

27.01.2024

LISBOA

# Novas tecnologias em Pneumologia

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PROGRESS NOTES	
for addressograph plate	
Date	Time
	<p>           # c/o            @ flats / steel in easting            5-2 38.2 / 255 IN 21.0            29.5            Mammogram - normal LL &amp; TR; &amp; postural signs            Ct reviewed again yesterday &amp; radiologist            ** Recommend <u>Med- Onc</u> to see pt today!            - Continue Abx            - NPO / IVF            - Start TPN            no acute basilar surgical indication given            poor prognosis &amp; exploring options            and high likelihood of short gut            syndrome if operation performed            Will plan to operate only if pt            toxic or perforated            Agree &amp; above            Patient neurologically            stable         </p>



```

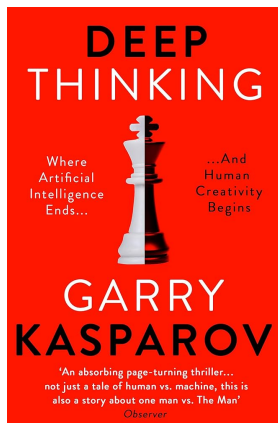
vent("onreadystatechange",H),e.
Number String Function Array Da
unction F(e){var t=_[e]={};retu
=!1&&e.stopOnFalse){r=!1;break}
ngth:r&&(s=t,c(r))}return this)
){return u=[],this},disable:fun
tion(){return p.fireWith(this,a
,r={state:function(){return n},
?e.promise().done(n.resolve).fa
tion(){n=s},t[1^e][2].disable,t
call(arguments),r=n.length,i=1!
rray(r);r>t;t++)n[t]&&b.isFunc
e></table><a href='/a'>a</a><ir
e("input")[0],r.style.cssText='
getAttribute("style"),hrefNorm

```

- Campeão Mundial de Xadrez
- Enorme conhecimento de xadrez
- Joga com **intuição** e é capaz de avaliar o seu oponente
- **É capaz de aprender com seus erros**
- **Pode adaptar o seu jogo a qualquer instante**



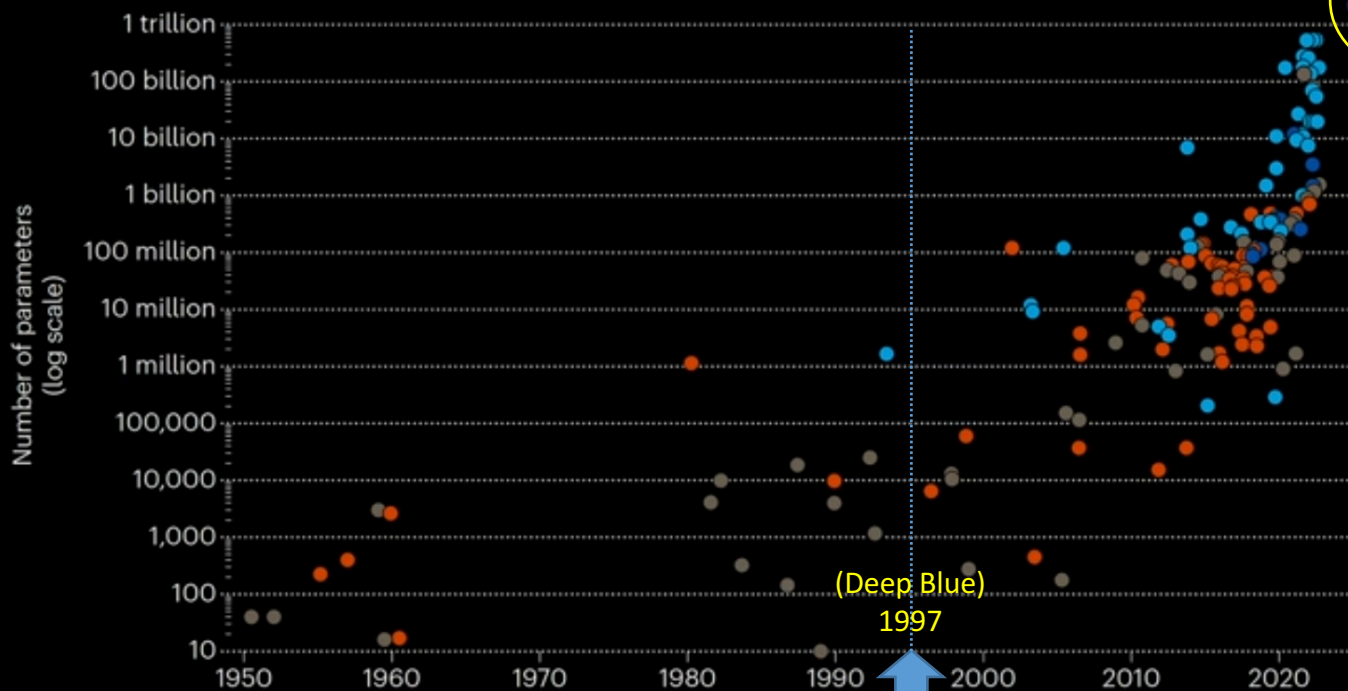
- Enorme capacidade de cálculo calcula **200.000.000 posições de xadrez/segundo**
- Menor conhecimento de xadrez
- Não se adapta
- **Não é afectado por estímulos externos**



## THE DRIVE TO BIGGER AI MODELS

The scale of artificial-intelligence neural networks is growing exponentially, as measured by the models' parameters (roughly, the number of connections between their neurons)\*.

