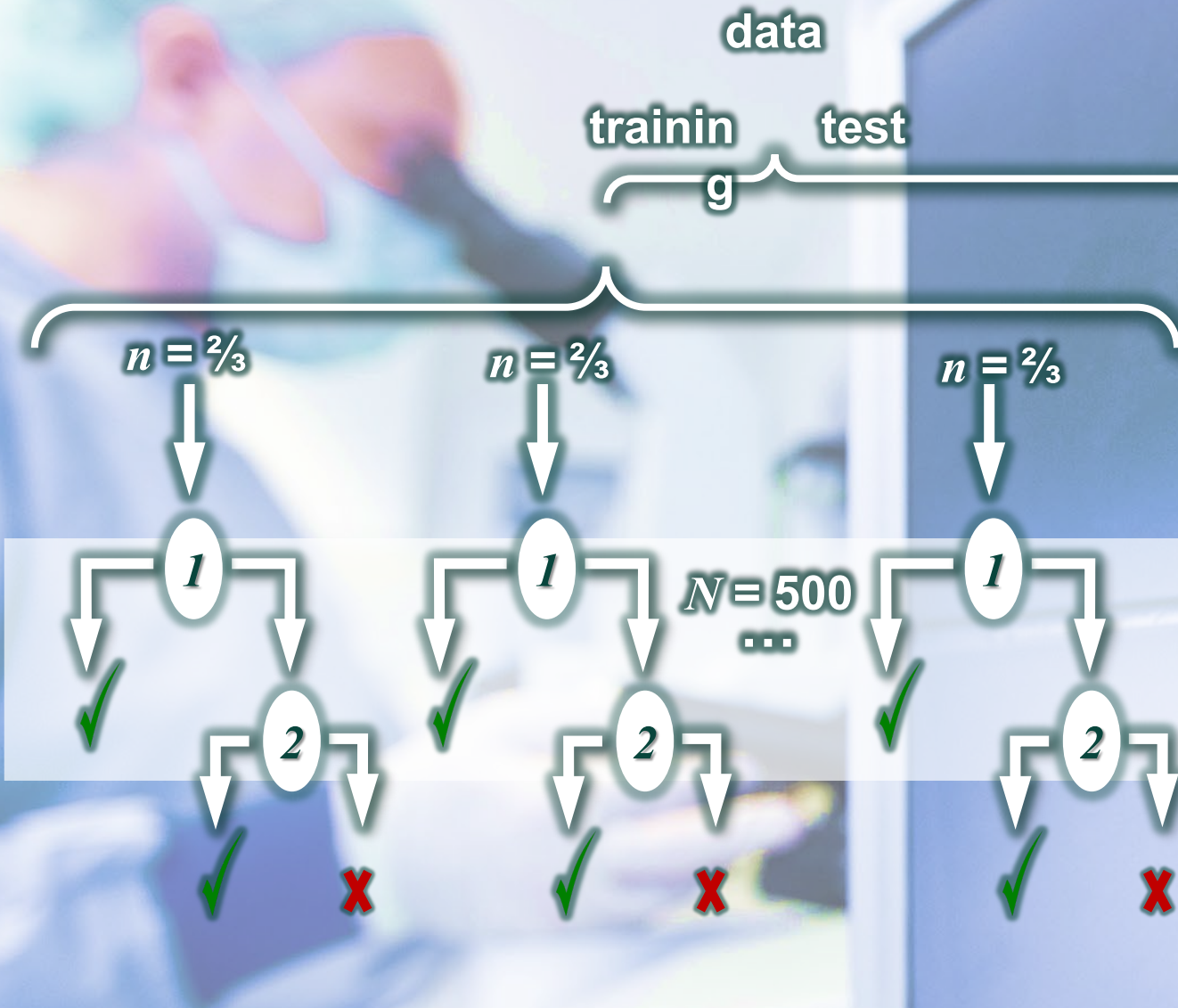
# “random forest”



# Ons

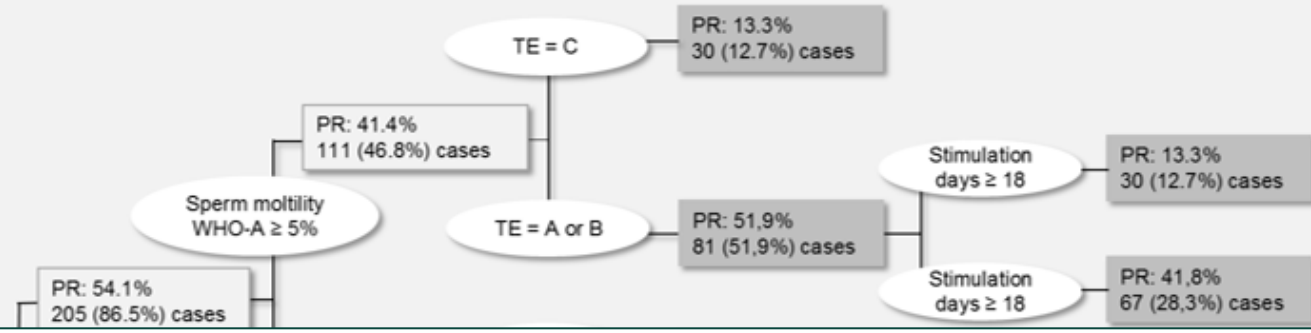
# onderzoek

# “random forest”

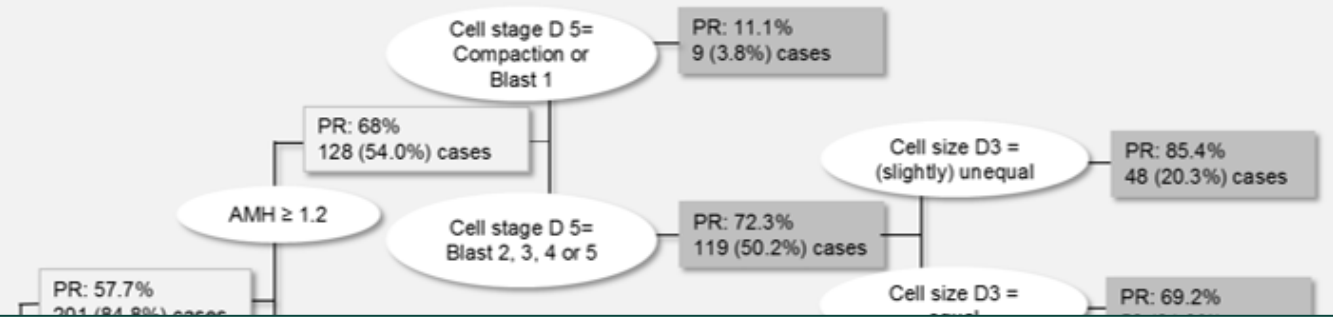




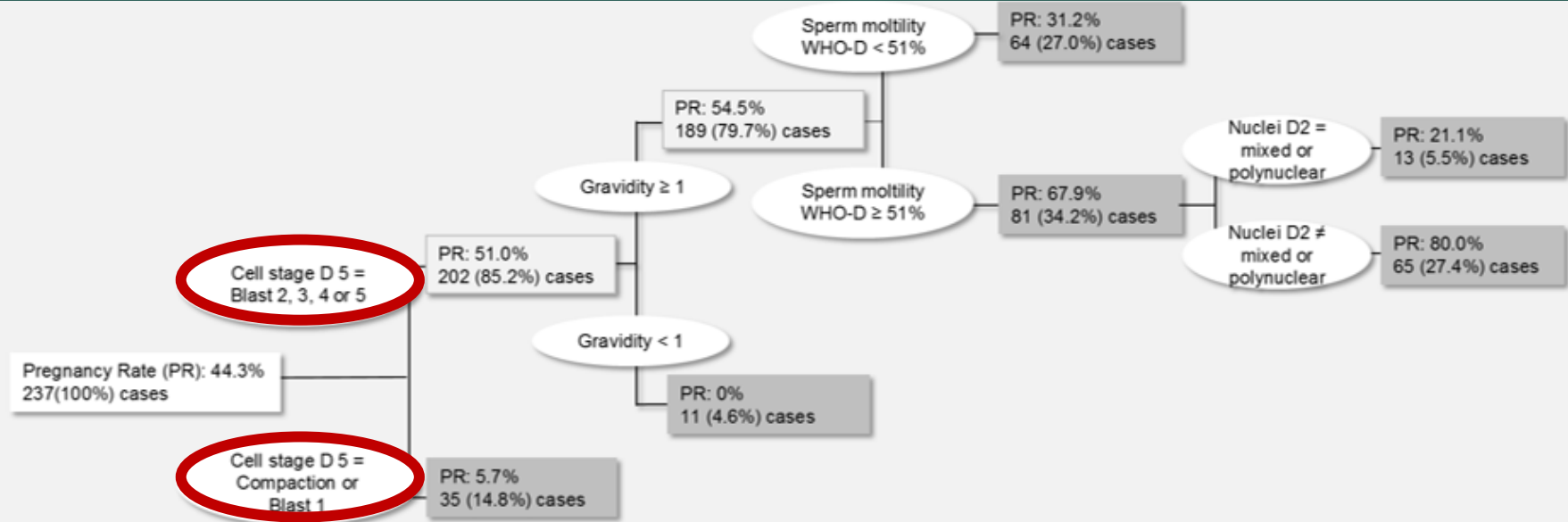
# Decision Tree 1

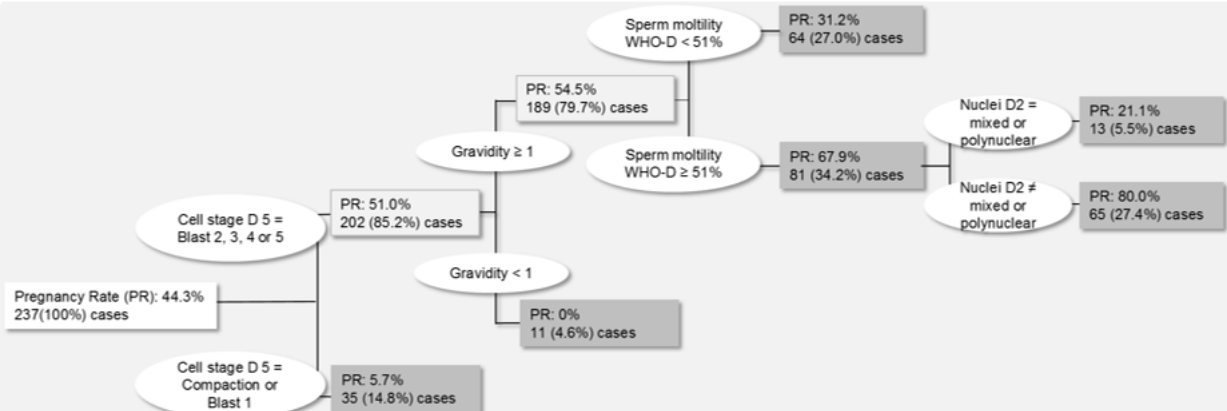
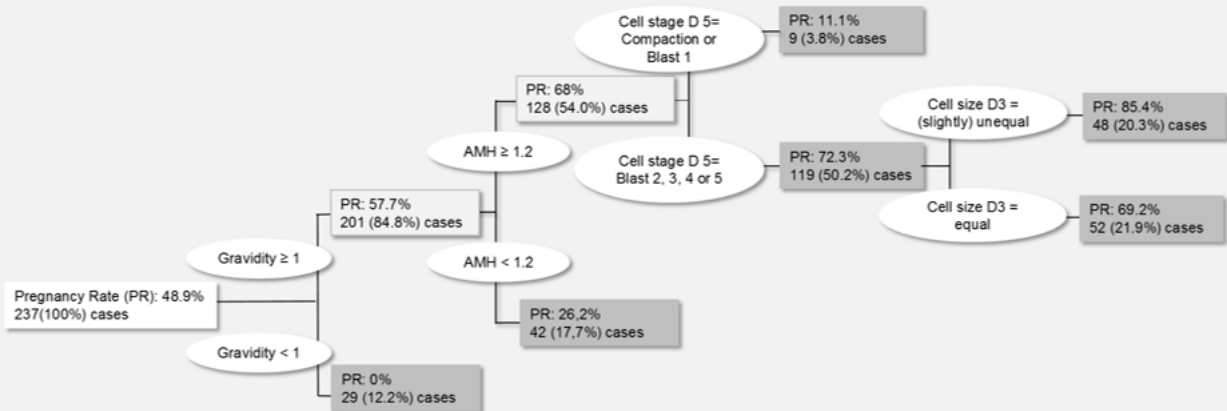
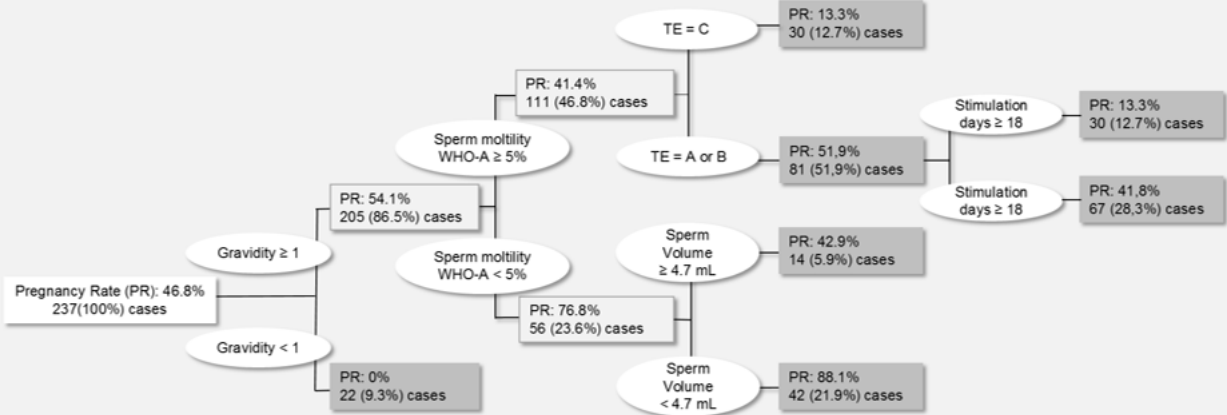


# Decision Tree 2



# Decision Tree 3





...%

...%

...%

Mean predicted Pregnancy probability

ZIEKENHUISaan de STROOM

N=500

Decision Tree 1

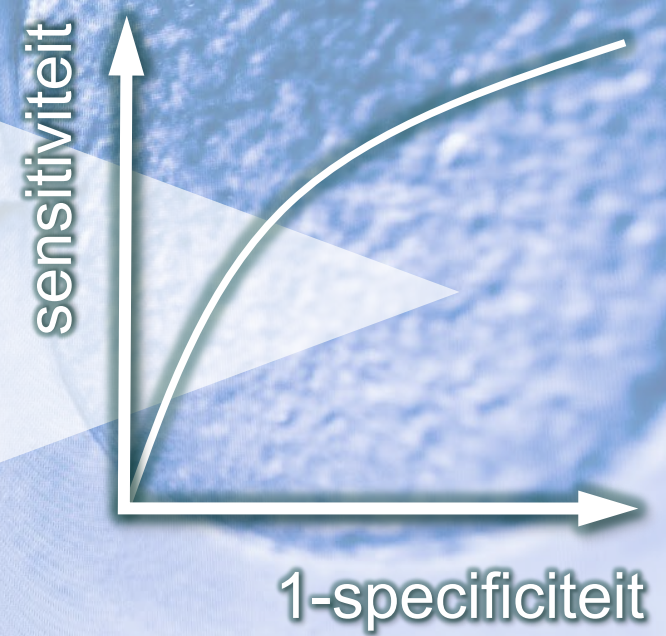
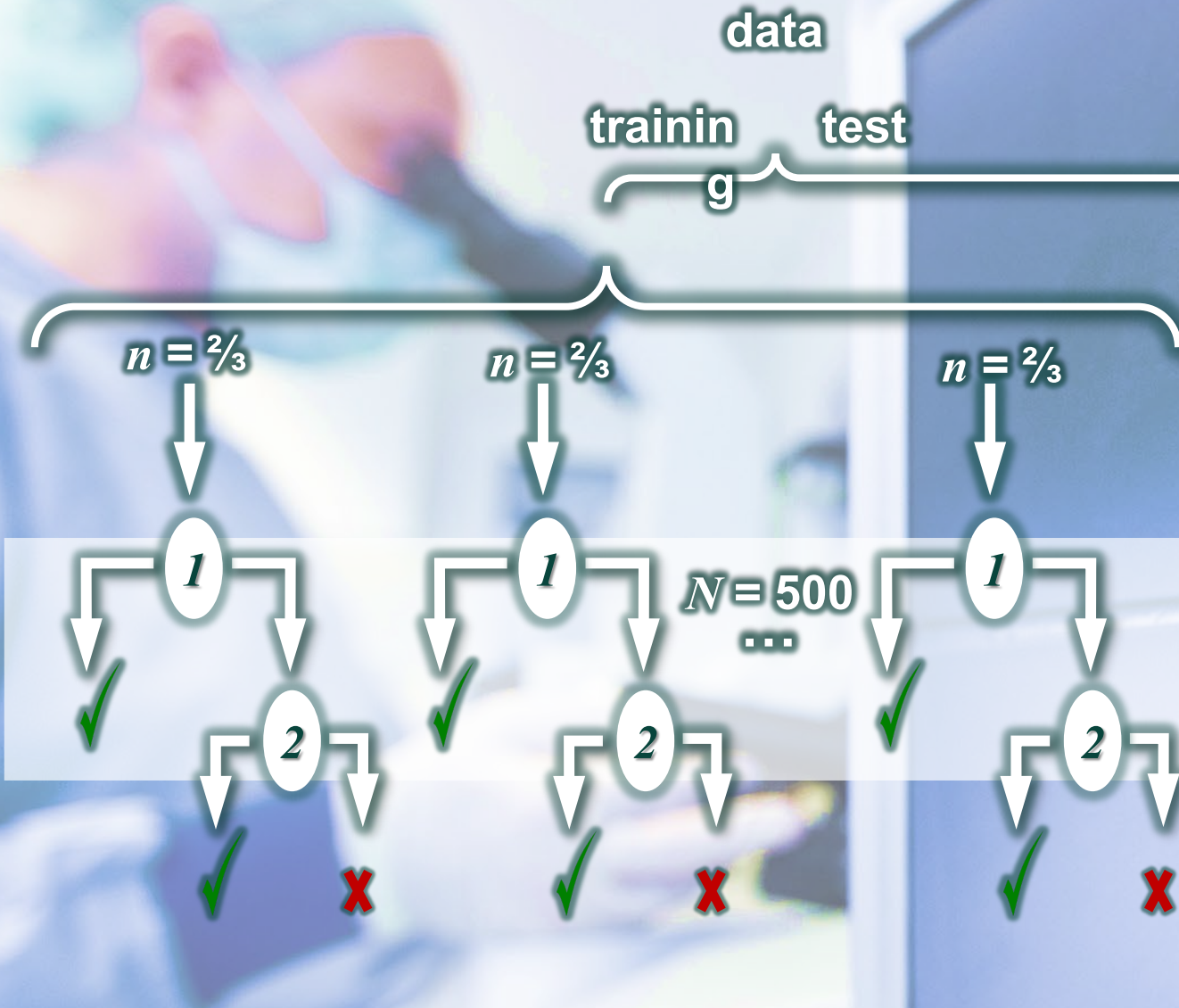
Decision Tree 2

