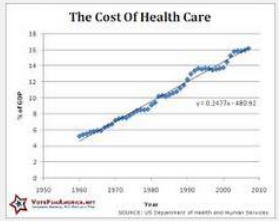
De digitale dokter

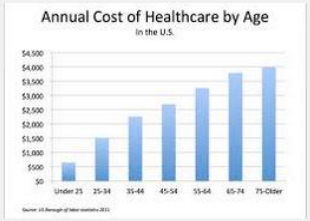
Geert Litjens
Diagnostic Image Analysis Group
Afdeling Pathologie

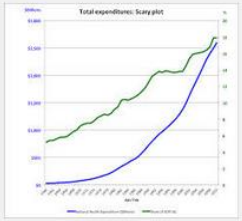
Radboudumc

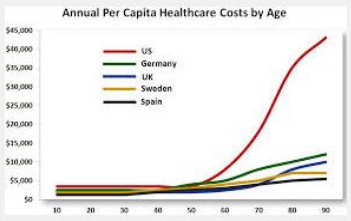
Google cost of healthcare

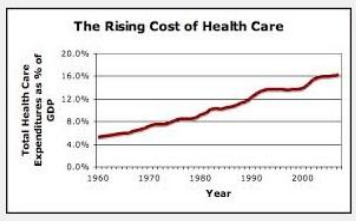
Web Images News Videos Shopping More Search tools

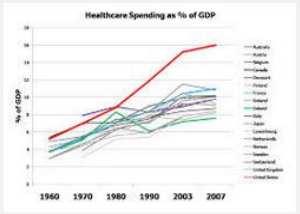


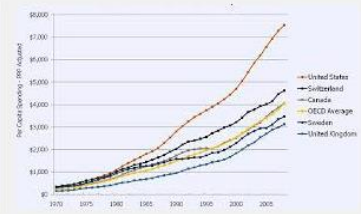


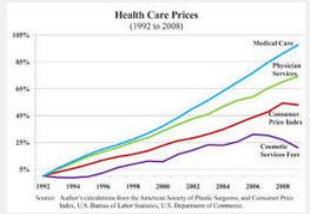


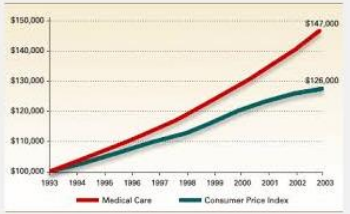


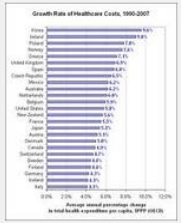


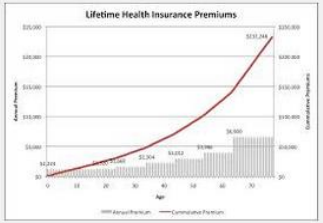


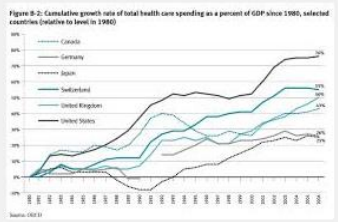


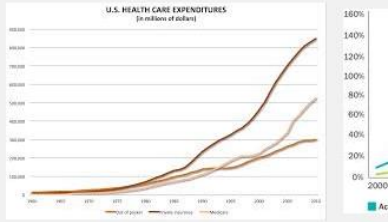


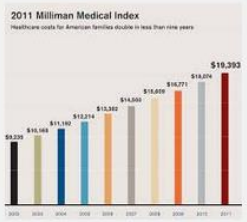


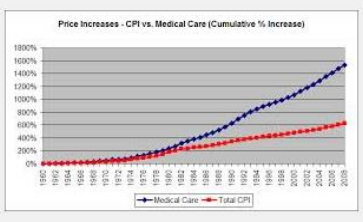


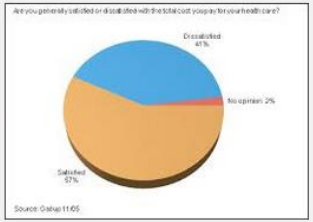




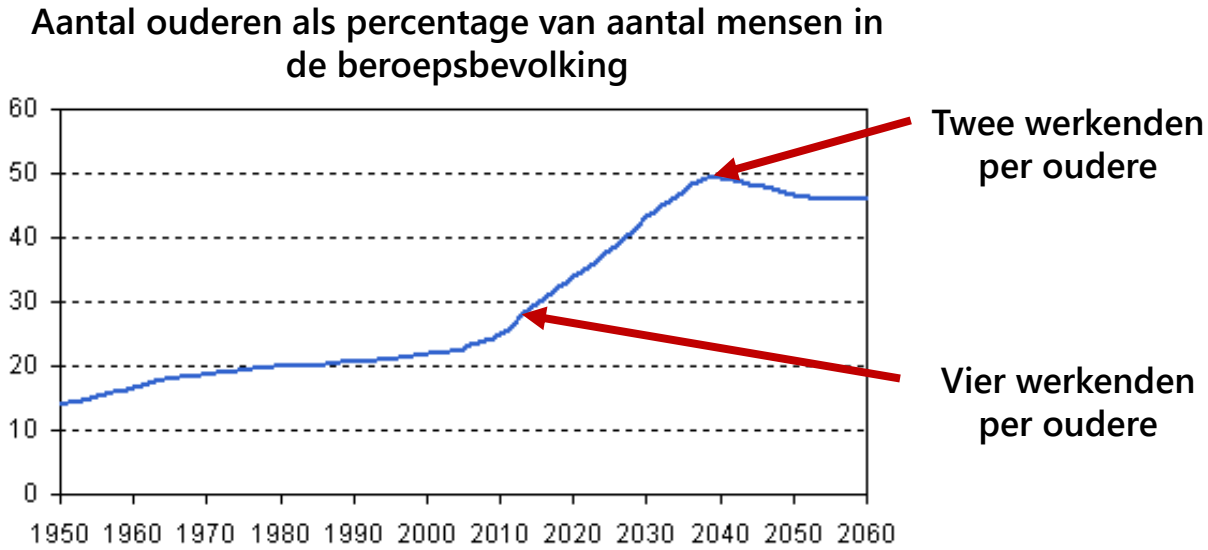








Vergrijzing



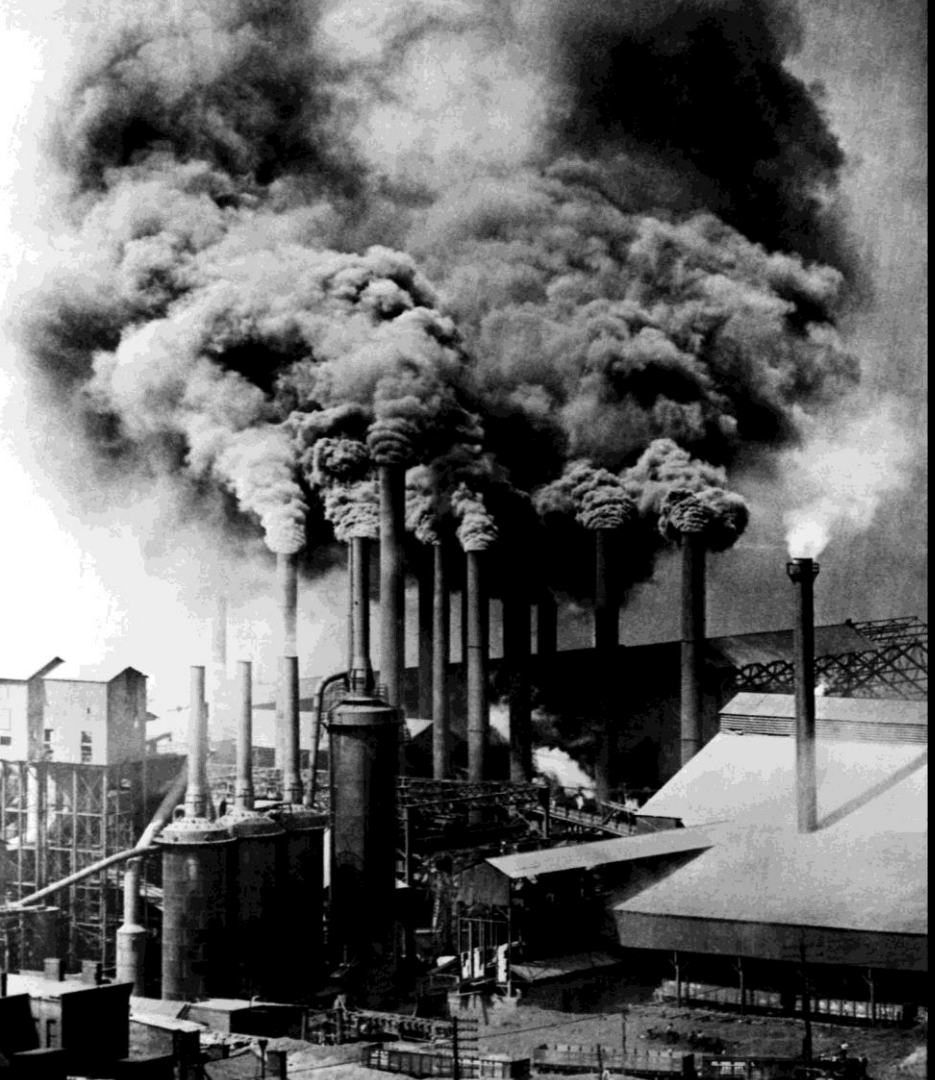
http://www.nationaalkompas.nl/bevolking/vergrijzing/toekomst