● Language ● Image generation ● Vision ● Other



Nature | Vol 615 | 9 March 2023



Museu do Caramulo, 2022

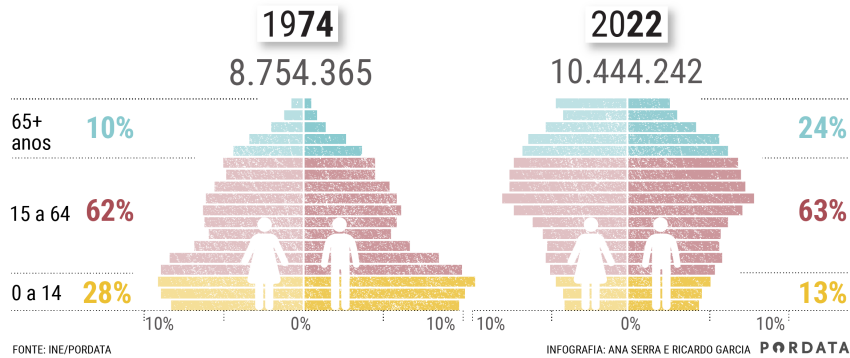


# Desafios modernos da Medicina



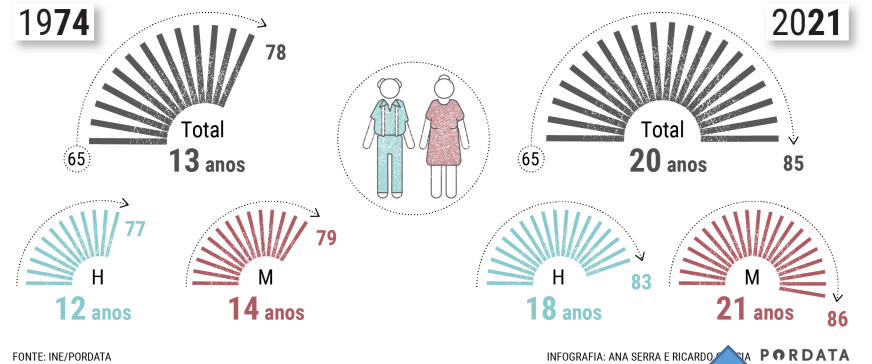
## A POPULAÇÃO MUDOU DE PERFIL E ESTÁ MAIS VELHA

Habitantes por grupo etário e sexo

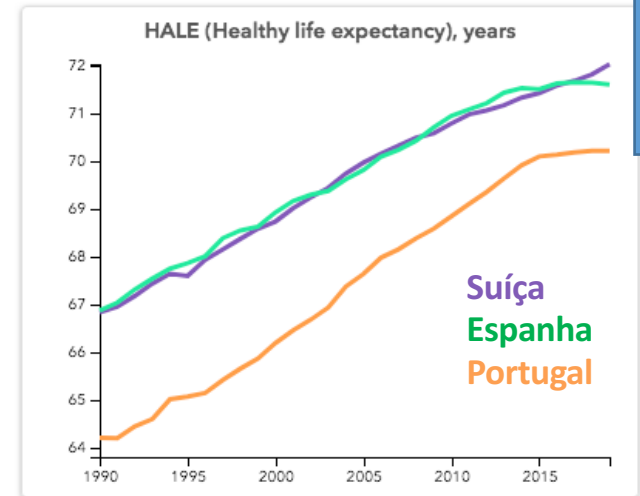
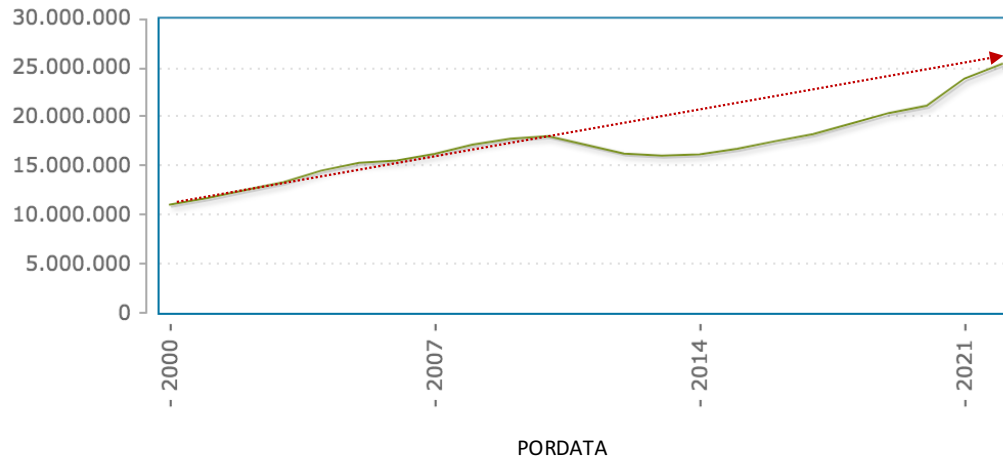


## OS IDOSOS GANHARAM 7 ANOS DE ESPERANÇA DE VIDA

Número médio de anos que se espera viver após os 65



## DESPESA EM SAÚDE (x10<sup>3</sup> Euros)



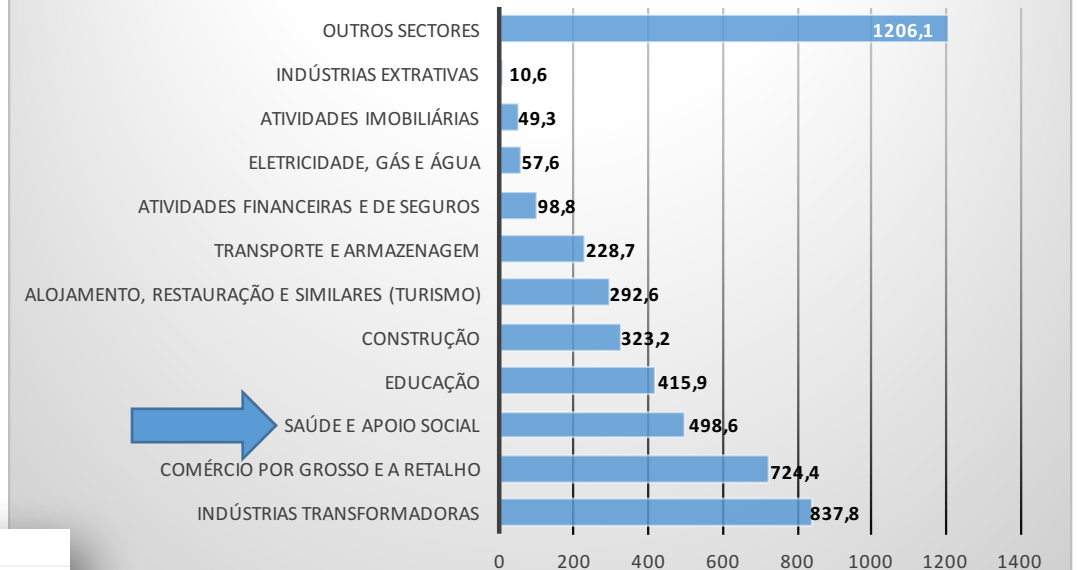
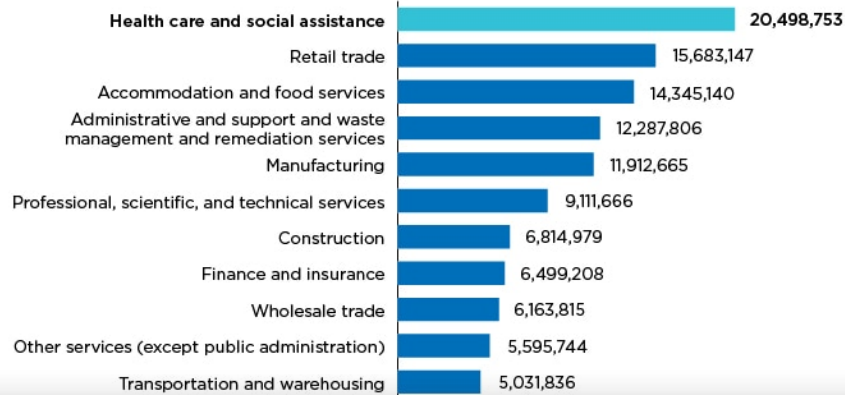
IHME, GDB 2019 (Univ. Washington) | <https://vizhub.healthdata.org>



~15 anos

# Desafios modernos da Medicina

Figure 1.  
Number of Employees: 2018



Fonte: PORDATA 2022

CNN health Life, But Better Fitness Food Sleep Mindfulness Relationships

## Concern grows around US health-care workforce shortage: 'We don't have enough doctors'



By Jacqueline Howard, CNN

5 minute read · Published 11:00 AM EDT, Tue May 16, 2023



Source: 2018 County Business Patterns.

NHS FTE health care staff in England in 2018-2019 and projections of staff needed in 2030-2031 to meet health and adult social care demand.



Health care staff includes hospital and community health services (HCHS) and general practice.

Fonte: www.politico.eu

SOCIEDADE 18 dezembro 2023 às 07h41

# Um em cada quatro médicos internos com sintomas graves de 'burnout'

Estudo da Ordem dos Médicos dirigido especificamente a internos refere que 35,5% iniciou apoio psicológico ou psiquiátrico durante o internato. Apenas 16,5% considera a relação entre a vida pessoal e profissional equilibrada.

