WELKOM!!

Wetenschapsdag 2024

NIERSTICHTING
Je nieren zijn je leven

nvn nierpatiënten vereniging nederland

nieren.nl
vergroot je kennis, deel je ervaring

Digitale analyse van het nierbiopt met kunstmatige intelligentie: wat hebben we geleerd van het DEEPGRAFT project?

- Spreker : Jesper Kers

Aanvang: 13:00 uur

AstraZeneca HANSA BIOPHARMA CSL Vifor Chiesi astellas

Amsterdam UMC
Universitair Medische Centra

Leids Universitair
Medisch Centrum

Nierbiopten beoordelen met behulp van AI biedt uitkomst!

Jesper Kers, MD, PhD
Nierpatholoog Amsterdam UMC, Leiden UMC
Amsterdam, The Netherlands

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Universitair Medische Centra

Leids Universitair
Medisch Centrum

Programma

Tour door de nierpathologie

Wat is kunstmatige intelligentie (AI) en waarom is dit nuttig?

Resultaten Nierstichting project DEEPGRAFT

Leuk die AI, maar wat nu?

Opleiding geneeskunde AMC-UvA

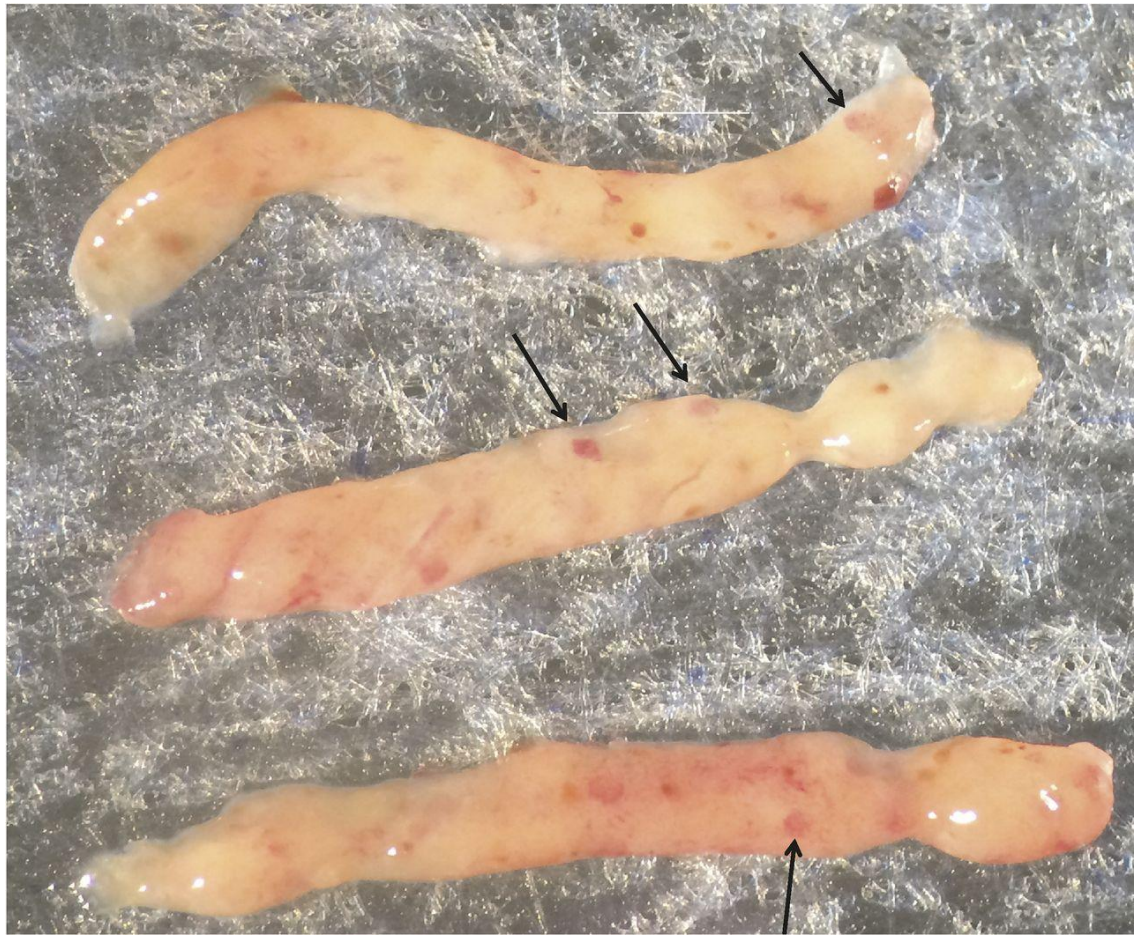
Promotie onderzoek AMC, Sorbonne Parijs, Vrije Universiteit Brussel

Opleiding patholoog Amsterdam UMC, differentiatie immunologie en AI Harvard/MIT Boston

Nierpatholoog Amsterdam UMC, Leiden UMC

Groepsleider AUMC/LUMC 10 PhD studenten

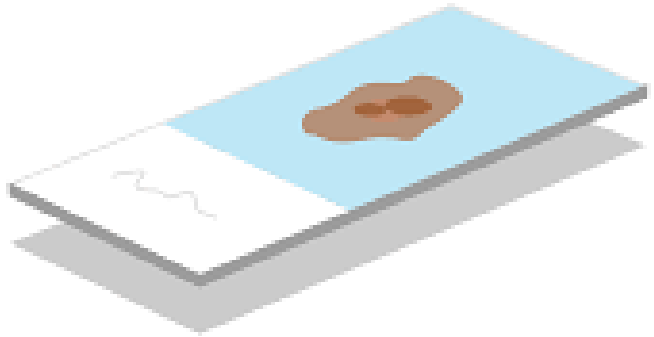
De patholoog

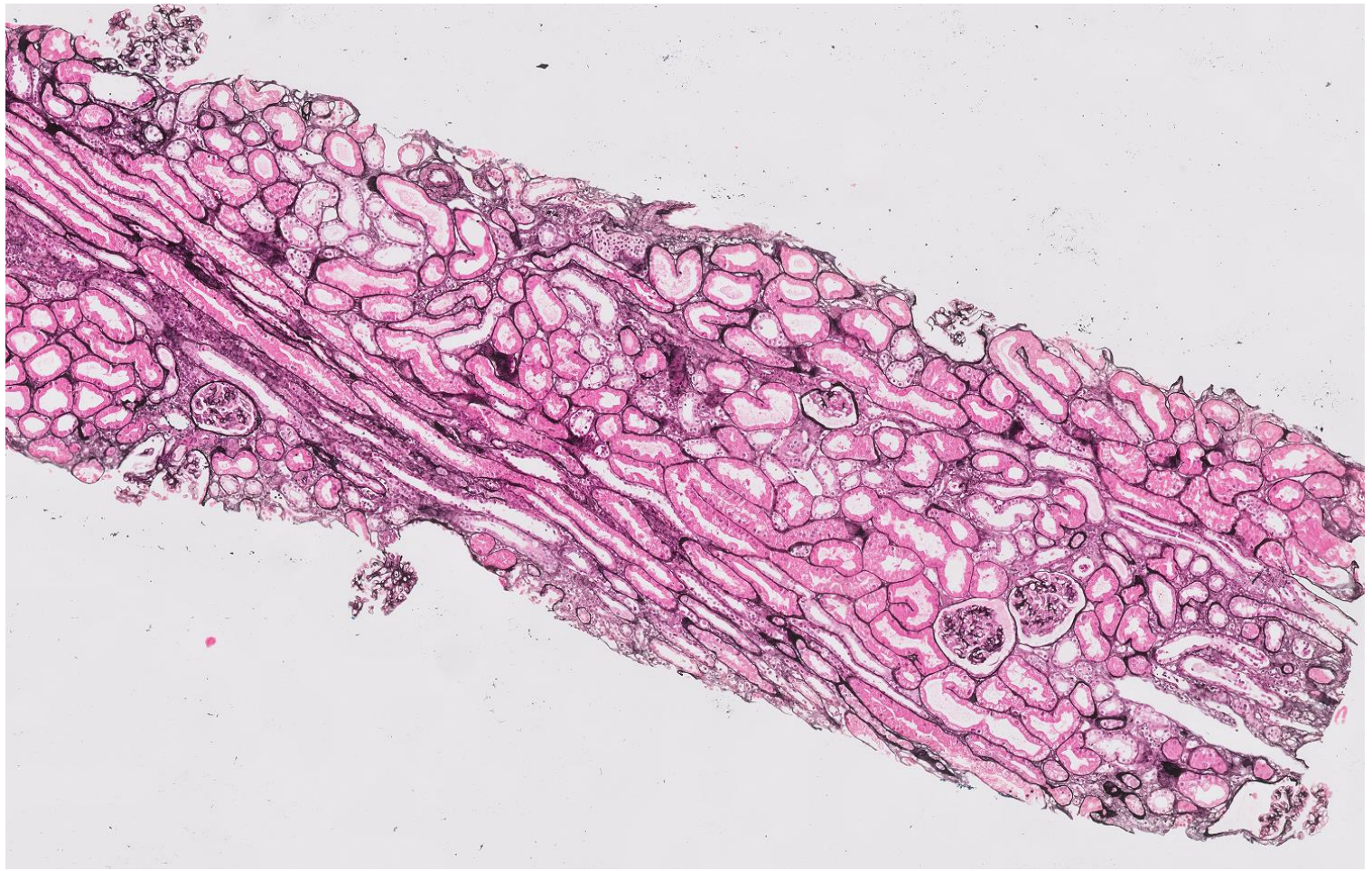


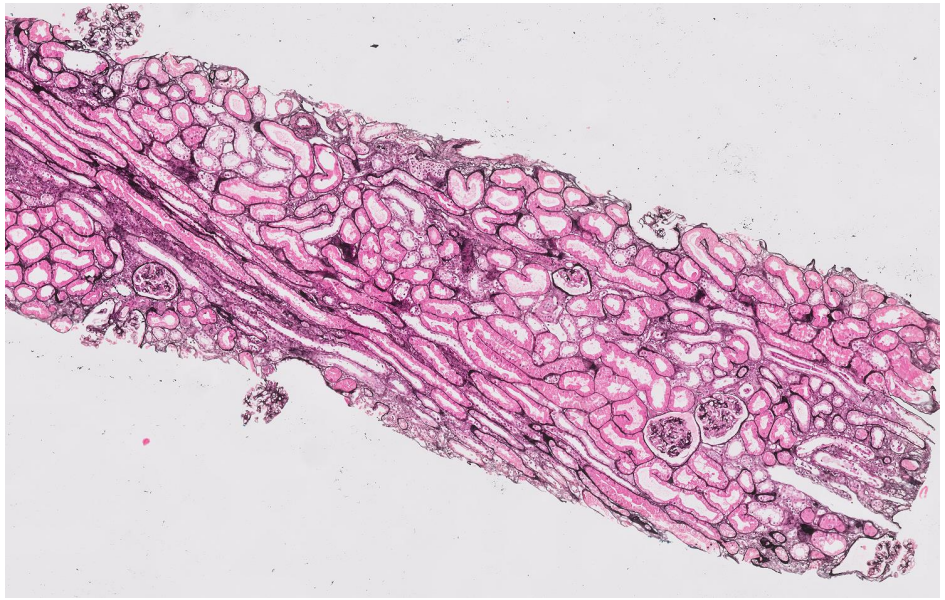
Formaline + paraffine (kaarsvet)

Vloeibare stikstof (-180 gr C)