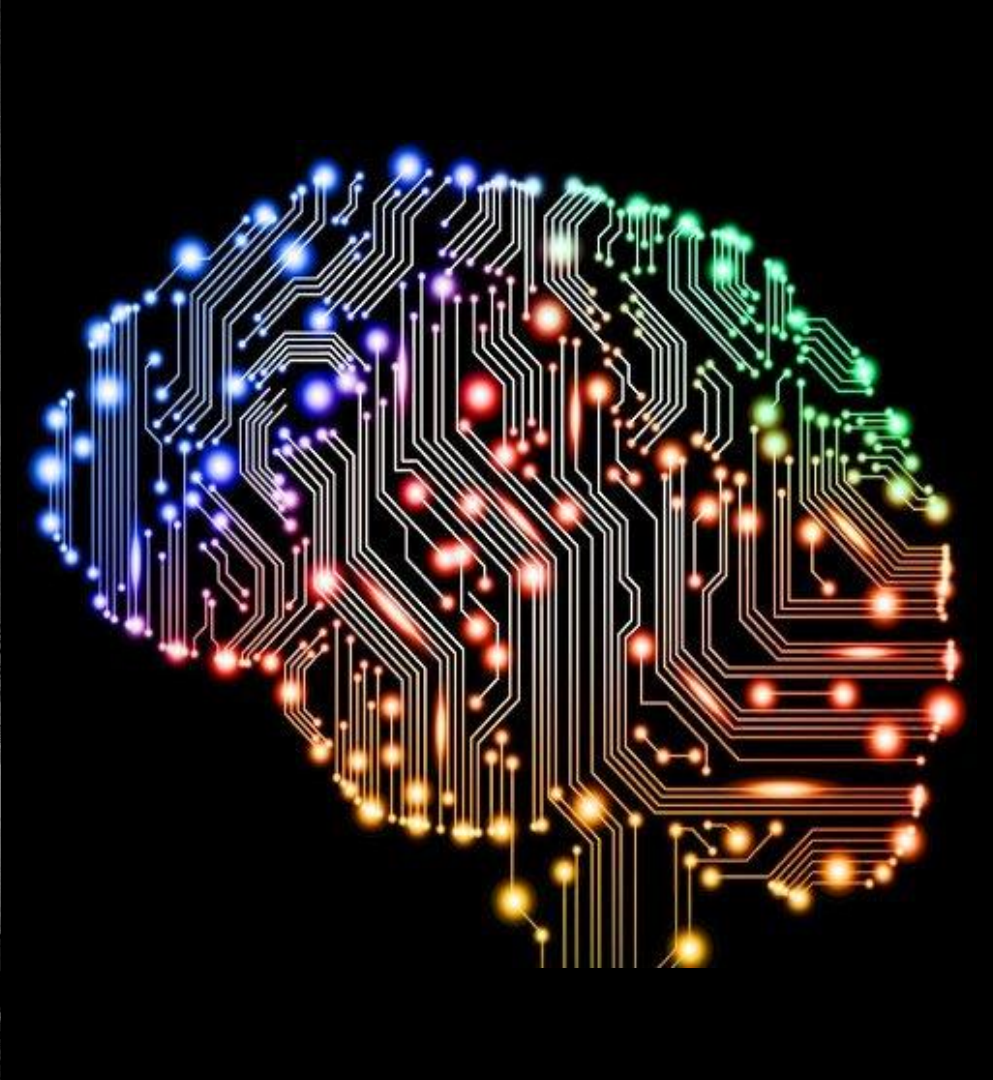
Oproep aan de Politieke Partijen

Gratis zorg bestaat niet, keuzes zijn onontkoombaar. Het is aan u, politieke leiders van Nederland, om zonder dralen kenbaar te maken waar uw partij voor staat.

eerlijk over uw politieke keuzes. Waar gaat het geld naar toe: technologie, thuiszorg, nieuwe chemotherapie, meer handen aan het bed?

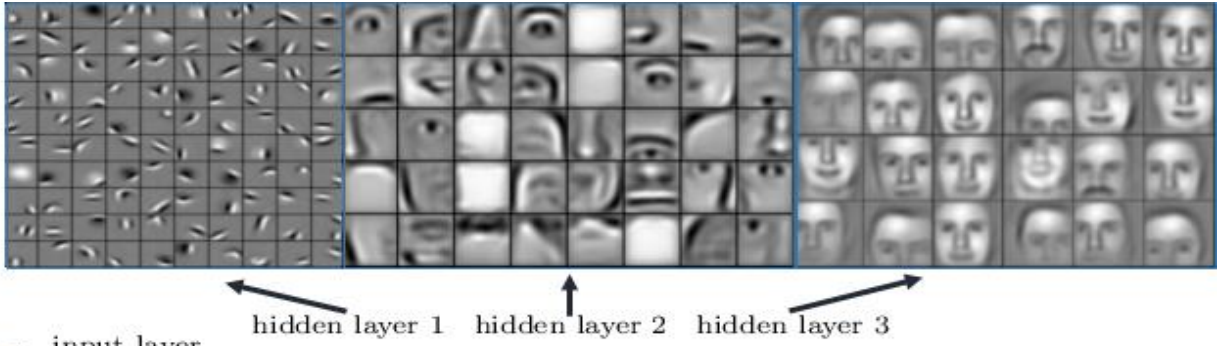
De grote paardenmestcrisis van 1894

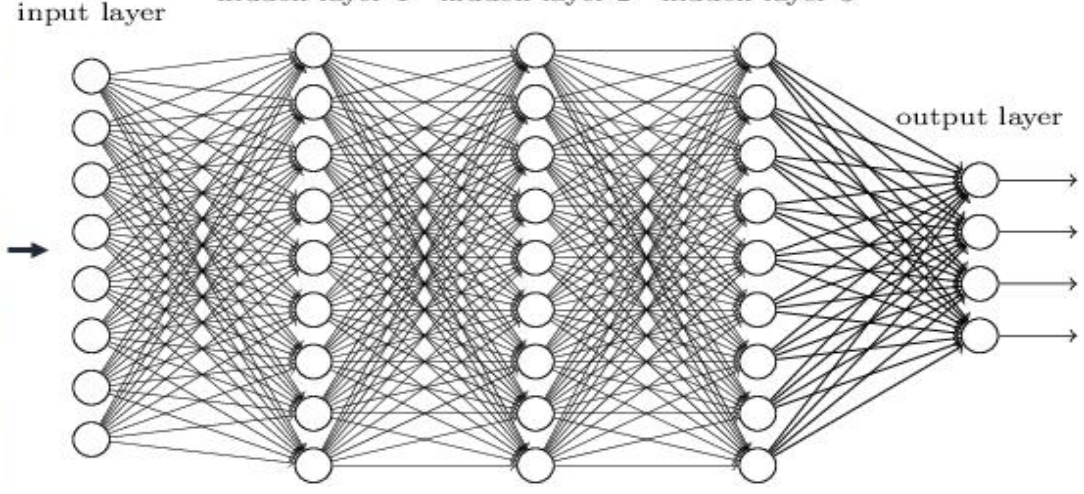




Deep learning

Deep neural networks learn hierarchical feature representations





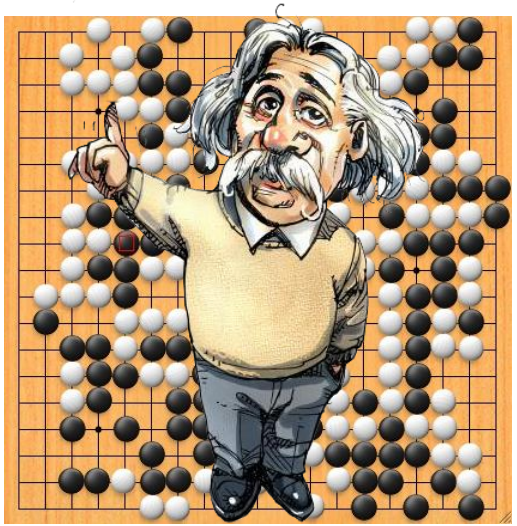
Mensen tegen computers

1997

2016

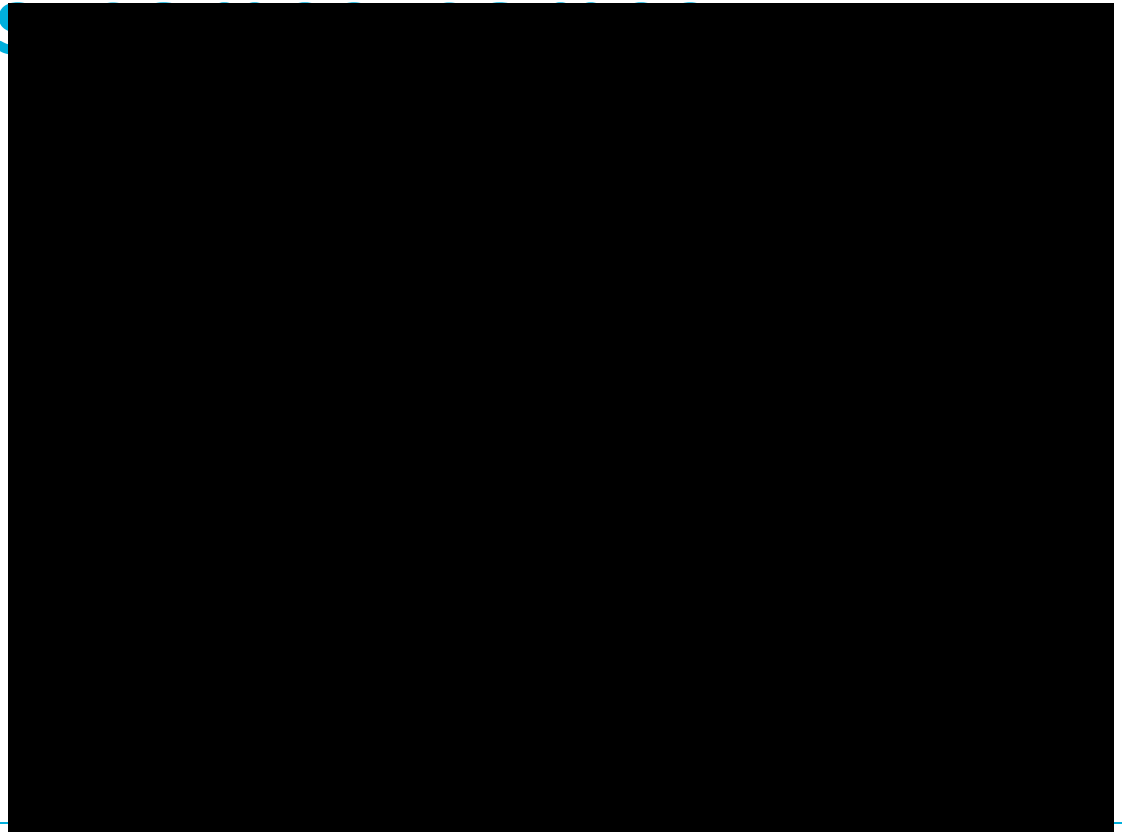
Why was this special?