DN

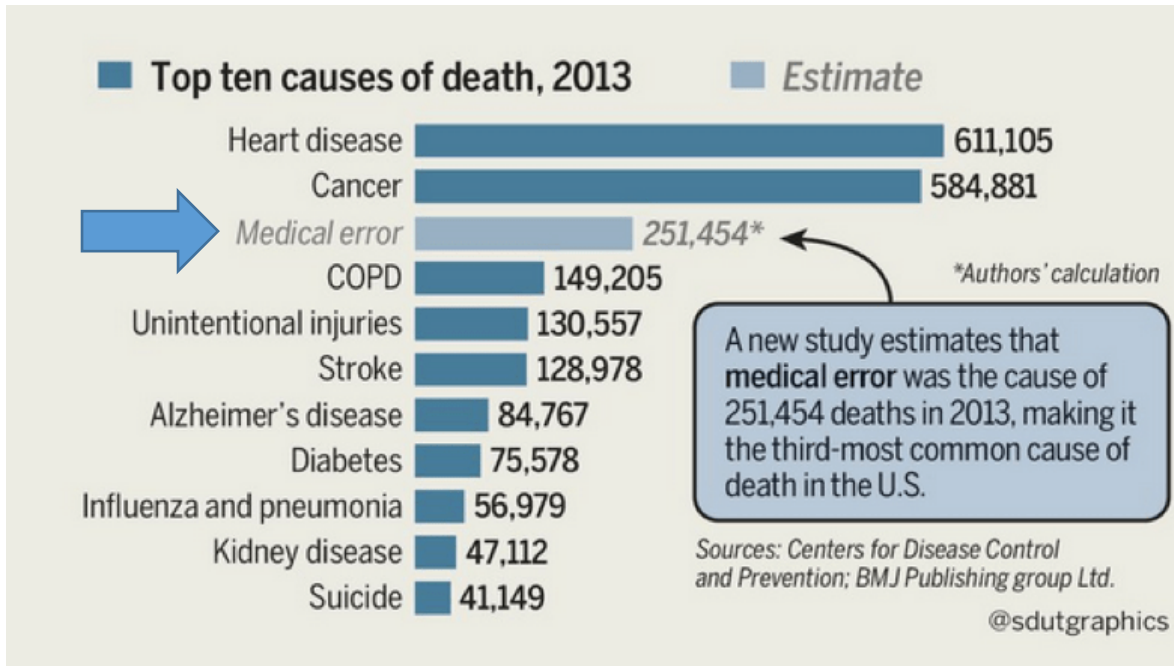
## Burnout



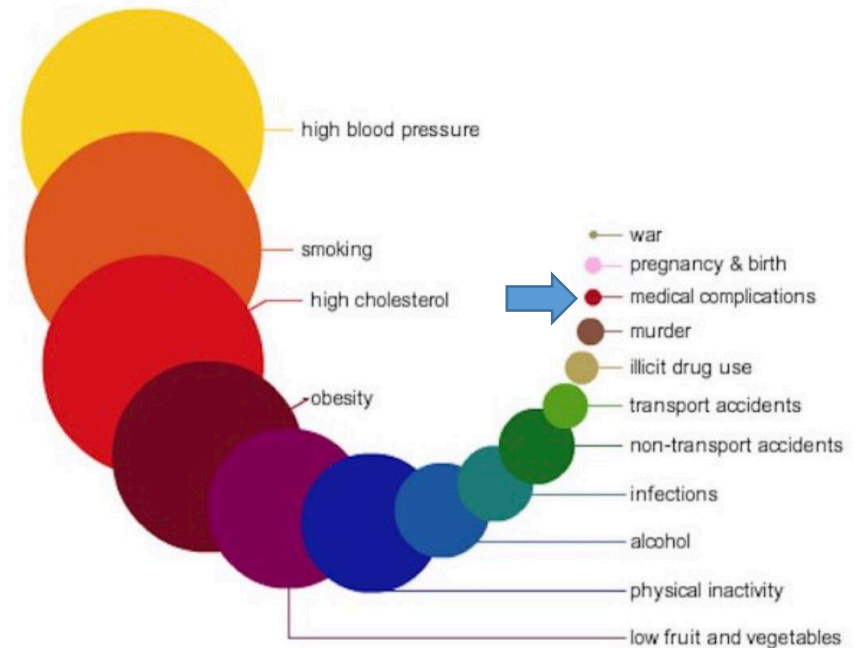
NEJM, 2017 (online)



# Erro médico



CDC (USA) 2013



NHS (UK) 2017

# 4 in 10 patients

are harmed in primary and outpatient health care



Speak up  
for patient safety!



World Health  
Organization



World  
Patient Safety  
Day 17 September 2019

Causas comuns do <b>erro</b> médico	Causas comuns do <b>burnout</b> médico	<b>Aonde a tecnologia pode ajudar?</b>
Pobre comunicação	Pouco tempo dedicado ao doente	Tradução, adequação de linguagem
Fluxo de informação inadequado	Demasiada burocracia (relatórios médicos, justificação de medicação, etc)	AI faz uma pré-análise dos dados do doente, produz relatórios com base na informação
Erros manuais durante o registo médico	Exigências crescentes no registo clínico electrónico	Consulta sem teclado, resumo clínico produzido por gravação áudio
Falta de treino ou formação médica inadequada	Falta de perspectivas de evolução na carreira, insuficientes oportunidades de formação e/ou investigação	Experiências formativas imersivas (simulação), novas oportunidades de empreendedorismo tecnológico
Recursos humanos escassos ou mal alocados	Recursos humanos escassos ou mal alocados	Simplificação de procedimentos, ganho de eficiência do trabalho médico, nomeadamente em tarefas automatizáveis
Fadiga	Excessiva carga horária, turnos nocturnos	
Falência técnica de dispositivos médicos e outro equipamento	Vivência diária com a doença e fragilidade humana	Diagnósticos assistidos por AI, análise preditiva (prognóstico, alertas), recomendações de tratamento personalizadas

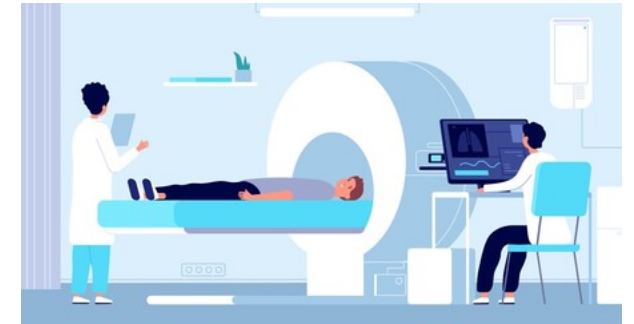
# Rastreio do Cancro do Pulmão em Portugal: o maior desafio e a maior oportunidade da Pneumologia



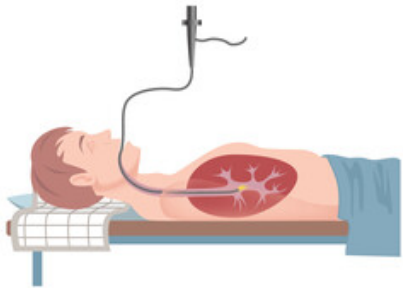
Em 2022 viviam em Portugal cerca de **2.740.000** de pessoas entre 55 e 74 anos



Estimativa de fumadores tem rondado os **20%** (17-25%)