Decision Tree 3

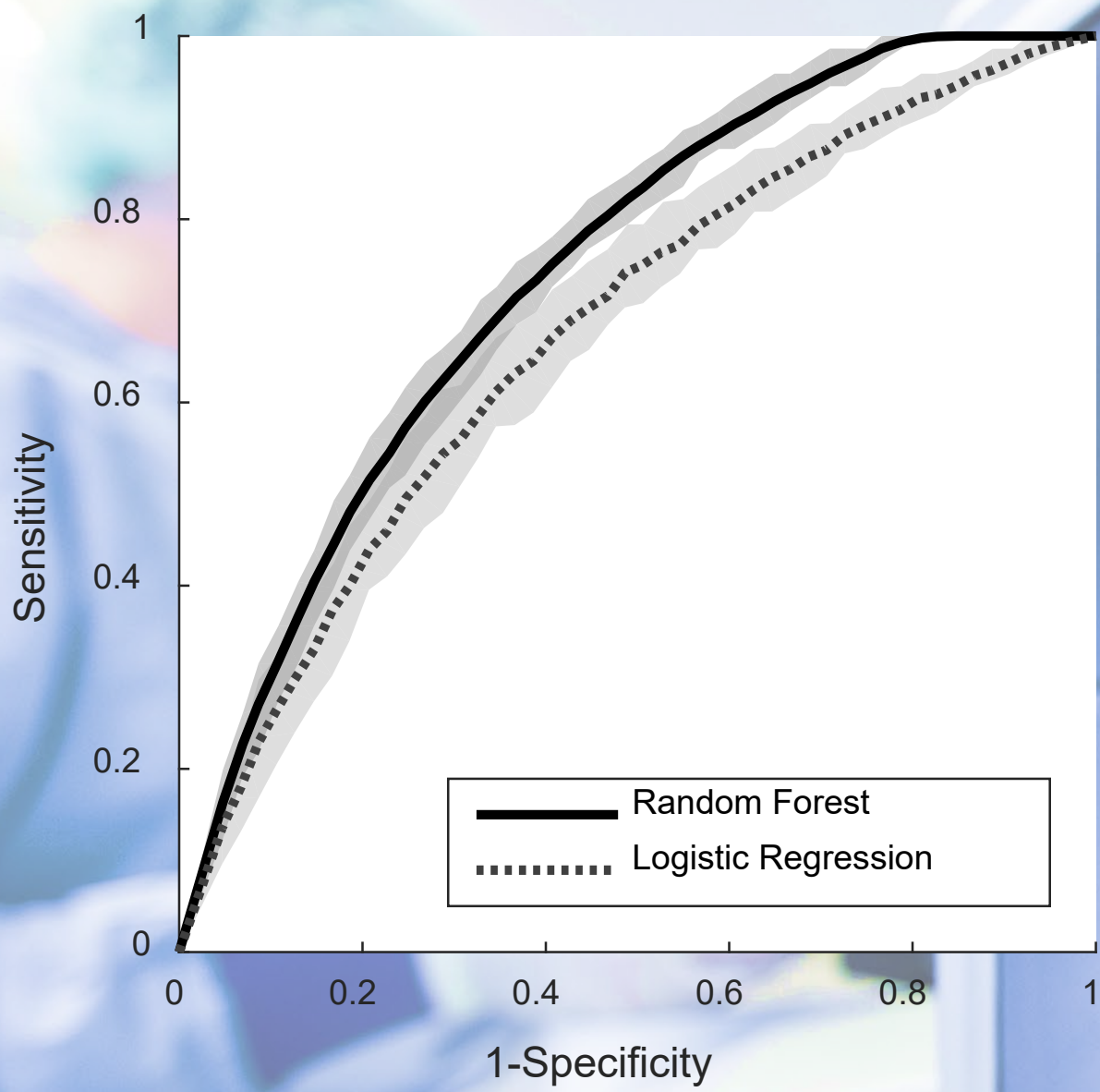
# Ons

# onderzoek

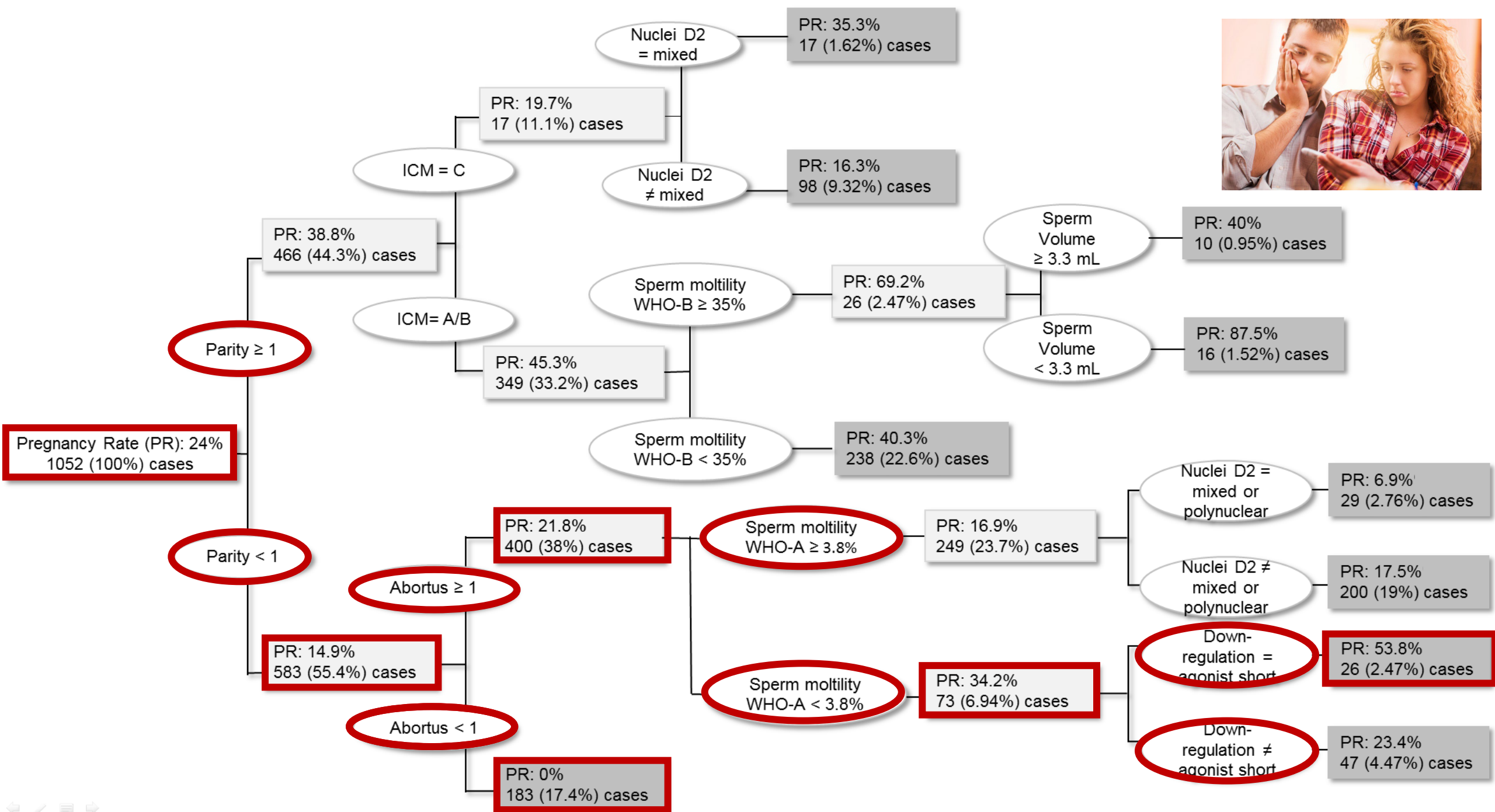
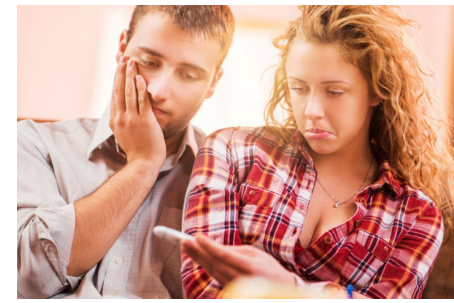
# “random forest”



# Ons onderzoek "random forest"




model	ROC curve area	accuracy	sensitivity	specificity
<i>Random Forest</i>	0.74 ± 0.03	0.56 ± 0.04	0.84 ± 0.07	0.48 ± 0.07
<i>Multivariate Logistic Regression</i>	0.66 ± 0.05	0.60 ± 0.06	0.66 ± 0.07	0.58 ± 0.08



# Conclusie

- > Logistisch regressie (LR) model is statisch o.b.v. waarde variabele
- > Random forest maakt IVF dataset inzichtelijk en veel meer variabelen worden meegenomen dan in LR model
- > Zelflerend predictiemodel voor IVF/ICSI-zwangerschappen per centra te gebruiken als kwaliteitssysteem
- > Machine learning helpt om patronen te ontdekken
- > Big data nuttig, maar wees kritisch!



# **Computers “denken” anders dan mensen: AI in de gynaecologie**

**Celine Blank MD PhD**

**Gynaecoloog – Fellow Reproductieve geneeskunde ZAS Augustinus**



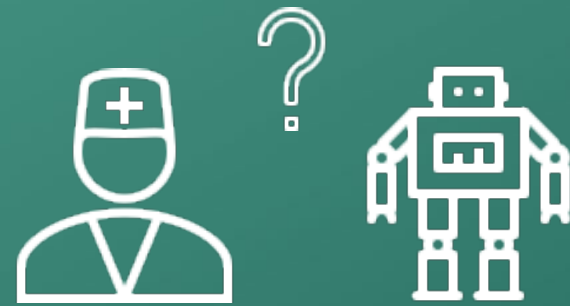
# Mammoradiologie & AI

Dr. Kathleen Dhont

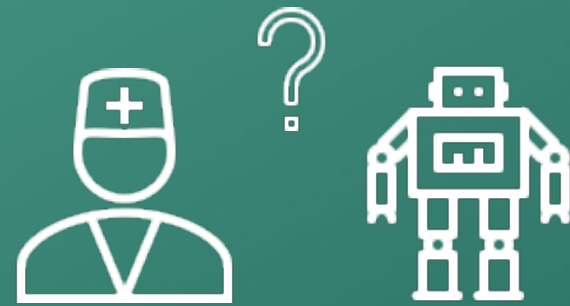
Radiologie ZAS ziekenhuizen campus  
Augustinus, Vincentius & Sint-Jozef



- I. Waarom überhaupt AI?
- II. Wat zegt de literatuur over AI?
- III. AI in de praktijk
- IV. AI in de toekomst



- I. Waarom überhaupt AI?
- II. Wat zegt de literatuur over AI?
- III. AI in de praktijk
- IV. AI in de toekomst



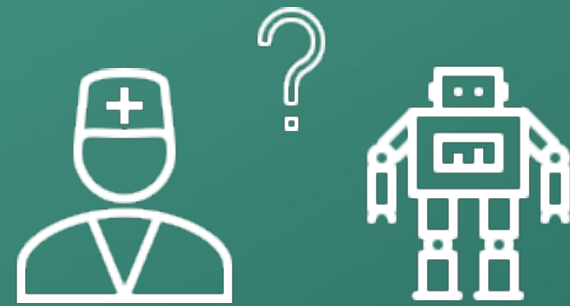
# Waarom überhaupt AI?

- Toenemende vraag naar onderzoeken
- 2<sup>de</sup> lezer systeem
- Toenemende complexiteit van onderzoeken (DBT, CEM, MRI ultrafast)

MG is een ideale toepassing voor AI

- Zeer veel (vrij uniforme) data voor trainen en testen
- Duidelijk definieerbaar eindpunt (kanker vs. geen kanker)

- I. Waarom überhaupt AI?
- II. Wat zegt de literatuur over AI?
- III. AI in de praktijk
- IV. AI in de toekomst



# Wat zegt de literatuur over AI?

OXFORD

JNCI J Natl Cancer Inst (2019) 111(9): dgy222

doi: 10.1093/jnci/dgy222

First published online March 5, 2019

Article

## ARTICLE

### Stand-Alone Artificial Intelligence for Breast Cancer Detection in Mammography: Comparison With 101 Radiologists

Alejandro Rodriguez-Ruiz, Kristina Lång, Albert Gubern-Merida, Mireille Broeders, Gisella Gennaro, Paola Clauser, Thomas H. Helbich, Margarita Chevalier, Tao Tan, Thomas Mertelmeier, Matthew G. Wallis, Ingvar Andersson, Sophia Zackrisson, Ritse M. Mann, Ioannis Sechopoulos

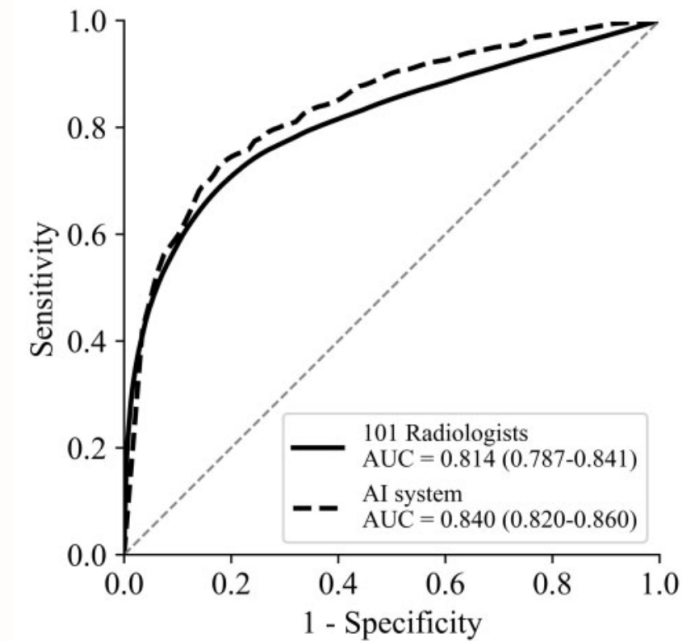


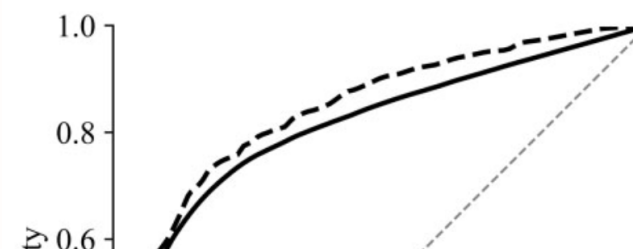
Figure 1. Receiver operating characteristic curve comparison between the reader-averaged radiologists and the artificial intelligence (AI) system in terms of area under the curve (AUC). Parentheses show the 95% confidence interval of the AUC.

# Wat zegt de literatuur over AI?



JNCI J Natl Cancer Inst (2019) 111(9): dgy222

doi: 10.1093/jnci/dgy222  
 First published online March 5, 2019  
 Article



**Conclusions:** The evaluated AI system achieved a cancer detection accuracy comparable to an average breast radiologist in this retrospective setting. Although promising, the performance and impact of such a system in a screening setting needs further investigation.

## in Mammography: Comparison With 101 Radiologists

Alejandro Rodriguez-Ruiz, Kristina Lång, Albert Gubern-Merida, Mireille Broeders, Gisella Gennaro, Paola Clauser, Thomas H. Helbich, Margarita Chevalier, Tao Tan, Thomas Mertelmeier, Matthew G. Wallis, Ingvar Andersson, Sophia Zackrisson, Ritse M. Mann, Ioannis Sechopoulos

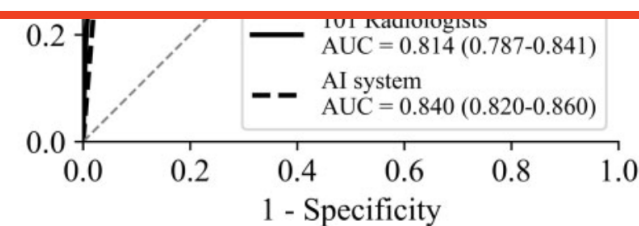


Figure 1. Receiver operating characteristic curve comparison between the reader-averaged radiologists and the artificial intelligence (AI) system in terms of area under the curve (AUC). Parentheses show the 95% confidence interval of the AUC.

# Wat zegt de literatuur over AI?

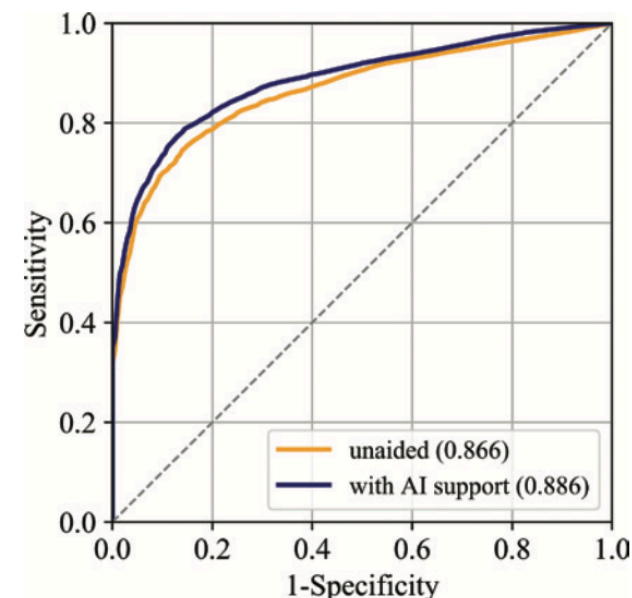
Radiology

ORIGINAL RESEARCH • BREAST IMAGING

## Detection of Breast Cancer with Mammography: Effect of an Artificial Intelligence Support System

*Alejandro Rodríguez-Ruiz, MSc • Elizabeth Krupinski, PhD • Jan-Jurre Mordang, MSc • Kathy Schilling, MD • Sylvia H. Heywang-Köbrunner, MD, PhD • Ioannis Sechopoulos, PhD • Rütse M. Mann, MD, PhD*

Radiology 2019; 00:1–10 • <https://doi.org/10.1148/radiol.2018181371>



**Figure 2:** Average receiver operating characteristic (ROC) curves under two reading conditions: unaided and with artificial intelligence (AI) support. Average is computed across 14 radiologists participating in this evaluation. Numbers in parentheses are areas under ROC curve.

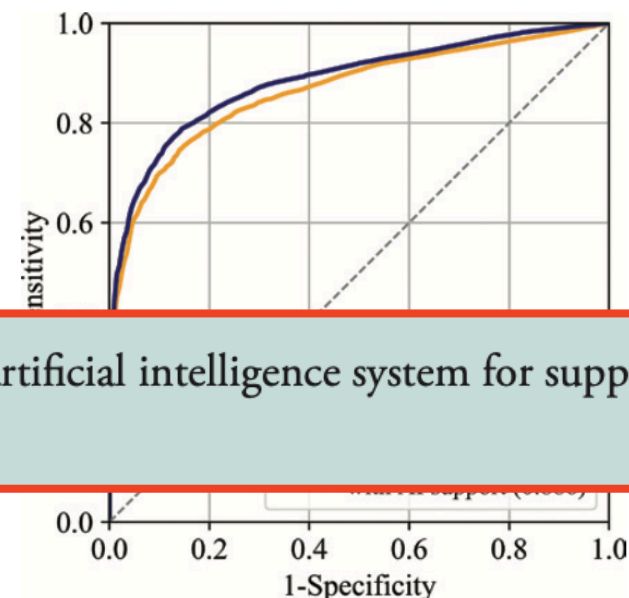
# Wat zegt de literatuur over AI?

## Radiology

ORIGINAL RESEARCH • BREAST IMAGING

### Detection of Breast Cancer with Mammography: Effect of an Artificial Intelligence Support System

**Conclusion:** Radiologists improved their cancer detection at mammography when using an artificial intelligence system for support, without requiring additional reading time.



**Figure 2:** Average receiver operating characteristic (ROC) curves under two reading conditions: unaided and with artificial intelligence (AI) support. Average is computed across 14 radiologists participating in this evaluation. Numbers in parentheses are areas under ROC curve.



# Wat zegt de literatuur over AI?

## THE LANCET

**Artificial intelligence-supported screen reading versus standard double reading in the Mammography Screening with Artificial Intelligence trial (MASAI): a clinical safety analysis of a randomised, controlled, non-inferiority, single-blinded, screening accuracy study**

*Kristina Lång, Viktoria Josefsson, Anna-Maria Larsson, Stefan Larsson, Charlotte Högberg, Hanna Sartor, Solveig Hofvind, Ingrid Aldana Rosso*

*Lancet Oncol 2023; 24: 936–44*

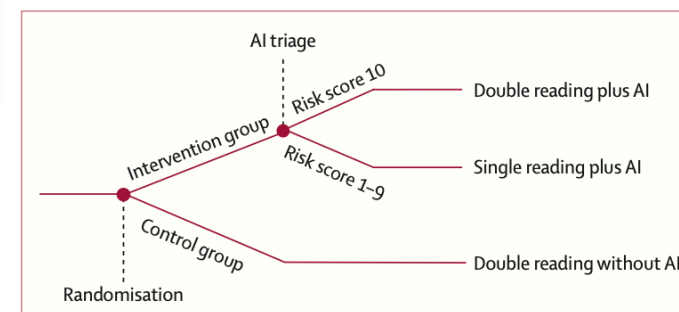


Figure 1: Overview of trial intervention  
AI=artificial intelligence.

Comparison between AI-assisted mammography and double reading	Standard double reading	AI-assisted double reading
Cancer detection rate (per 1,000 screened women)	5.1	6.1
Recall rate	2%	2.2%
False-positive rate	1.5%	1.5%
Positive predictive value of recall	24.8%	28.3%

# Wat zegt de literatuur over AI?

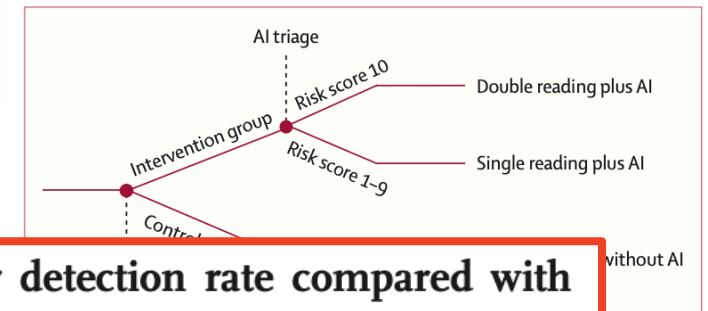
## THE LANCET

### Artificial intelligence-supported screen reading versus standard double reading in the Mammography Screening

**Interpretation** AI-supported mammography screening resulted in a similar cancer detection rate compared with standard double reading, with a substantially lower screen-reading workload, indicating that the use of AI in mammography screening is safe. The trial was thus not halted and the primary endpoint of interval cancer rate will be assessed in 100 000 enrolled participants after 2-years of follow up.

*Kristina Lång, Viktoria Josefsson, Anna-Maria Larsson, Stefan Larsson, Charlotte Högberg, Hanna Sartor, Solveig Hofvind, Ingrid Aldana Rosso*

*Lancet Oncol 2023; 24: 936–44*



reading	Standard double reading	AI-assisted mammography
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Positive predictive value of recall	24.8%	28.3%

# Wat zegt de literatuur over AI?

## THE LANCET

**Screening performance and characteristics of breast cancer detected in the Mammography Screening with Artificial Intelligence trial (MASAI): a randomised, controlled, parallel-group, non-inferiority, single-blinded, screening accuracy study**

*Veronica Hernström, Viktoria Josefsson, Hanna Sartor, David Schmidt, Anna-Maria Larsson, Solveig Hofvind, Ingvar Andersson, Aldana Rosso,*

*Lancet Digit Health 2025;*

*7: e175-83*

# W

## THE LANCET

### Screen detect Intelli group study

Veronica Hern  
Lancet Digit  
7: e175-83

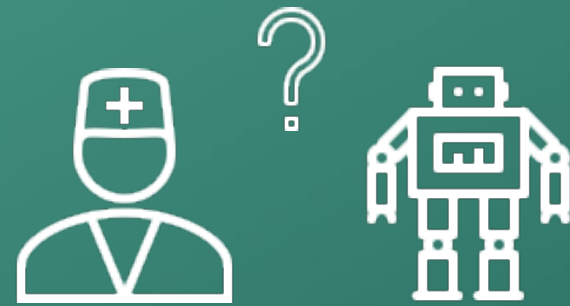
#### Added value of this study

To our knowledge, this is the first randomised controlled trial investigating the use of AI in mammography screening. In this protocol-defined analysis, the objective was to study early screening performance measures and screen-reading workload together with a characterisation of the type and stage of detected cancers in the entire trial population. Characterisation of detected cancers is important for our improved understanding of the clinical impact of AI-supported mammography screening. The AI-supported screen-reading procedure resulted in a significant increase in cancer detection compared with standard double reading, without increasing the false-positive rate while reducing the screen-reading workload. The increased detection was predominantly of small, lymph-node negative, invasive cancers, and in addition to luminal A, included more detected triple-negative, human epidermal growth factor receptor 2 positive, and luminal B cancers. There was no increased detection of low-grade ductal carcinoma in situ. The results indicate that an AI-supported screen reading procedure can contribute to the early detection of breast cancer likely to be clinically progressive.

#### Implications of all the available evidence

Taken together, results of this randomised controlled trial indicate that an AI-supported screen-reading procedure can safely be used to reduce the screen-reading workload and that the significant increase in cancer detection probably contributes to the early detection of clinically relevant breast cancer. Assessment of the primary endpoint of the interval cancer rate will provide further insight into the prognostic implications of use of AI in mammography screening.