25 possible moves on average per turn
40 moves per game



250 possible moves on average per turn
150 moves per game

Games



Asscher waarschuwt: 'extreme ongelijkheid' door robotisering

Door onze politieke redactie

DEN HAAG. Minister Lodewijk Asscher (Sociale Zaken, PvdA) omarmt de robotisering, maar waarschuwt voor de extreme ongelijkheid die daarvan het gevolg kan zijn.

Op een congres dat zijn ministerie vandaag over dit onderwerp organiseert, zegt Asscher dat de digitale ontwikkeling „op een keerpunt is beland" en de „vergaande effecten nu pas goed zichtbaar worden". De technologische ontwikkelingen raken volgens hem vooral aan de inkomens en werkgelegenheid aan de 'onderkant' en van de 'middenklasse'.

Tegelijkertijd ziet Asscher de robotisering als een grote kans. Nederland moet er met zijn open en ontwikkelde economie juist van profiteren, vindt hij. „We kunnen geen robotvrij eiland worden in Europa. Technologische vooruitgang zorgt voor meer welvaart, meer veiligheid en een hogere levensverwachting."

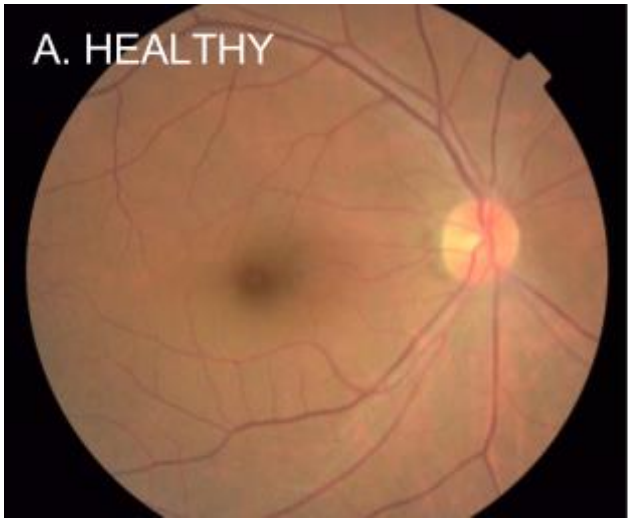
Volgens hem is het dringend nodig dat het middelbaar beroepsonderwijs „een kwaliteitssprong" maakt. Op basisscholen zouden vaardigheden aangeleerd moeten krijgen waar behoefte aan is in „het tweede machinetijdperk". Lezen, schrijven en rekenen is belangrijk, zegt Asscher, „maar in de digitale economie komt het steeds meer aan op conceptueel denken, brede patroonherkenning en complexe communicatie".

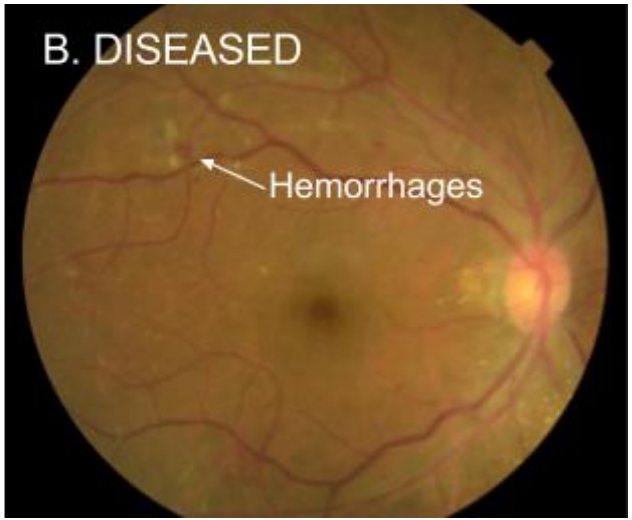
Asscher ziet nog een ander groot gevolg van de robotisering: de balans tussen arbeid en kapitaal komt volgens hem onder druk te staan. Als de productiviteit in bedrijven sterk stijgt door nieuwe technologie, komt „de rijkdom vooral terecht bij de profiterende kapitaalbezitters: de eigenaren van de robots". Ook hoogopgeleide werknemers hebben er voordeel bij: zij laten robots functioneren. Laagopgeleide werknemers krijgen steeds vaker een los contract en ze verdienen minder.

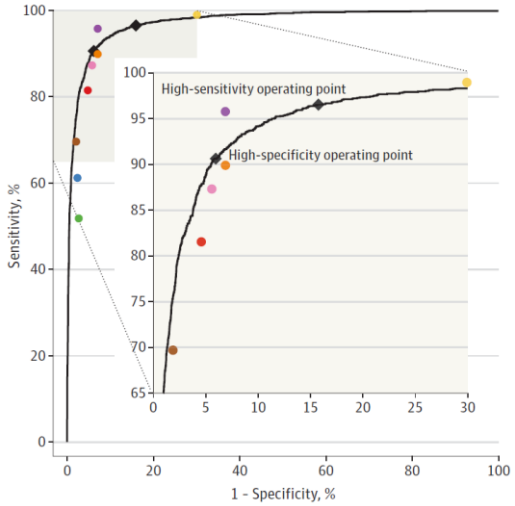
Volgens Asscher „is het zaak om ervoor te zorgen dat technologie hand in hand blijft gaan van een eerlijke verdeling van de resulterende welvaart". Hij vindt dat de zeggenschap van werknemers in een bedrijf - „op de werkvloer en in georganiseerd verband" - internationaal beter moet worden geregeld. Hij waarschuwt voor „extreme ongelijkheid". „Dat is niet alleen economisch schadelijk maar ook maatschappelijk ongewenst."

[+] **Opinie** pagina 17

Computer op het niveau van de oogarts







Gulshan et al. Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs. *JAMA (2016)*

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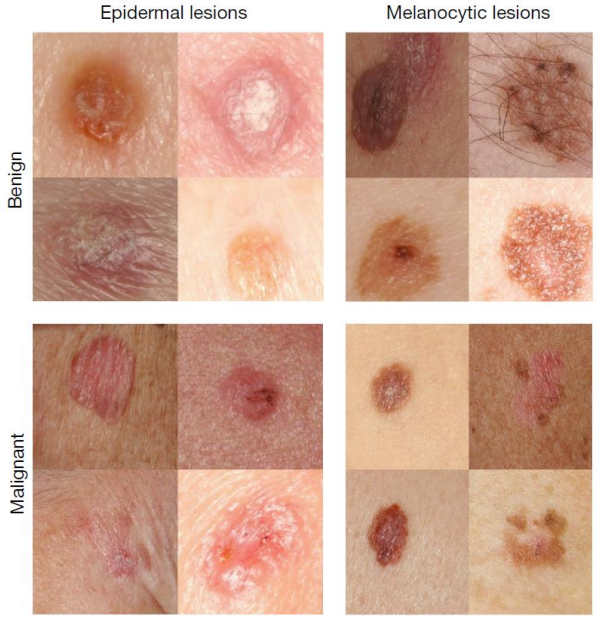
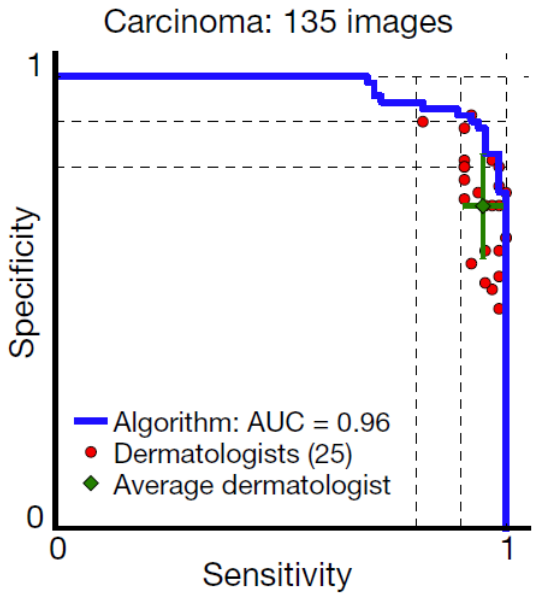
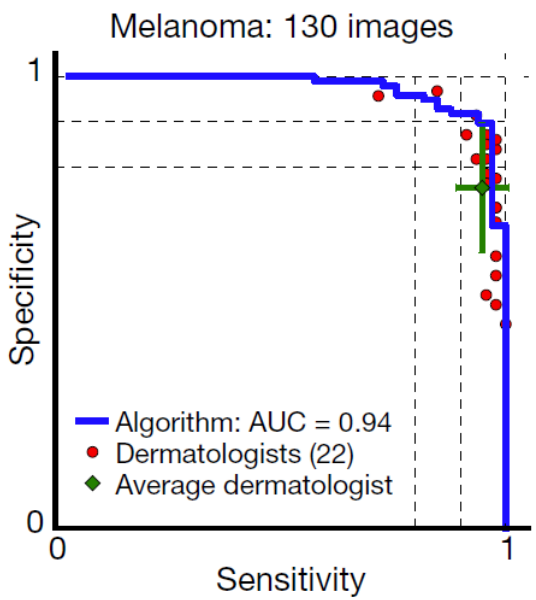
…en de dermatoloog







Esteva et al. Dermatologist-level classification of skin cancer with deep neural networks. *Nature (2016)*

Radboudumc

Histopathologic work-up of lymph nodes

CAMELYON16

ISBI challenge on cancer metastasis detection in lymph node

Home Background Rules Register Data Evaluation Submit Results Organizers Download Forum Program Admi

The data in this challenge contains a total of 400 whole-slide images (WSIs) of sentinel lymph node from two independent datasets collected in Radboud University Medical Center (Nijmegen, the Netherlands), and the University Medical Center Utrecht (Utrecht, the Netherlands).