LEICA RM2235
Leica

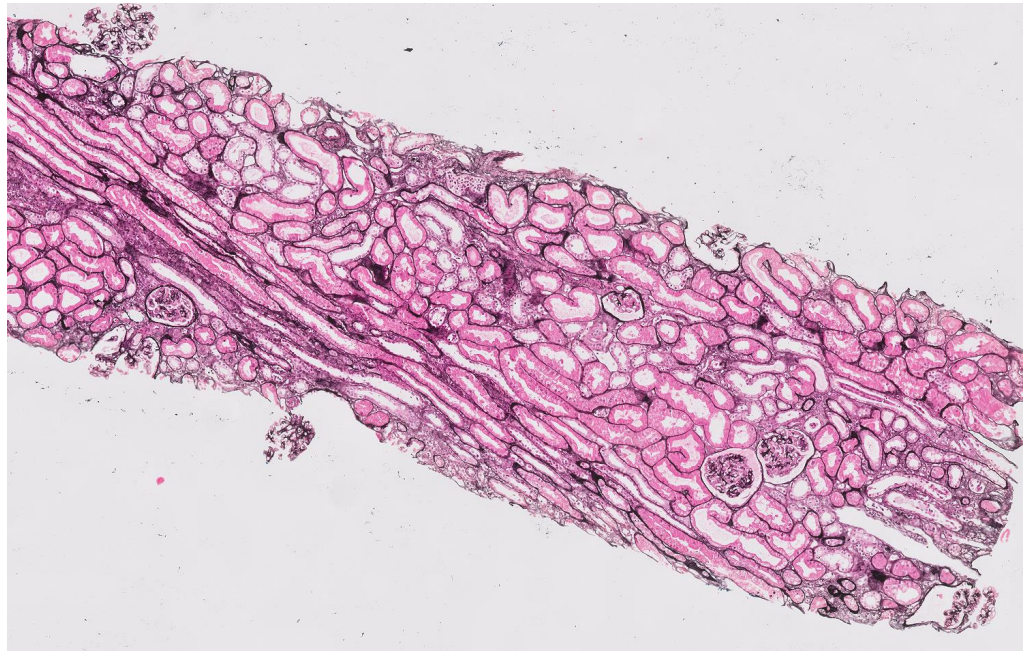






Patholoog = patronen van ziekte herkennen

Combinatie patronen + klinische interpretatie = diagnose



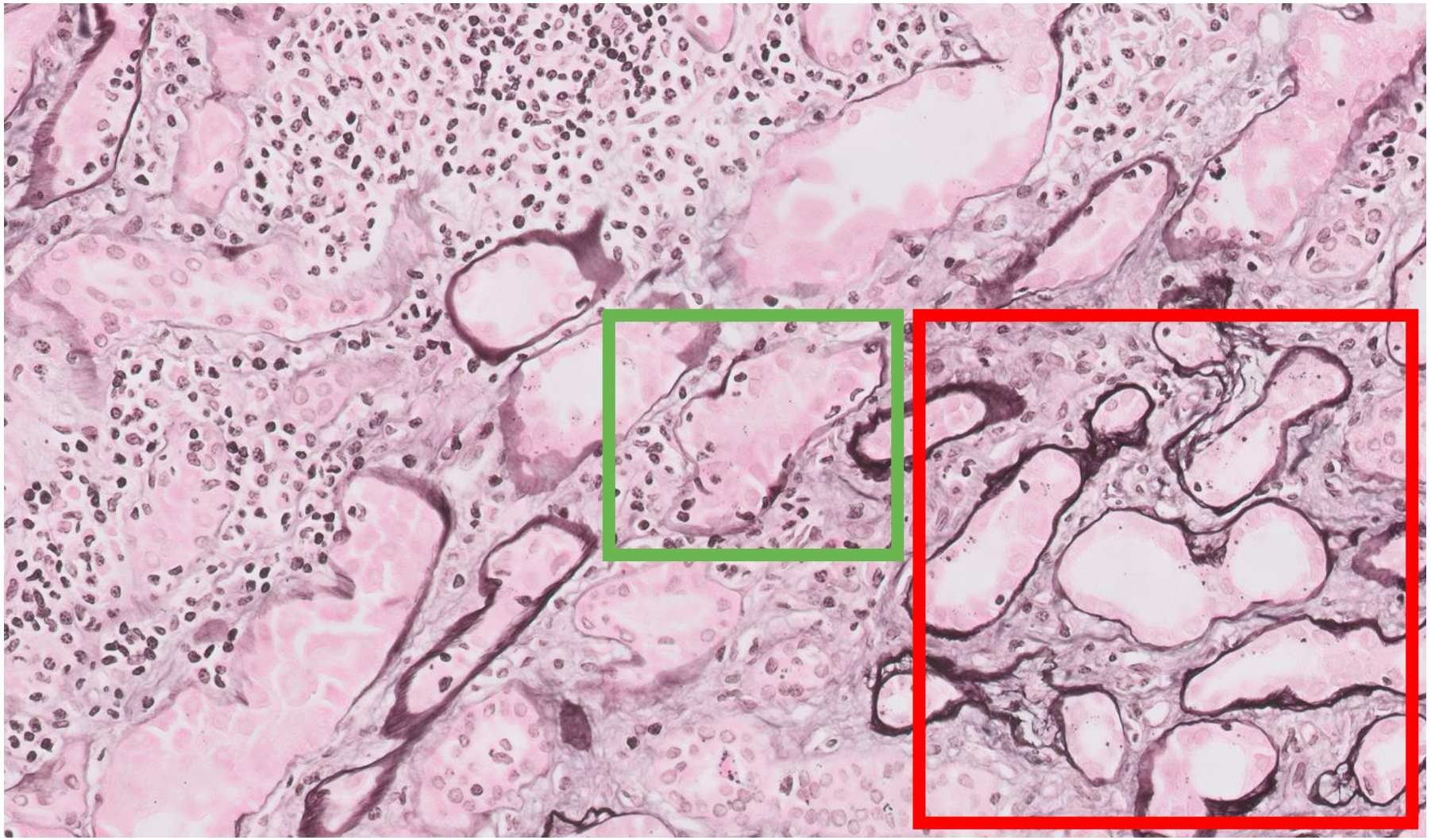
Patronen van ziekte herkennen

Ontsteking

Litteken of schade

Infecties

Toxiciteit



Ontsteking

Litteken of schade

Infecties

Toxiciteit

Ernst afwijking?

Hoe uitgebreid?

TABLE 2. *Comparison of kappa values achieved before and after the initiation of graphical performance feedback*

	Before	After	Change	p value
Acute glomerulitis	0.193	0.193	0.000	0.980
Arteriolar hyaline	0.233	0.221	−0.012	0.922
Interstitial fibrosis grade	0.306	0.249	−0.057	0.348
Intimal arteritis	0.327	0.415	0.088	0.494
Intimal thickening grade	0.360	0.333	−0.027	0.820
Mononuclear infiltration grade	0.320	0.391	0.071	0.224
Tubular atrophy grade	0.314	0.213	−0.101	0.196
Tubulitis	0.160	0.279	0.119	0.056

0 = geen overeenstemming
1 = volledige overeenstemming

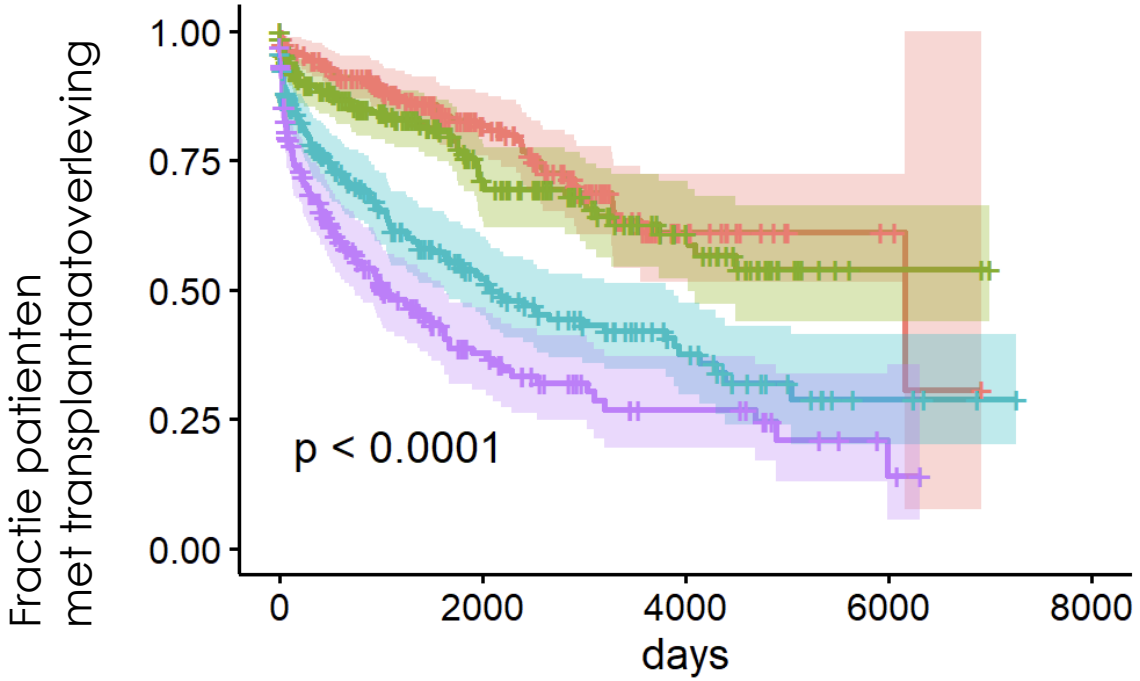
Mate van overeenstemming is relevant voor de patient!

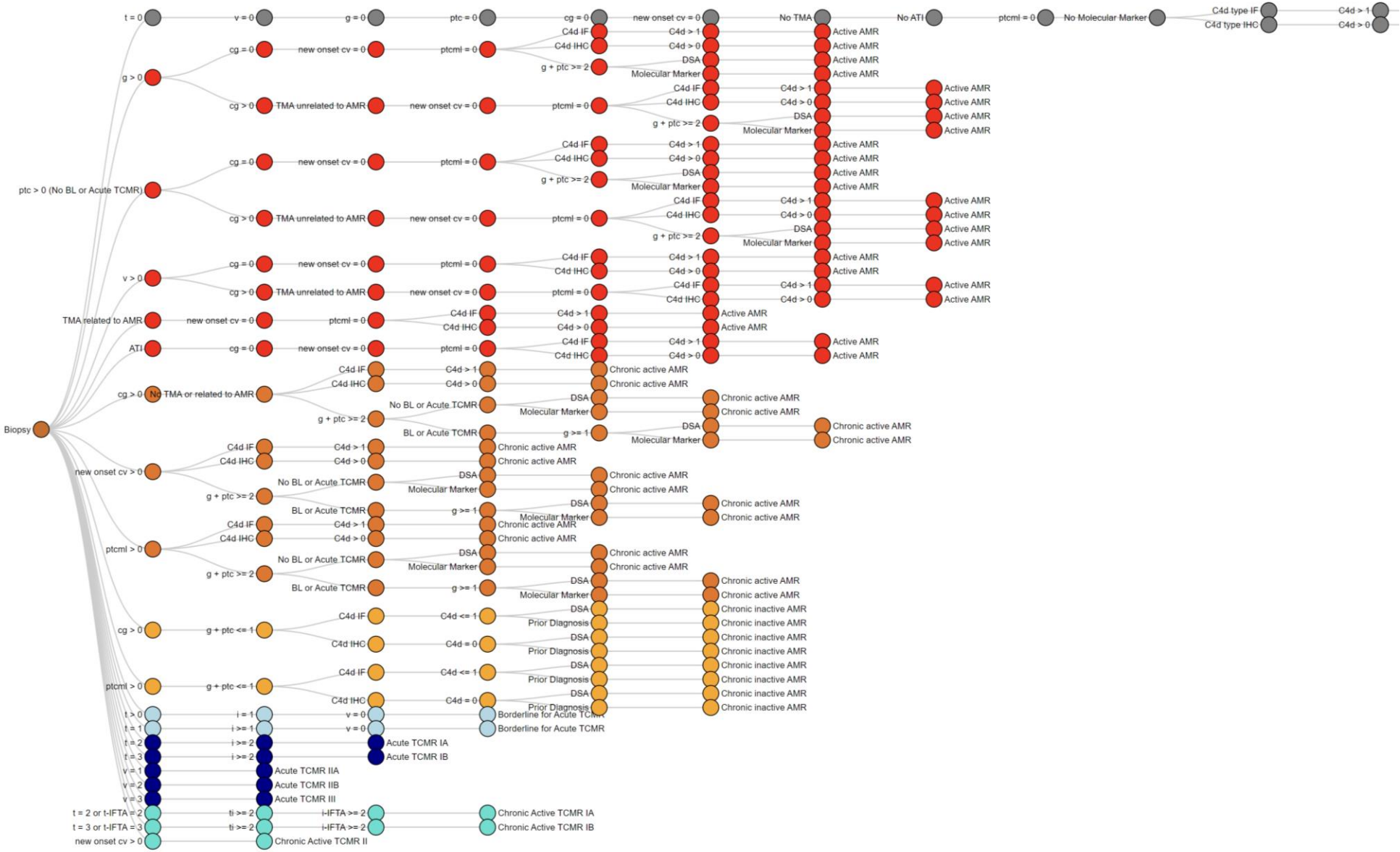
Q1 (veel overeenstemming)

Q2 …

Q3 …

Q4 (weinig overeenstemming)




Biopsy
t = 0
v = 0
g = 0
ptc = 0
cg = 0
C4d IF
C4d IHC
g + ptc >= 2
new onset cv = 0
C4d > 1
C4d > 0
DSA
Molecular Marker
No TMA
Active AMR
ptcml = 0
C4d type IF
C4d type IHC
No Molecular Marker
No ATI
g > 0
cg > 0
TMA unrelated to AMR
ptc > 0 (No BL or Acute TCMR)
v > 0
TMA related to AMR
ATI
cg > 0 No TMA or related to AMR
new onset cv > 0
ptcml > 0
cg > 0 g + ptc <= 1
ptcml > 0 g + ptc <= 1
t > 0
t = 1
t = 2
t = 3
v = 1
v = 2
v = 3
t = 2 or t-IFTA = 2
t = 3 or t-IFTA = 3
new onset cv > 0
i = 1
i >= 1
i >= 2
ti >= 2
v = 0
C4d <= 1
C4d = 0
Prior Diagnosis
No BL or Acute TCMR
BL or Acute TCMR
g >= 1
i-IFTA >= 2
Chronic active AMR
Chronic inactive AMR
Borderline for Acute TCMR
Acute TCMR IA
Acute TCMR IB
Acute TCMR IIA
Acute TCMR IIB
Acute TCMR III
Chronic Active TCMR II
Chronic Active TCMR IA
Chronic Active TCMR IB

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Kan kunstmatige intelligentie helpen patronen te herkennen?