- I. Waarom überhaupt AI?
- II. Wat zegt de literatuur over AI?
- III. AI in de praktijk
- IV. AI in de toekomst



# AI in de praktijk

AI voor mammografie en tomosynthese in gebruik sinds 09/2023

RUBEE® Breast AI INSIGHT Package **AGFA** Agfa  
HealthCare

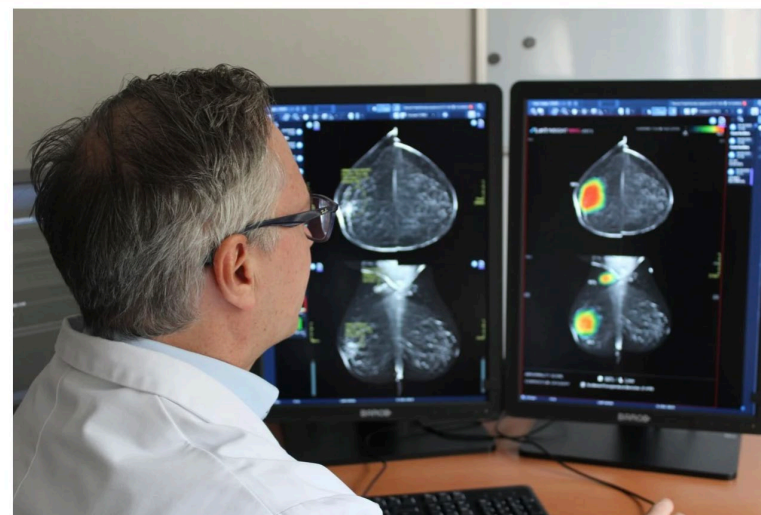
Powered by Lunit INSIGHT MMG & Lunit INSIGHT DBT  Lunit

AI software op basis van deep learning



GZA

GZA Ziekenhuizen gebruiken artificiële intelligentie en contrastmammografie om borstkanker beter op te sporen



Dokter De Schepper kijkt een mammografie waarop AI software via een 'heat map' de risicozones aangeeft. — © GZA Ziekenhuizen

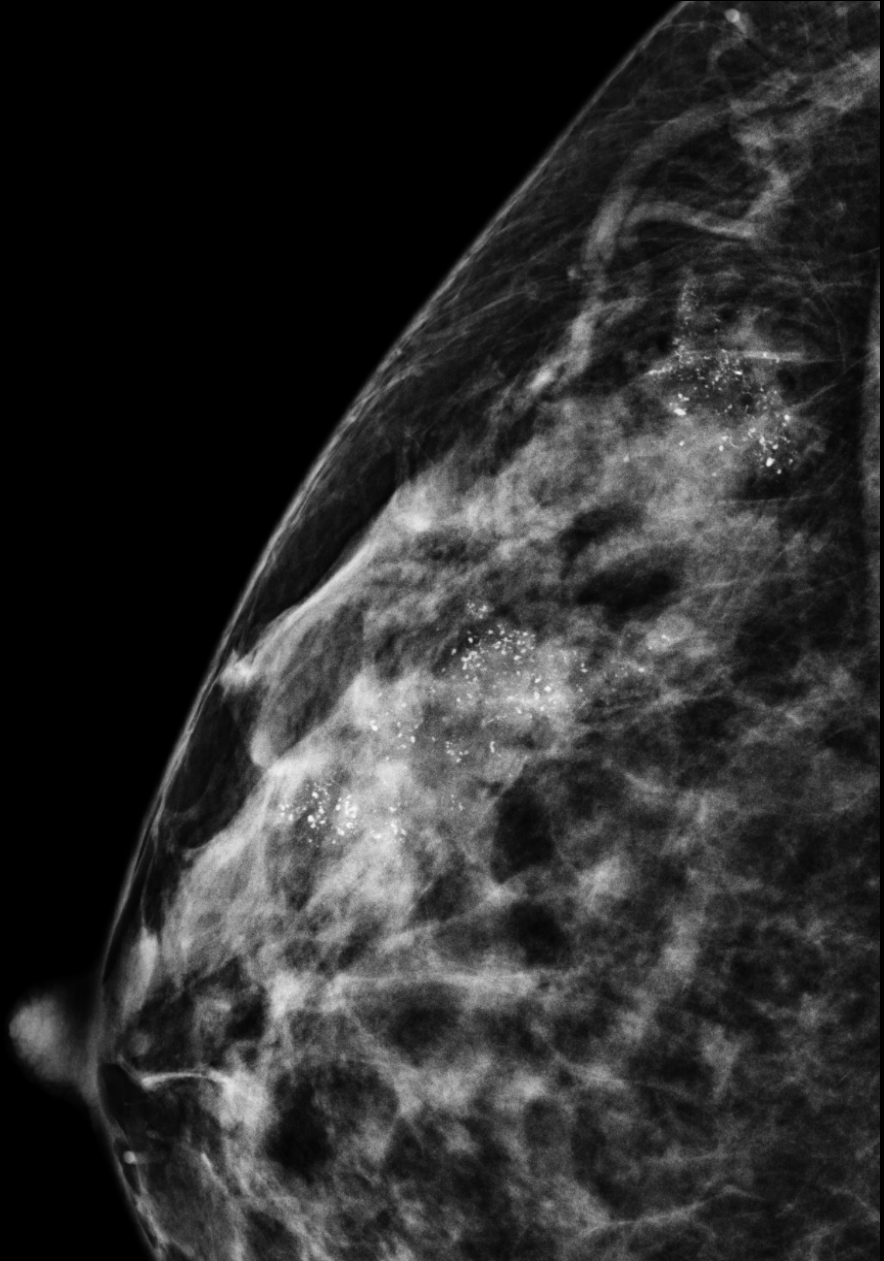
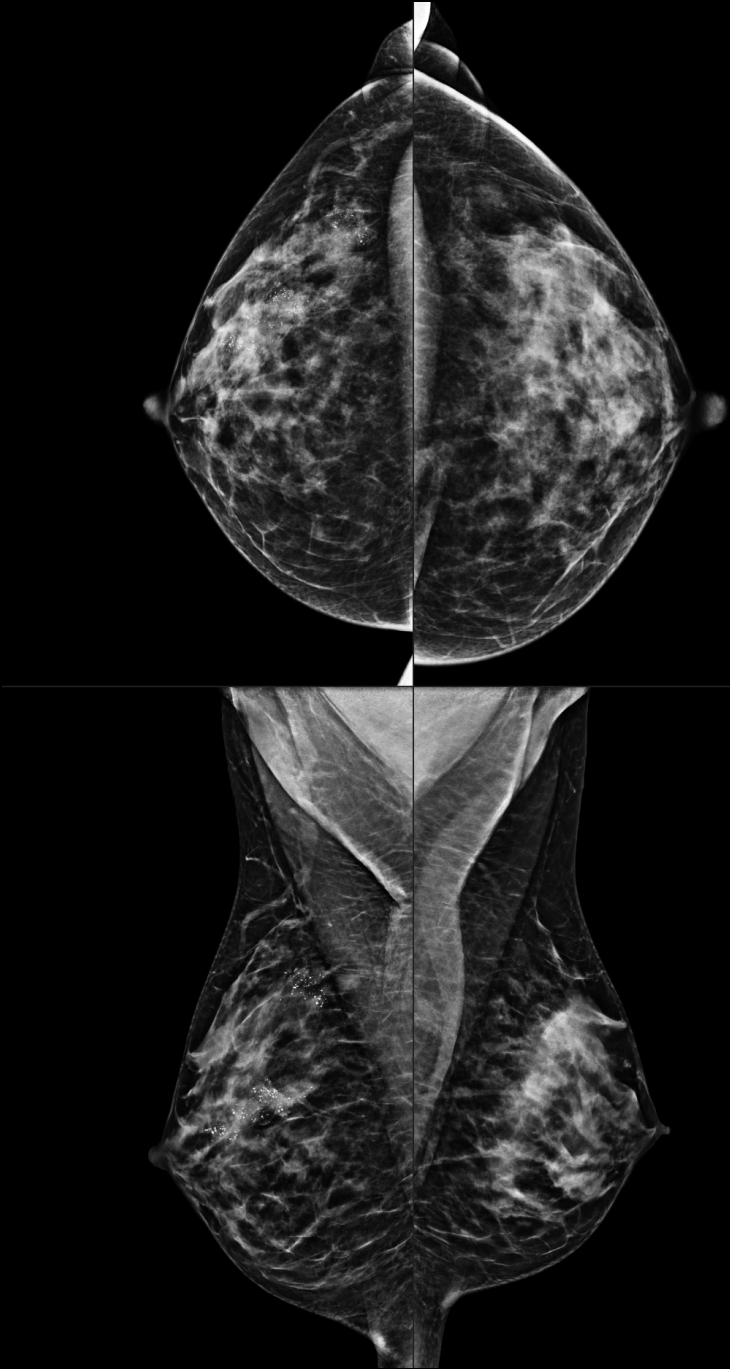
vr̄ nws

**N**  
Nieuwsblad

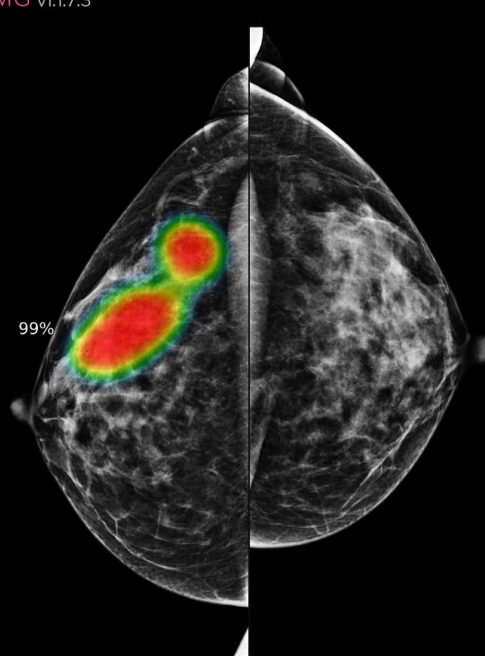
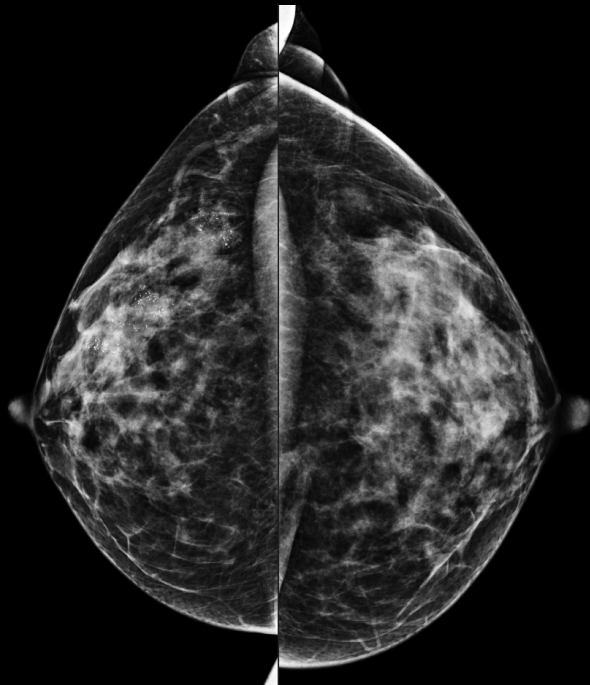
**HLN**

**SPECIALIST**

ZIEKENHUIS  
aan  
de STROOM



♀ 35 jaar palpabele harde zone RUOQ



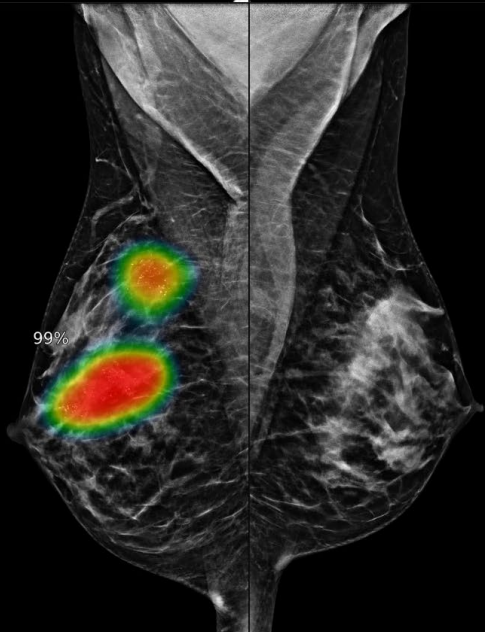
**BESLUIT:**

**SPECIMEN: Mastectomie rechter borst**

Tumor: Bifocaal invasief adenocarcinoma, NST  
 Differentiatiegraad: graad 2  
 Afmeting tumor: Grootste focus: 20 mm  
 Kleinste focus: 8 mm.  
 Kenmerken tumor: Ki-67: 30%.  
 MAI: 4/2 mm<sup>2</sup>  
 LVI of PNI niet aantoonbaar.  
 sTILs: 1%  
 Uitgebreid DCIS aanwezig met diameter invasief NST en DCIS: 70mm.  
 Resectiestatus: R1(is): microscopisch enkel in situ tumor thv snijrand  
 <0.3 mm tot het anterior caudale snedevlak. DCIS tot in het anterior caudale snedevlak,  
 inferolateraal in de borst. Op ca. 2.5 cm van de anterieure draad  
 Sentinel node: 1 tumorvrije SN

**TNM PATHOLOGISCHE STAGERING (editie 8):**

Rechter borst: p T1c N0(SN) V0 L0 Pn0 G2 R1(is)



LMLO  
150px

Intelligent  
3D

**BESLUIT:**

**SPECIMEN: Profylactische mastectomie links**

Geen noemenswaardige bijzonderheden. Geen argumenten voor een maligniteit.

QUALITY SCORE

R 99% / L Low

POSITION CATEGORY

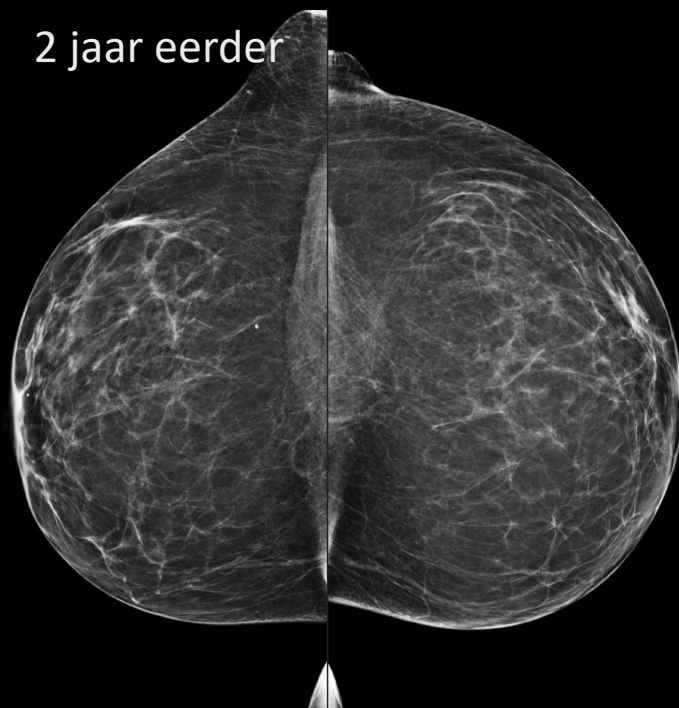
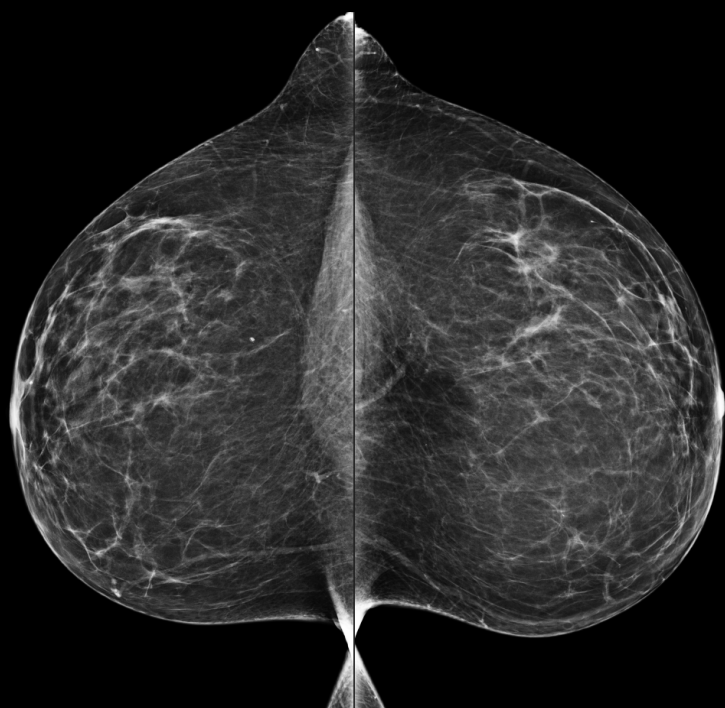
C Heterogeneously Dense (7 of 10)

♀ 35 jaar palpabele harde zone RUOQ



2 jaar eerder

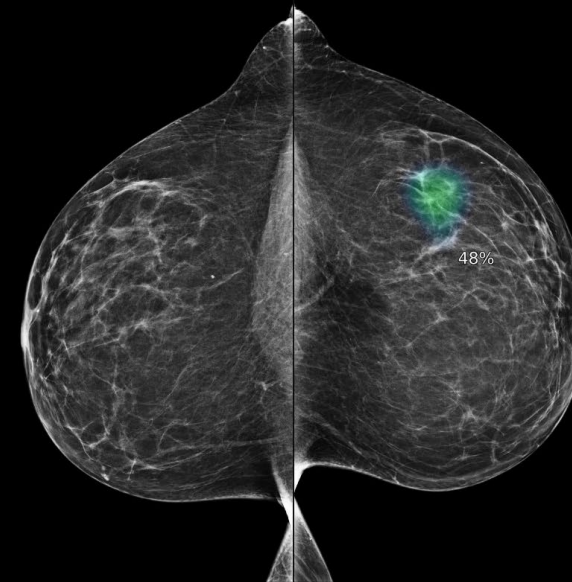
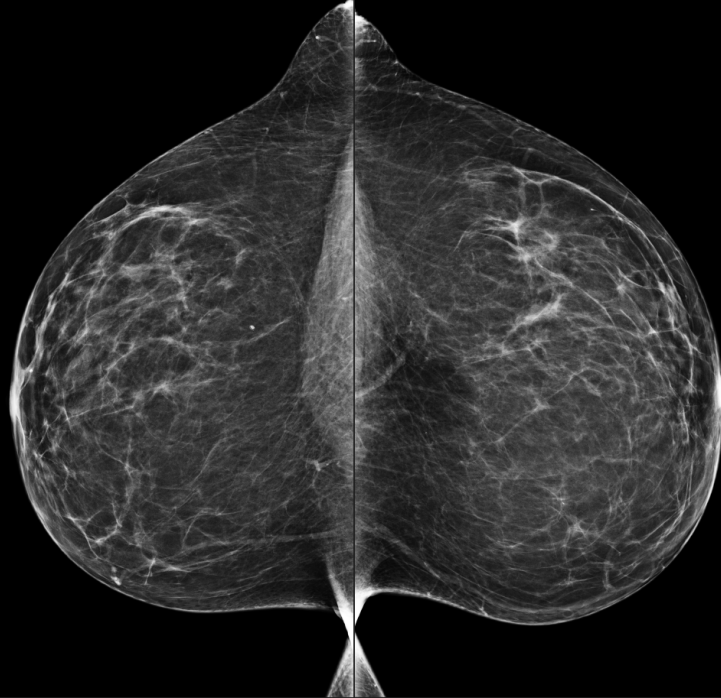
4 jaar eerder



♀ 63 jaar asymptomatisch

RCC

LCC



RMLO

LMLO  
150px



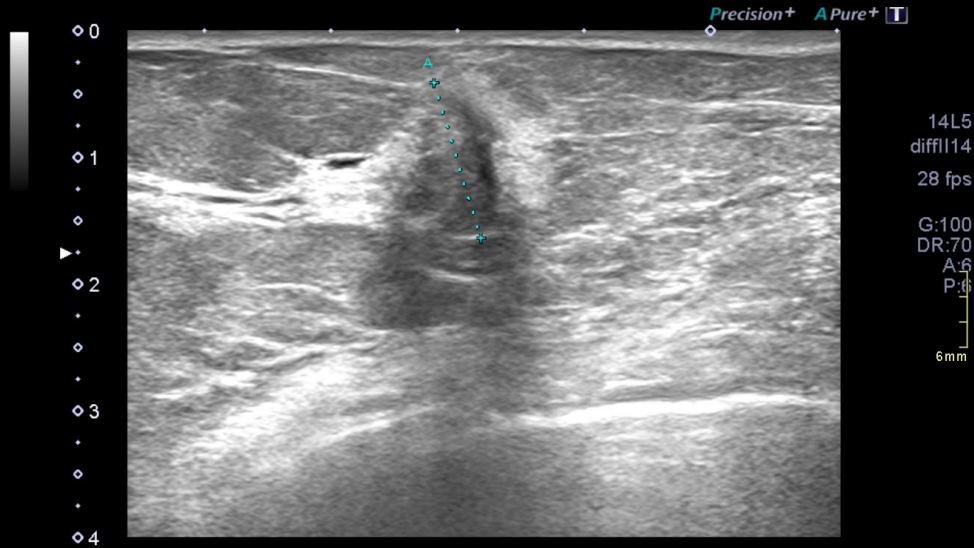
ABNORMALITY SCORE

R Low / L 76%

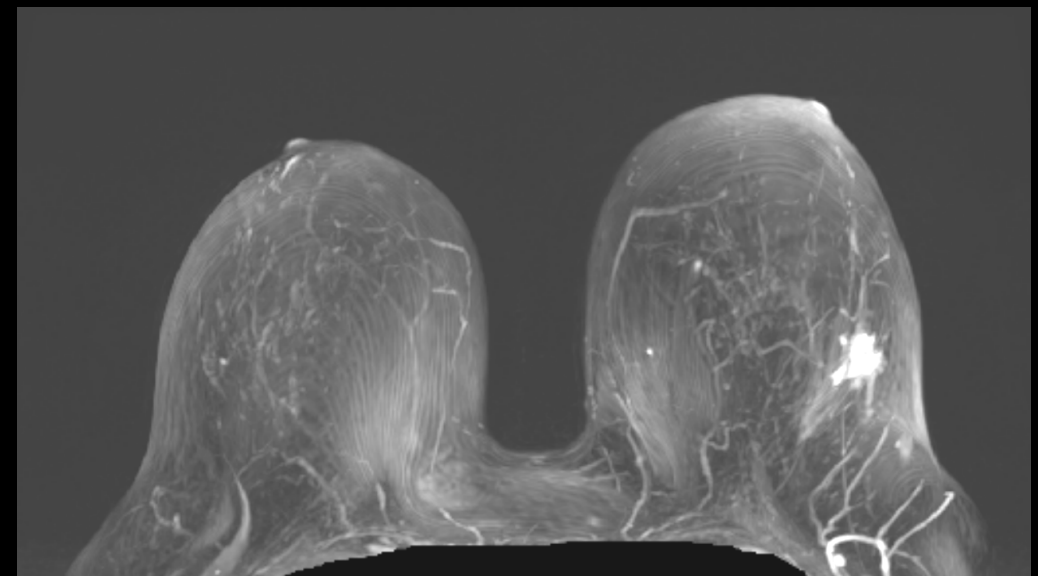
COMPOSITION CATEGORY

A Almost Entirely Fatty (2 of 10)