The training dataset

The first training dataset consists of 170 WSIs of lymph node (100 Normal and 70 containing metastases) and the second 100 WSIs (including 60 normal slides and 40 slides containing metastases).

The ground truth data for the slides containing metastases is provided in two formats:

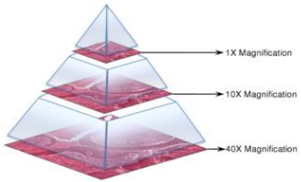
- .xml files containing vertices of the annotated contours
- WSI binary Masks

The test dataset

The test dataset consists of 130 WSIs which are collected from both Universities.

Visualizing the images and annotations

Whole-slide images are generally stored in a multi-resolution pyramid structure. Image files contain multiple downsampled versions of the original image. Each image in the pyramid is stored as a series of tiles, to facilitate rapid retrieval of subregions of the image. Reading these images using standard image tools or libraries is a challenge because these tools are typically designed for images that can comfortably be uncompressed into RAM or a swap file. OpenSlide is a C library that provides a simple interface to read WSIs of different formats.



Automated Slide Analysis Platform (ASAP) is an open source platform for visualizing, annotating and automatically analyzing whole-slide histopathology images. ASAP is built on top of several well-developed open source packages like OpenSlide, Qt and OpenCV. We strongly recommend the participants to use this platform for visualizing the slides and viewing the annotations. You can download ASAP from Github.

CAMELYON17

Home Background Rules Data Evaluation Registration Download Submission Results Forum Organisers Program

Overview

Built on the success of its predecessor, CAMELYON17 is the second grand challenge in pathology organised by the Diagnostic Image Analysis Group (DIAG) and Department of Pathology of the Radboud University Medical Center (Radboudumc) in Nijmegen, The Netherlands.

The goal of this challenge is to evaluate new and existing algorithms for automated detection and classification of breast cancer metastases in whole-slide images of histological lymph node sections. This task has high clinical relevance and would normally require extensive microscopic assessment by pathologists. The presence of metastases in lymph nodes has therapeutic implications for breast cancer patients. Therefore, an automated solution would hold great promise to reduce the workload of pathologists while at the same time reduce the subjectivity in diagnosis.

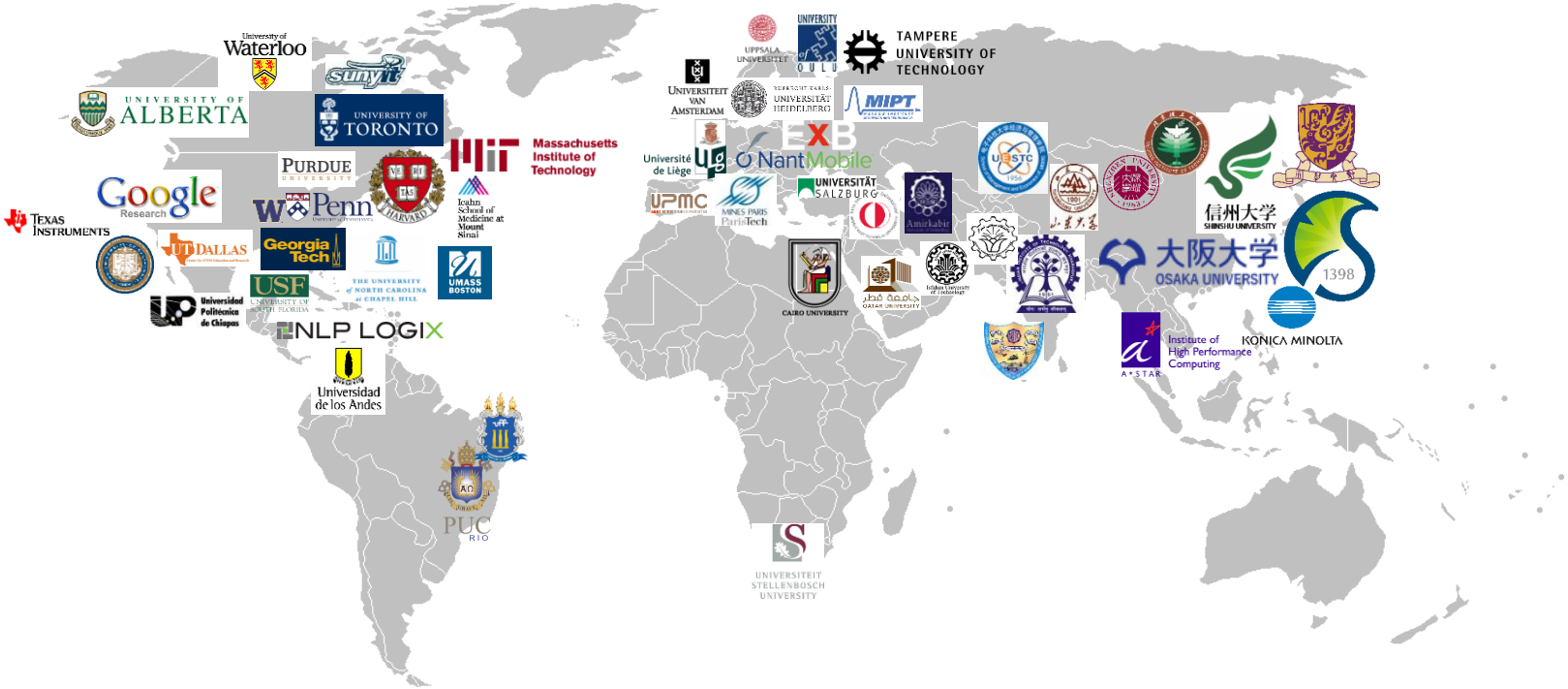
Last year at ISBI, we organised the highly successful CAMELYON16 grand challenge, in which 32 submissions from as many as 23 research groups were received. This was the first challenge ever using whole-slide images, having participants download over 600GB of data. This year, CAMELYON17 will invigorate the challenge by moving from slide level analysis to patient level analysis (i.e. combining the assessment of multiple lymph node slides into one outcome). This will bring the efforts closer to direct usefulness in a clinical setting. Compared to last year, the dataset will be significantly extended and will contain images from five medical centers.

How to participate

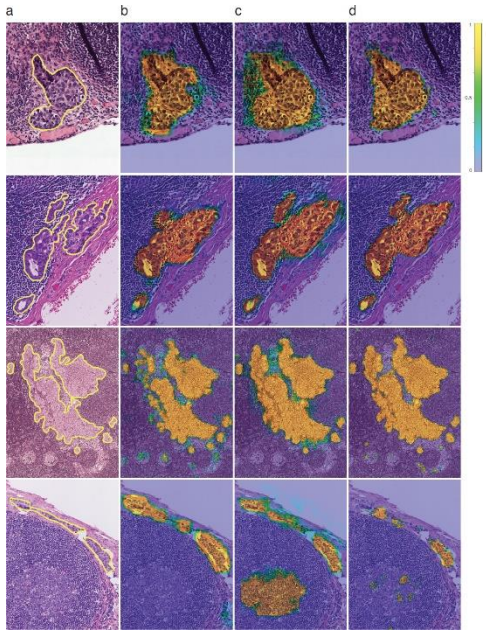
1. Read the rules carefully.
2. Register for the challenge by filling in the online registration form. Registration is a mandatory step before downloading data and submitting results to the challenge. We recommend registering with a Gmail address.
3. When your registration to CAMELYON17 is accepted, you will receive an invitation to the Google Drive where the challenge data set is shared.
4. CAMELYON17 has a Google group which enables discussion about different topics relevant to the challenge. We encourage you to participate in this group after registration.
5. After the results submission deadline, the organisers will evaluate the results. The results will be made public at the challenge workshop, and afterwards, on this website.

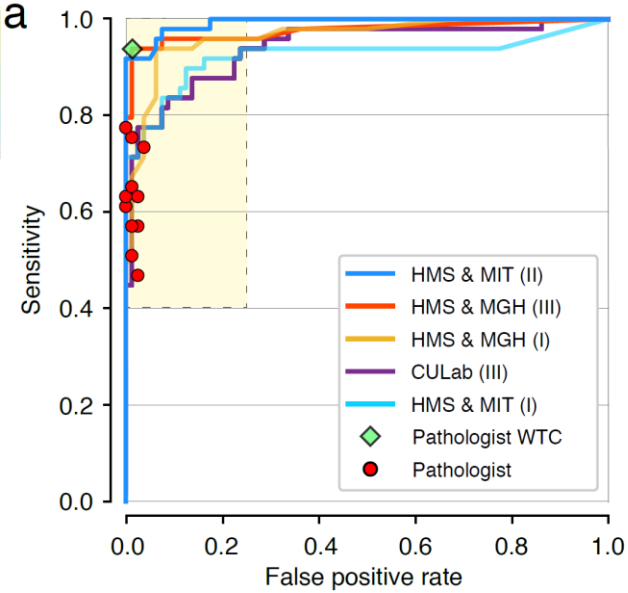
Important dates

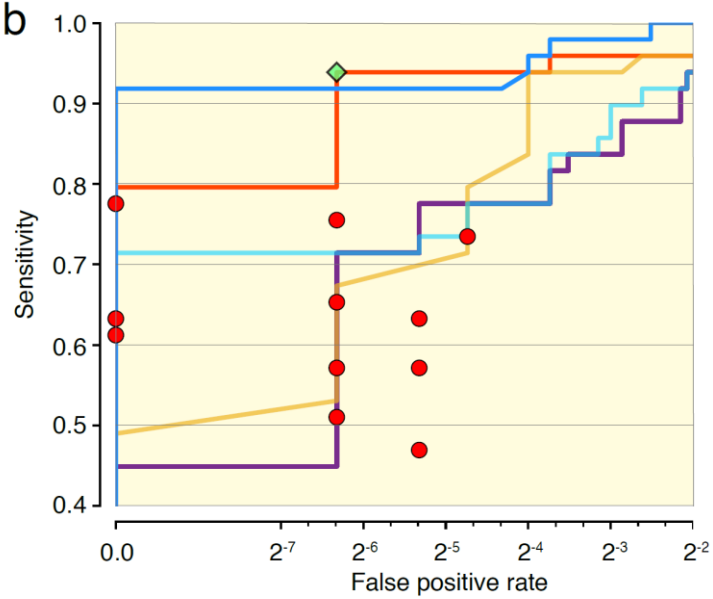
Radboudumc


University of Waterloo
UNIVERSITY OF ALBERTA
sunyit
UNIVERSITY OF TORONTO
PURDUE UNIVERSITY
Google Research
Penn
HARVARD
Massachusetts Institute of Technology
Icahn School of Medicine at Mount Sinai
TEXAS INSTRUMENTS
UT DALLAS
Georgia Tech
UMASS BOSTON
USF
THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL
Universidad Politécnica de Chiapas
NLP LOGIX
Universidad de los Andes
PUC RIO
UPPSALA UNIVERSITET
UNIVERSITY OF OULU
TAMPERE UNIVERSITY OF TECHNOLOGY
UNIVERSITEIT VAN AMSTERDAM
RUPRECHT-KARLS-UNIVERSITÄT HEIDELBERG
MIPT
Université de Liège
EXB
NantMobile
UPMC
MINES ParisTech
UNIVERSITÄT SALZBURG
AmurKabie
CAIRO UNIVERSITY
UBSTC
信州大学 SHINSHU UNIVERSITY
大阪大学 OSAKA UNIVERSITY
1398
KONICA MINOLTA
Institute of High Performance Computing
A*STAR
UNIVERSITEIT STELLENBOSCH UNIVERSITY