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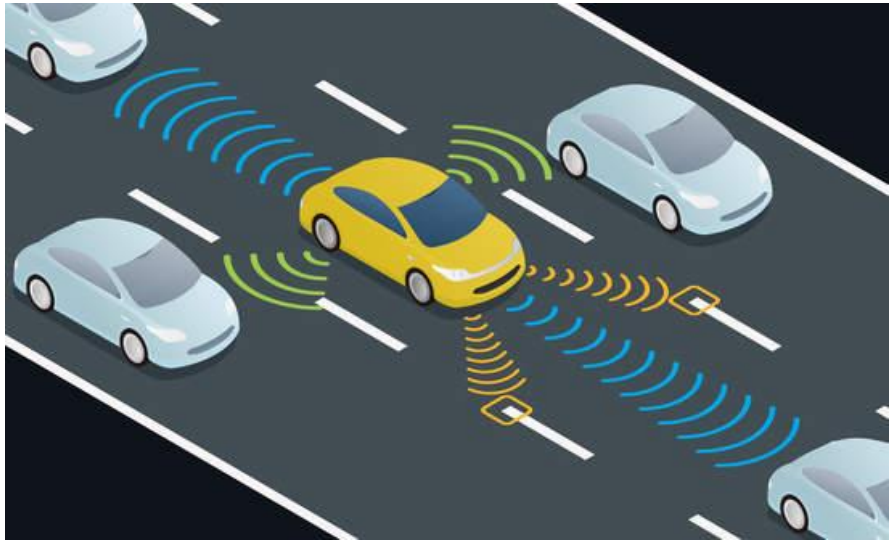

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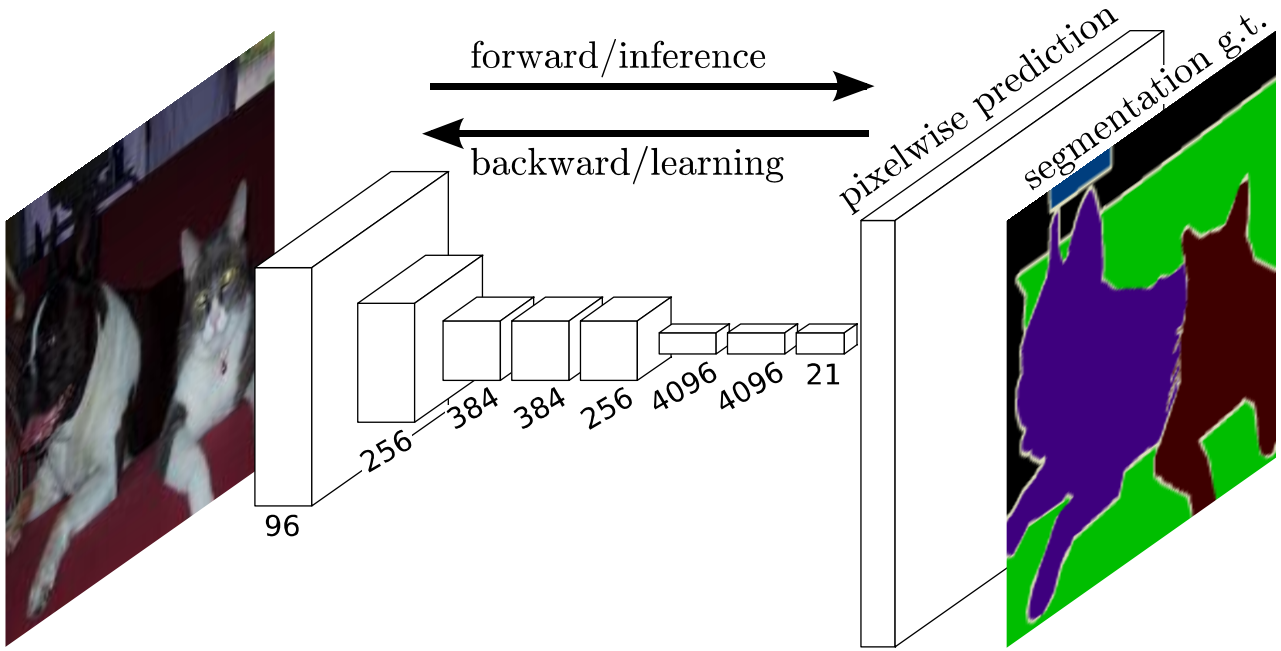
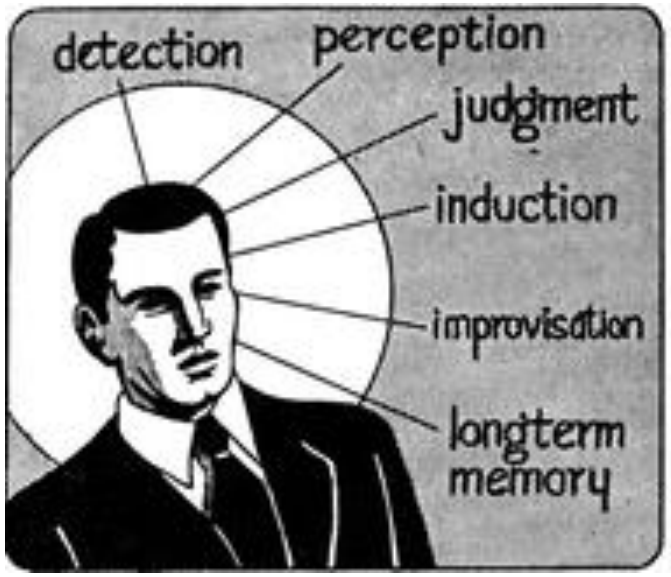
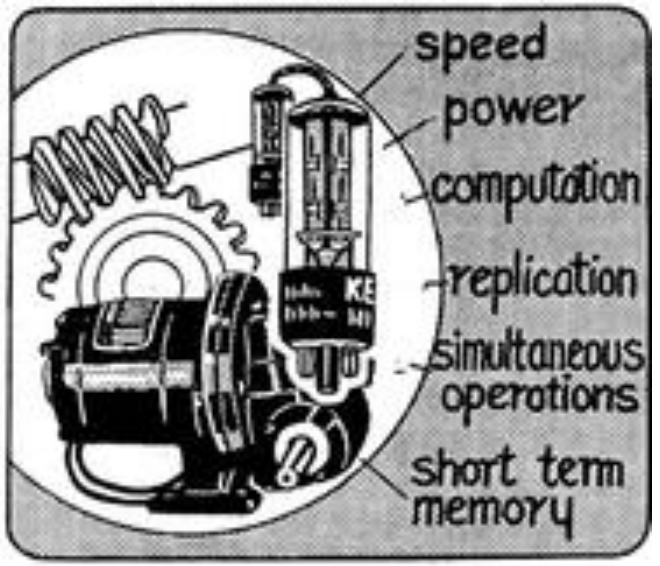
Patholoog: Visuele patroonherkenning

Computer visie: van pixels naar kennis



AI + patholoog = betere diagnostiek





Doelen DEEPGRAFT (DEEP learning on kidney GRAFT biopsies
2018 - 2024

1. Eerste ontwikkeling van AI speciaal voor nierbiopten
2. Beter begrijpen/visualiseren van de AI patronen

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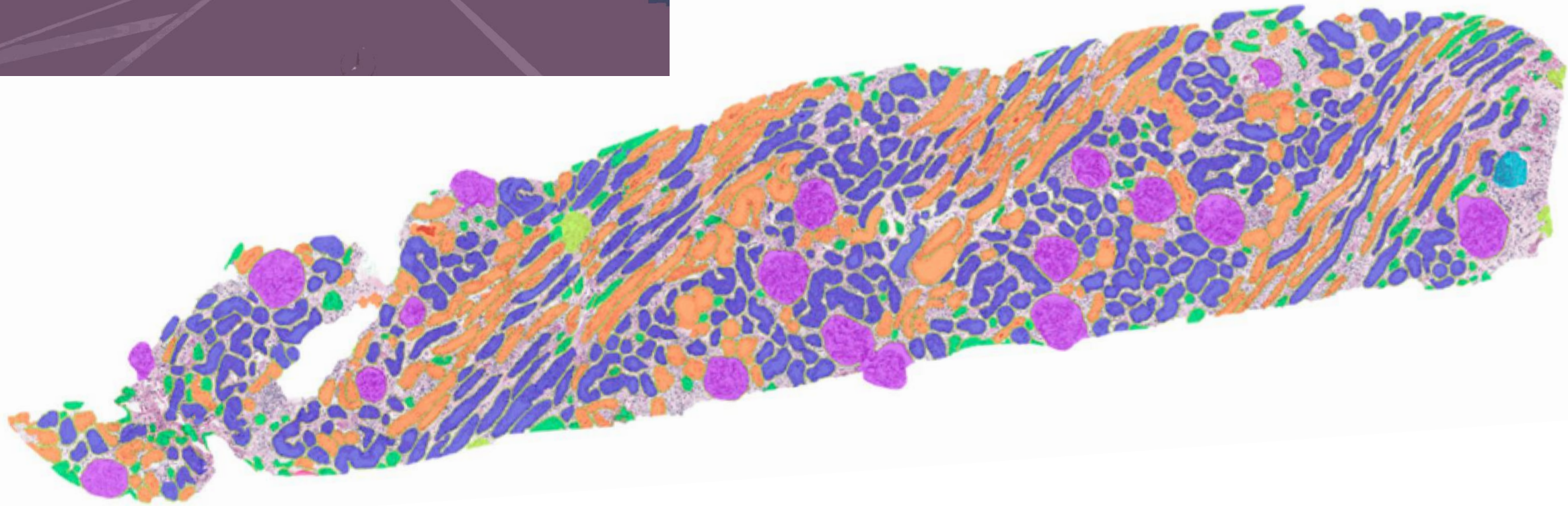
JASN



Samenwerking Radboud UMC, Nijmegen

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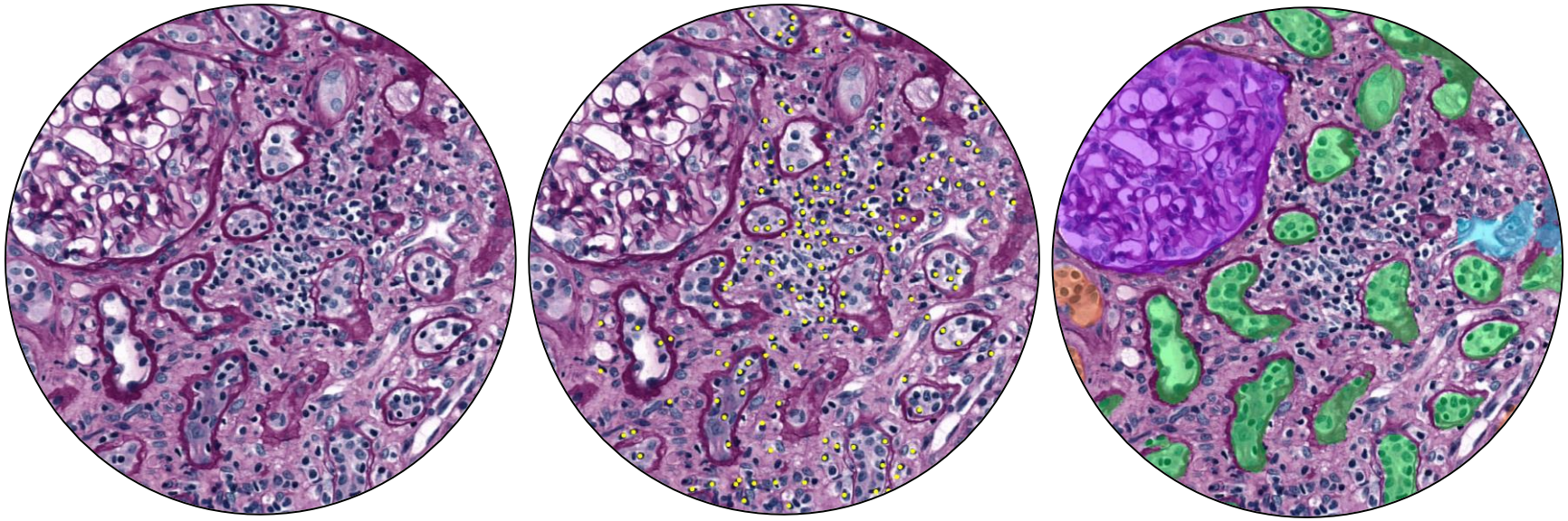