♀ 63 jaar asymptomatisch



2u 3u Perifeer Links I



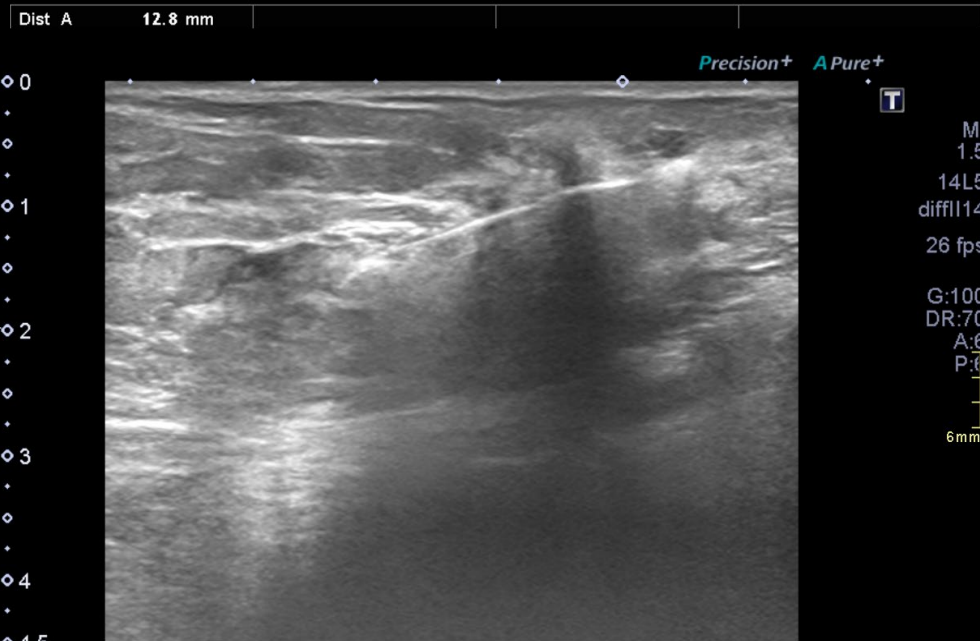
**BESLUIT:**

**SPECIMEN: Tumorectomie links +sentinel + recoupe naar anterior**

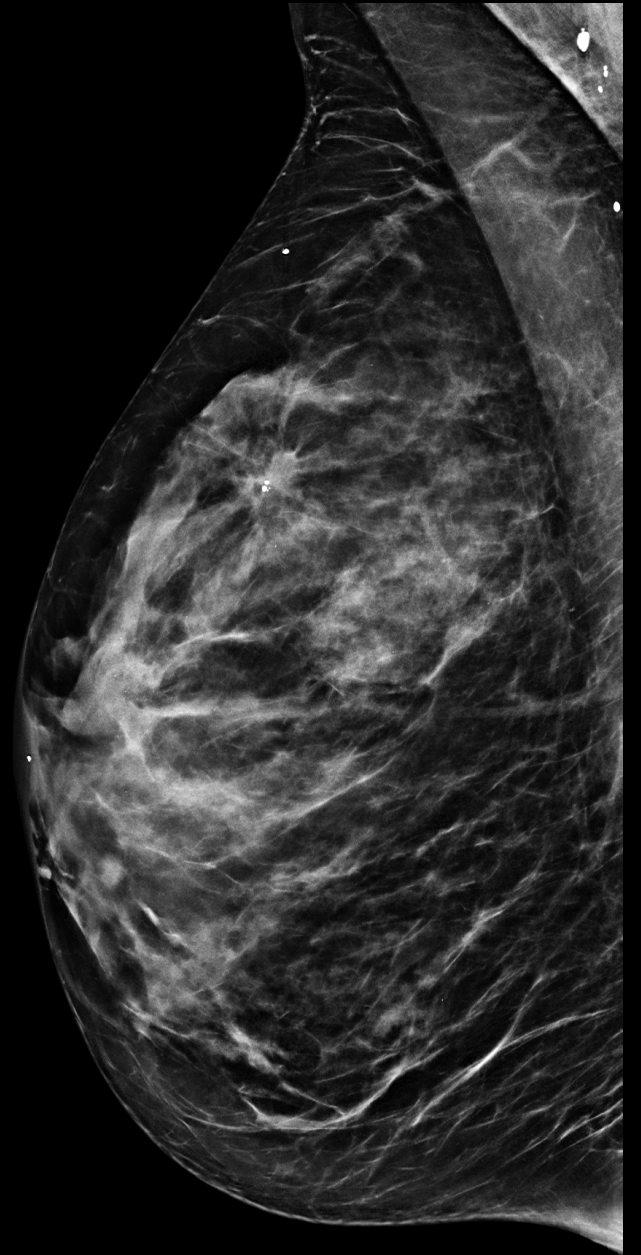
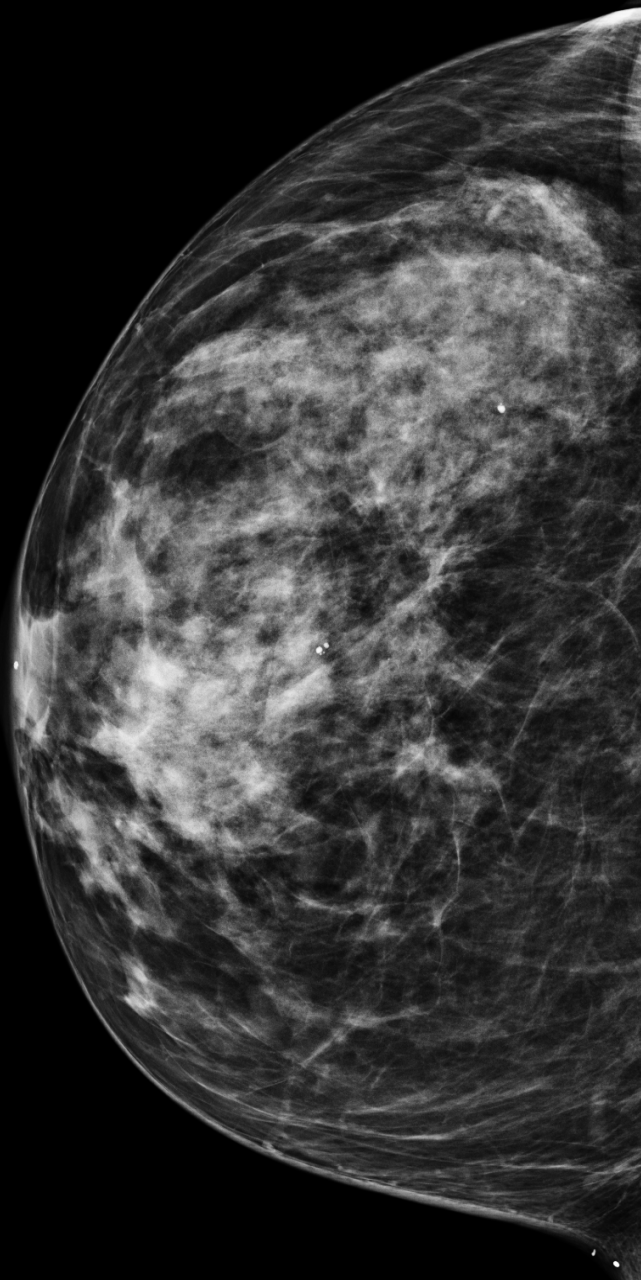
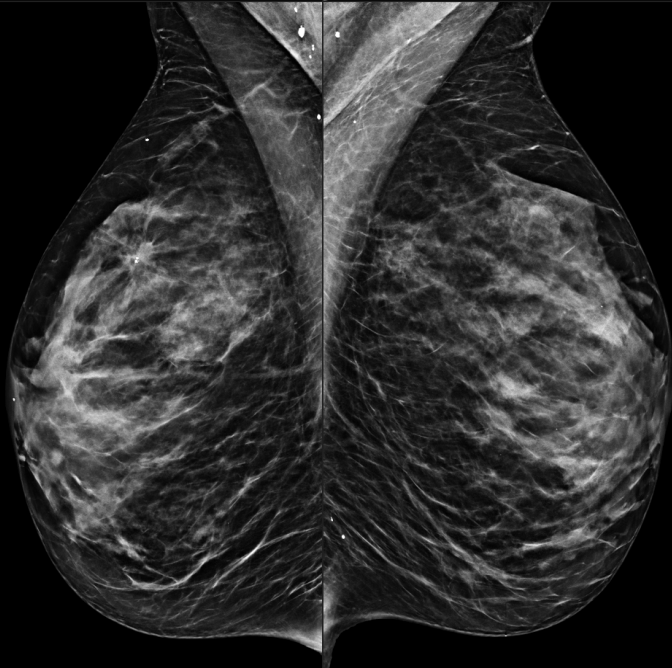
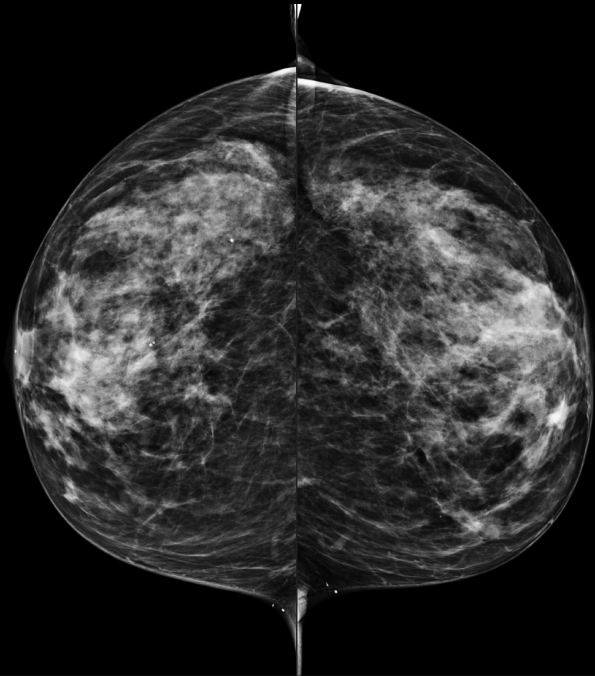
Tumor:	Invasief lobulair carcinoom
Differentiatiegraad:	Graad 2
Afmeting tumor:	Doormeter van 1,4 cm
Kenmerken tumor:	Ki-67 :30 % MAI: 5 Stromale TIL's: 5 % Aanwezigheid van enkele harde LCIS Geen lymfovasculaire permeatie. Geen perineurale invasie
Resectiestatus:	R0: geen residueel tumorweefsel De definitieve snijranden van de recoupe naar anterior zijn tumorvrij
Sentinel node:	N= 2 lymfeklieren. Sentinelprocedure: in een van de lymfeklieren micrometastase van 0,29 mm

**TNM PATHOLOGISCHE STAGERING (editie 8):**

Linkerborst: p T1c N1(SN)mi L0 Pn0 G2 R0



2u 3u Perifeer Links



♀ 57 jaar VG TE + RT RUOQ

LCC

age available for analysis

No LCC image available for analysis

LMLC  
150px

EndReport  
III 2D

150px

#1  
#00

42%

91%

70 M

BNORMALITY SCORE

R 91% / L Low

R 70

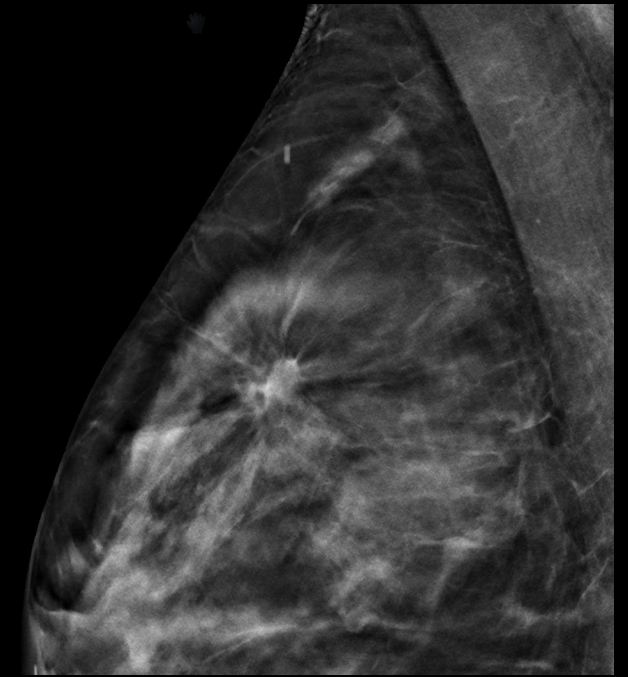
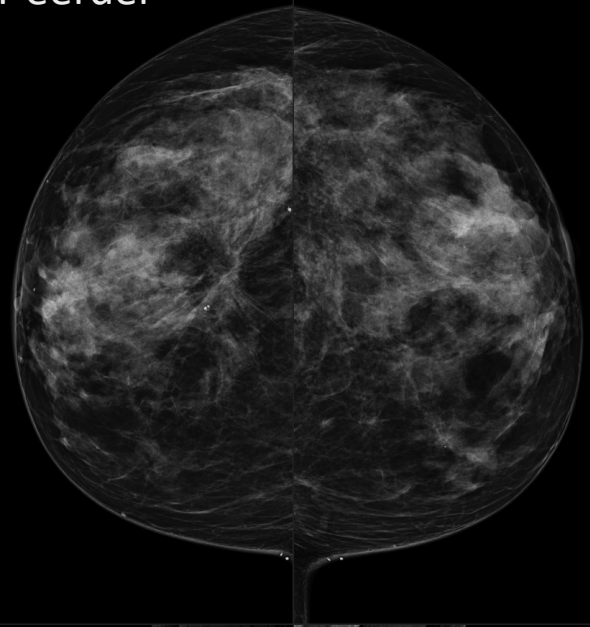
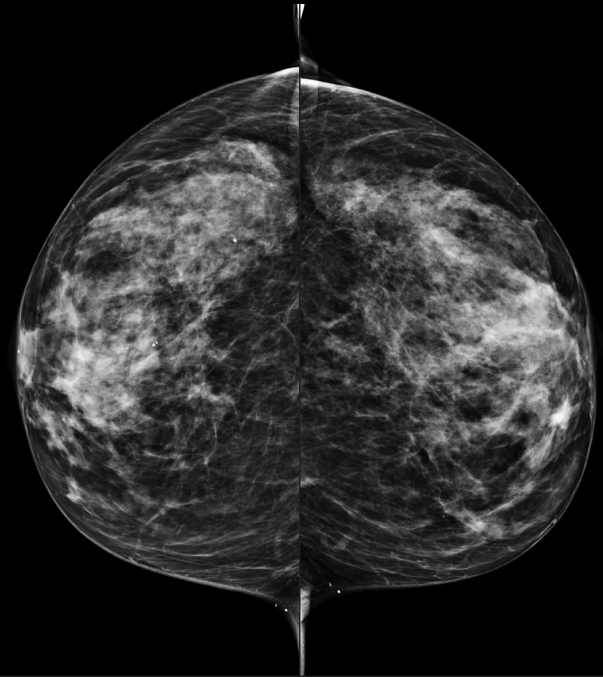
L Low

COMPOSITION CATEGORY

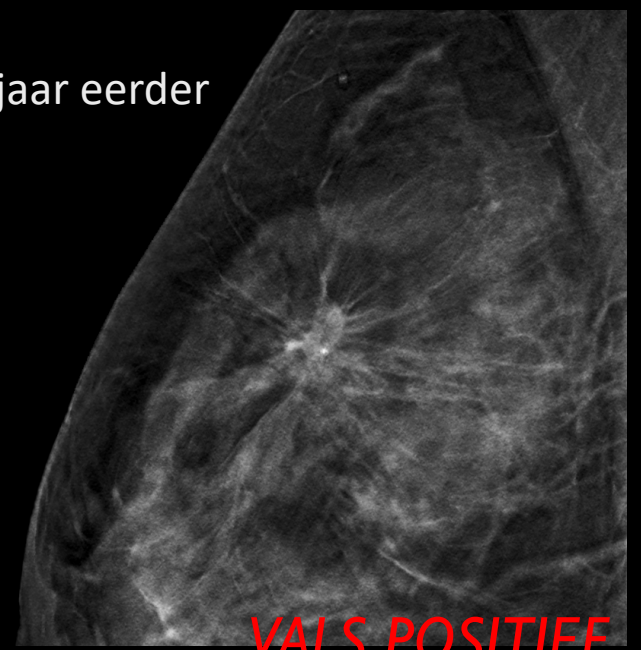
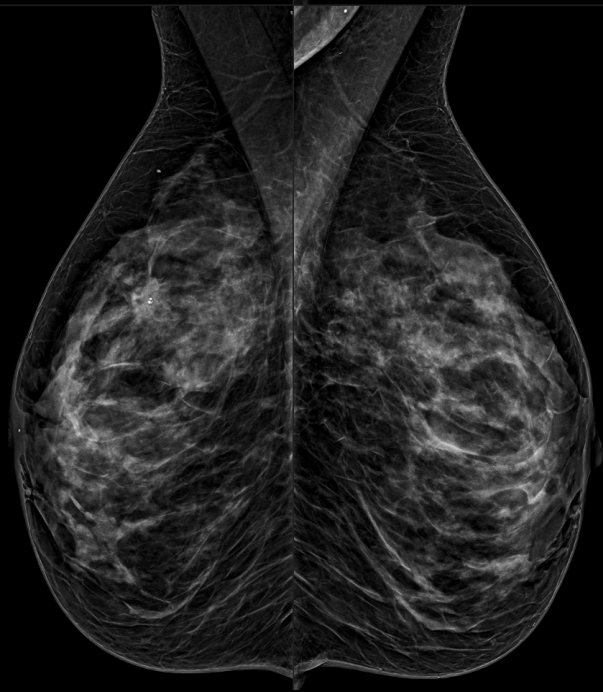
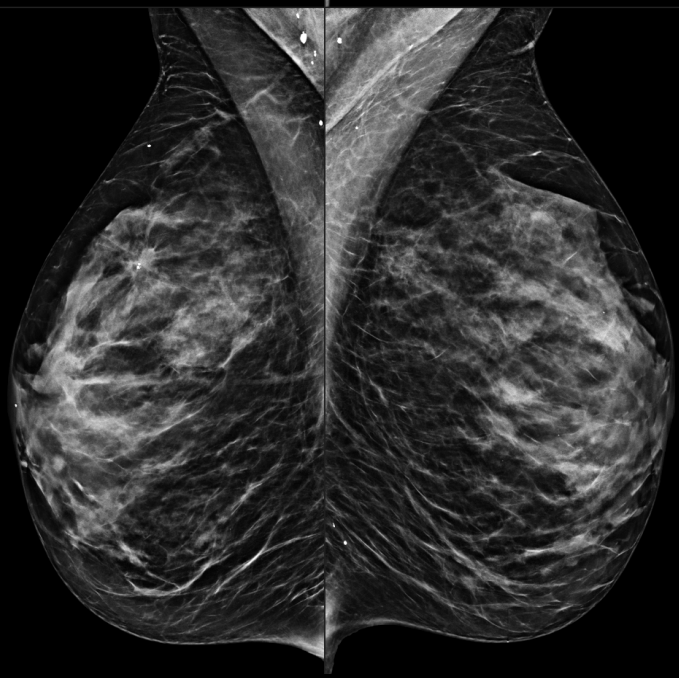
C Heterogeneously Dense (7 of 10)