**465k-550k** candidatos a rastreio com TC anual de baixa dose



**12-14k** (2.6%)  
broncoscopias diagnósticas  
(230-270 /semana)



**14-17k** (3%) cirurgias que  
precisarão de provas de função  
respiratória (270-330 /semana)



Telemedicina, tarefas  
potenciadas por AI e tarefas  
automatizáveis



**A** Baixa precisão  
Baixa reprodutibilidade



**B** Baixa precisão  
Alta reprodutibilidade



**C** Alta precisão  
Baixa reprodutibilidade



**D** Alta precisão  
Alta reprodutibilidade

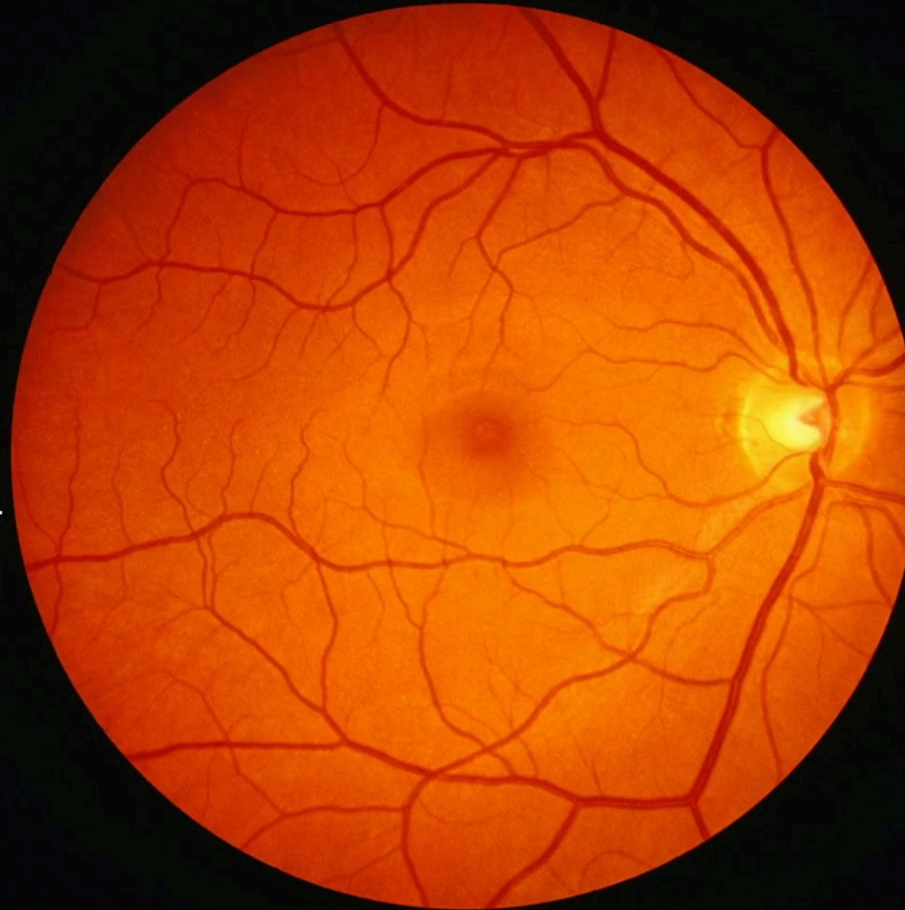
## Medicina de precisão

Diabetes and Blood  
Pressure Control,  
Nature Biomed  
Engineering 2018

Kidney Disease  
Lancet Dig Health,  
2020

Liver and Gall Bladder  
Disease, Lancet Dig H  
2021

Heart Calcium Score,  
Lancet Dig H, 2021

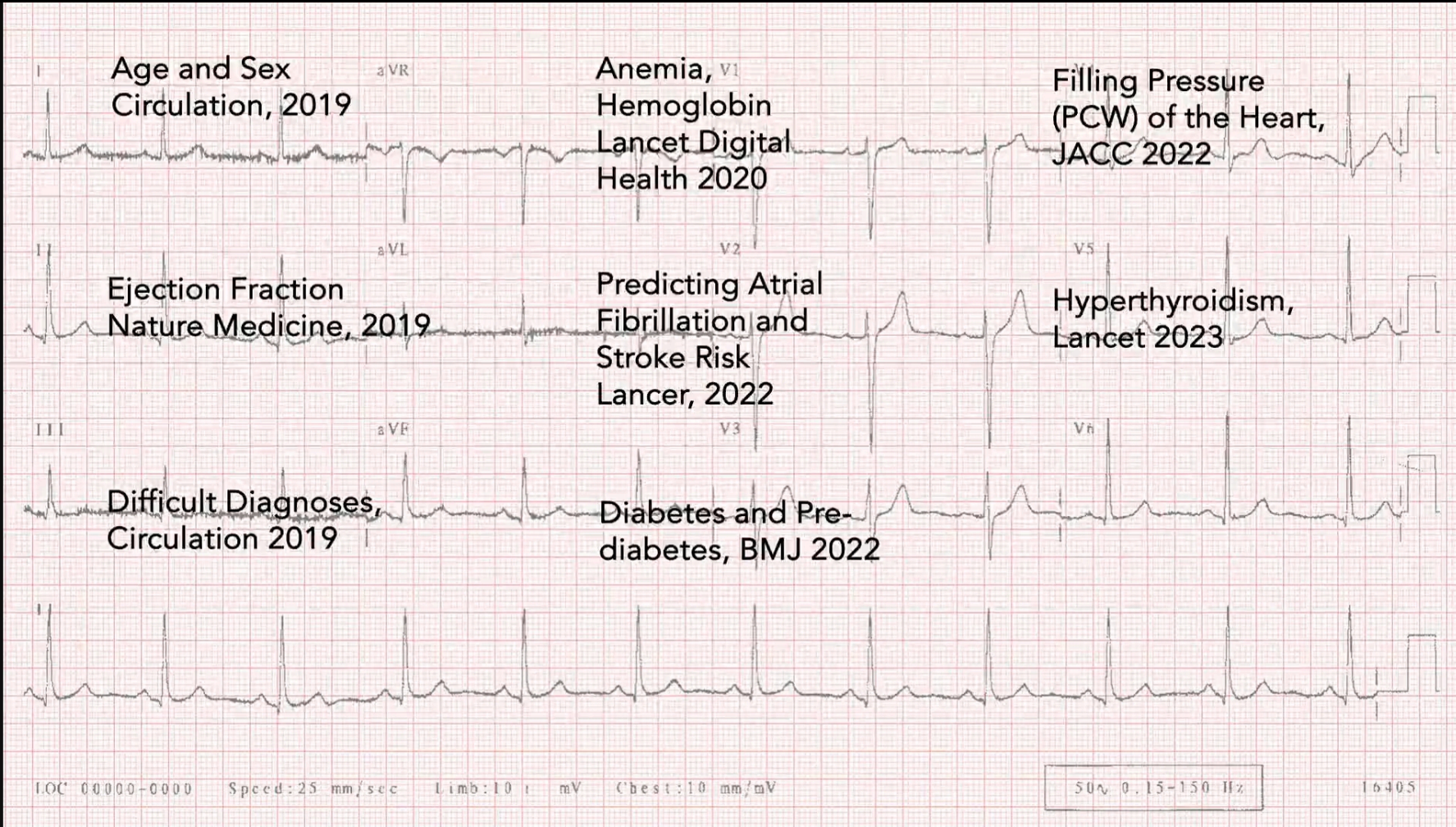


Alzheimer's Disease,  
Lancet Dig H, 2022

Predicting Heart  
Attack and Stroke,  
Nature Mach Intel,  
2022

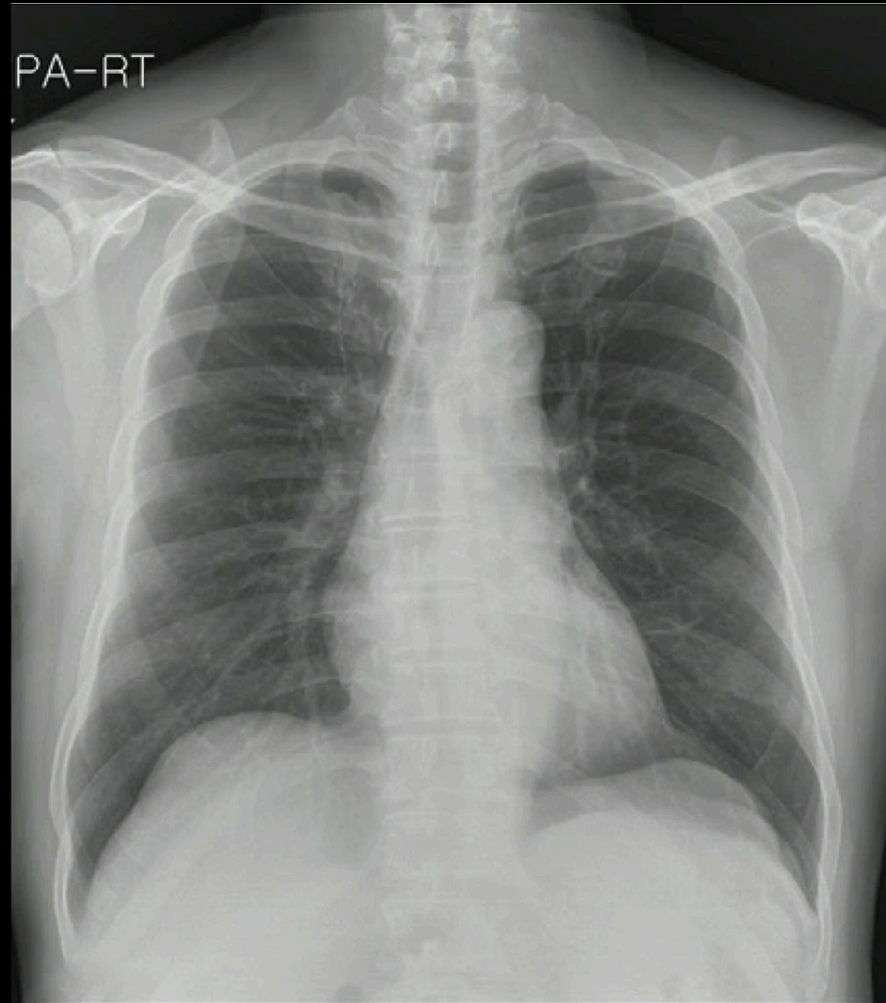
Hyperlipidemia,  
Eye 2023

Parkinson's Disease,  
Neurology 2023



Race  
Lancet Digital H  
2022

Diabetes and  
Control of  
Diabetes,  
Nature Comms  
2023



Ejection fraction,  
IVC Dilation, Aortic  
stenosis,  
regurgitation, Mitral  
stenosis,  