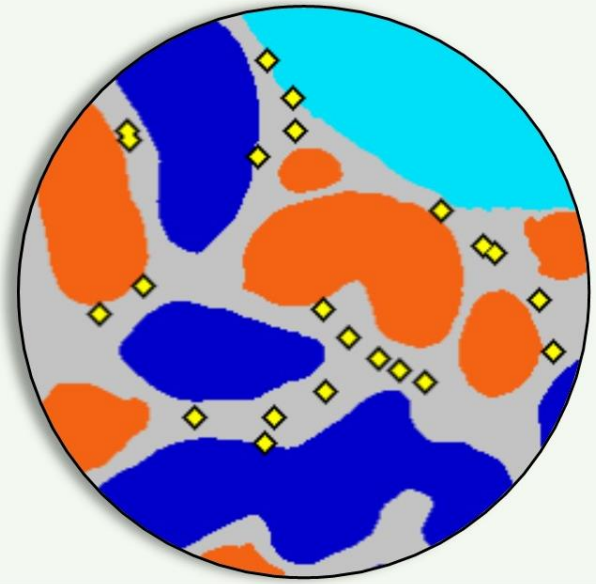

Automated quantification of lymphocytes inside specific tissue classes

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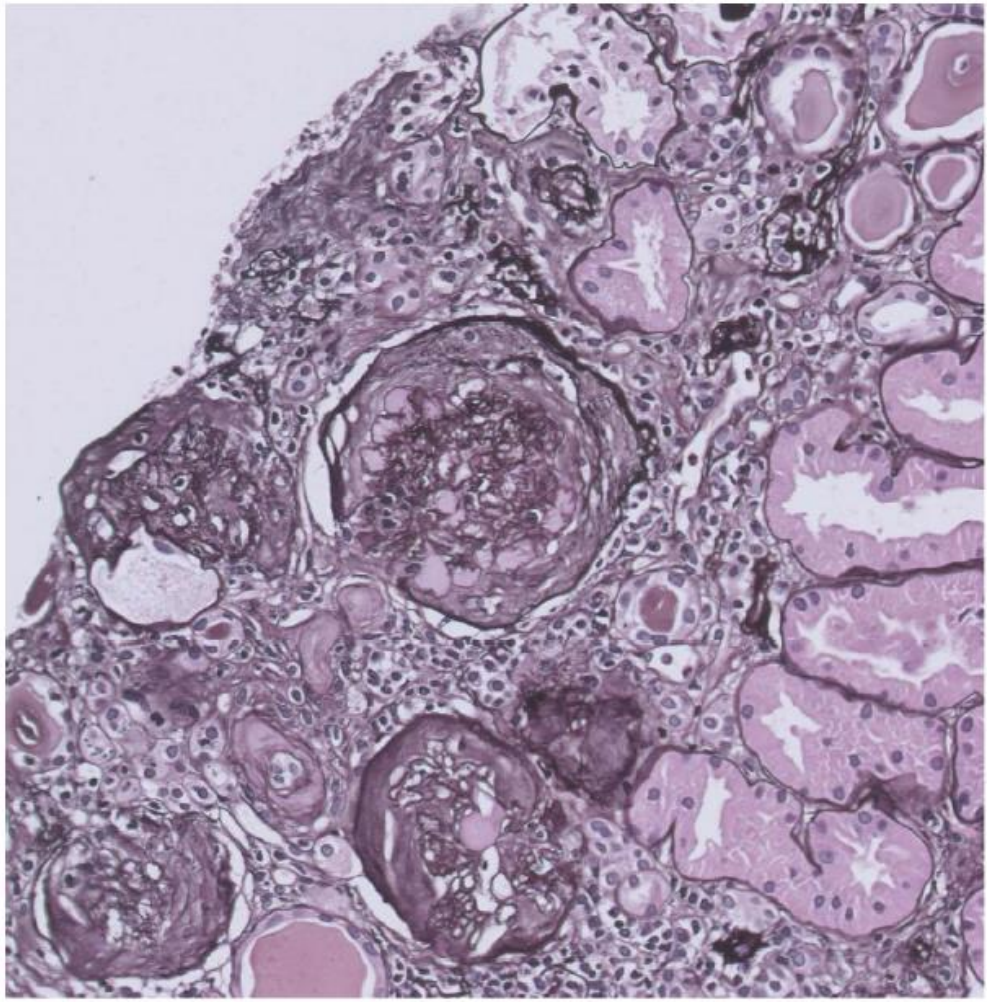
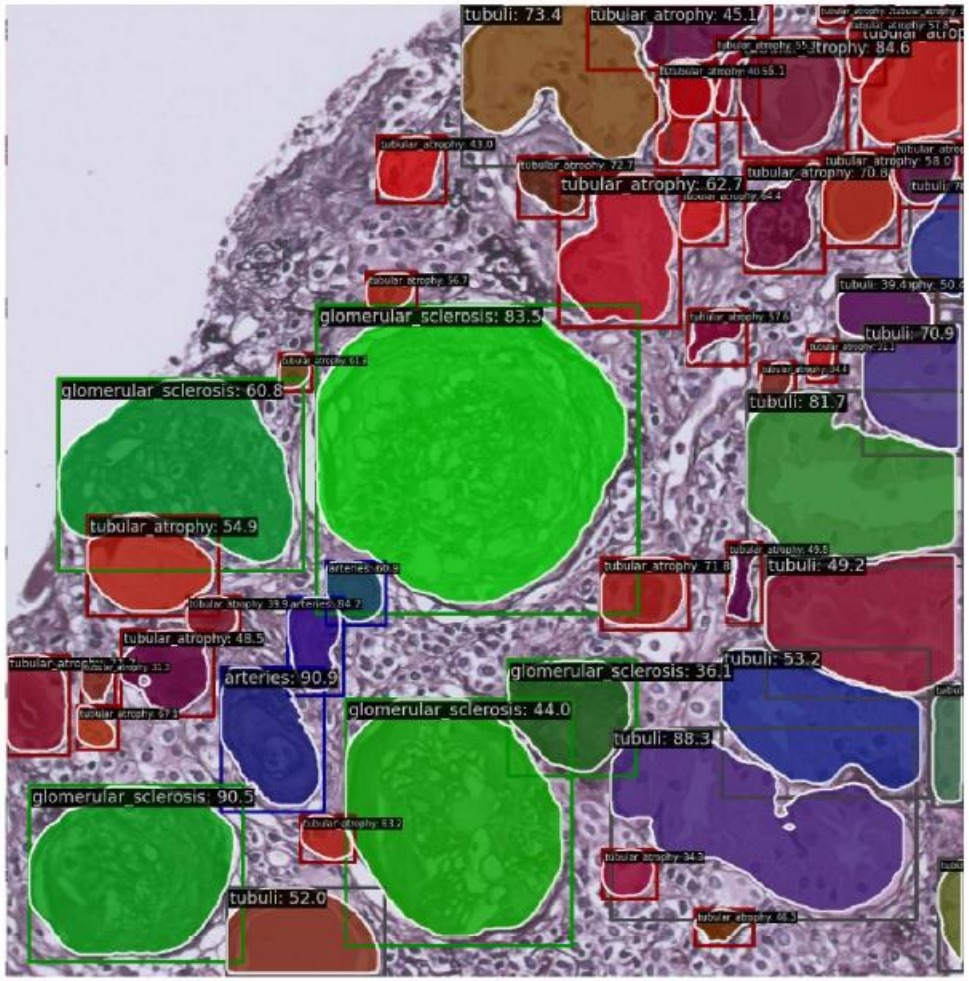


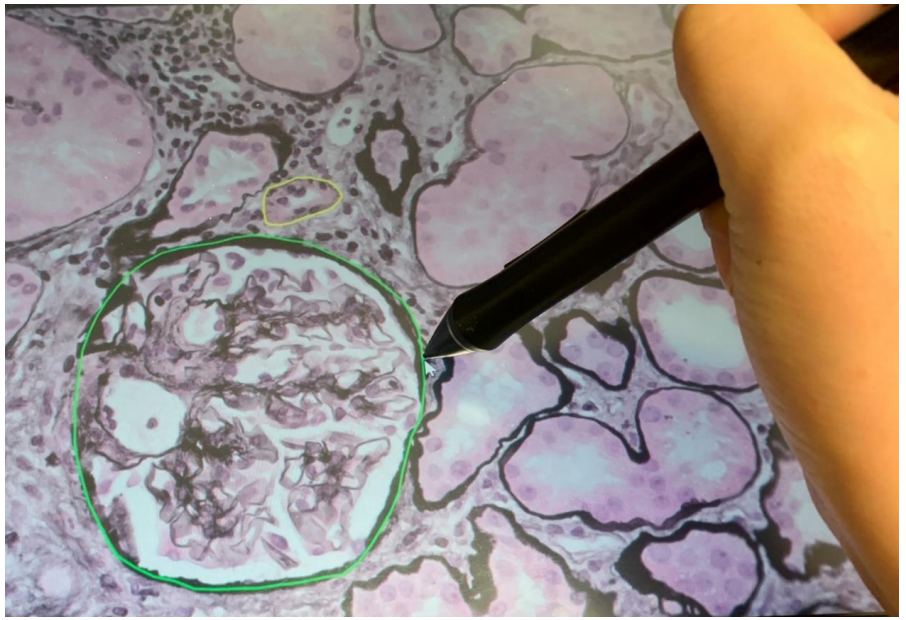
(a) ROI image



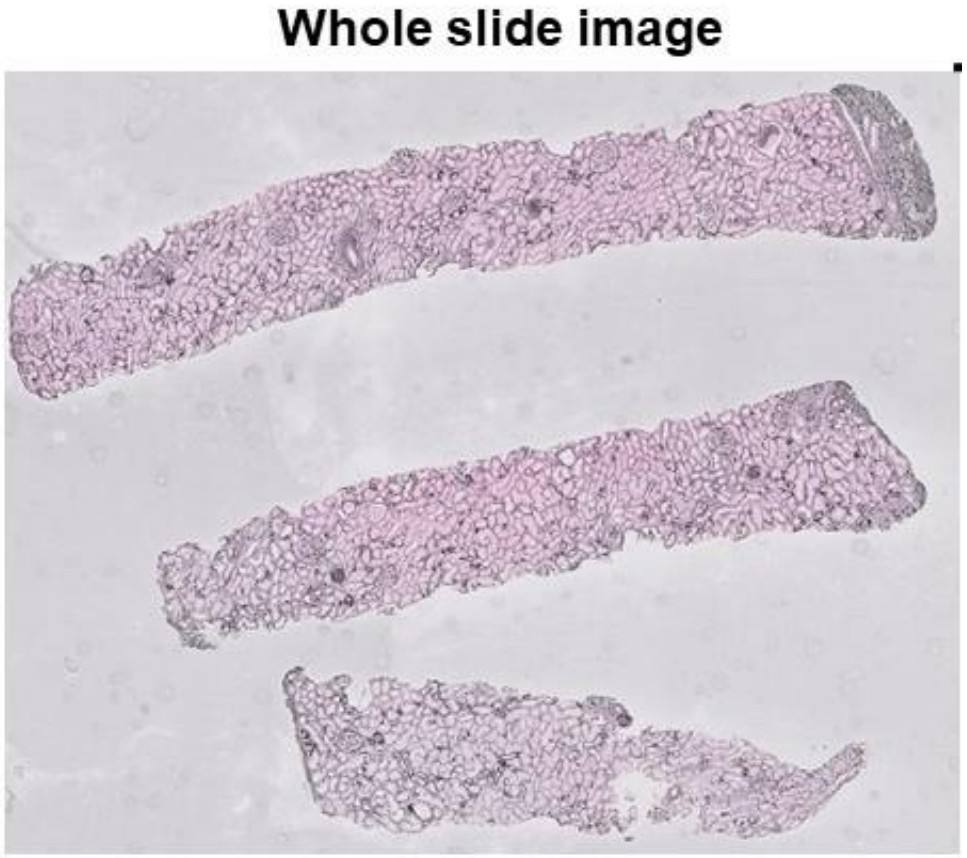
(d) instance lesion classification

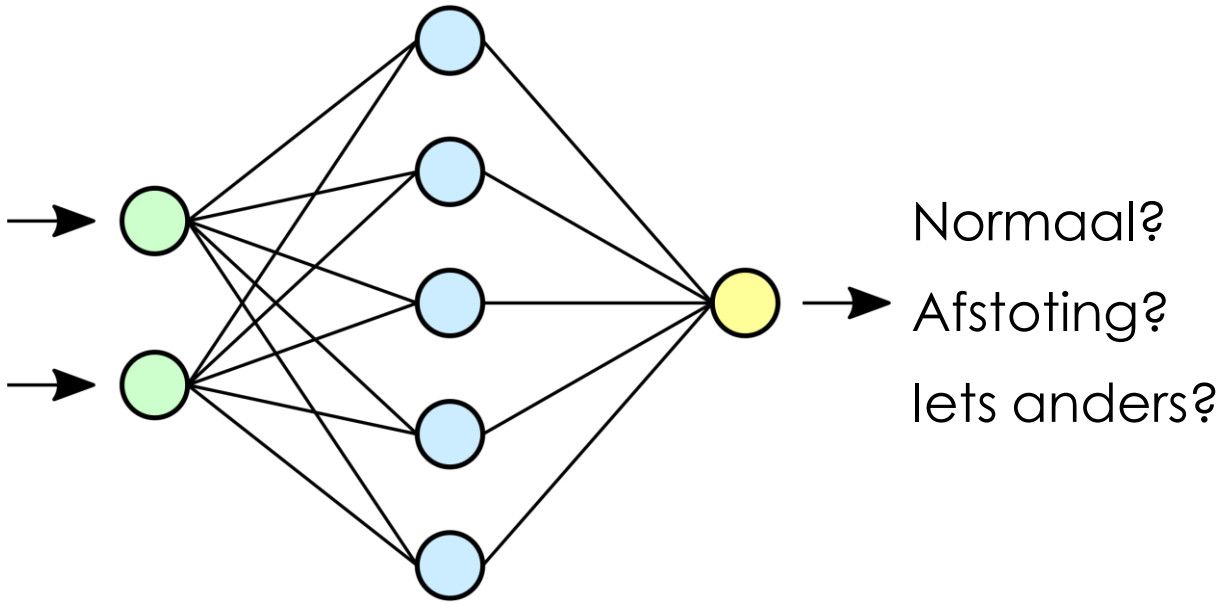
Samenwerking Universiteit Leiden

Annoteren kost veel tijd en expertise!