♀ 57 jaar VG TE + RT RUOQ

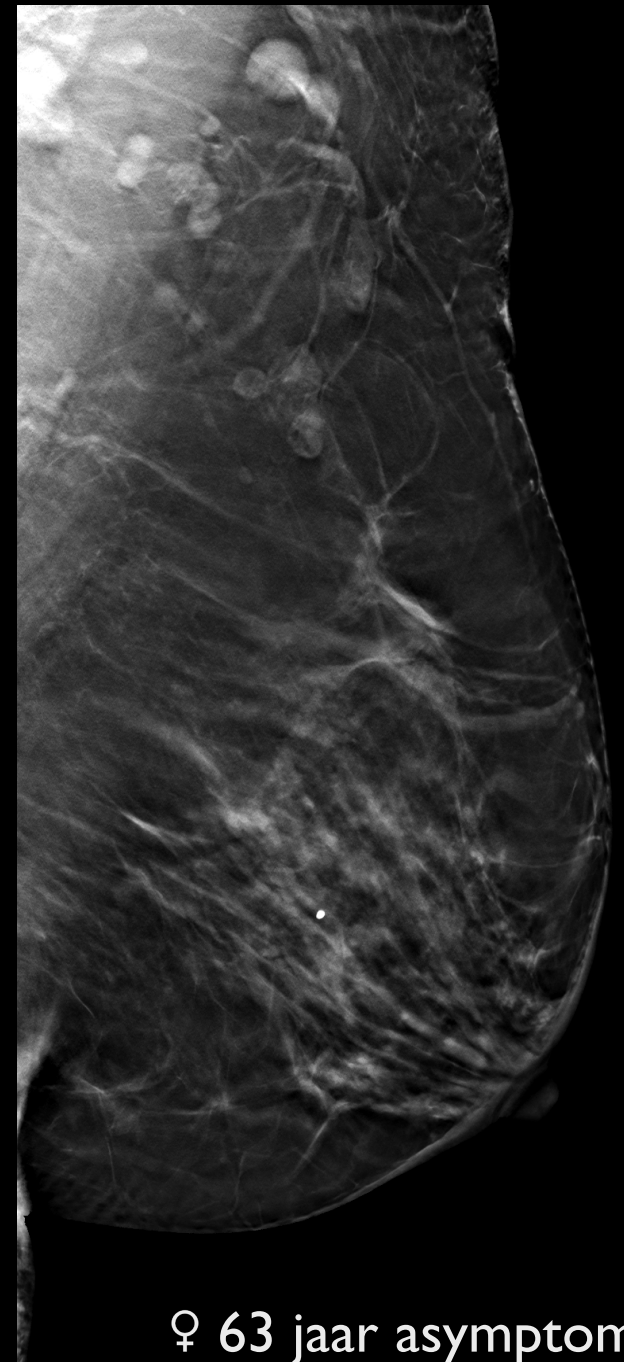
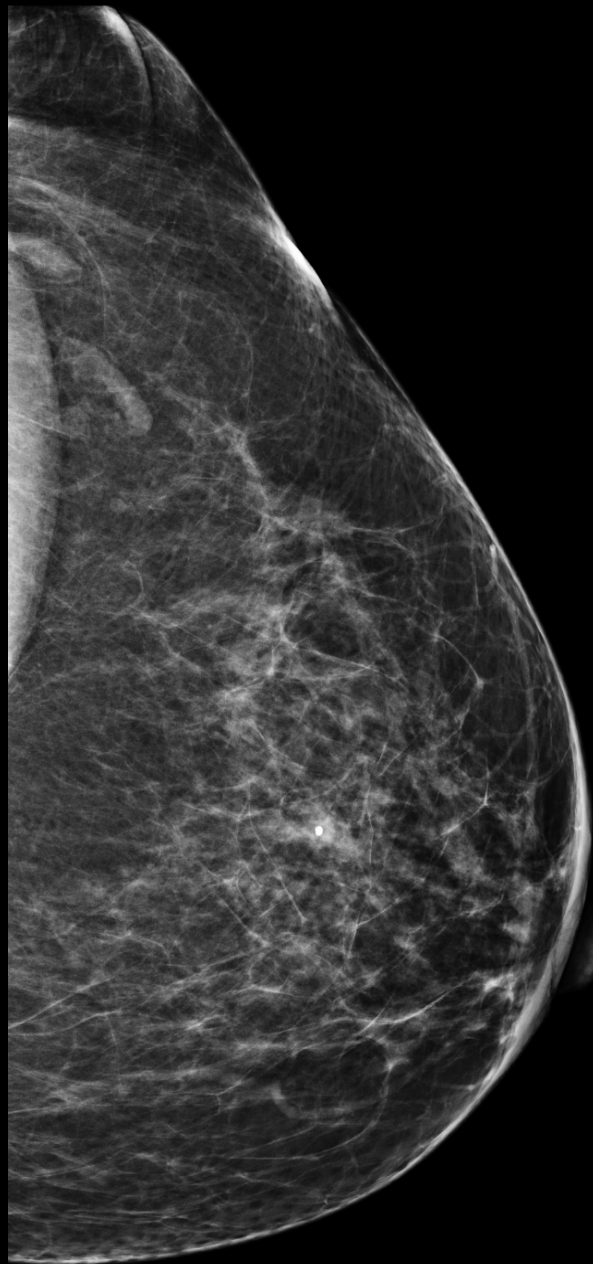
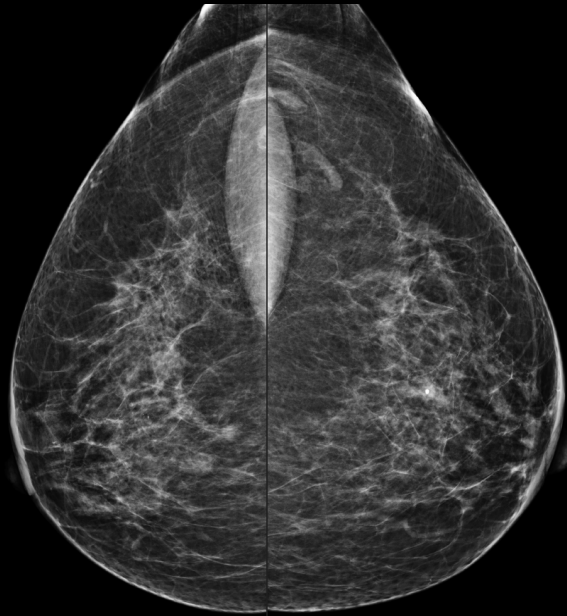
5 jaar eerder



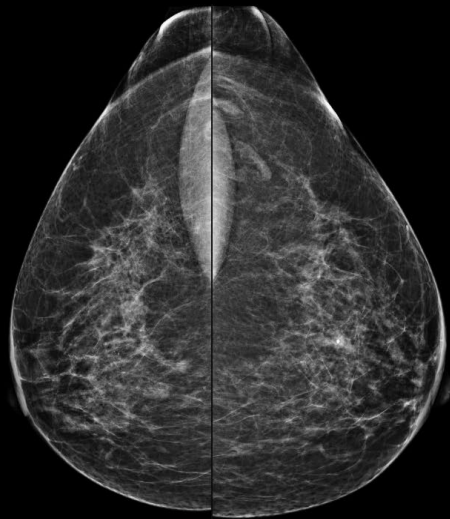
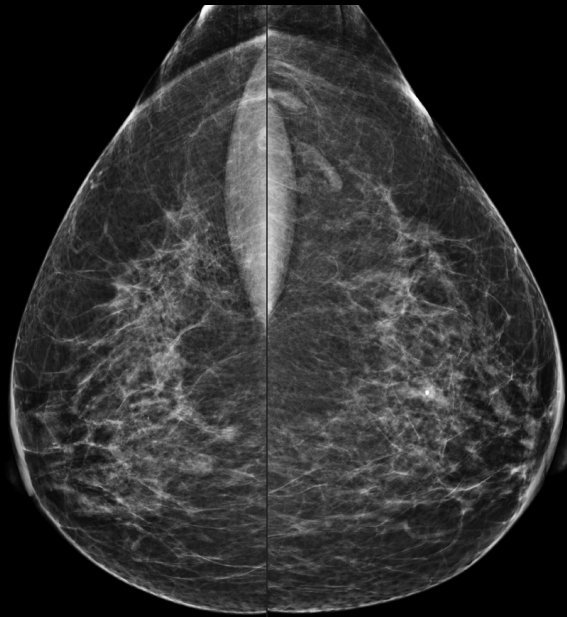
5 jaar eerder



**VALS POSITIEF**



♀ 63 jaar asymptomatisch



LCC

Image available for analysis

No LCC image available for analysis



LMLC  
150px

III 2D



150px

#SL / Score  
#1  
#B4

BI-RADS CATEGORY

R Low / L Low

BI-RADS CATEGORY

B Scattered Fibroglandular Densities (3 of 10)

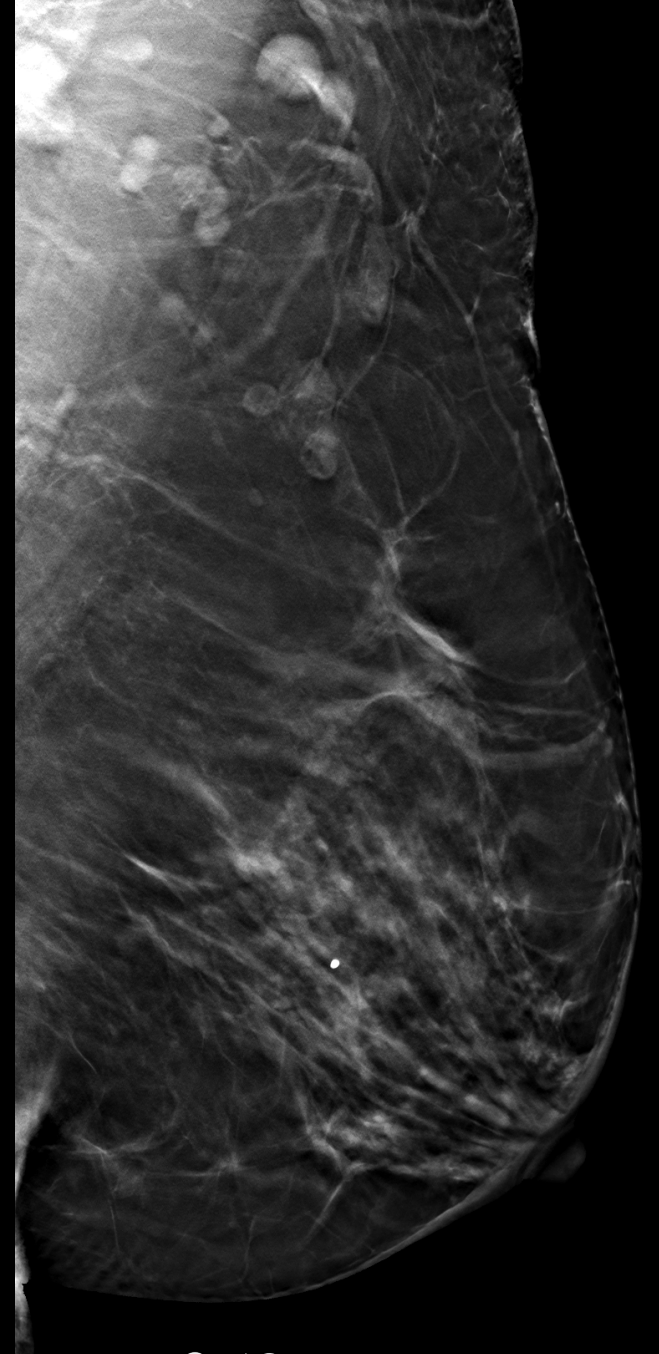
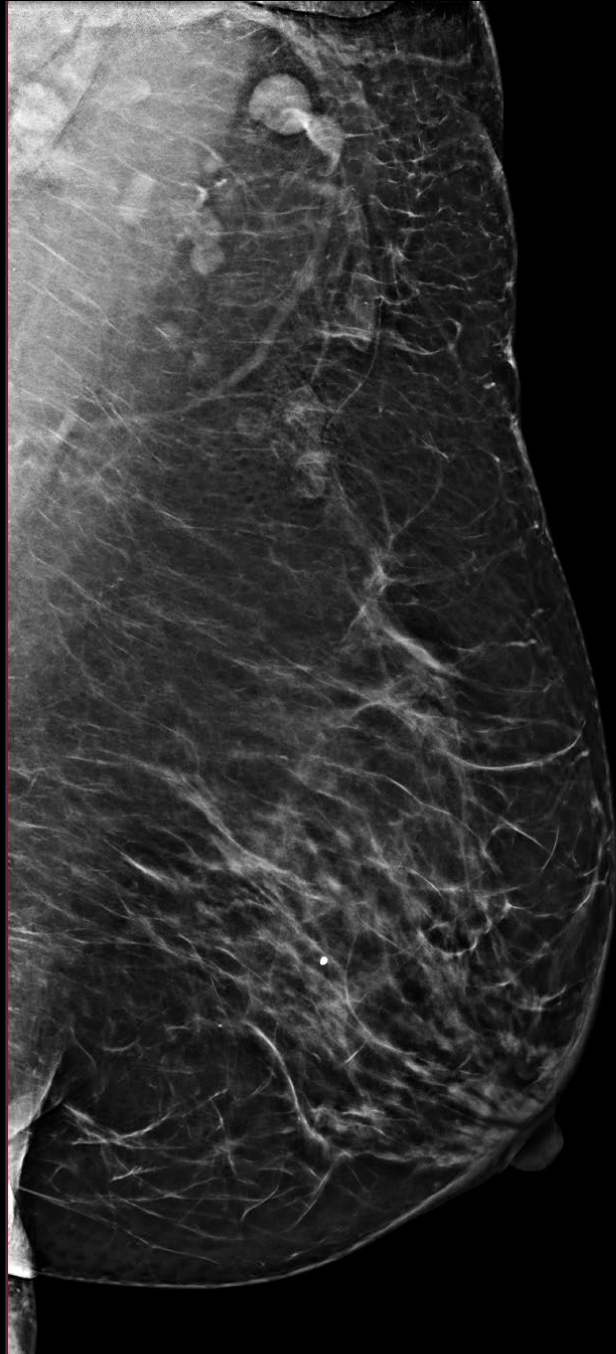
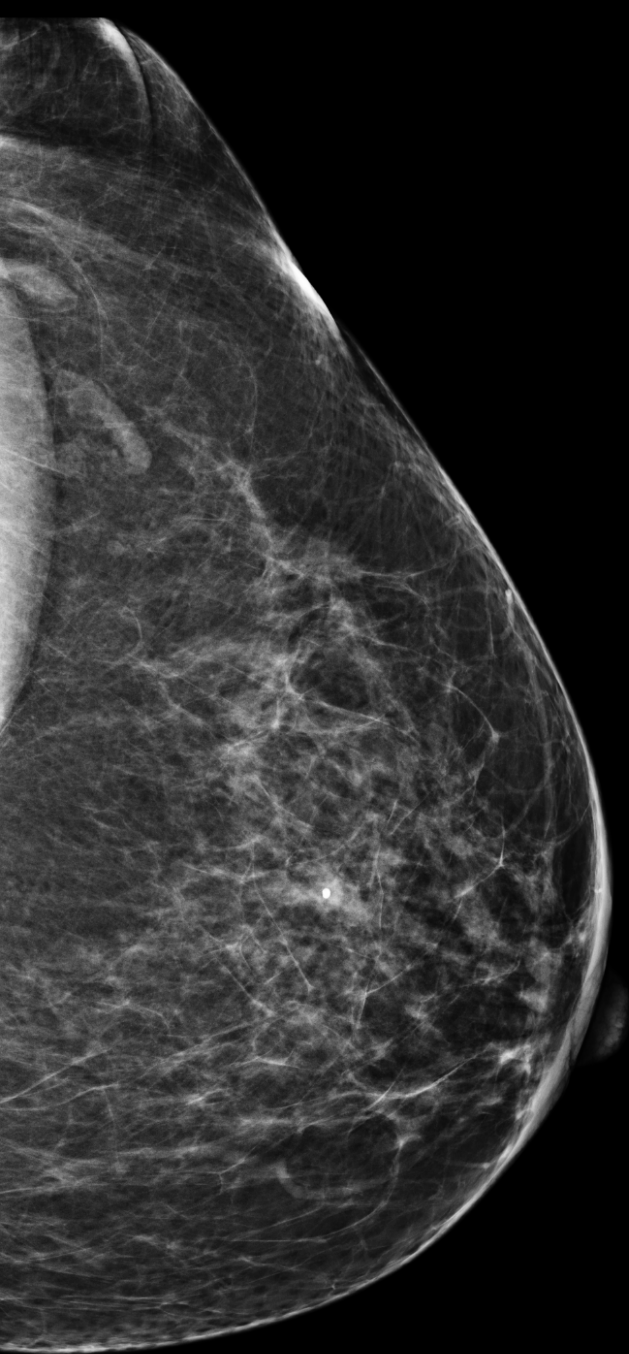
R Low

L Low

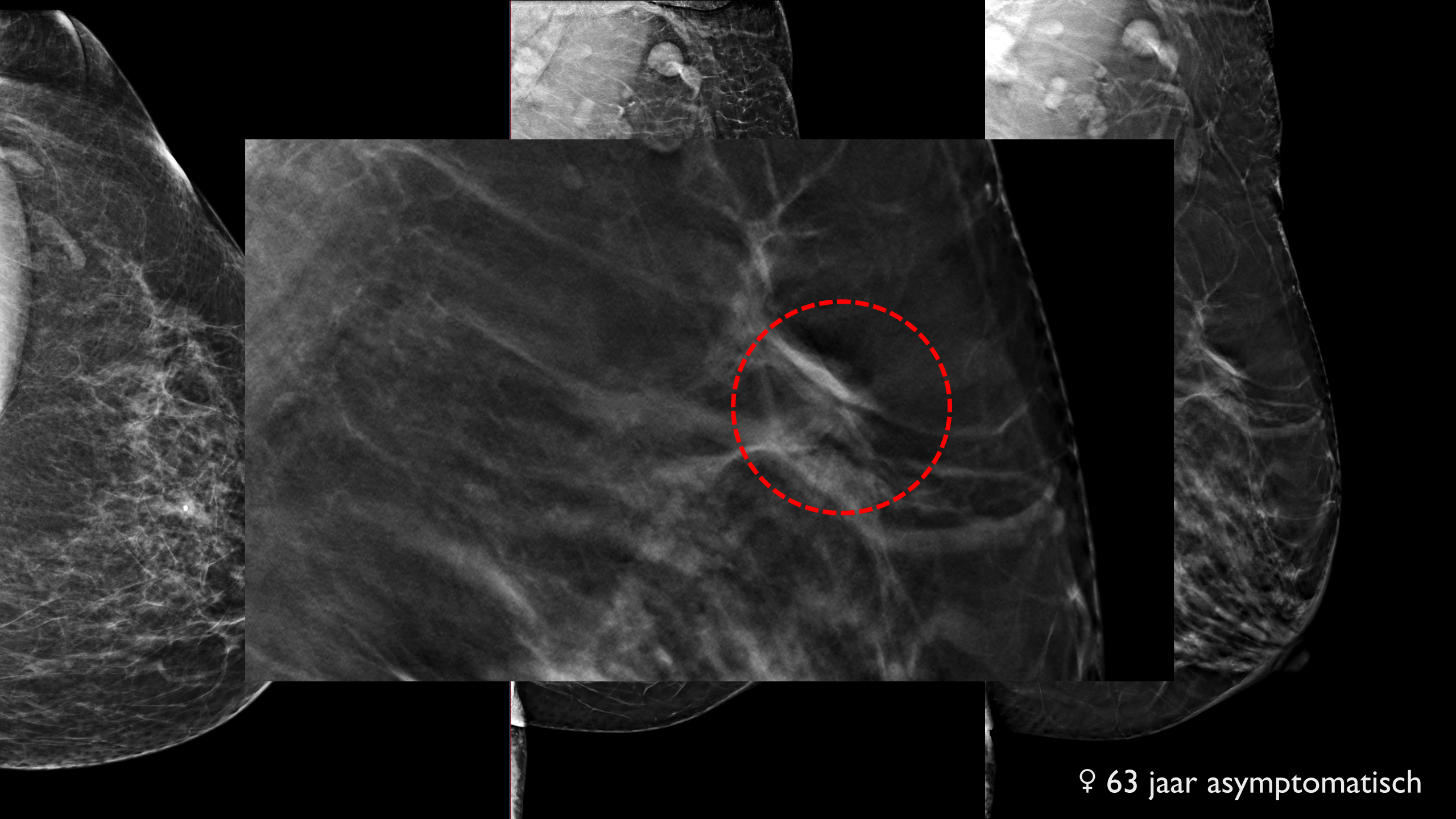
CAUTION:  
Not for clinical use.