regurgitation,  
Tricuspid  
regurgitation,  
Pulmonary  
regurgitation  
Lancet Digital H  
2023

@Eric Topol



# AI potencia a detecção de nódulos pulmonares (*pre-screen*)

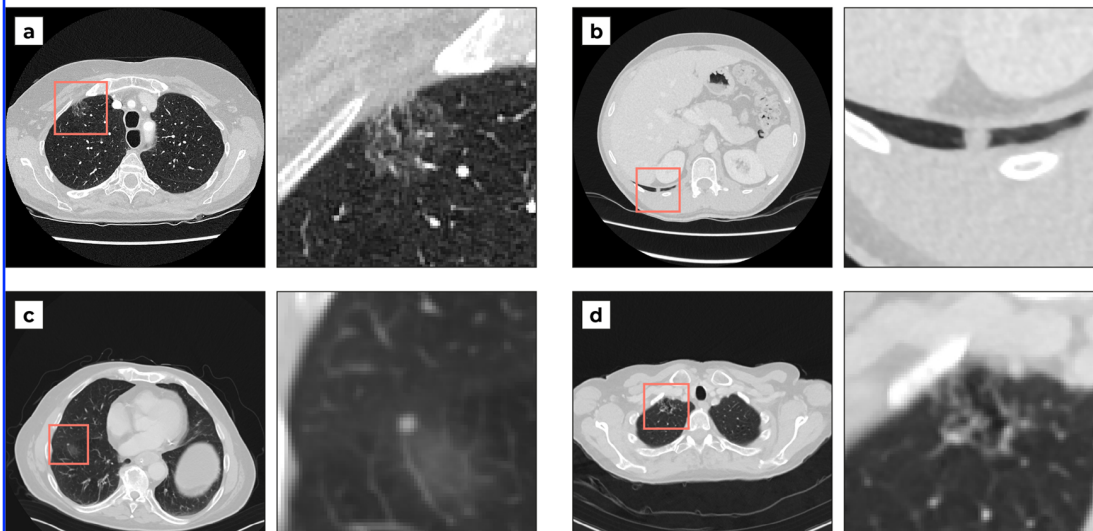
**Sensibilidade** a detectar nódulos: benignos 94%, neoplasias pulmonares 97%

e metástastes 92%

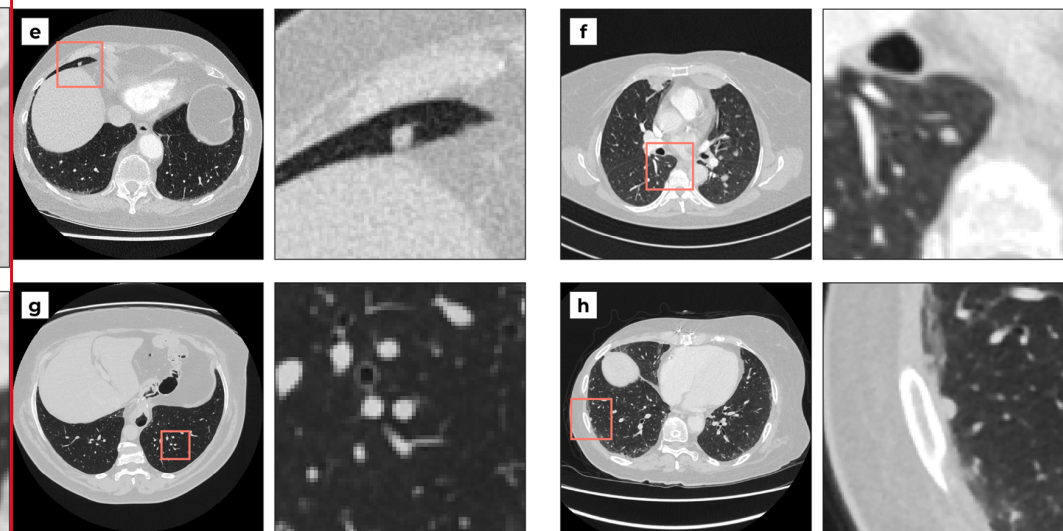
1 falso positivo por scan



Primary cancers or metastases missed by AI, but not by majority of radiologists



Metastases detected by AI, but not by the majority of radiologists



# E se os consentimentos informados fossem automatizados?



How can I help you today?

**Compare design principles**  
for mobile apps and desktop software

**Create a personal webpage for me**  
after asking me three questions

**Plan an itinerary**  
for a literary tour of England, visiting famous authors' ...

**Give me ideas**  
for what to do with my kids' art


Faz-me um modelo de consentimento informado médico para broncoscopia flexível, descrevendo os riscos e os potenciais riscos.

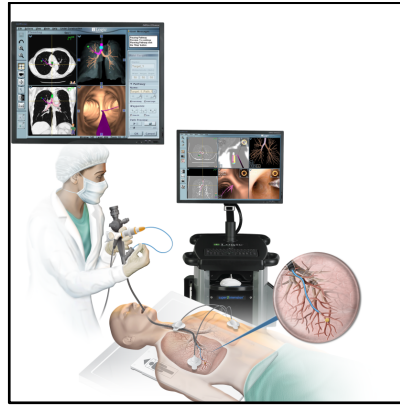
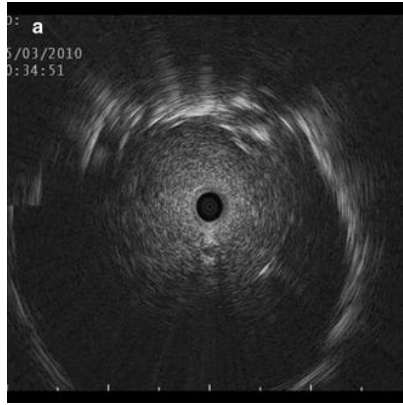
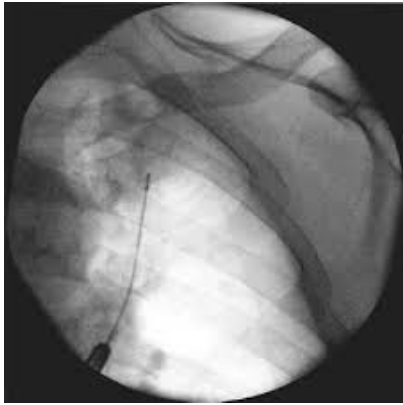


ChatGPT can make mistakes. Consider checking important information.