…en de patholoog







Ehteshami et al. *Submitted*

Radboudumc

THE NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT STRATEGIC PLAN

National Science and Technology Council

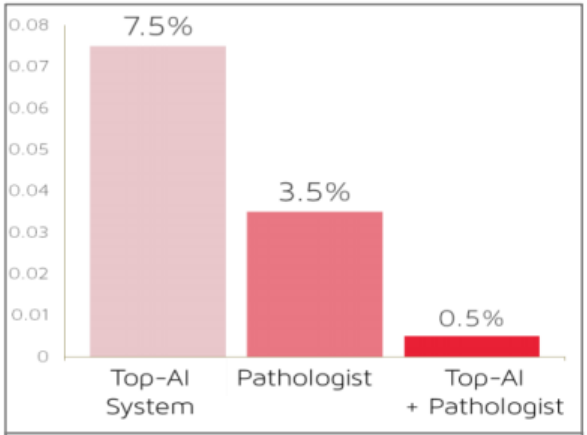
Networking and Information Technology Research and Development Subcommittee

October 2016

National Institutes of Health (NIH) grants-supported research

ARTIFICIAL INTELLIGENCE FOR COMPUTATIONAL PATHOLOGY

Image interpretation plays a central role in the pathologic diagnosis of cancer. Since the late 19th century, the primary tool used by pathologists to make definitive cancer diagnoses is the microscope. Pathologists diagnose cancer by manually examining stained sections of cancer tissues to determine the cancer subtype. Pathologic diagnosis using conventional methods is labor-intensive with poor reproducibility and quality concerns. New approaches use fundamental AI research to build tools to make pathologic analysis more efficient, accurate, and predictive. In the 2016 Camelyon Grand Challenge for metastatic cancer detection,[69] the top-performing entry in the competition was an AI-based computational system that achieved an error rate of 7.5%.[70] A pathologist reviewing the same set of evaluation images achieved an error rate of 3.5%. Combining the predictions of the AI system with the pathologist lowered the error rate to down to 0.5%, representing an 85% reduction in error (see image).[71] This example illustrates how fundamental research in AI can drive the development of high performing computational systems that offer great potential for making pathological diagnoses more efficient and more accurate.



AI significantly reduces pathologist error rate in the identification of metastatic breast cancer from sentinel lymph node biopsies.

Radboudumc

Reportage Kankeronderzoek

Opmars van de digitale patholoog

Pathologen zeggen hun microscoop vaarwel. Computers beloven een revolutie bij opsporing van tumoren.

Van onze verslaggever
Gerard Reijn

Peter Bult

Jeroen van der Laak

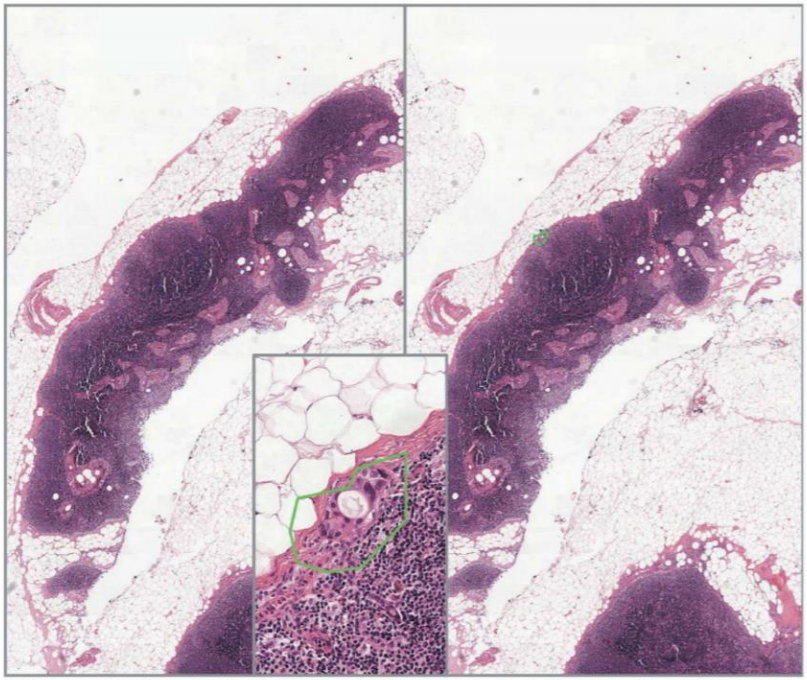
NIJMEGEN Je krijgt hem bijna nooit te zien, maar de dokter die uiteindelijk vaststelt of je kanker hebt, is de patholoog. De oncoloog en de radioloog zullen hun vermoedens hebben, maar de diagnose kanker staat pas vast als de patholoog het zegt.

Het belangrijkste instrumentarium daarbij is de microscoop. De patholoog ziet zelden patiënten, maar richt zich op honderden malen vergrote stukjes weefsel, ontdekt daarin bepaalde patronen en besluit dan: ja of nee.

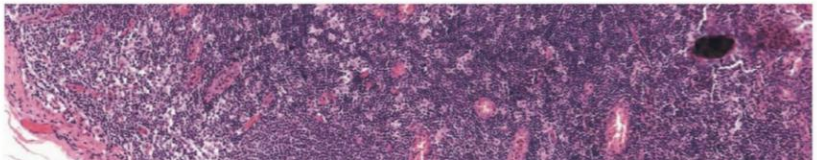
ton kwijt aan opslagkosten. En die rekening loopt snel op: al die beelden worden tientallen jaren bewaard. Ook de rest van het systeem moet top zijn. Anders zit je als patholoog maar te wachten tot de beelden zijn binnengekomen.

Maar het is de moeite waard, zegt Paul van Diest, hoofd van de afdeling pathologie van UMC Utrecht. Nu al zijn de voordelen merkbaar, zegt hij. 'Ik had het niet verwacht, maar het werkt sneller.' Door de digitalisering staat het vakgebied voor een revolutie.

Wil een patholoog nu



Patholoog Peter Bult, verbonden aan het Radboudumc: 'De computer vindt hier een kleine metastase, een uitzaaiing, die door een patholoog nog wel eens over het hoofd kan worden gezien.'



Diagnostic Image Analysis Group

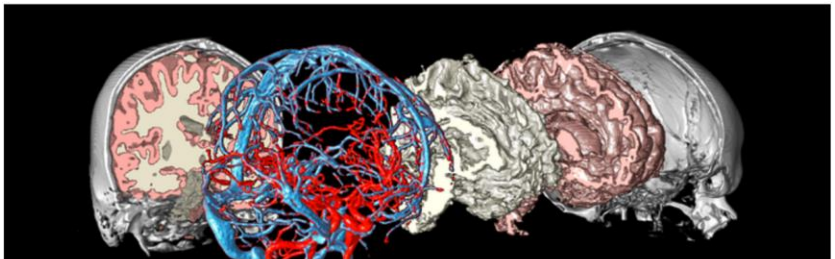
The Diagnostic Image Analysis Group is part of the Department of Radiology and Nuclear Medicine of Radboud University Medical Center. We develop computer algorithms to aid clinicians in the interpretation of medical images and thereby improve the diagnostic process.

The group has its roots in computer-aided detection of breast cancer in mammograms, and we have expanded to automated detection and diagnosis in breast MRI, ultrasound and tomosynthesis, chest radiographs and chest CT, prostate MRI, neuro-imaging and the analysis of retinal and digital pathology images.

It is our goal to have a significant impact on healthcare by bringing our technology to the clinic. We are therefore fully certified to develop, maintain, and distribute software for analysis of medical images in a quality controlled environment (MDD Annex II and ISO 13485). To date two products, ProCAD and CAD4TB, have been CE marked and are in active use in over ten countries.

On this site you find information about the history of the group and our collaborations, an overview of people in DIAG, current projects, publications and theses, contact information, and info for those interested to join our team.