Trainen met “zwakke” labels





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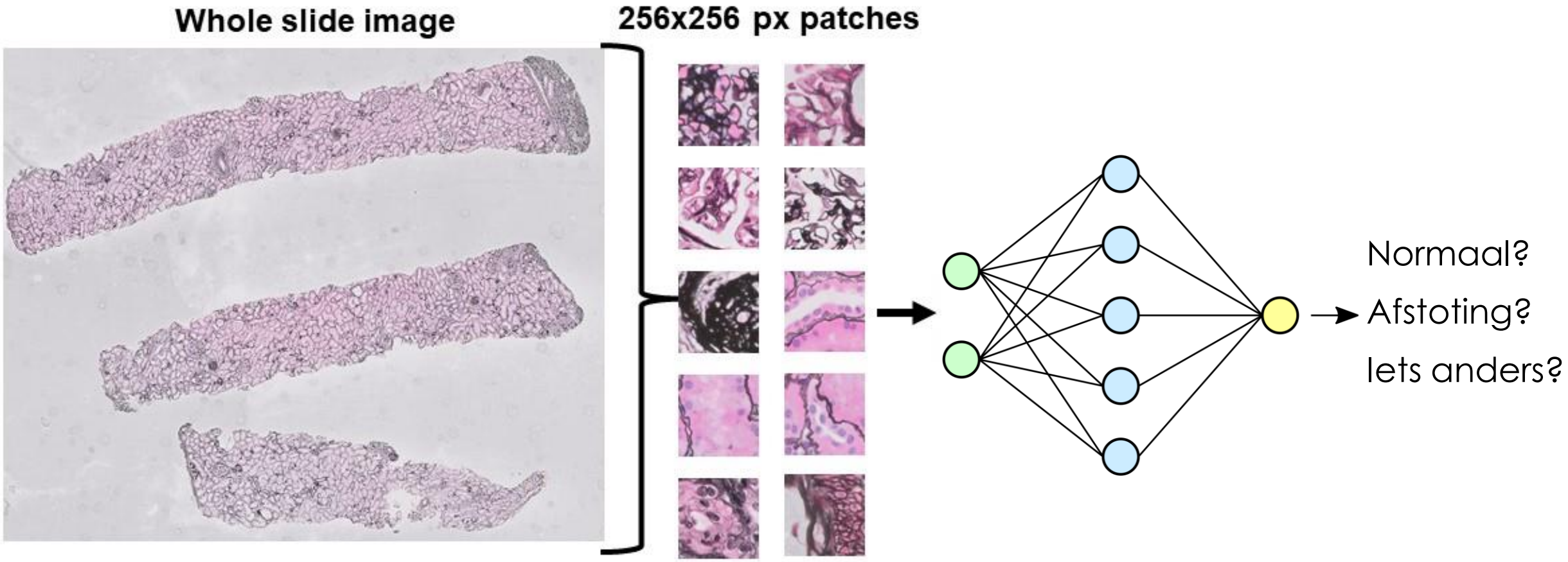
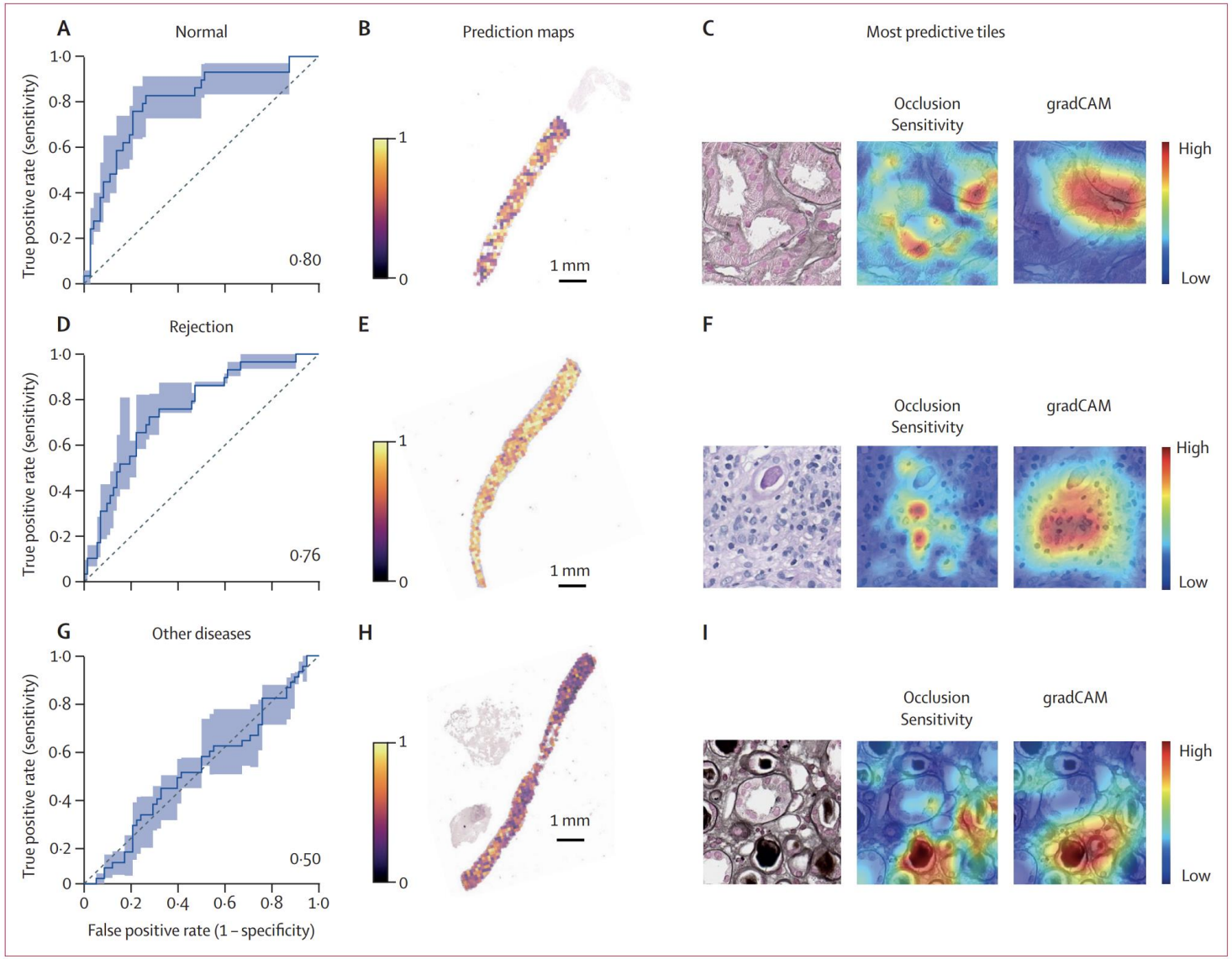


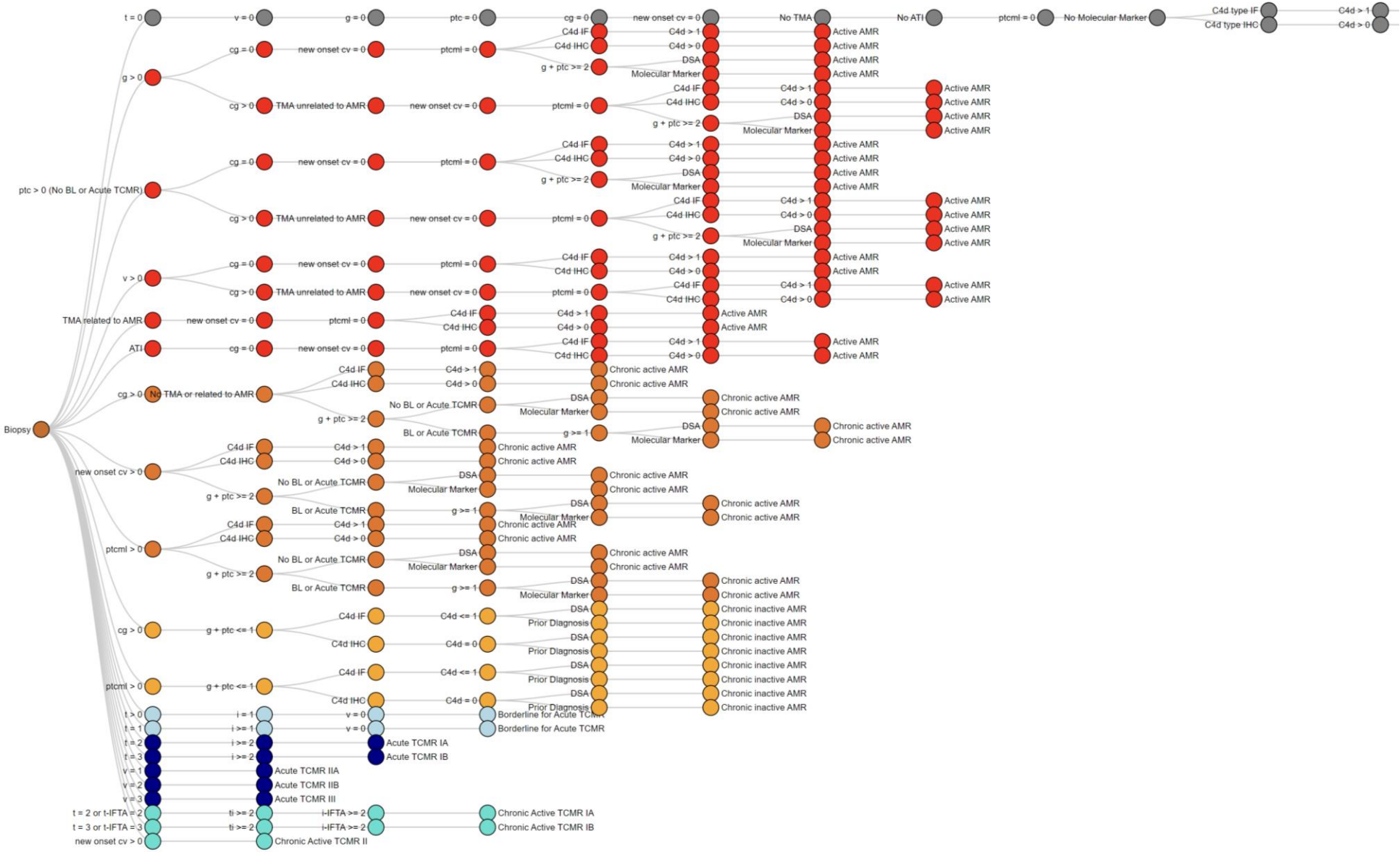
Van pixel naar barcode
"ChatGPT" voor pathologie

Neuraal netwerk op barcodes

Classificatie


A
Normal
True positive rate (sensitivity)
1·0
0·8
0·6
0·4
0·2
0
0·80
B
Prediction maps
1
0
1 mm
C
Most predictive tiles
Occlusion Sensitivity
gradCAM
High
Low
D
Rejection
True positive rate (sensitivity)
0·76
E
1 mm
F
Occlusion Sensitivity
gradCAM
High
Low
G
Other diseases
True positive rate (sensitivity)
0·50
0
0·2
0·4
0·6
0·8
1·0
False positive rate (1 – specificity)
H
1 mm
I
Occlusion Sensitivity
gradCAM
High
Low


THE LANCET
Digital Health
Volume 3 · Issue 12 · December 2021
www.thelancet.com/digital-health
Editorial
It's not easy being green
See page e751
Articles
Dynamic prediction of renal survival among deeply phenotyped kidney transplant recipients using AI
See page e795
Review
Blockchain applications in healthcare for COVID-19 and beyond
See page e819
oa
OPEN ACCESS


Biopsy
t = 0
v = 0
g = 0
ptc = 0
cg = 0
C4d IF
C4d IHC
g + ptc >= 2
new onset cv = 0
C4d > 1
C4d > 0
DSA
Molecular Marker
No TMA
Active AMR
ptcml = 0
C4d type IF
C4d type IHC
No Molecular Marker
No ATI
g > 0
cg > 0
TMA unrelated to AMR
ptc > 0 (No BL or Acute TCMR)
v > 0
TMA related to AMR
ATI
cg > 0 No TMA or related to AMR
new onset cv > 0
ptcml > 0
cg > 0 g + ptc <= 1
ptcml > 0 g + ptc <= 1
t > 0
t = 1
t = 2
t = 3
v = 1
v = 2
v = 3
t = 2 or t-IFTA = 2
t = 3 or t-IFTA = 3
new onset cv > 0
i = 1
i >= 1
i >= 2
ti >= 2
v = 0
C4d <= 1
C4d = 0
Prior Diagnosis
No BL or Acute TCMR
BL or Acute TCMR
g >= 1
i-IFTA >= 2
Chronic active AMR
Chronic inactive AMR
Borderline for Acute TCMR
Acute TCMR IA
Acute TCMR IB
Acute TCMR IIA
Acute TCMR IIB
Acute TCMR III
Chronic Active TCMR II
Chronic Active TCMR IA
Chronic Active TCMR IB