♀ 63 jaar asymptomatisch

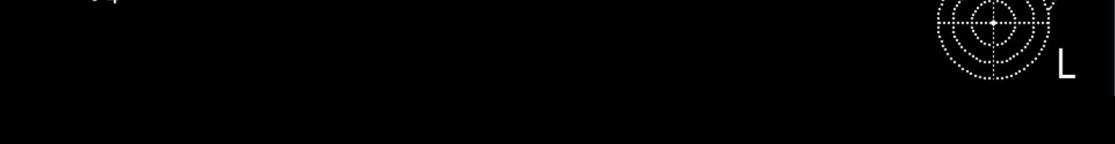
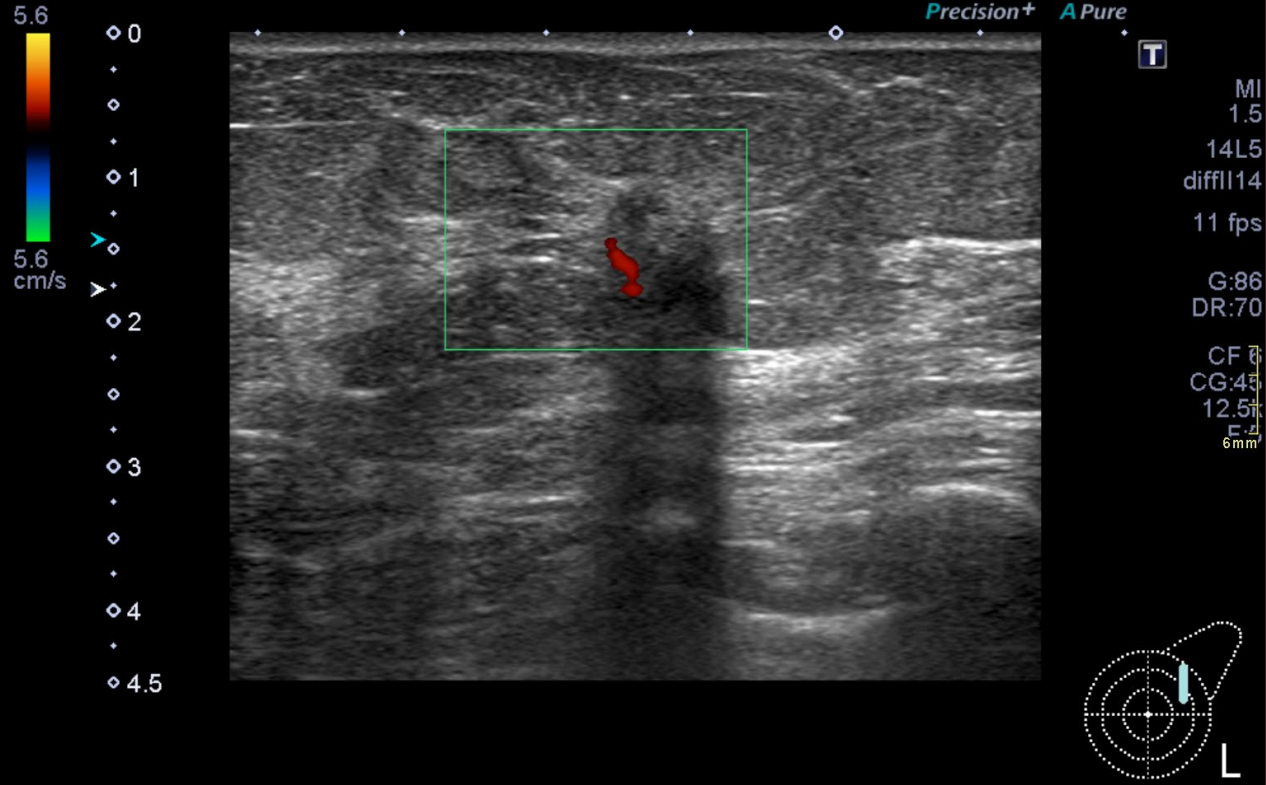
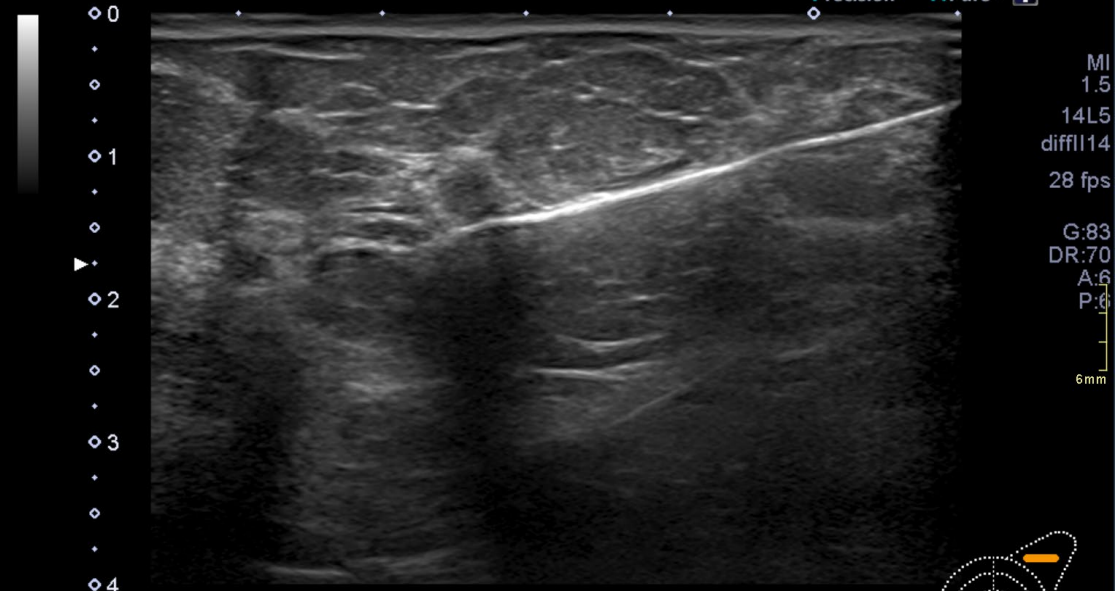
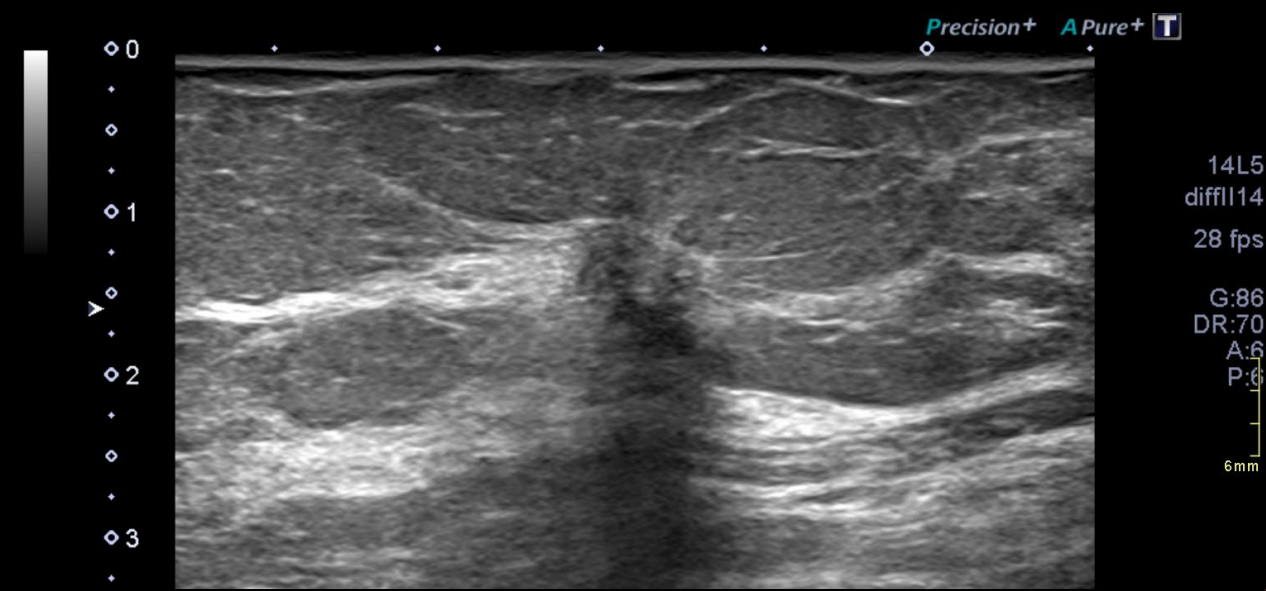




♀ 63 jaar asymptomatisch



♀ 63 jaar asymptomatisch



**BESLUIT:**

**SPECIMEN:** Tumorectomie linkerborst, recoupe 3 uur

Tumor:	Invasief carcinoom, NST (ductaal)
Differentiatiegraad:	Graad 1
Afmeting tumor:	Doormeter van 12 mm
Kenmerken tumor:	KI-67: 5 % MAI: 2 Stromale TIL's: minder dan 5 % Enkele kleinere haarden cribriform DCIS, lage maligniteitsgraad. Binnen de contouren van de invasieve component Geen lymfovasculaire permeatie. Geen perineurale invasie
Resectiestatus:	R0: geen residueel tumorweefsel 1 mm is de minimale tumorvrije marge naar 3 uur ter hoogte van tumorectomie De definitieve snijranden van de recoupe op 3 uur zijn tumorvrij
Sentinel node:	N= 2 tumorvrije lymfeklieren. Sentinelprocedure: bevestigt de diagnose

**TNM PATHOLOGISCHE STAGERING (editie 8):**  
Linkerborst: p T1c N0(SN) L0 Pn0 G1 R0

**VALS NEGATIEF**

# AI in de praktijk

- AI heat-map wordt niet geüpload naar de PACS
  - Gezien vals positieve en vals negatieve resultaten
  - Wordt geïnterpreteerd door de radioloog

Geachte collega,

**Bevindingen mammo:**

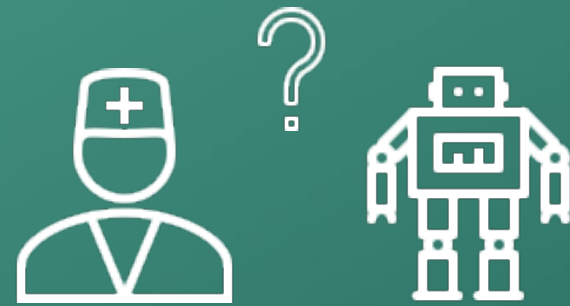
Het onderzoek werd uitgevoerd op een full-field digitaal mammografiesysteem.

Er werden 3D-tomosynthesebeelden gerealiseerd en de beelden werden geëvalueerd op een workstation.

De beelden werden bijkomend geanalyseerd door AI-software en de bevindingen werden gevalideerd door ondertekenende radioloog.

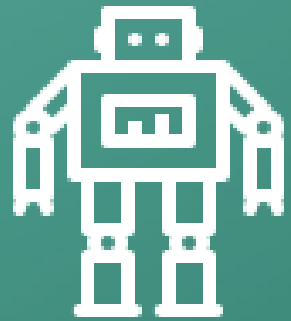
- Medicolegaal nog geen specifieke Belgische wetgeving

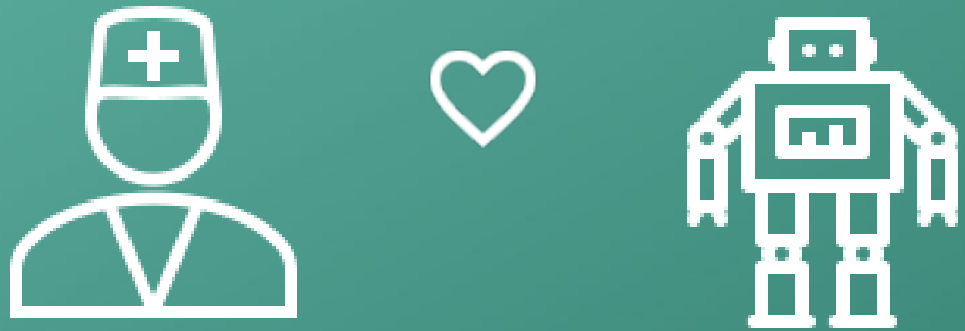
- I. Waarom überhaupt AI?
- II. Wat zegt de literatuur over AI?
- III. AI in de praktijk
- IV. AI in de toekomst



# AI in de toekomst

- Double reading + AI
  - *In de toekomst AI als tweede lezer?*
  - *Triage door AI voor nood aan tweede lezer?*
- AI nu vooral voor detectie en diagnose MG
  - AI voor andere modaliteiten
    - *MRI?*
    - *US?*
  - AI voor risicostratificatie / gepersonaliseerde screening







# AI in de pathologie

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Balans tussen innovatie en ethiek

**Glenn Broeckx**

PA<sup>2</sup>, GZA-ZNA Ziekenhuizen (ZAS)

- Borst en gynaecopatholoog, MD
- Bioinformaticus, Bsc
- PhD-student

# Disclosures

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AstraZeneca: congress support, paid consultancies, research sponsoring

IBEX: research sponsoring, congress support

Imagene: congress support

Johnson and Johnson: paid consultancies, research sponsoring

Merck Sharp & Dome (MSD): speaker's fees, paid consultancies, advisory boards

Novartis: paid consultancies, speaker's fees

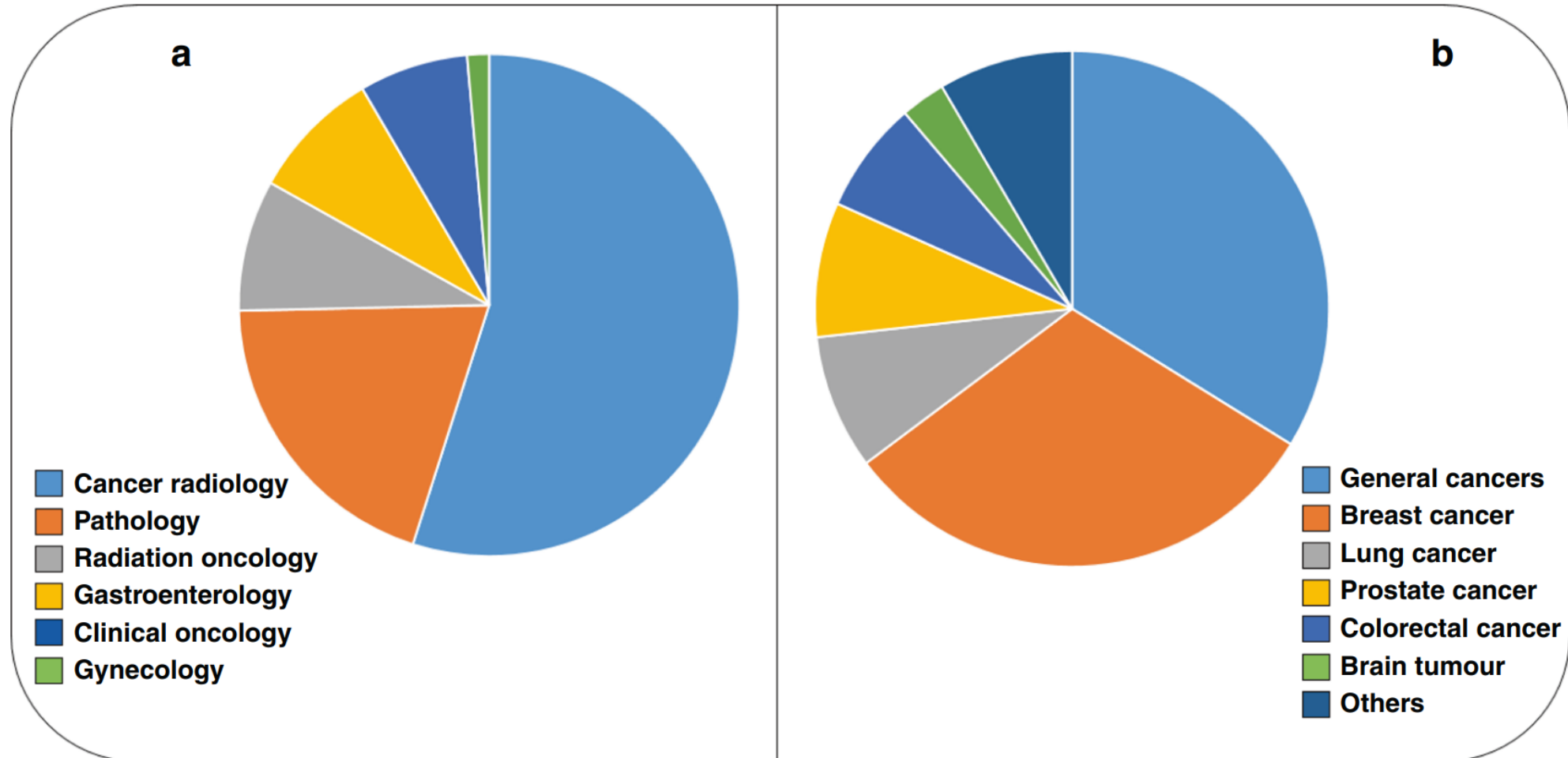
Owkin: research sponsoring

Roche (Dx and Phx): congress support, advisory boards, paid consultancies

Geen AI tool gebruikt bij het maken van deze presentatie.



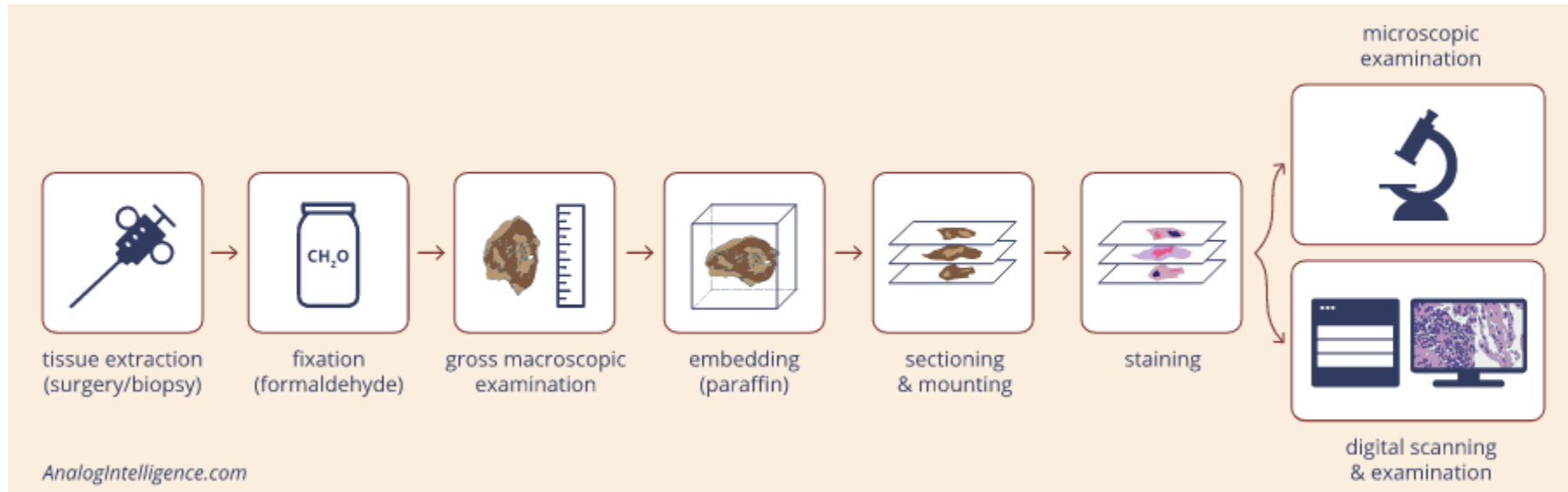
# Overzicht van AI in oncologie



## References:

1. Luchini, C., Pea, A. & Scarpa, A. Artificial intelligence in oncology: current applications and future perspectives. Br J Cancer 126, 4–9 (2022). <https://doi.org/10.1038/s41416-021-01633-1>

# Workflow pathologie labo



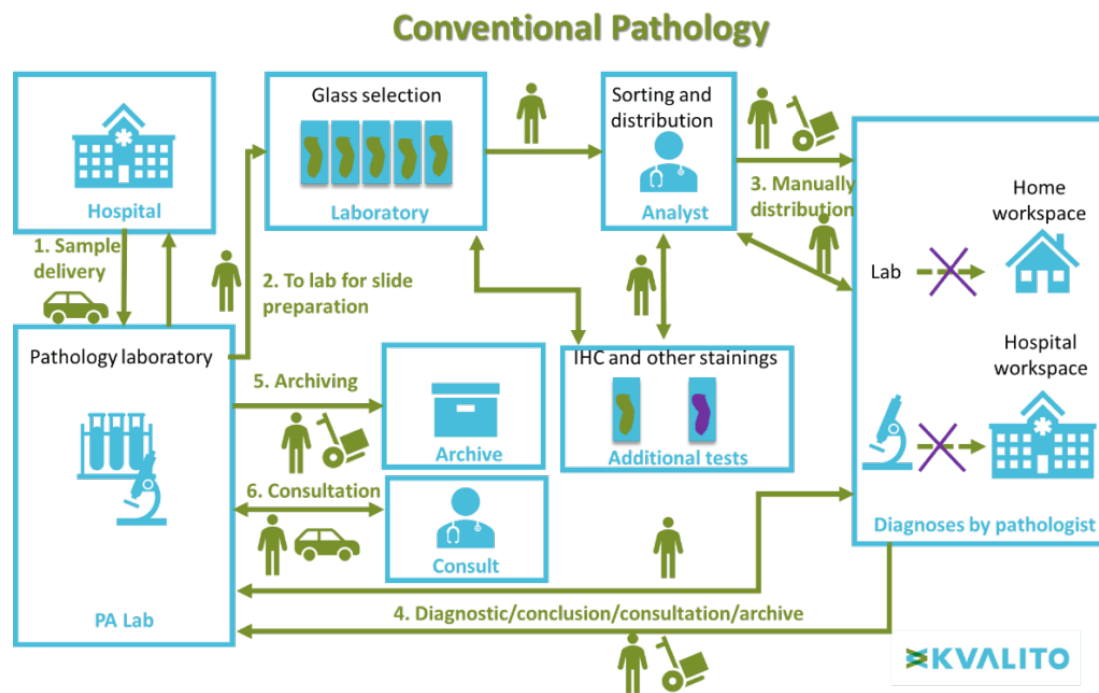
#### References:

1. Afbeelding van analogintelligence.com

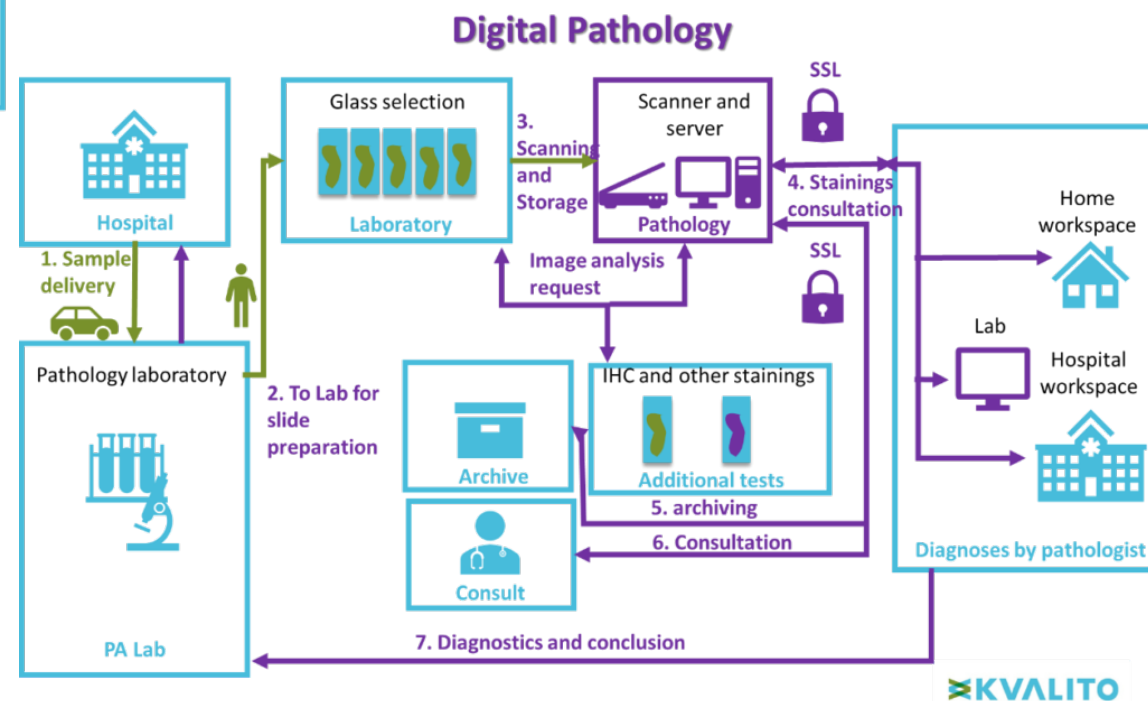
# Zicht op de patholoog



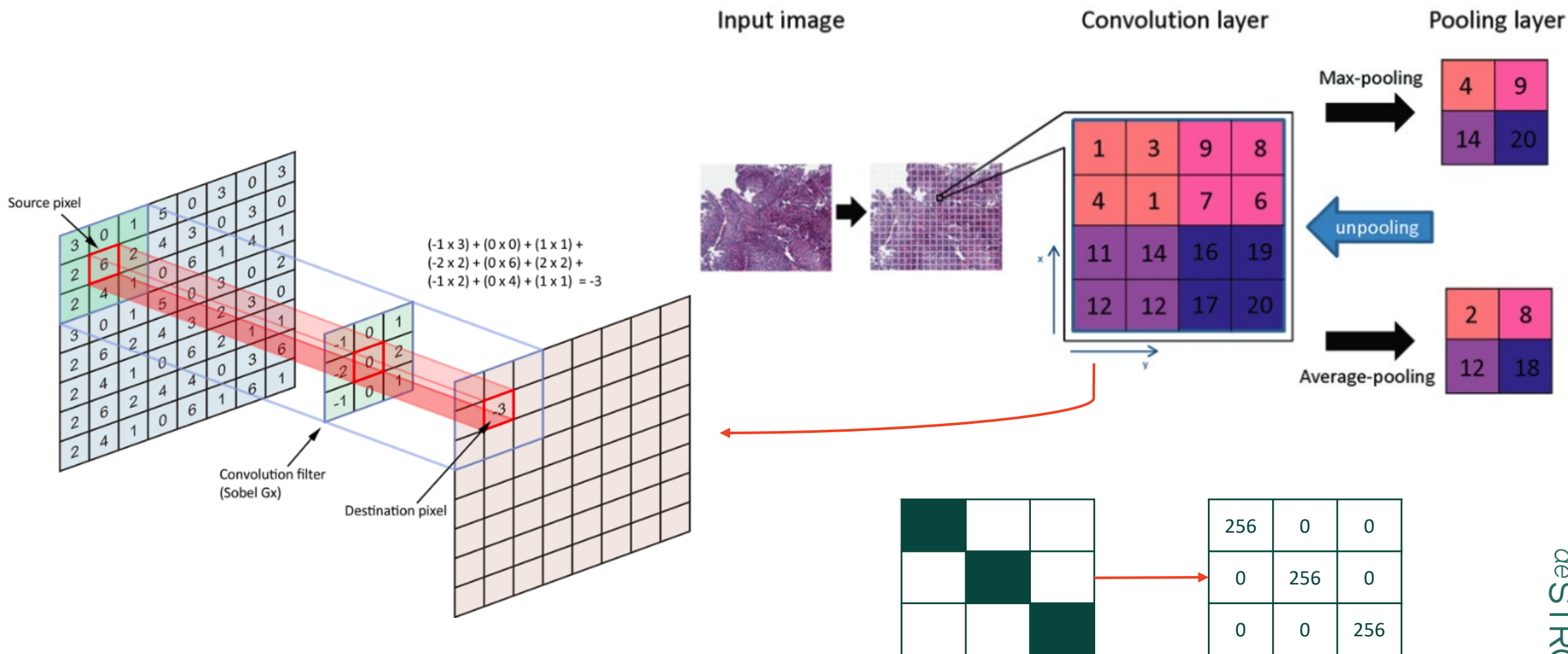
# Impact van digitale pathologie op de workflow