Highlight



Chair


Bram van Ginneken
+31 24 3619811


Nico Karssemeijer
+31 24 3614548

Faculty


Francesco Ciompi
+31 24 3614322


Henkjan Huisman
+31 24 3617536


Colin Jacobs
+31 24 3614539


Jeroen van der Laak
+31 24 3614367


Geert Litjens
+31 243614322


Rashindra Manniesing
+31 24 3616708


Bram Platel
+31 24 3614766


Eva van Rikxoort
+31 24 3614539


Clarisa Sánchez
+31 24 3616708


Cornelia Schaefer-Prokop
+31 24 3616708

Scientific Staff


Albert Gubern-Mérida
+31 24 3614539


Ernst Scholten
+31 24 3655792

Technical Staff


Paul Konstantin Gerke
+31 24 3652283


Sjoerd Kerkstra
+31 24 3610972


Sven Lafebre
+31 24 3610972


James Meakin
+31 24 36 52283


Luuk Oostveen
+31 24 3613484


Irene Otte-Holler
+31 24 36 68920


Carl Shneider
+31 24 3655792


Laura Stoilescu
+31 24 3652270

PhD Candidates


Max Argus
+31 24 3655792


Christiana Balta


Jean-Paul Charbonnier
+31 24 3655792


Mehmet Dalmis
+31 24 3653731


Babak Ehteshami Bejnordi
+31 24 3655793


Oscar Geessink
+31 653579421


Meyke Hermsen
+31 24 3668916


Katharina Holland
+31 24 3652283


Thijs Kooi
+31 24 3090032


Bart Liefers
+31 24 3616651


Jan-Jurre Mordang
+31 24 3652289


Ajay Patel
+31 24 3652272


Sarah van Riel
+31 24 3655792


Maschenka Balkenhol
+31 24 36 68920


Peter Bandi
+31 24 3614322


Kaman Chung
+31 24 3653731


Oscar Debats
+31 24 3655793


Leticia Gallardo Estrella
+31 24 3652289

Mohsen Ghafoorian
+31 24 3652289

Thomas van den Heuvel
+31 24 3616651

Gabriel Humpire Mamani

Sil van de Leemput
+31 24 3616651

Midas Meijs
+31 24 3090032

Marcel Oei
+31 24 3652282

Rick Philipsen
+31 24 3652289

Wendelien Sanderink
+31 24 3618763

Arnaud Arindra Adiyoso Setio
+31 24 3655792

David Tellez
+31 24 3614322

Suzan Vreemann
+31 24 3652283

Ewoud Smit

Freerk Venhuizen
+31 24 3652272

Jan van Zelst
+31 24 3653723

Visiting Researchers

Zijian Bian
+31 24 3690032

Yannick Hogewind

Thomas van Heyningen

Itsara Wichakam

Medical Imaging 2003: Image Processing, Milan Sonka, J. Michael Fitzpatrick, Editors,
Proceedings of SPIE Vol. 5032 (2003) © 2003 SPIE · 1605-7422/03/$15.00

Award Paper

Assessing the Skeletal Age From a Hand Radiograph: Automating the Tanner-Whitehouse Method

M. Niemeijer[a], B. van Ginneken[a], C.A. Maas[a], F.J.A. Beek[b] and M.A. Viergever[a]

[a]Image Sciences Institute, University Medical Center Utrecht, The Netherlands
[b]Dept. of Radiology, University Medical Center Utrecht, The Netherlands

ABSTRACT

The skeletal maturity of children is usually assessed from a standard radiograph of the left hand and wrist. An established clinical method to determine the skeletal maturity is the Tanner-Whitehouse (TW2) method. This method divides the skeletal development into several stages (labelled A,B, ...,I). We are developing an automated system based on this method. In this work we focus on assigning a stage to one region of interest (ROI), the middle phalanx of the third finger. We classify each ROI as follows. A number of ROIs which have

Figure 1. Example of several different stages of development of an ossification center in the finger.

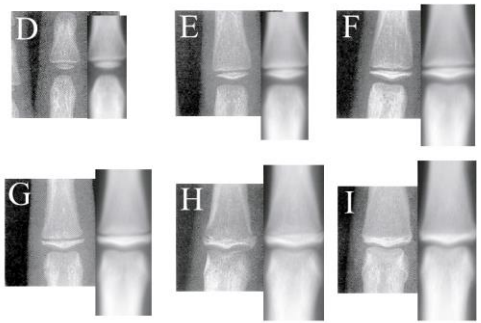
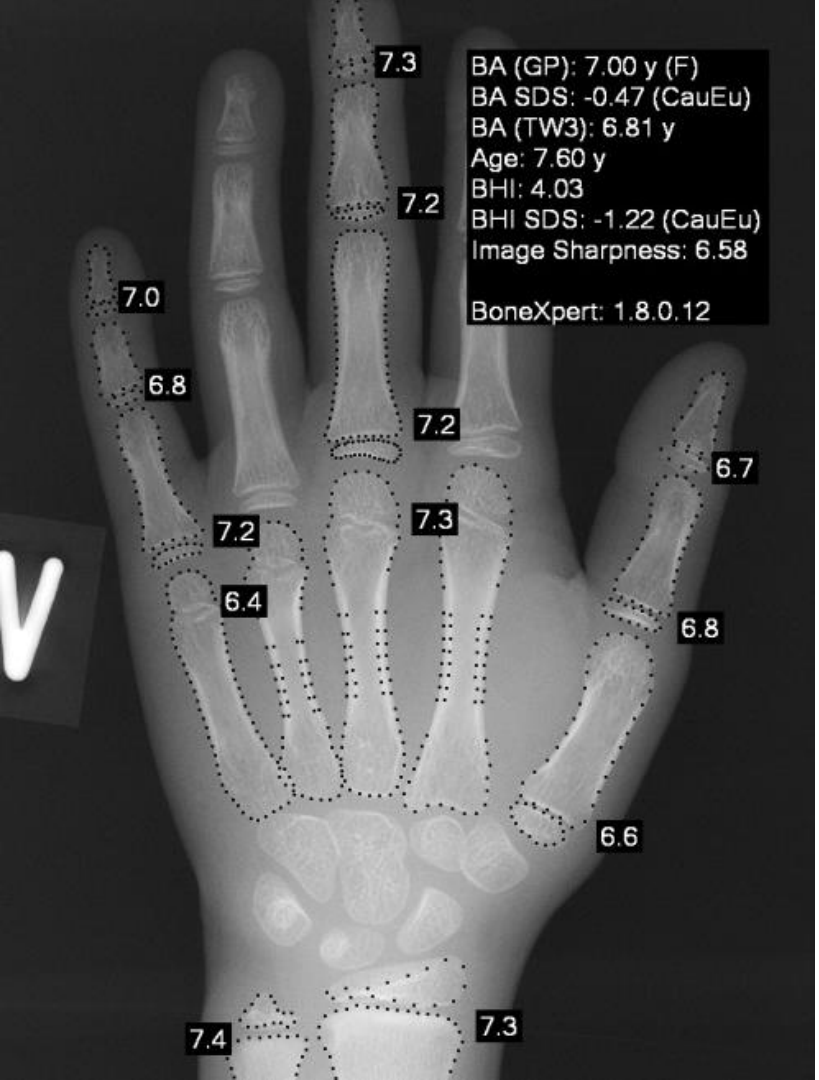


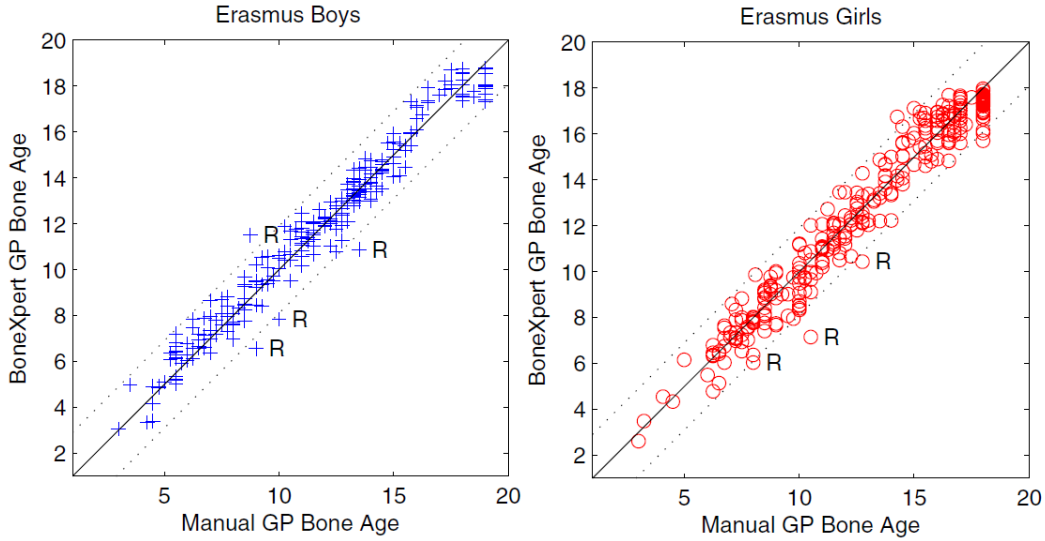
Figure 3. Mean images for stages D to I of the middle phalanx of the third finger. On the left of each pair the TW2 atlas reference image is shown. On the right the mean image used in our experiments.

	second observer				
	E	F	G	H	I
E	16	2	0	0	0
F	4	11	4	0	0
G	0	2	11	0	0
H	0	0	0	9	2
I	0	0	0	0	10