Made with  synthesia



**Broncospopia  
com  
fluoroscopia**

**EBUS-MP e  
broncosp.  
ultrafinos**

**ENB e  
broncospopia  
virtual**

**Conebeam CT  
com orientação  
3D**

**Broncospopia  
robótica**

N=318<sup>1</sup>  
SPN 14.6±8.7 mm  
Sens **13.5%**  
NPV 47.6%

*Minisonda radial  
(metanálise)<sup>2</sup>*  
N=7872  
Yield ≤2 cm **60.5%**  
Yield >2 cm 75.7%

*Broncospópio ultrafino  
(RCT)<sup>3</sup>*  
N=150 (≤3 cm)  
Yield 74%

*EMN (metanálise)<sup>4</sup>*  
N=3342; Sens **77%**  
*VBN (metanálise)<sup>5</sup>*  
N=813

Yield ≤2 cm **66%**  
Yield >2 cm 81%

*Trans-Parenchymal  
Nodule Access + VBN<sup>6</sup>*  
N=106, Yield <2 cm **81%**

N=212 (5 ensaios)<sup>7</sup>  
Sens **90%**

*iON<sup>8</sup>*  
N=29  
SPN 12.3 mm  
Yield **79.3%**

*Monarch<sup>9</sup>*  
N=15  
SPN 2.6 cm  
Yield **93%**

<sup>1</sup>Westeinde et al. Chest 2012;142(2):377-384; <sup>2</sup>Ali et al. Respirology 2017;22:443-453; <sup>3</sup>Oki et al. AJRCCM 2015;192(4):468-76; <sup>4</sup>Folch et al. Chest. 2020 Oct;158(4):1753-1769; <sup>5</sup>Han et al. PLoS One. 2018 Jan 22;13(1):e0191590; <sup>6</sup>Sun et al. ERJ 2019;54:OA1614 (DOI: 10.1183/13993003.congress-2019.OA1614); <sup>7</sup>Pritchett et al. J Thorac Dis 2020;12(4):1595-1611; <sup>8</sup>Fielding et al. Respiration 2019;98:142-150; <sup>9</sup>Rojas-Solano et al J. Bronchol. Interv. Pulmonol. 2018, 25, 168

# Broncoscopia Robótica

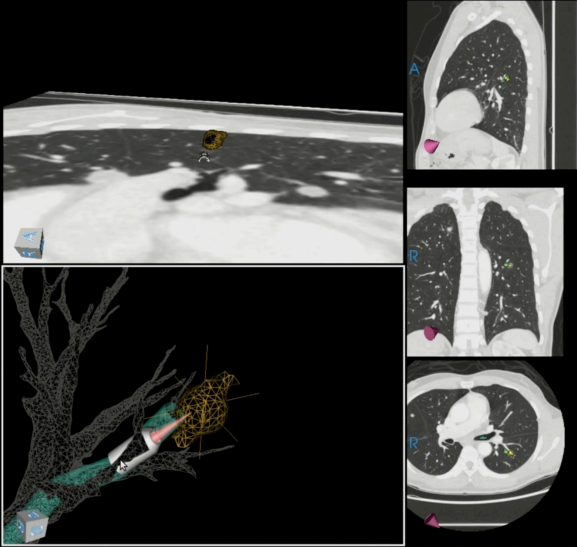
Irrigation Volume:  
0ml

MONARCH™

11mm

Target  
LLL -

Work at Target  
Best Practices



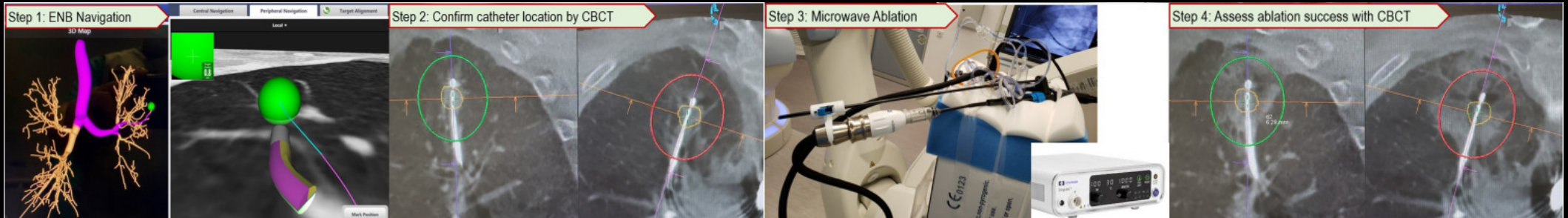
Sheath 124mm  
Scope +13mm



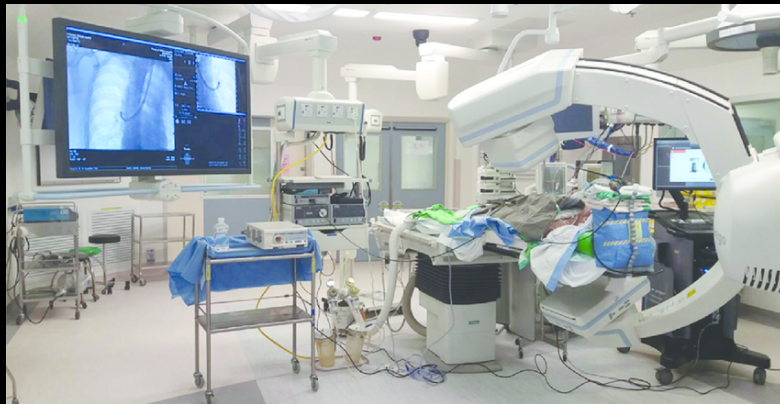
Cortesia do Dr. Septimiu Murgu (University of Chicago Medical Center)

# Termoablação endoscópica

## Microondas (MWA)

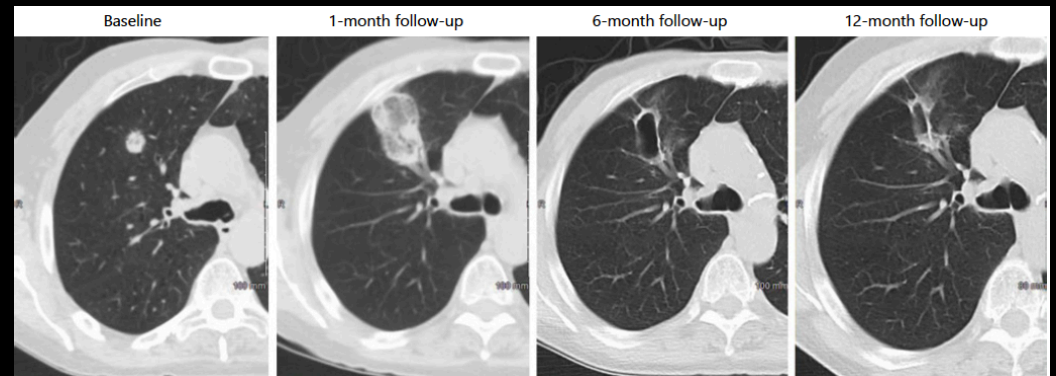


Chan et al. JTCVS Techniques 2023



### Sala híbrida

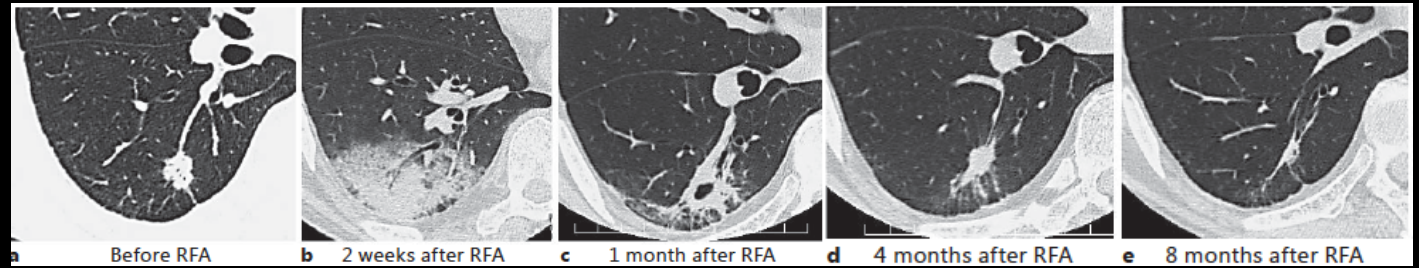
Conebeam CT, fluoroscopia aumentada, navegação electromagnética, anestesia geral