- Extra scan stap
- Minder fysieke stappen
- Sneller en gemakkelijker toegang tot coupes

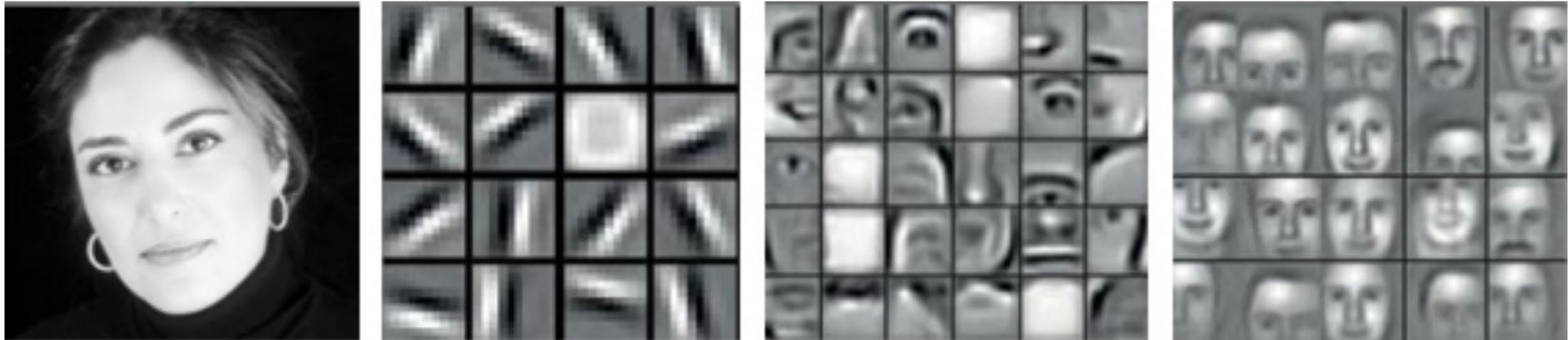


# Convolutie en pooling (nD)



# Deep learning feature extraction

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## References:

1. Prayuda AJD. The evolution of computer vision techniques on face detection, part 2. Published in Nodeflux on Medium 2018; <https://medium.com/nodeflux/the-evolution-of-computer-vision-techniques-on-face-detection-part-2-4a3b22d7c2>



# AI optische illusies (1)



#### References:

1. Prayuda AJD. The evolution of computer vision techniques on face detection, part 2. Published in Nodeflux on Medium 2018; <https://medium.com/nodeflux/the-evolution-of-computer-vision-techniques-on-face-detection-part-2-4a3b22df7c2>

# AI optische illusies (2)



## References:

1. Gaudenz Boesch. What's the difference between Machine Learning and Deep Learning? Published on Viso.ai; <https://viso.ai/deep-learning/deep-learning-vs-machine-learning/>

# AI optische illusies (3)



# AI optische illusies (4)



References:

1. <https://www.npr.org/sections/the-salt/2016/03/11/470084215/canine-or-cuisine-this-photo-meme-is-fetching>

# Al optische illusies (5)



References:

1. [https://www.boredpanda.com/blog/wp-content/uploads/2016/03/dog-food-comparison-bagel-muffin-lookalike-teenybiscuit-karen-zack\\_700.jpg](https://www.boredpanda.com/blog/wp-content/uploads/2016/03/dog-food-comparison-bagel-muffin-lookalike-teenybiscuit-karen-zack_700.jpg)

# Al optische illusies (6)



#### References:

1. <https://pbs.twimg.com/media/CdIm-TwUMAl-HLl.jpg>

# Commerciële software

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# Hologic Genius

**genius**  
REVIEW STATION

CANCEL TAGS... COMPLETE REVIEW

Approximate Cell Count: 12900    Imaged: 1/25/2023 2:57 AM    Algorithm Version: 1.0.16.0

Marked

Marked

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Marked

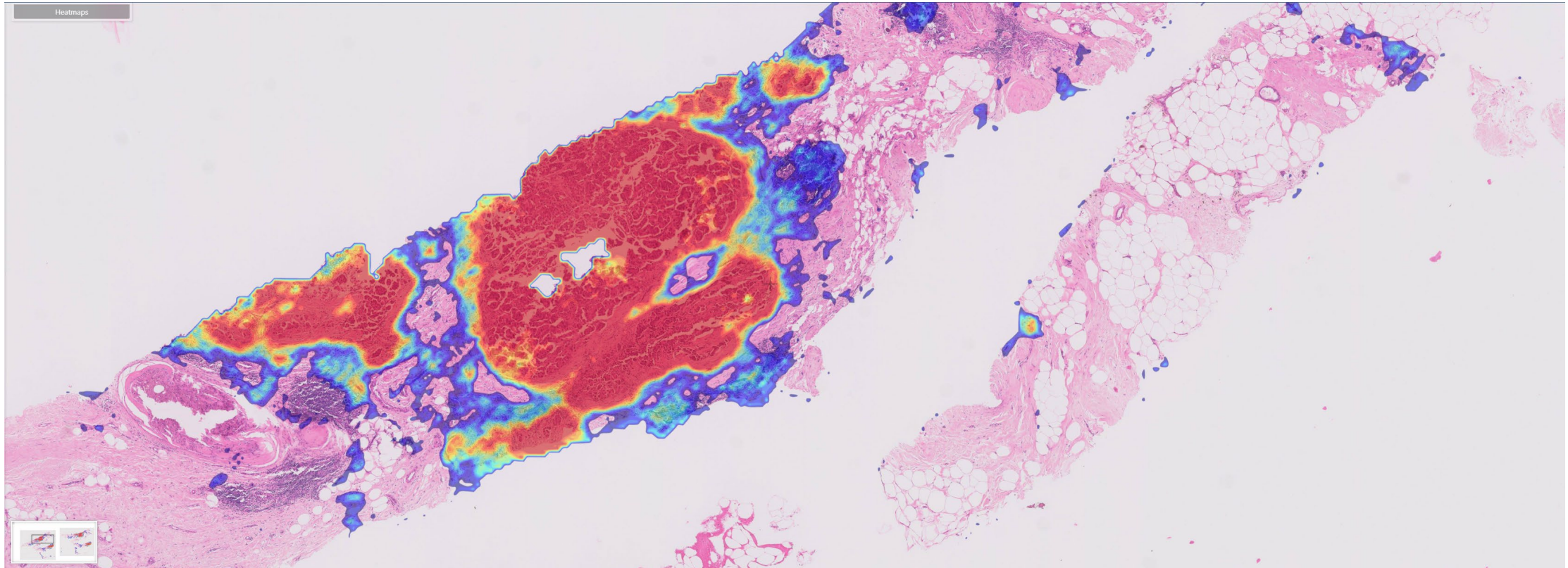
+ 5

Comments (1)





# IBEX Galen™ breast



References:  
1. IBEX

# Methoden eigen studie

## Sample retrieval

- 248 breast excisions ~ 2-3 H&E slides
- Retrospectively
- Pathology archives PA<sup>2</sup> Antwerp

## Ground truth

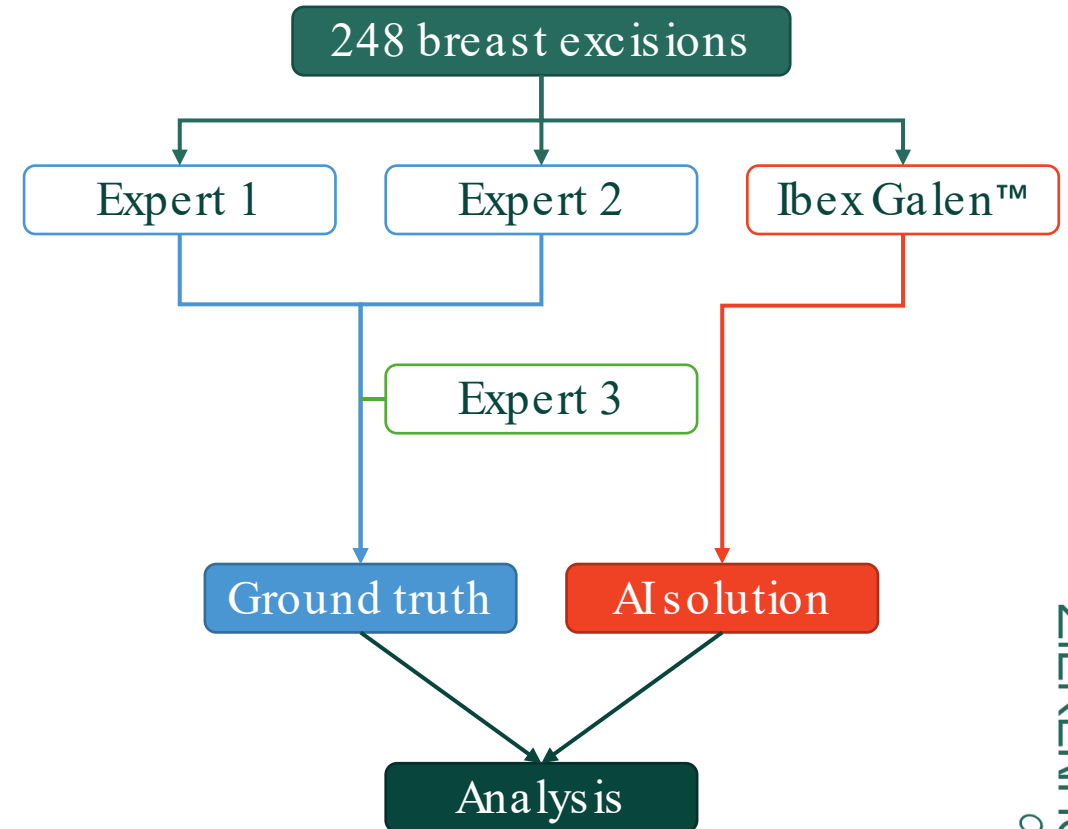
- Consensus 2 independent and blinded expert readers
- 3<sup>rd</sup> expert reader for discrepant cases

## Artificial Intelligence

- Ibex Galen™ platform
- Detection of invasive carcinoma and ductal carcinoma in situ
- Differentiation between invasive carcinoma subtypes
- Differentiation between DCIS grade

## Analysis

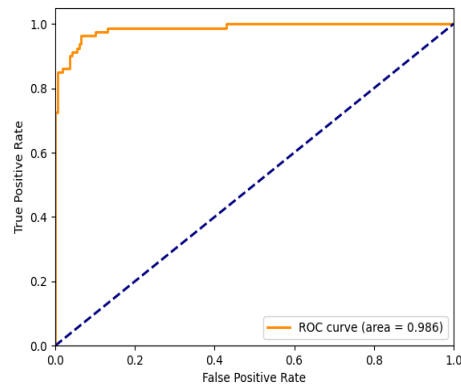
- Confusion matrices: accuracy, sensitivity, specificity
- Receiver of Operating Characteristics (ROC) curve: area under the curve (AUC)



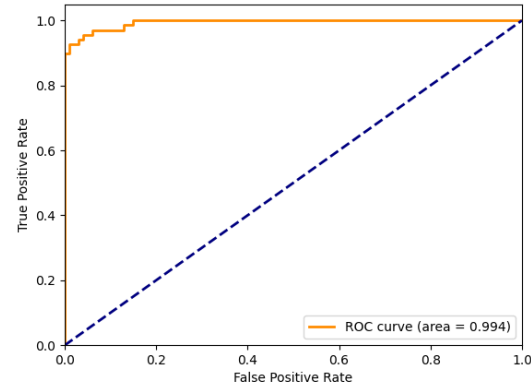
# Resultaten: primary endpoints

Analysis	AUC [95% CI]	Sensitivity	Specificity
Detection of invasive carcinoma	0.986 [0.973; 0.998]	89.9% [0.887; 0.996]	96.3% [0.840, 0.939]
Detection of DCIS	0.994 [0.987; 1.000]	95.6% [0.868, 0.995]	95.0% [0.882, 0.986]
Differentiation of subtypes	0.963 [0.922; 1.000]	85.3% [0.742, 0.927]	90.0% [0.541, 1]
Differentiation of DCIS grade	0.970 [0.931; 1.000]	90.2% [0.791, 0.964]	100.0% [0.561, 1]

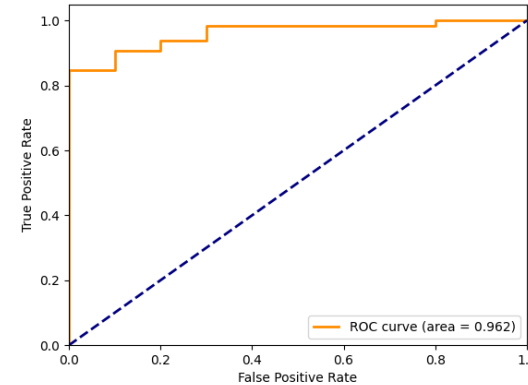
Invasive Cancer Detection



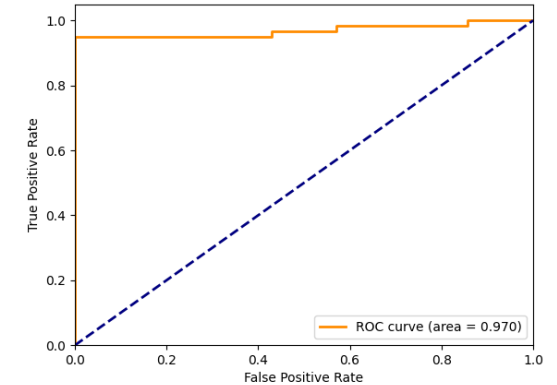
DCIS Detection



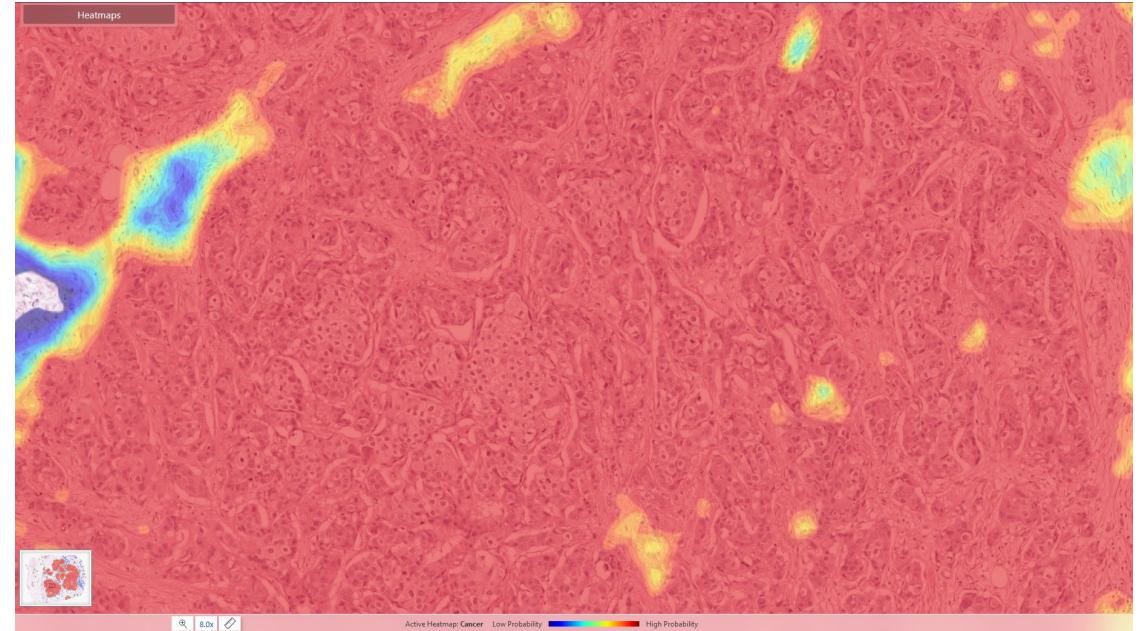
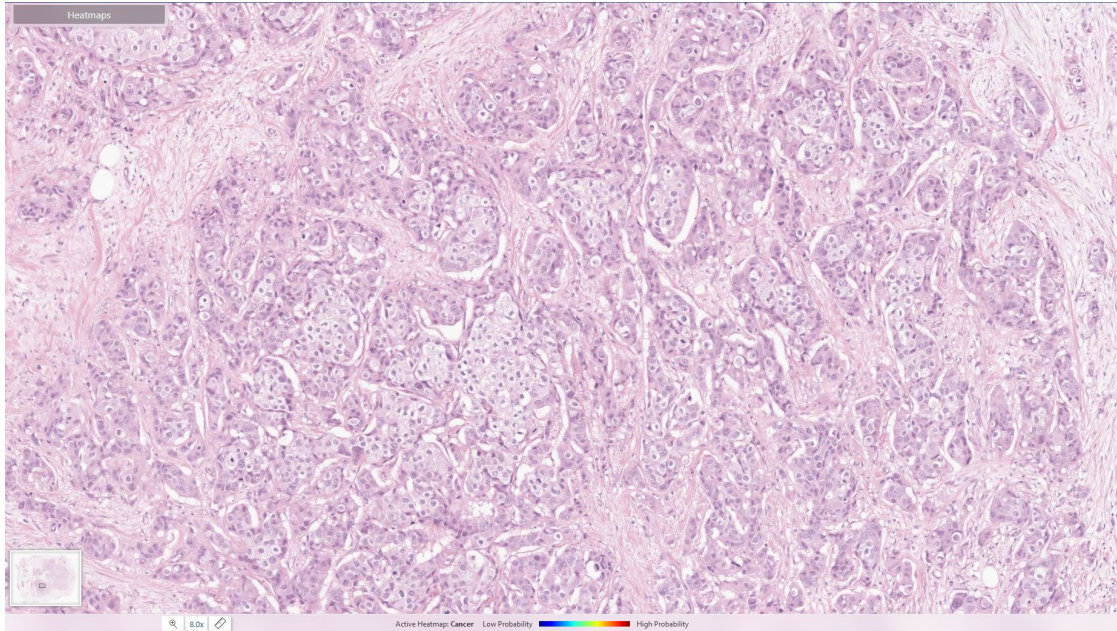
ILC vs IDC



DCIS LG vs HG

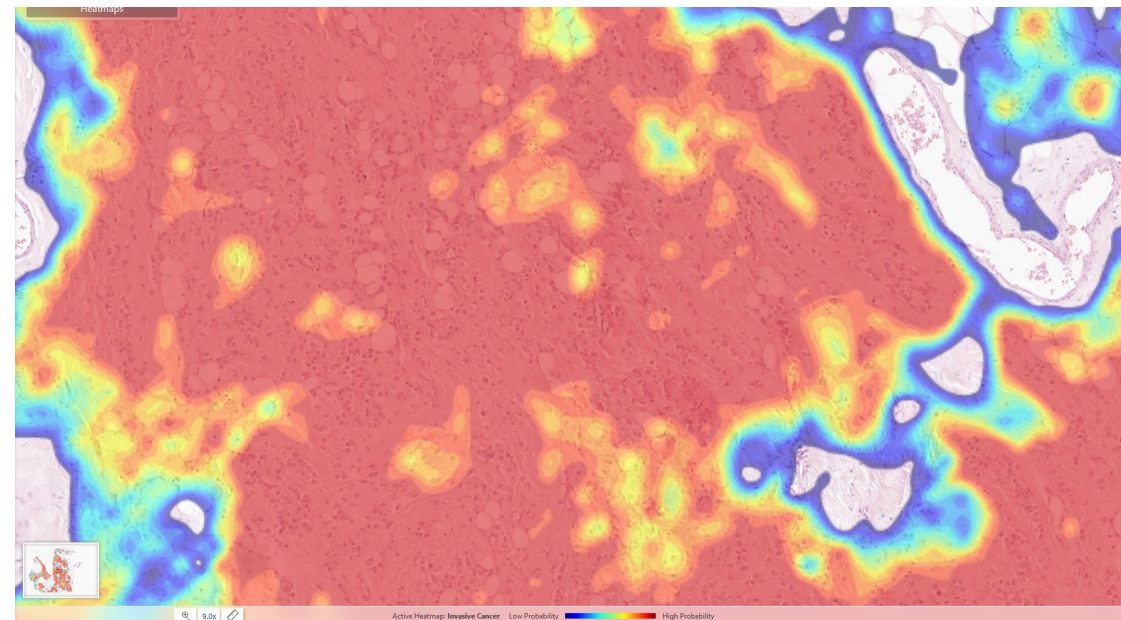
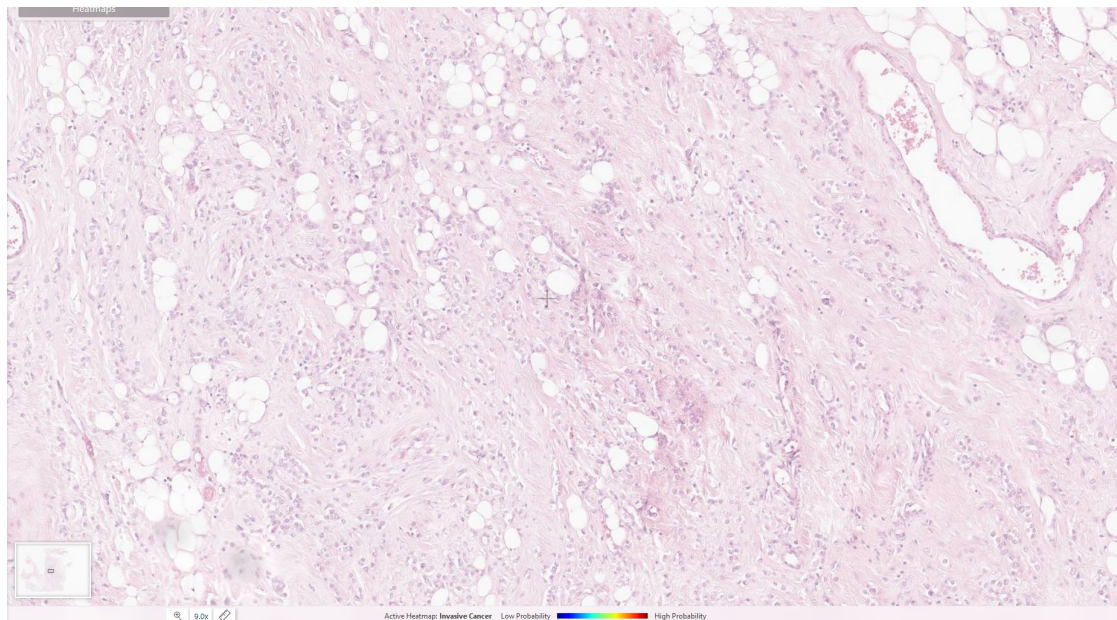