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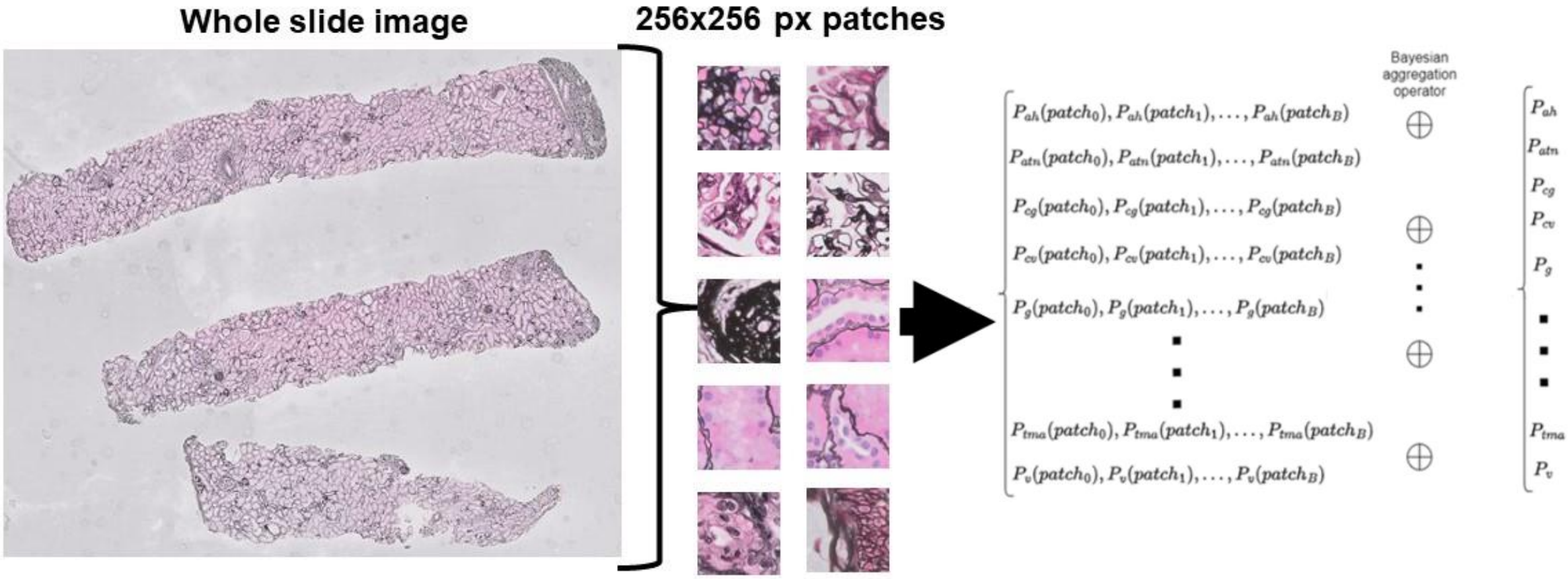
Gehele classificatie voorspellen!



Van pixel naar barcode **Speciaal neuraal netwerk** **Kans op afwijking**

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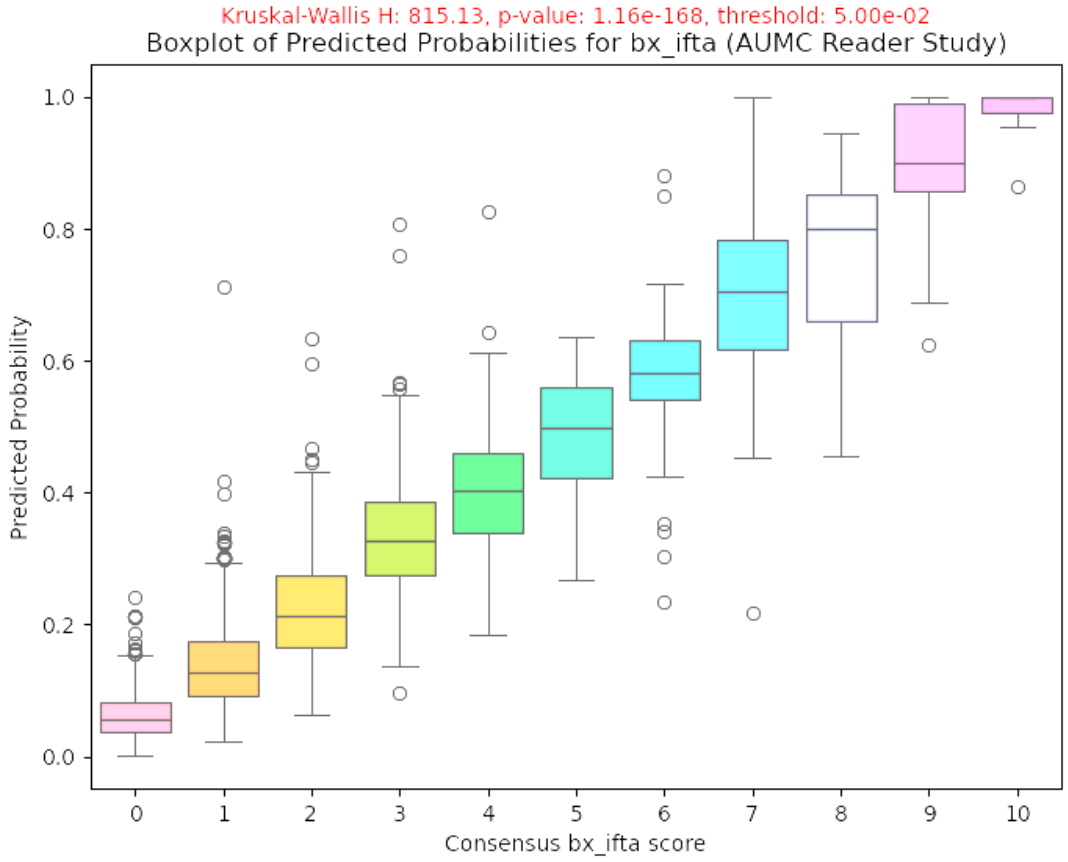
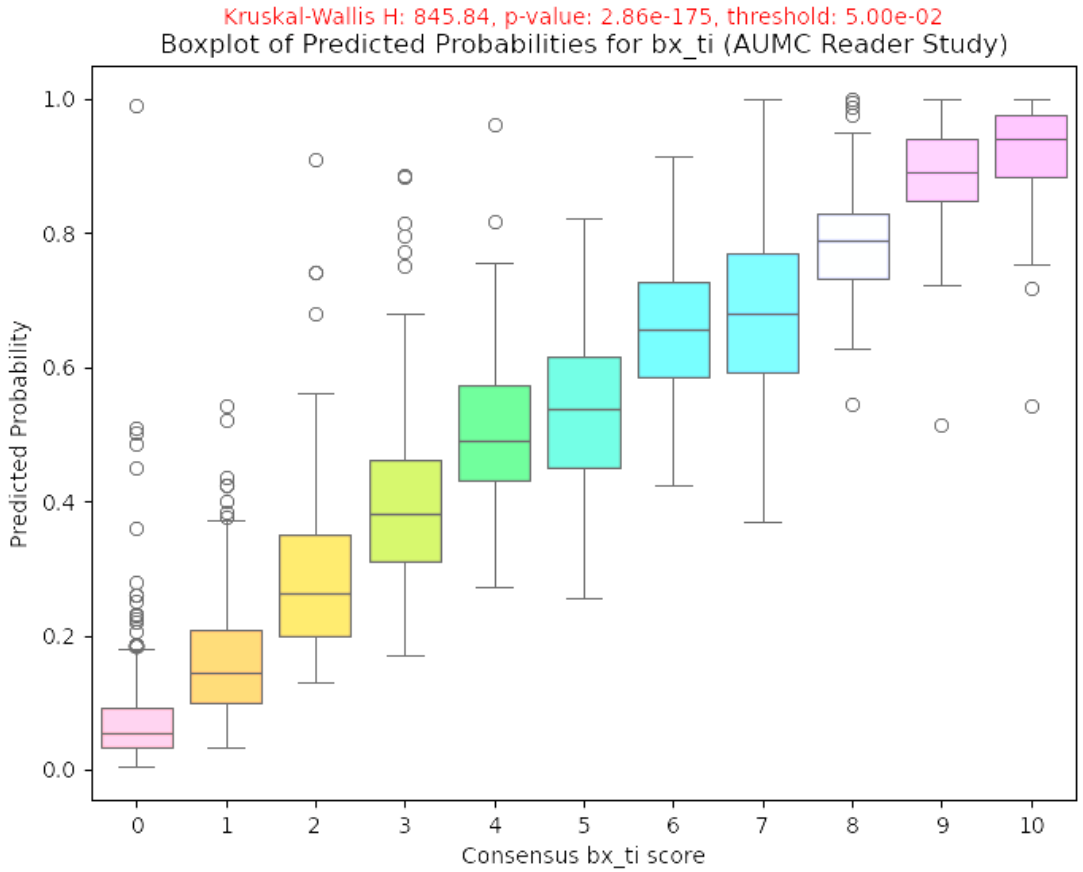
Banff-NET litteken nier



Banff-NET ontsteking nier



Ten opzichte van consensus 67 pathologen

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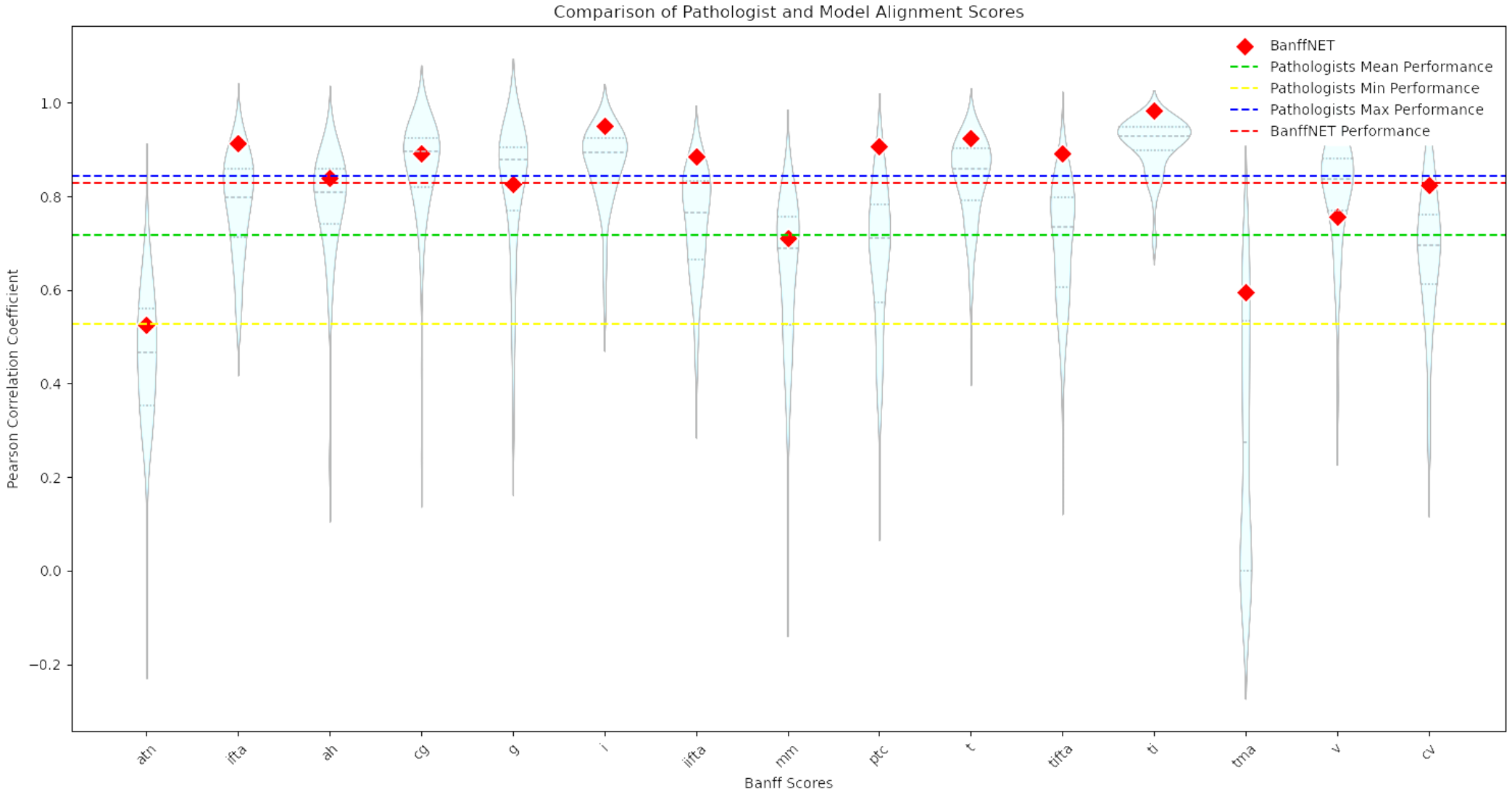
Banff-NET heeft hogere accuratesse dan 80% van de pathologen