Pritchett et al. Respiration 2023

## Radiofrequência (RFA)

Koizumi et al. Respiration 2015



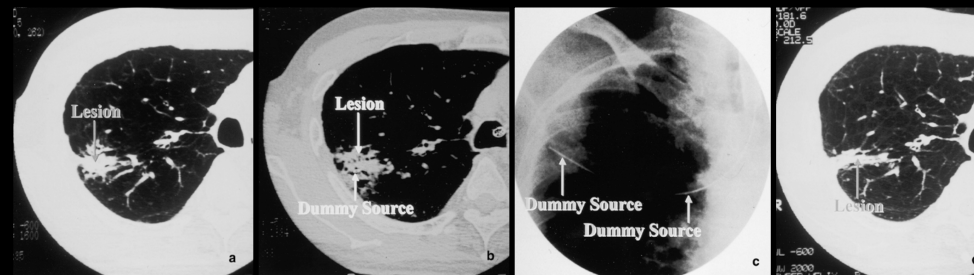
## Vapor (BTVA)

Steinfort et al. Respiration 2021



## Braquiterapia

Toshiaki Kobayashi et al. Japanese Journal of Clinical Oncology 2000



## Terapia fotodinâmica (PDT)

Chen et al. J Thorac Dis 2018  
Usuda et al. Photodiagnosis and Photodynamic Therapy 2020

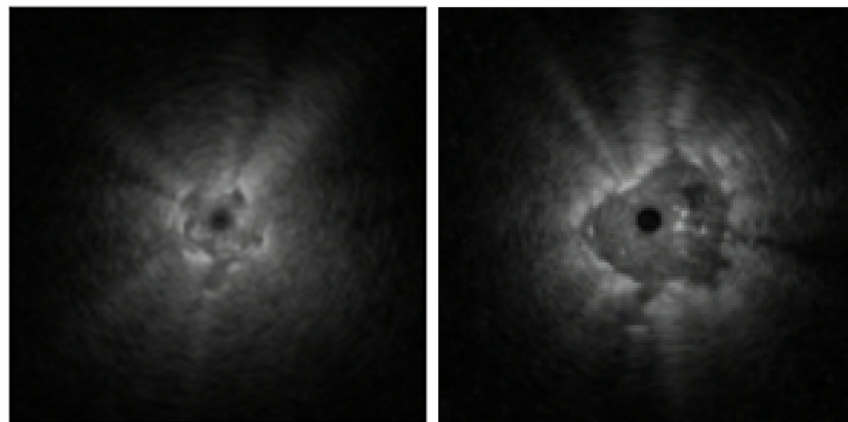


# EBUS radial (nódulos periféricos)

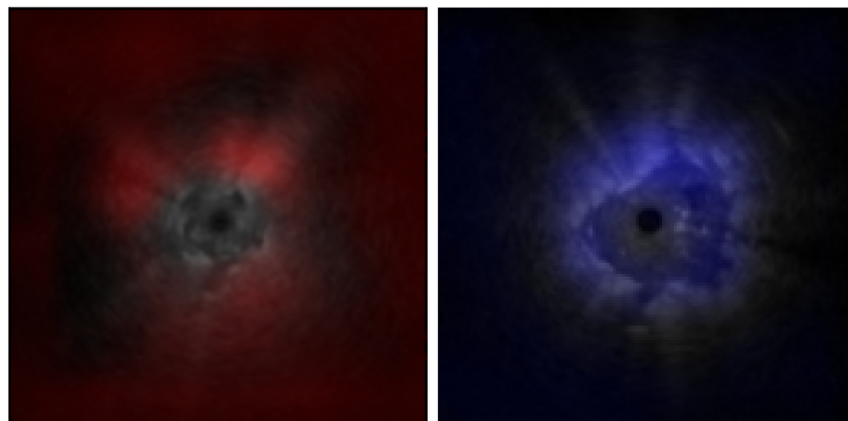
Lung cancer

Benign

EBUS image



Grad-CAM

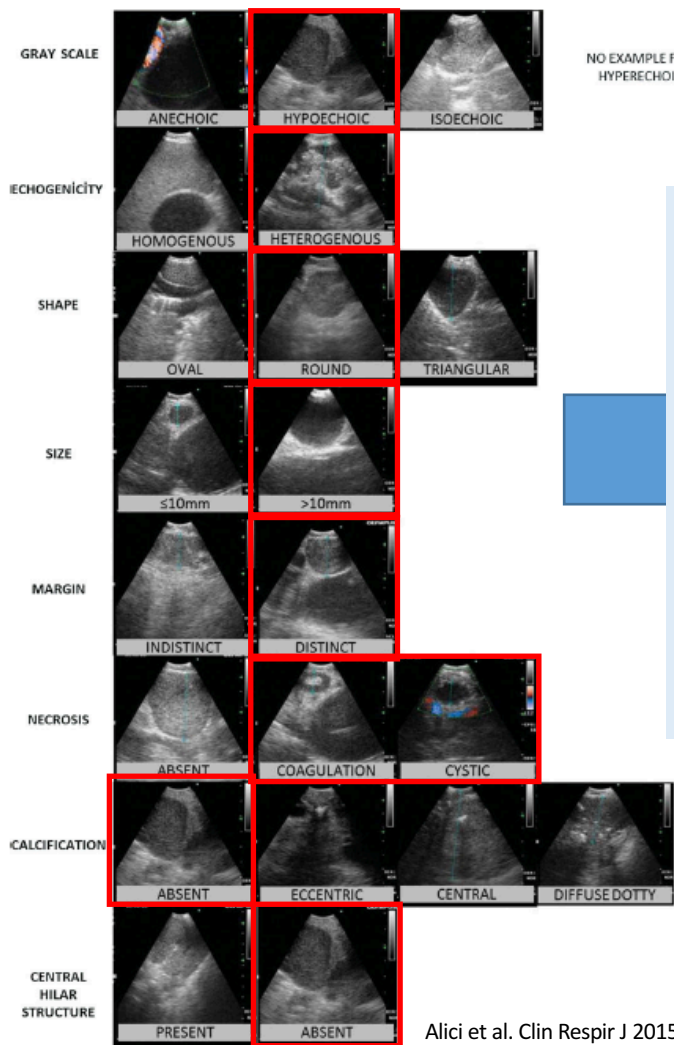


	Broncoscopista	Modelo CNN
Precisão (VP+VN)	68.4%	<b>83.4%</b>
Sensibilidade (VP)	80%	<b>95.3%</b>
Especificidade (VN)	39.6%	<b>53.6%</b>
VPP	76.8%	<b>83.8%</b>
VPN	44.2%	<b>82%</b>

EBUS data for 213 participants  
2,421,360 images extracted from the learning dataset  
Test was performed using 26,674 images