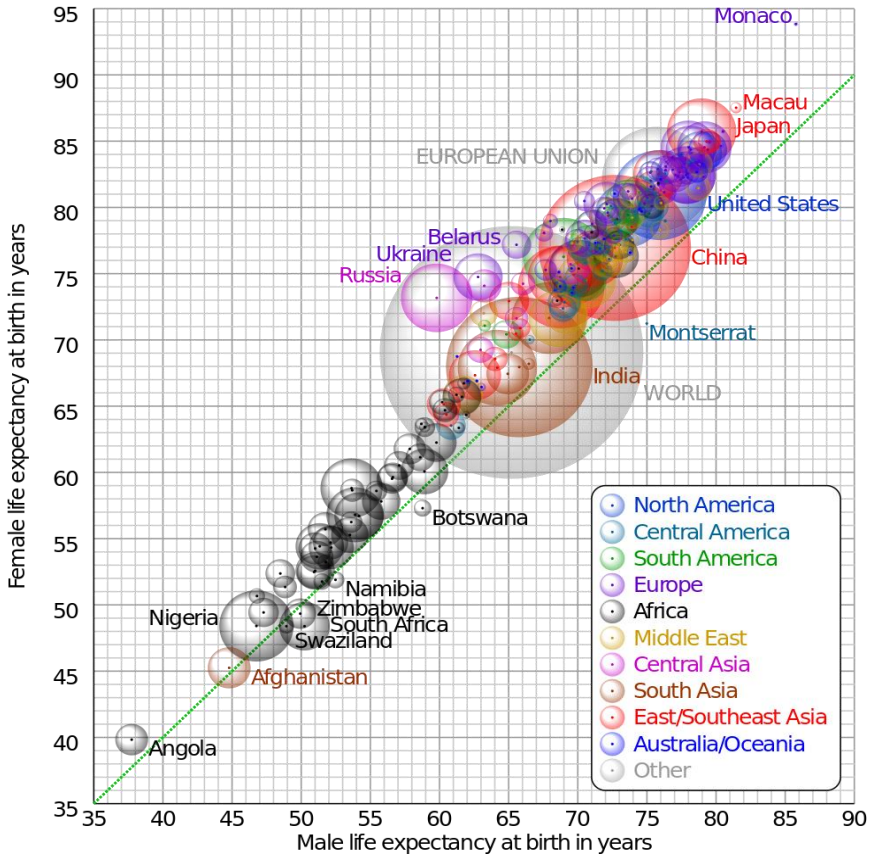
80.3% correct

100% correct within one stage





Van Rijn et al. Pediatr Radiol (2009) 39:591–7


Female life expectancy at birth in years
Male life expectancy at birth in years
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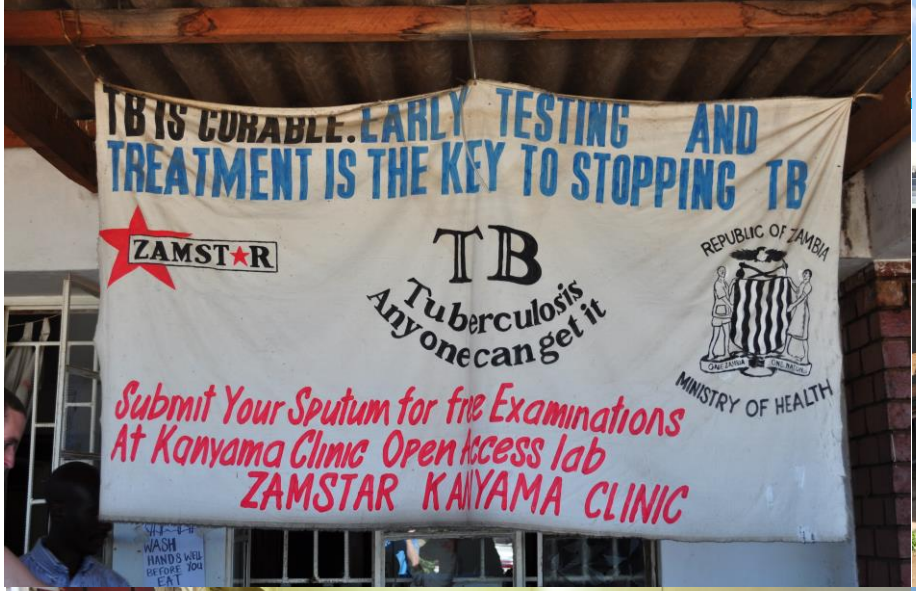
Monaco
Macau
Japan
EUROPEAN UNION
United States
Belarus
Ukraine
Russia
China
Montserrat
India
WORLD
Botswana
Namibia
Zimbabwe
Nigeria
South Africa
Swaziland
Afghanistan
Angola
North America
Central America
South America
Europe
Africa
Middle East
Central Asia
South Asia
East/Southeast Asia
Australia/Oceania
Other


TB IS CURABLE. EARLY TESTING AND
TREATMENT IS THE KEY TO STOPPING TB
ZAMSTAR
TB
Tuberculosis
Anyone can get it
REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
Submit Your Sputum for free Examinations
At Kanyama Clinic Open Access lab
ZAMSTAR KANYAMA CLINIC


CAD4TB
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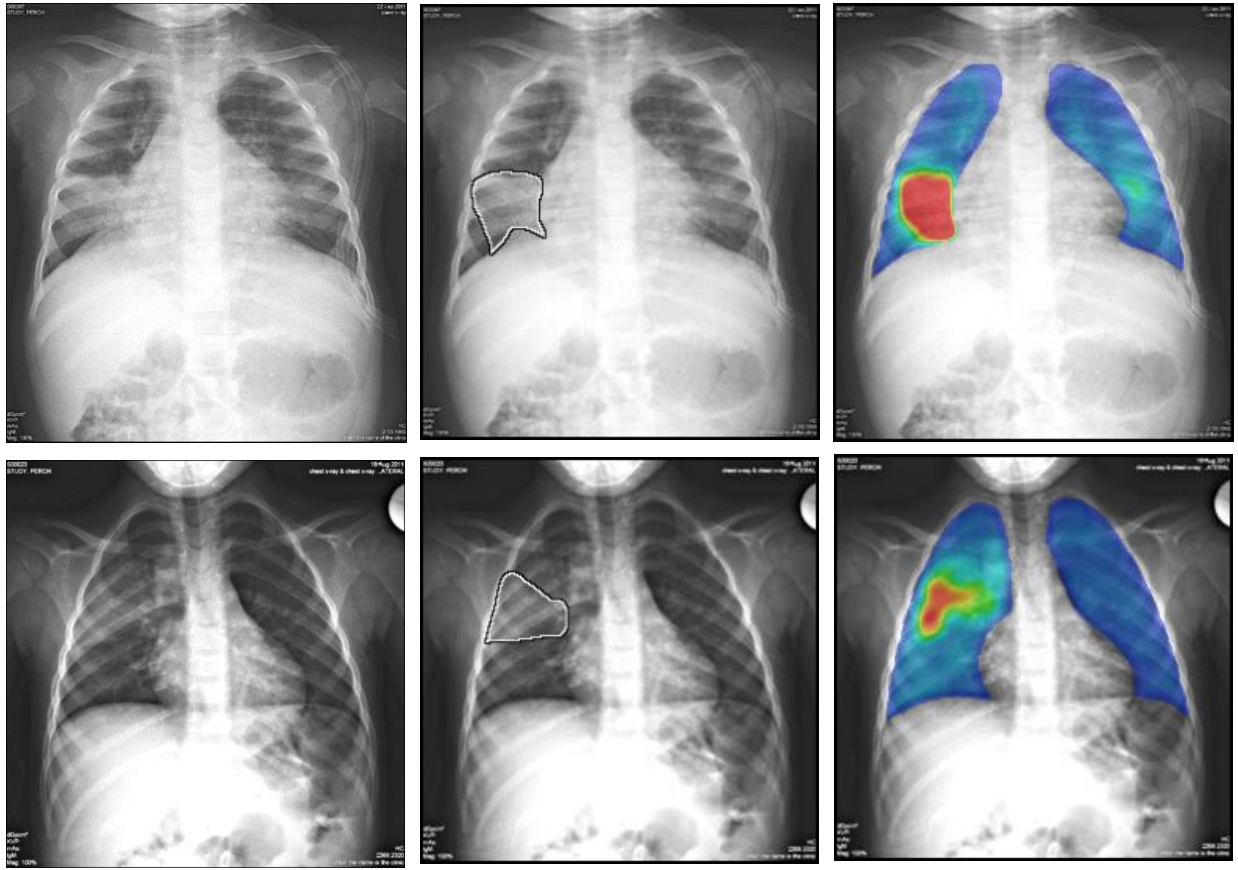
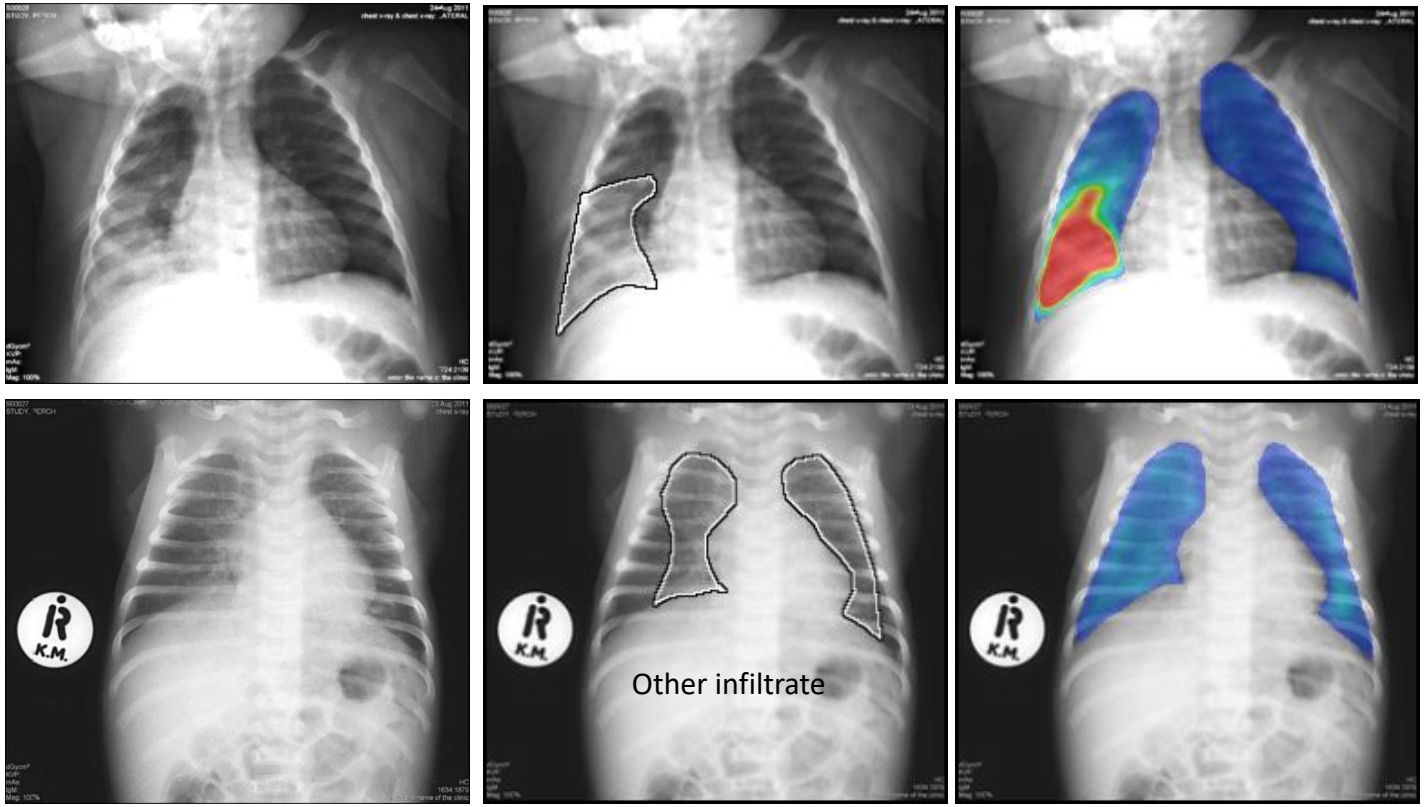
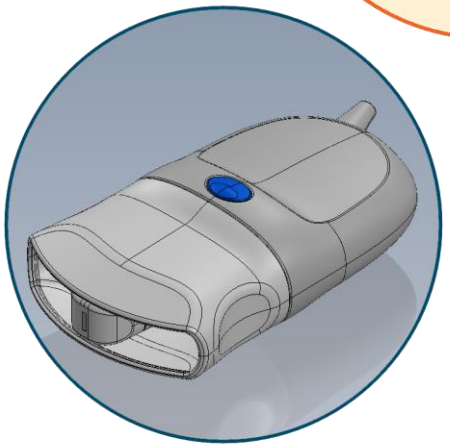