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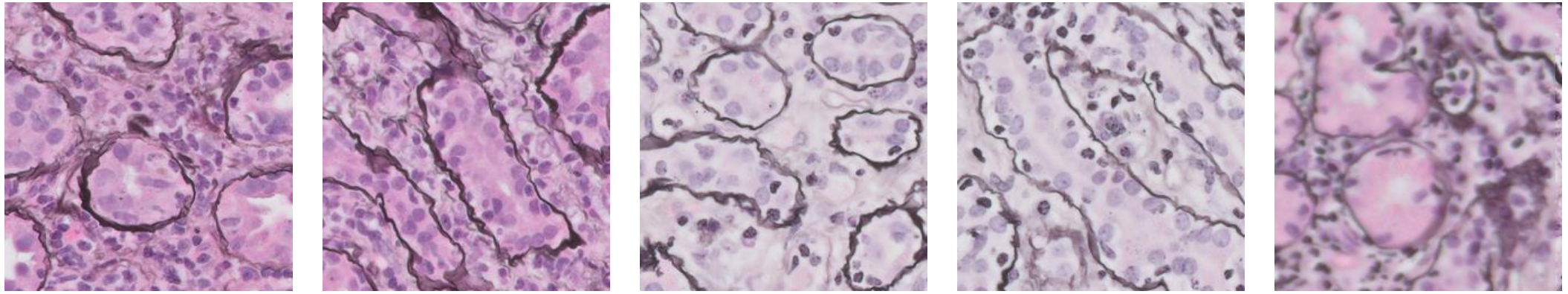
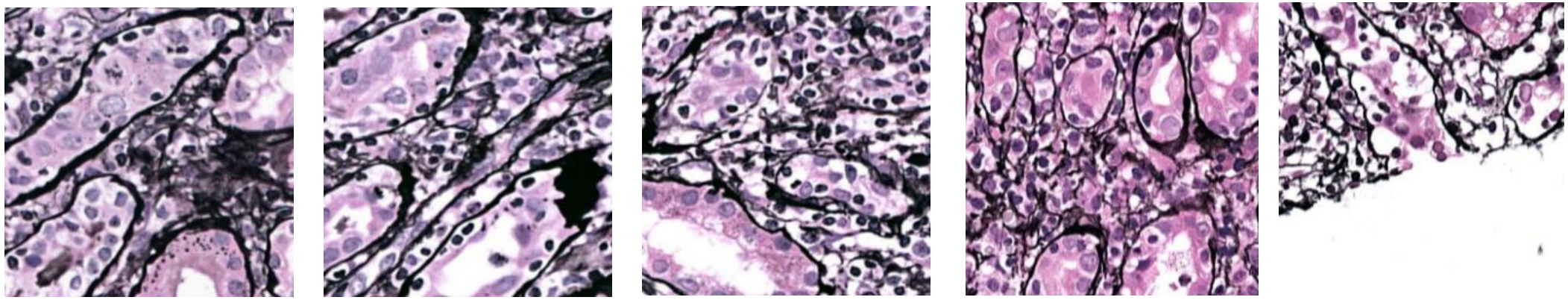
Tubulitis op Amsterdamse biopten (gezien tijdens trainen)



Tubulitis op Radboud biopten (nooit gezien door Banff-NET)



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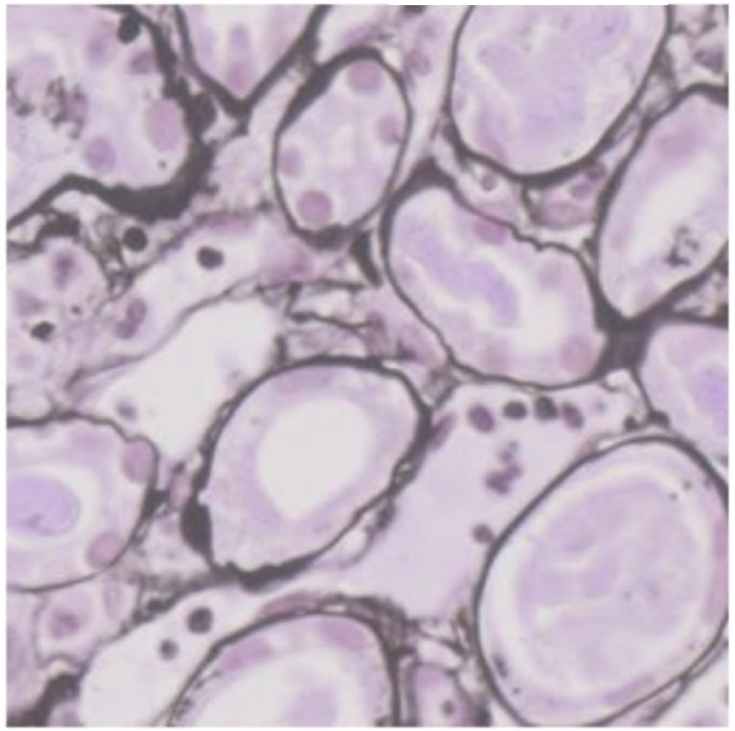
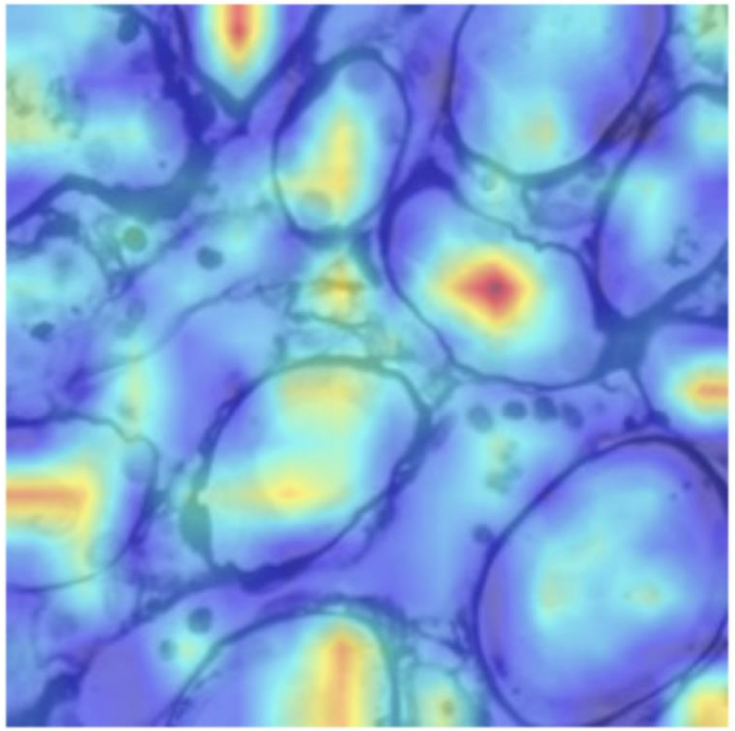
Banff-NET herkent meerdere afwijkingen per regio

Original Image

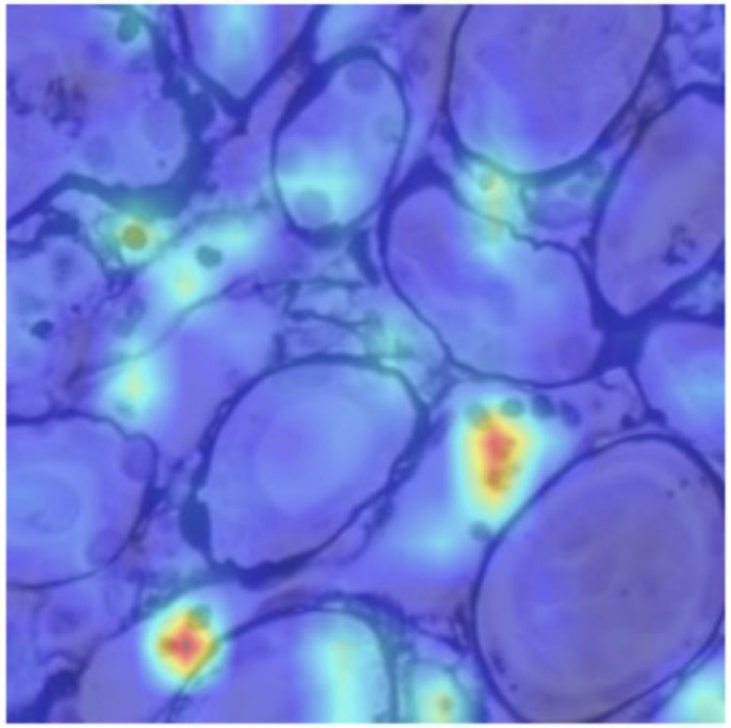


Attention-Based Relevance Map



Acute tubulusschade

Attention-Based Relevance Map



Ontsteking kleine vaatjes

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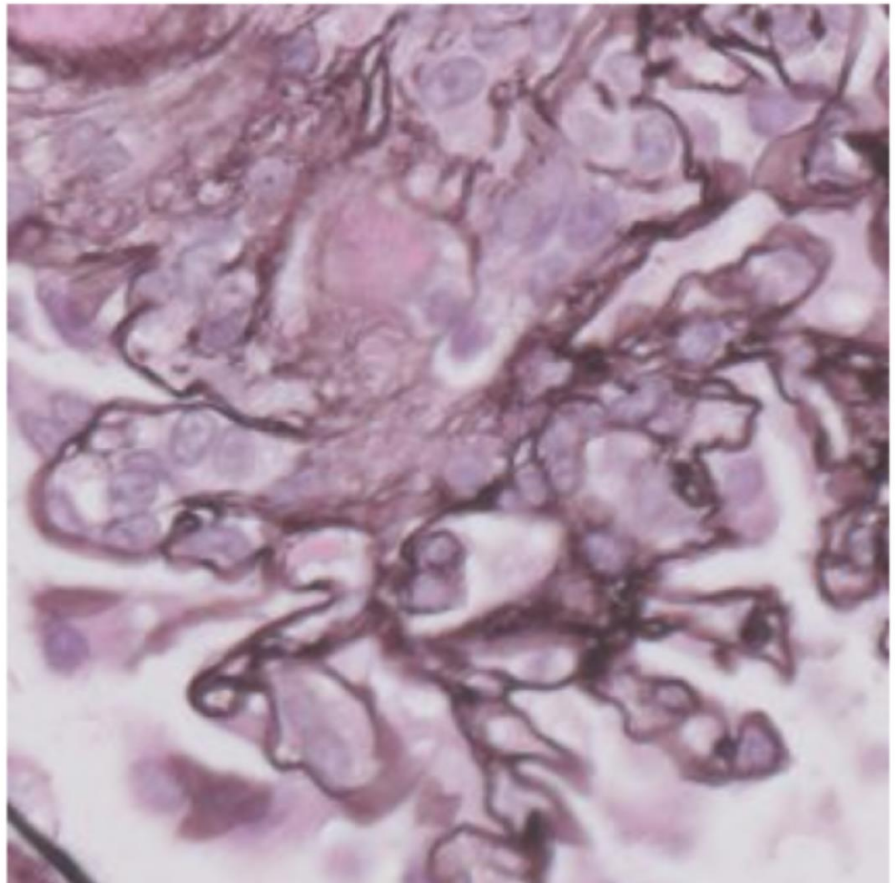
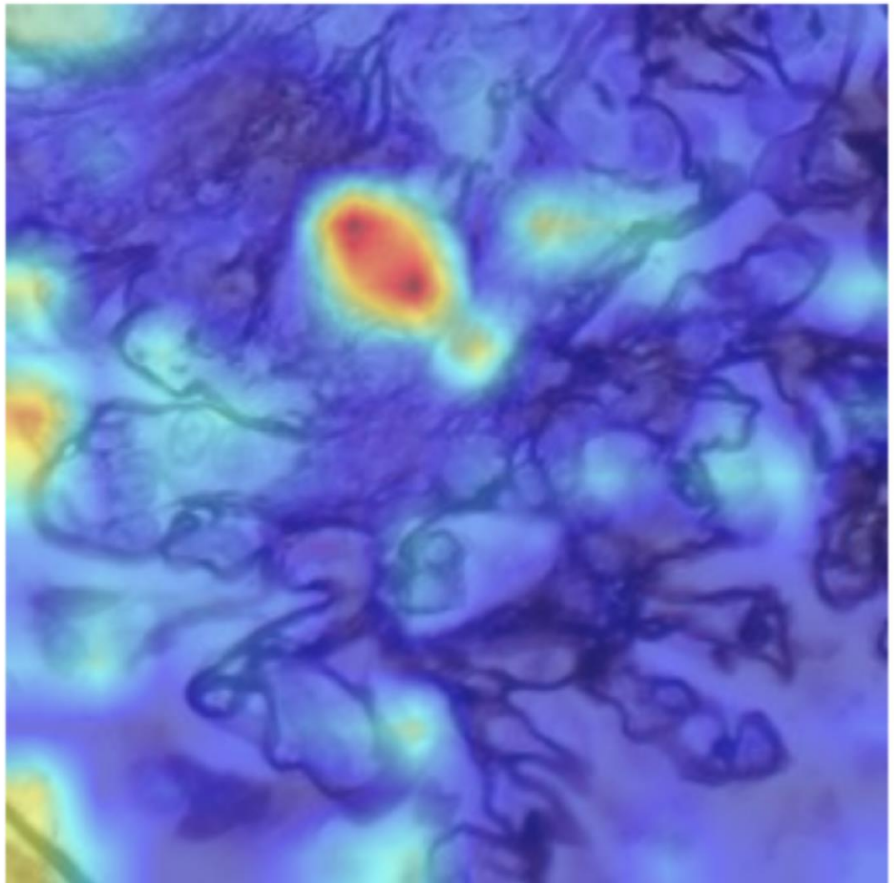
Banff-NET herkent moeilijke en lokale afwijkingen