# Voorbeeld detectie invasief carcinoma NST

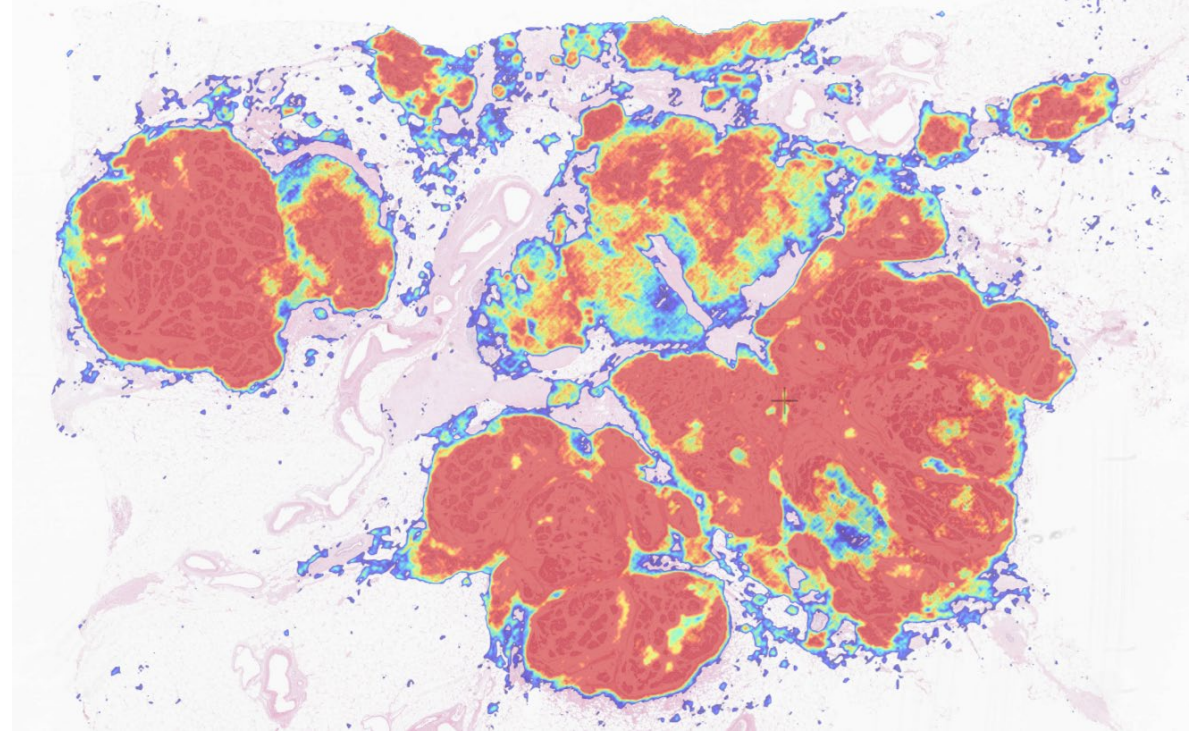
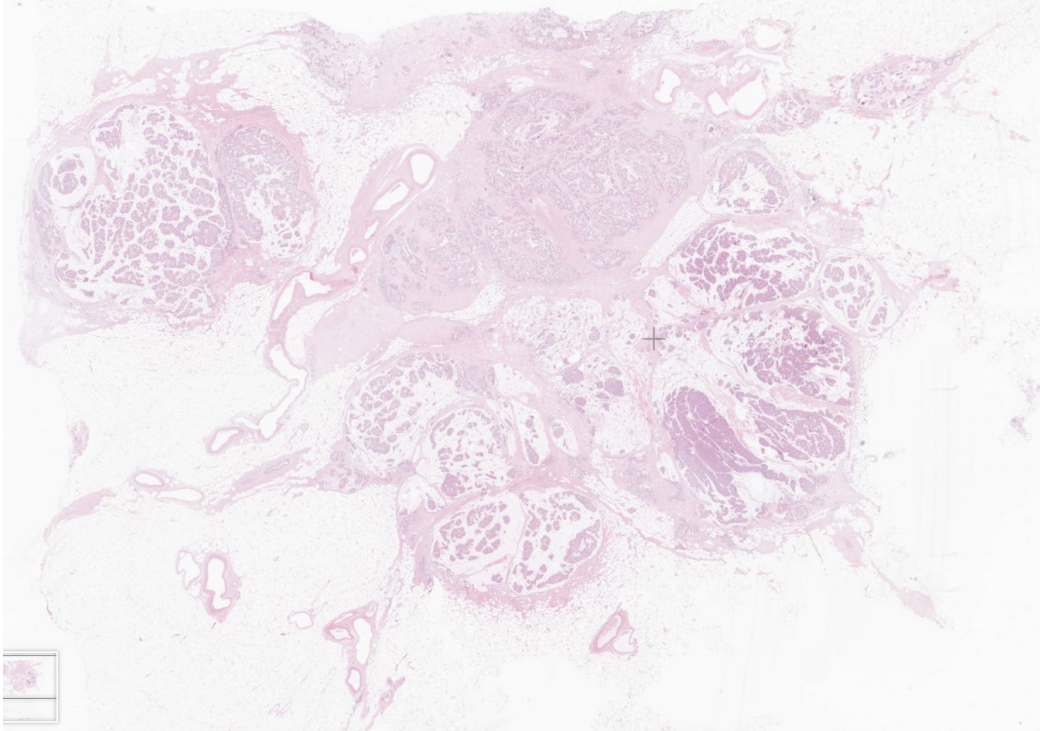


References:  
1. IBEX

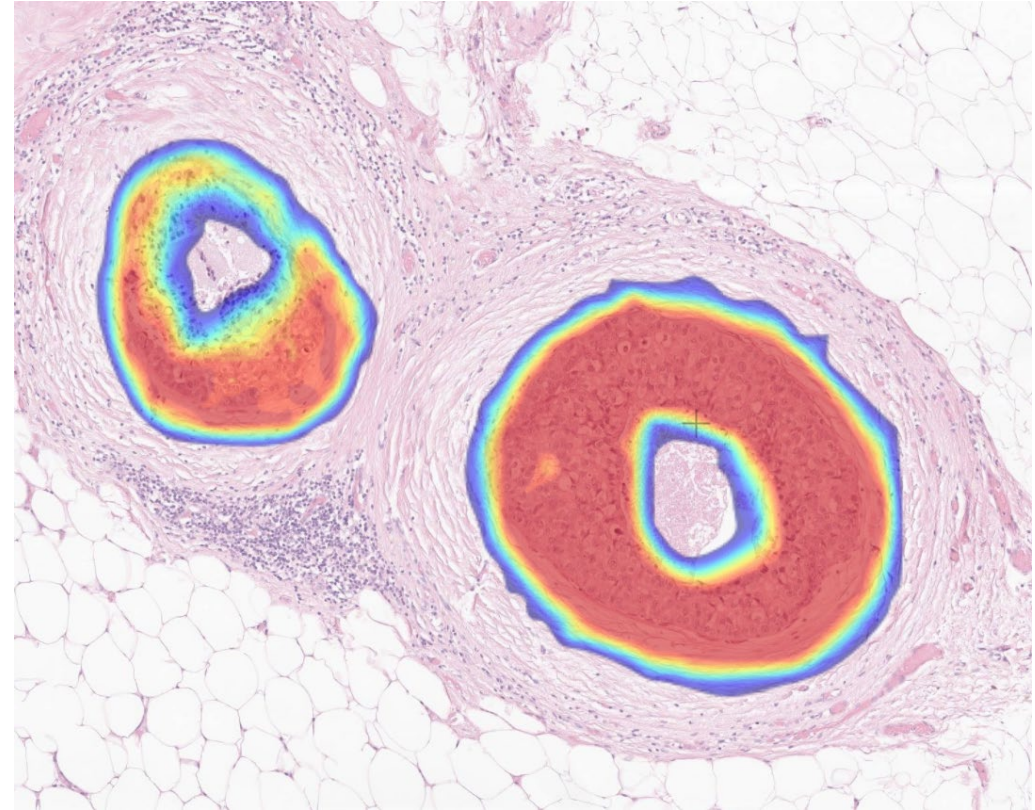
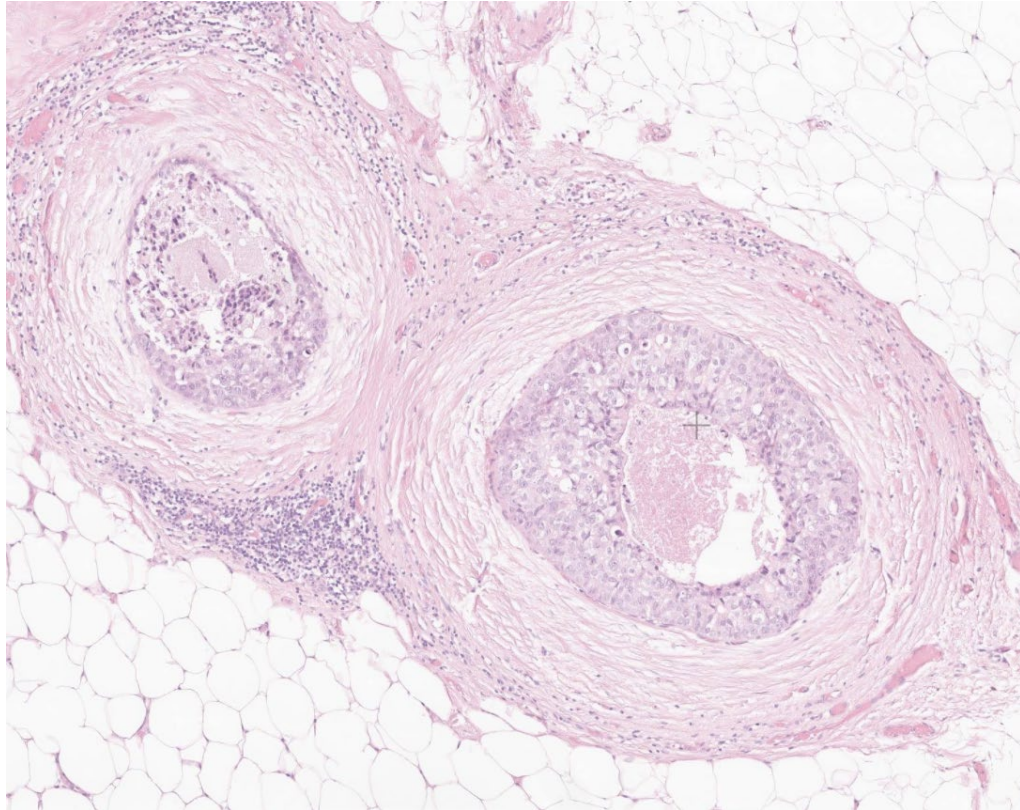
# Voorbeeld detectie invasief lobulair carcinoma



# Voorbeeld detectie invasief mucineus carcinoma

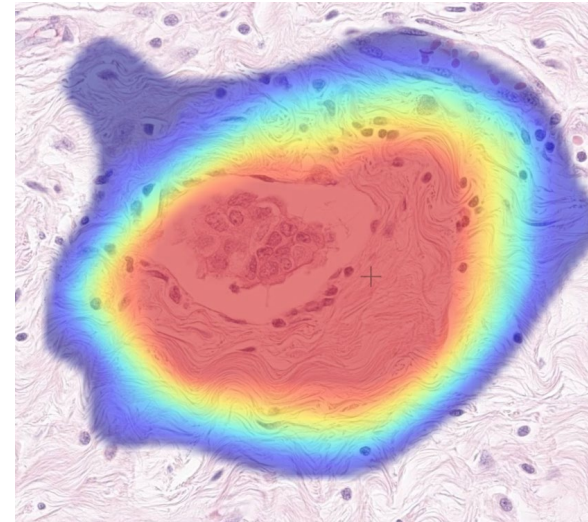
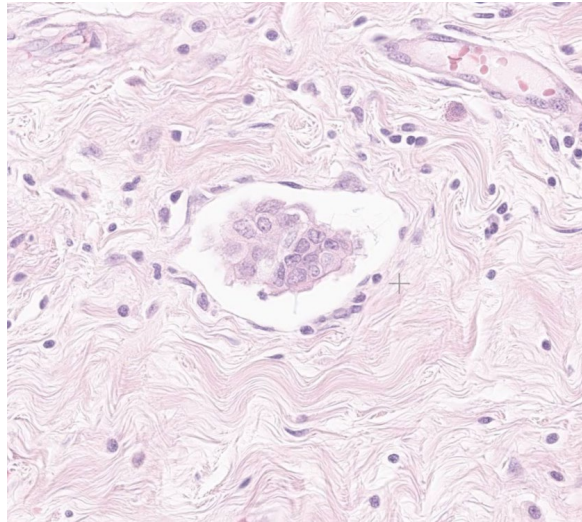


# Voorbeeld detectie hooggradig DCIS



# Resultaten: exploratory endpoints

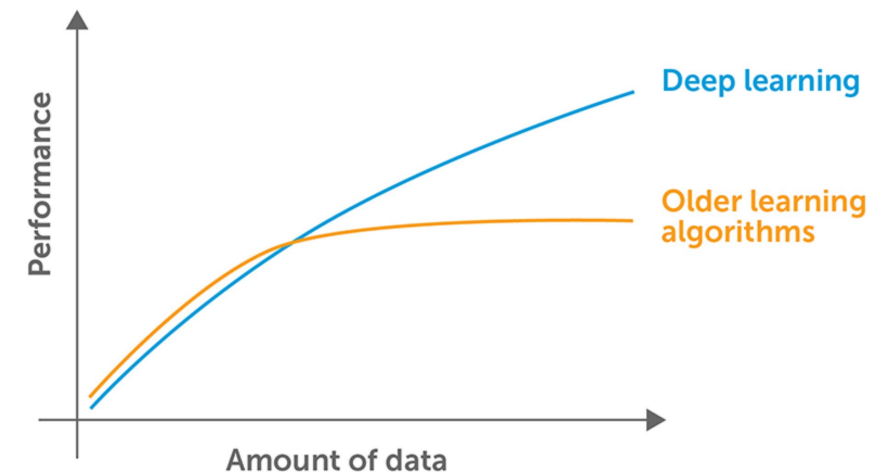
Analysis	AUC [95% CI]	Sensitivity	Specificity
Stromal tumor infiltrating lymphocytes (sTILs)	0,958 [0,919; 0,998]	91,4% [0,814; 0,963]	100% [0,851; 1,000]
Detection of lymphatic invasion	0,896 [0,825; 0,968]	72,2% [0,560; 0,841]	86,4% [0,732; 0,936]





# Waarom nu AI?

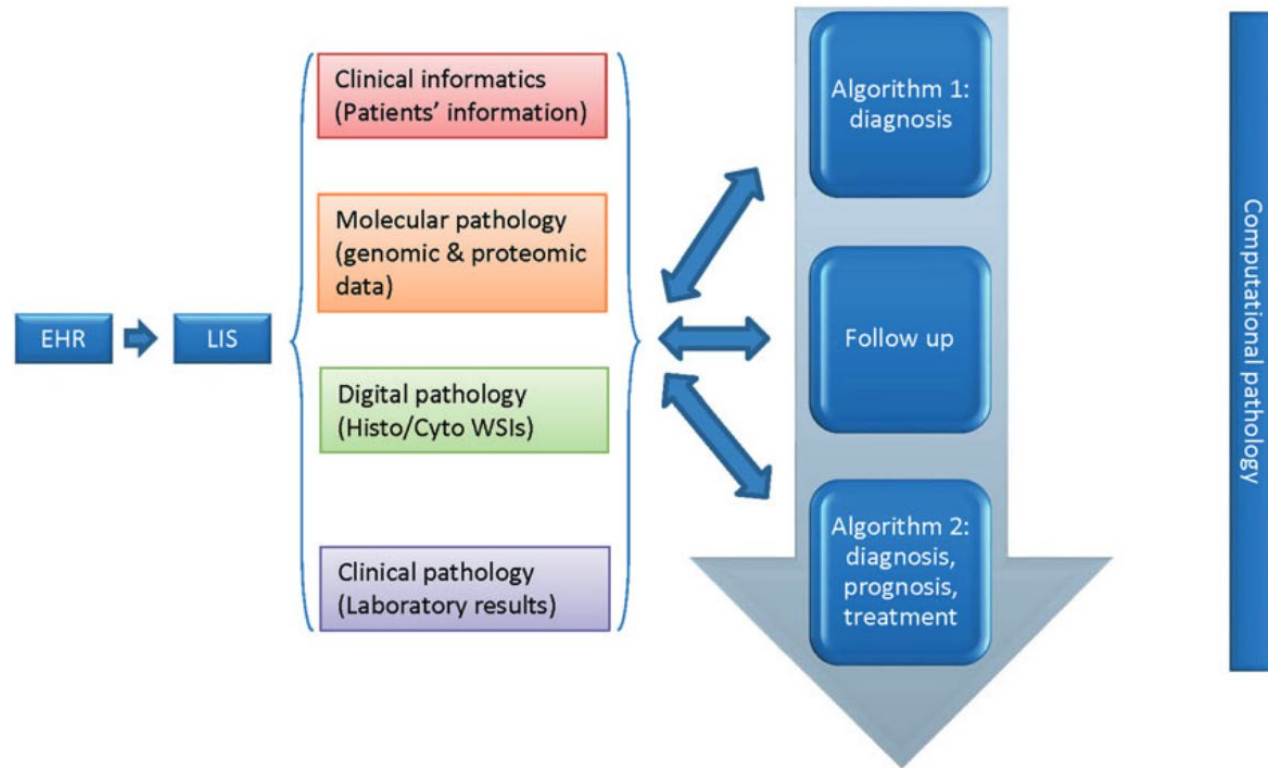
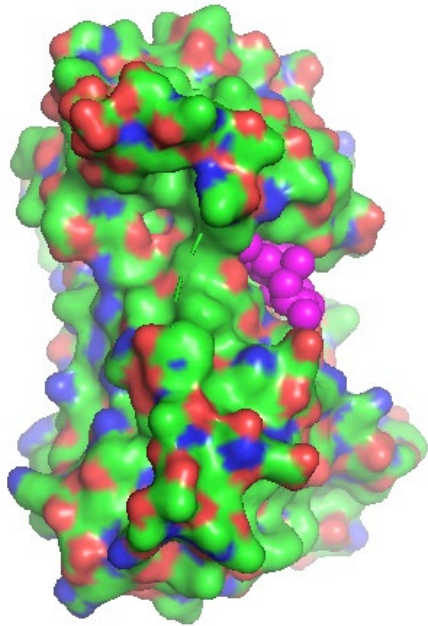
- Taak automatisatie
  - Meer data (en complexere data)
  - Nood aan standaardisatie
- }
- Complexere algoritmes & geen menselijke bias
- Gedaalde hardwarekosten
  - Opportuniteiten
    - Gebruik van meer bronnen bij besluitvorming
    - Integratie in Klinische studies



## References:

1. Yousif M, Van Diest PJ, Laurinavicius A, Rimm D, Van Der Laak J, Madabhushi A, et al. Artificial intelligence applied to breast pathology. *Virchows Archiv* 2022;480(1):191–209.
2. Cui M, Zhang DY. Artificial intelligence and computational pathology. *Laboratory Investigation* 2021;101(4):412–22.

# AI toekomstperspectieven



## References:

1. Yousif M, Van Diest PJ, Laurinavicius A, Rimm D, Van Der Laak J, Madabhushi A, et al. Artificial intelligence applied to breast pathology. *Virchows Archiv* 2022;480(1):191–209.
2. Cui M, Zhang DY. Artificial intelligence and computational pathology. *Laboratory Investigation* 2021;101(4):412–22.

# Take home messages

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Integratie en implementatie: Het is er/het komt er (meer en (complexere) data)

- Nood aan AI: workflowverbeteringen, standardisatie, hulp bij gepersonaliseerde geneeskunde
- Versplinterd landschap aan AI platformen (+duur)
- Ethiek (!): Ken sterktes en zwaktes van AI en modellen → Vertrouwen! (→ **Educatie!**)

Applicaties

- Veel en er komen er elke maand bij

Opportunities

- Oncologie gecentreerd gezondheidszorgmodel
- Samenwerkingen: intramuros en extramuros (farmaceutische bedrijven, ingenieurs)

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Bevestig via de QR-code  
je deelname



# Practopics

Praktische topics voor de huisarts

Of klik op de link in de Q&A rechtsboven.