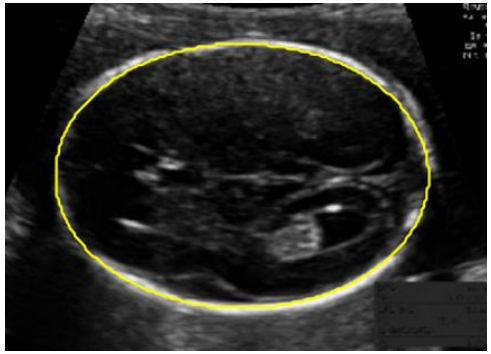

Other infiltrate

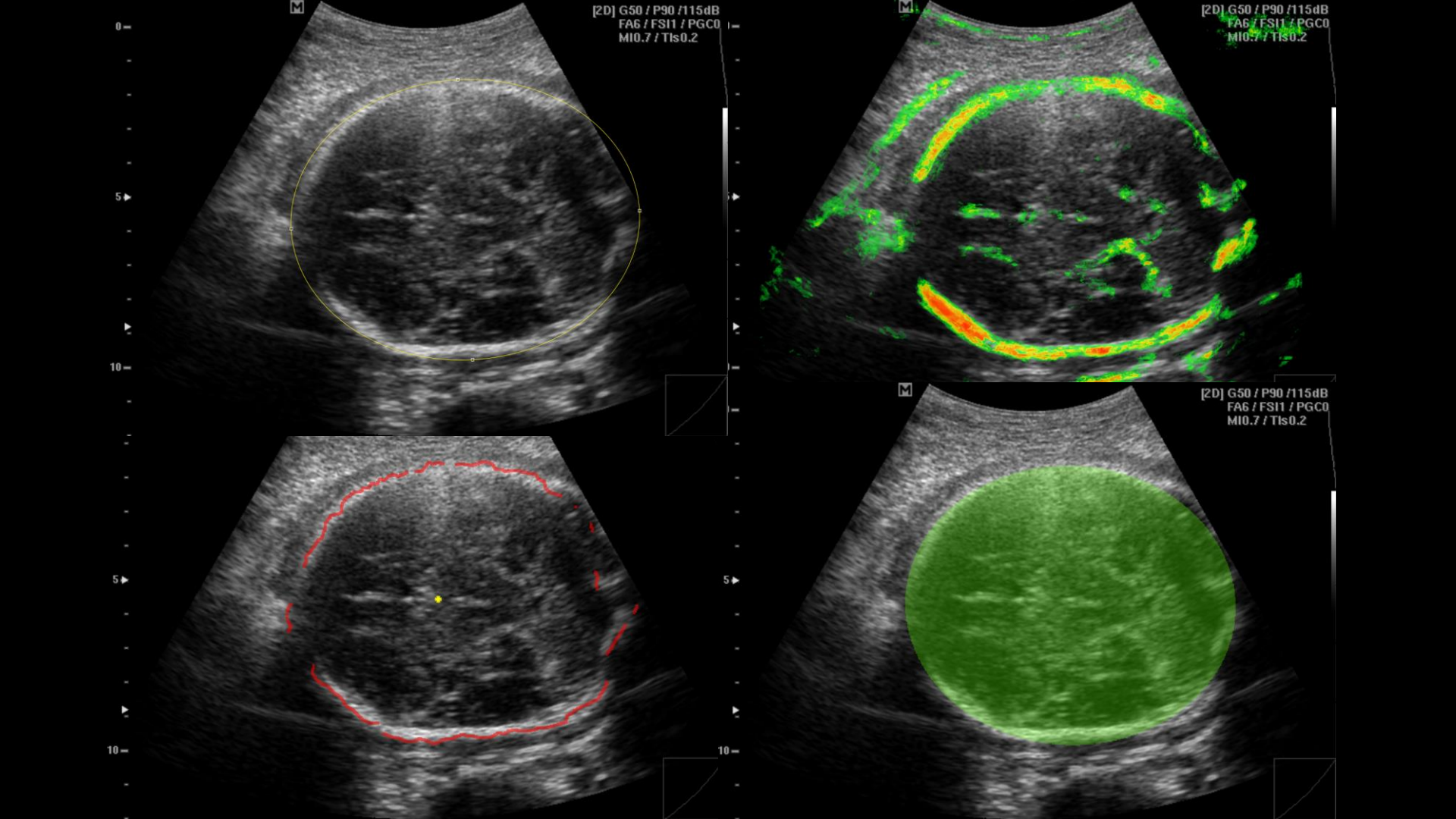
99%

OF ALL MATERNAL DEATHS OCCUR IN DEVELOPING COUNTRIES.

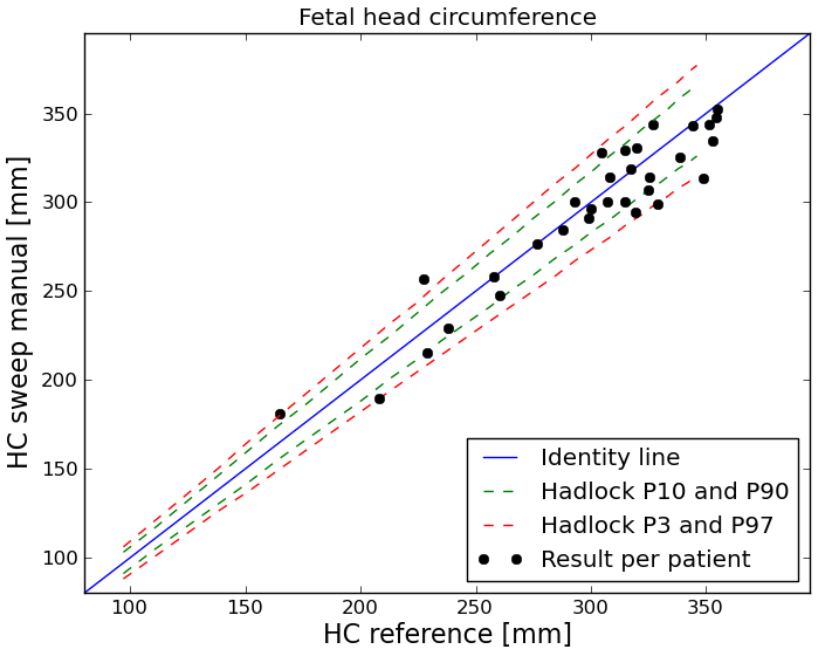


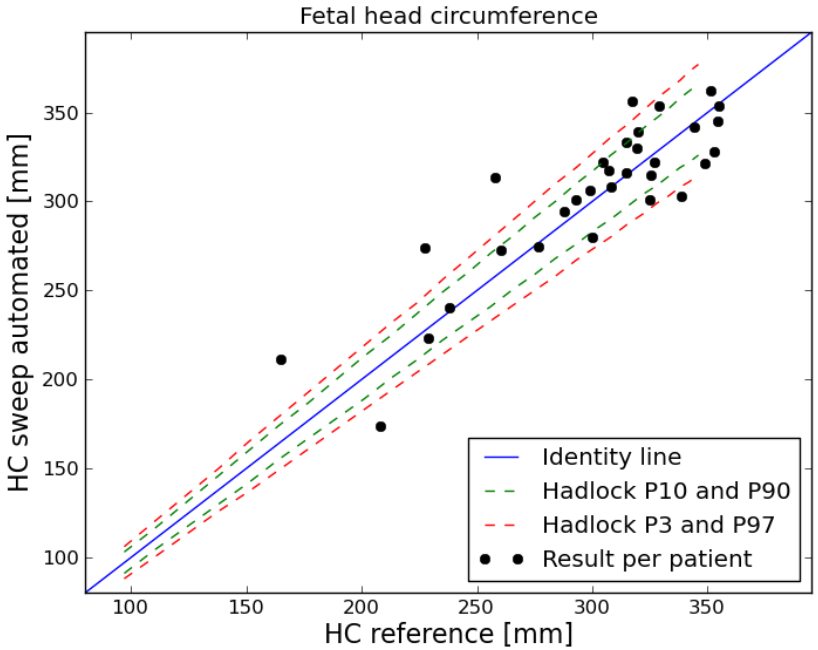
Sweep protocol and Babyviewer




[2D] G50 / P90 /115dB
FA6 / FSI1 / PGC0
MI0.7 / TIs0.2
[2D] G50 / P90 /115dB
FA6 / FSI1 / PGC0
MI0.7 / TIs0.2
[2D] G50 / P90 /115dB
FA6 / FSI1 / PGC0
MI0.7 / TIs0.2

Estimation fetal head circumference





De digitale dokter:

- …komt eraan
- …neemt steeds meer duidelijk gedefinieerde (zoek)taken over van de gewone dokter
- …reduceert de kosten van de zorg
- …is enorm nuttig in landen waar een groot tekort aan goed opgeleide dokters is