Original Image showing tma



Attention-Based Relevance Map



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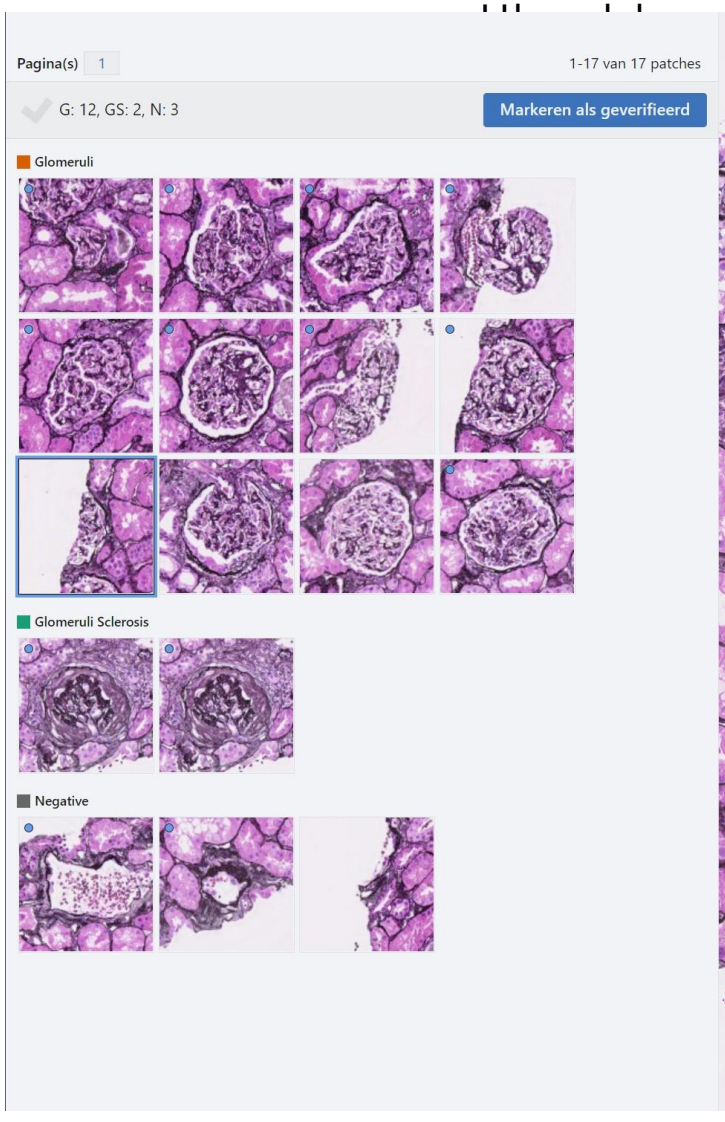
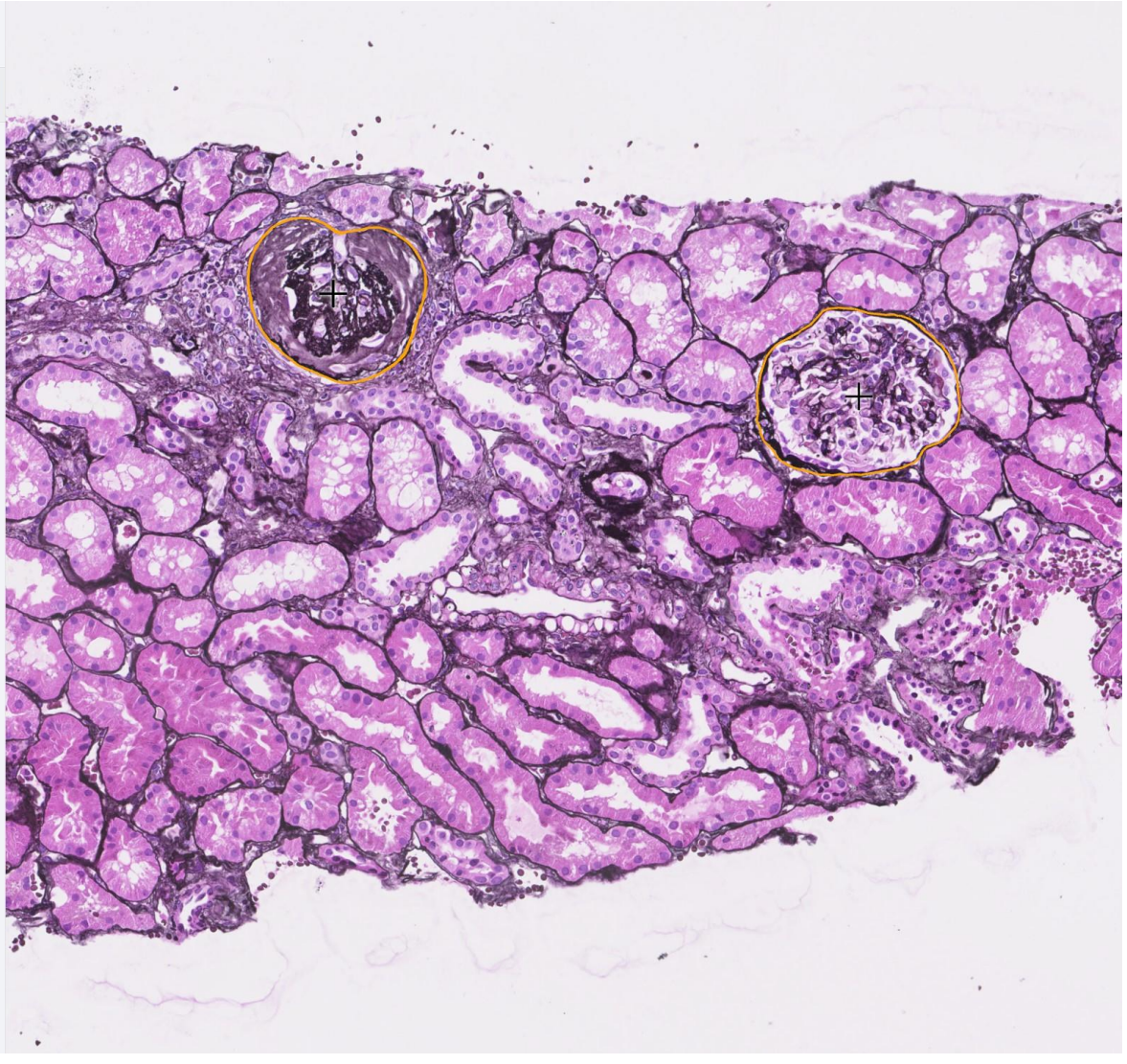
Impact voor patienten: **Implementatie kliniek!**

Samenwerking UMC





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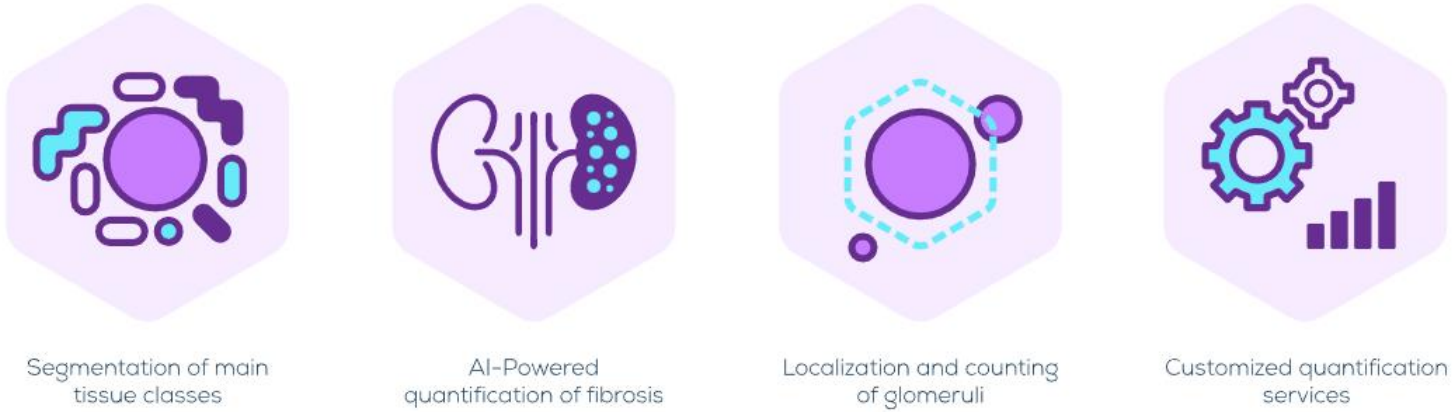
Impact voor patienten: **Certificering FDA/EMEA**



Aiosyn's Kidney image analysis news

Aiosyn achieve more perspective | HISTOWIZ

Aiosyn achieve more perspective | Physiogenex THE METABOLIC DISEASES EXPERTS

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Publicaties DEEPGRAFT

Hermsen et al. 2019 JASN
De Bel et al. 2019 proc mach learn res
Farris et al. 2020 Am J Transplant
Bulow et al. 2020 Kidney Int
Hermsen et al. 2021 Lab Invest
Zhang et al. 2022 ArXiv
Kers et al. 2022 Lancet Digital Health
Vasey et al. 2022 BMJ
Vasey et al. 2022 Nature Medicine
Hermsen et al. 2022 Am J Pathol
Roufosse et al. 2023 Am J Transplant
Farris et al. 2023 Transplant Int
Xiong et al. 2023 ArXiv
Vo et al. ArXiv
Tasca et al. 2024 Nature Reviews Nephrology
Tam et al. 2024 Front Transplant
Brussee et al. 2024 ArXiv

Presentaties op uitnodiging DEEPGRAFT

Banff Foundation 2019, Banff, Canada
AITRAC CARE-DX 2020, San Francisco, VS
TTS 2020, Seoel, Korea
European Pathology Conference 2021, Gotenborg, Zweden
TTS 2022, Buenos Aires, Argentinie
Banff Foundation 2022, Pittsburg, VS
Hot topics in transplantation 2023, Genua, Italie
Deep learning for renal pathology 2023, Chongqing, China
USCAP-RPS 2023, New Orleans, VS
Swiss Society for Pathology 2023, Lausanne, Zwitserland
ERA 2024, Stockholm, Zweden
Brazilian Society for Pathology 2024, Belem, Brazilie
ATC 2024, Philadelphia, VS
UK Kidney week 2024, Edinburgh, Schotland
Precision medicine course 2024, Bari, Italie
Banff foundation 2024, Parijs, Frankrijk
Saudi Society for Pathology 2024, Riyadh, Saoedi Arabie
Deep learning for pathology course 2024, Salvador, Brazilie

Het talent!

Giorgio Buzzanca (PhD student LUMC)	Weakly supervised learning, GNN modeling
Ling He (Postdoc LUMC)	Semantic segmentation modelling
Zhan Xiong (PhD student LIACS)	Instance/panoptic segmentation modelling
Jia Li (PhD student LIACS)	Weakly supervised learning
Siemen Brussée (PhD student LUMC)	Weakly supervised learning, GNN modelling
Pieter Valkema (PhD student LUMC)	Software engineering, segmentation modeling

Groep Aiko de Vries, LUMC
Groep Frederike Bemelman, AUMC
Groep Peter Boor in RWTH Aachen
Groep Maarten Naesens, KU Leuven
Groep Jeroen van der Laak, RUNMC
Groep Tri Nguyen, UMC Utrecht
Groep Anne-Roos Schrader, LUMC
Collega's nephropathologen en nefrologen
Fellows nefropathologie Amsterdam UMC

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Nierbiopten beoordelen met behulp van AI biedt uitkomst!

Jesper Kers, MD, PhD
Nierpatholoog Amsterdam UMC, Leiden UMC
Amsterdam, The Netherlands

DANK!!

Wetenschapsdag 2024

NIERSTICHTING Je nieren zijn je leven

nvn nierpatiënten vereniging nederland

nieren.nl vergroot je kennis, deel je ervaring

Je hebt zojuist een presentatie van de Nierpatiënten Vereniging Nederland bekeken of bijgewoond.

Hiermee willen we niet alleen onze leden, maar alle nierpatiënten informeren over nierziekten en het leven ermee. Ben je geen lid, maar sta je achter het werk van de NVN? Steun ons dan met een gift. Zodat we mooie webinars/themadagen kunnen blijven maken. Wij zijn blij met elke bijdrage! Scan hiervoor deze QR-code.

AstraZeneca HANSA BIOPHARMA CSL Vifor Chiesi astellas