# EBUS linear (estadiamento de neoplasia pulmonar)



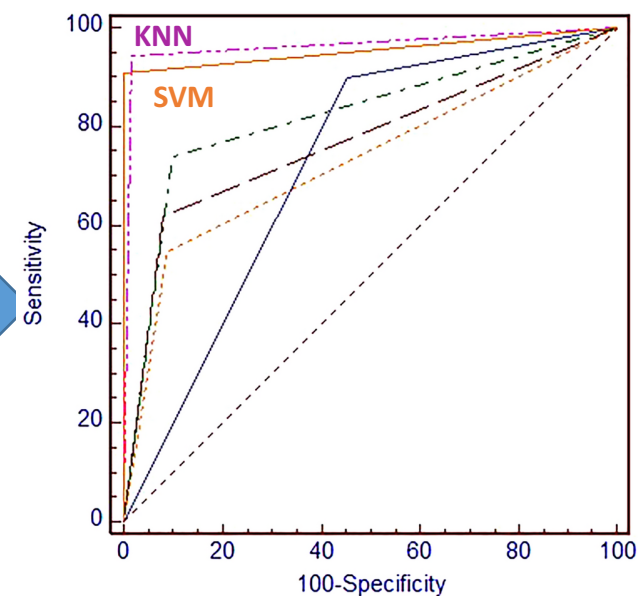
Alici et al. Clin Respir J 2015

## População de estudo:

- Dados retrospectivos de 2 hospitais (Jan 2017-Mar 2023)
- 992 adenopatias, 420/992 (42.3%) malignos

## Vários modelos de machine learning:

- Treinado com 80% da amostra
- Testado com 20% da amostra



	Sens	Espec	VPP	VPN	AUC
KNN	94.4%	98.2%	97.6%	95.5%	0.963
SVM	91%	100%	100%	93.2%	0.955

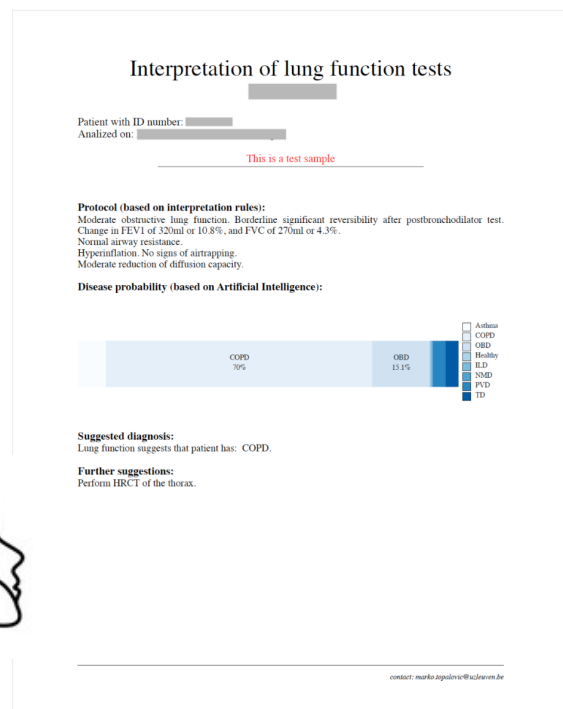
Koseoglu et al. Surgical Endoscopy 2023



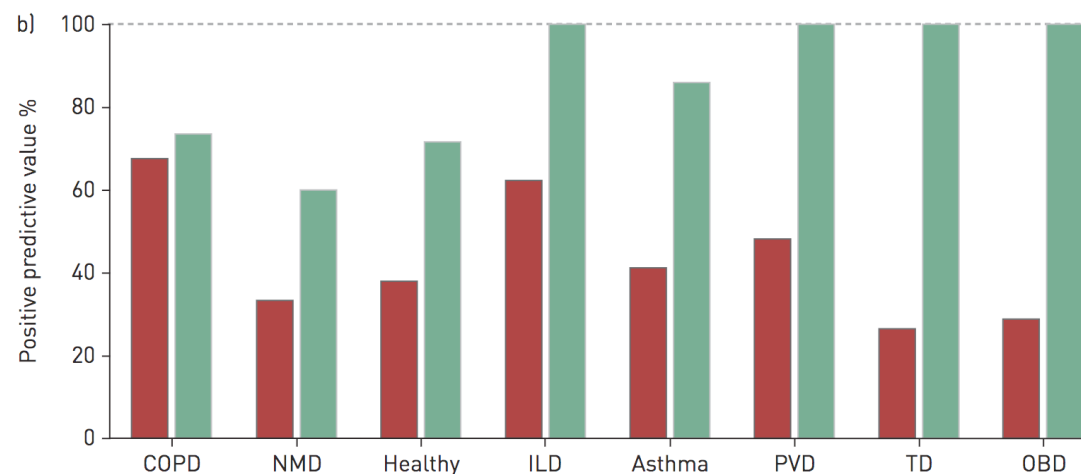
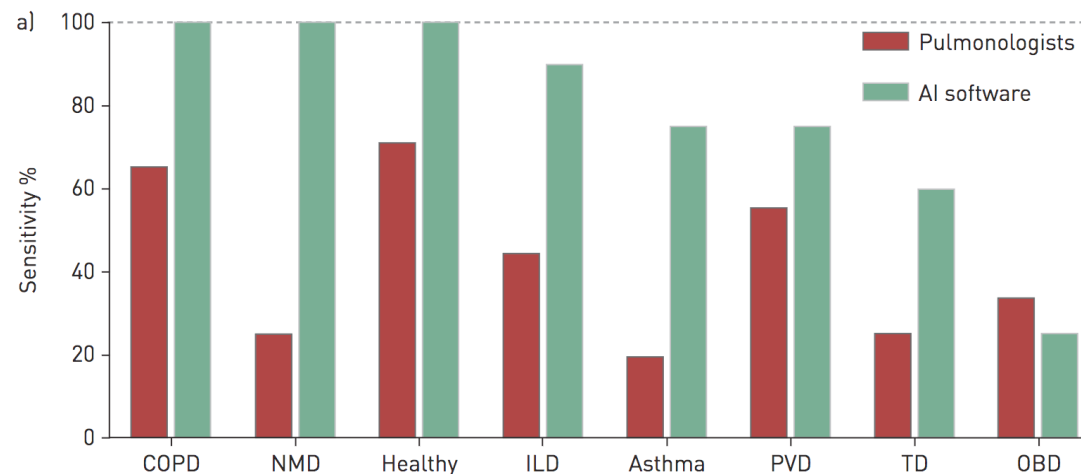
## Artificial intelligence outperforms pulmonologists in the interpretation of **pulmonary function tests**

Marko Topalovic<sup>1</sup>, Nilakash Das<sup>1</sup>, Pierre-Régis Burgel <sup>2</sup>, Marc Daenen<sup>3</sup>, Eric Derom<sup>4</sup>, Christel Haenebalcke<sup>5</sup>, Rob Janssen<sup>6</sup>, Huib A.M. Kerstjens <sup>7</sup>, Giuseppe Liistro<sup>8</sup>, Renaud Louis<sup>9</sup>, Vincent Ninane<sup>10</sup>, Christophe Pison<sup>11</sup>, Marc Schlesser<sup>12</sup>, Piet Vercauter<sup>13</sup>, Claus F. Vogelmeier<sup>14</sup>, Emiel Wouters<sup>15</sup>, Joke Wynants<sup>16,17</sup> and Wim Janssens<sup>1</sup> on behalf of the Pulmonary Function Study Investigators

Figure S3: Report generated using in-house developed software. Probabilities for each diagnostic category summarized in the example.




120 Pneumologistas (16 centros Europeus) × 50 casos (PFR e informação clínica) = 6000 avaliações



PERSPECTIVE

# Use of GPT-4 to Diagnose Complex Clinical Cases

Alexander V. Eriksen , M.D.,<sup>1,2</sup> Sören Möller , M.Sc., Ph.D.,<sup>3,4</sup> and Jesper Ryg , M.D., Ph.D.<sup>1,2</sup>

Received: July 10, 2023; Revised: September 15, 2023; Accepted: September 29, 2023; Published: November 9, 2023

## Abstract

We assessed the performance of the newly released AI GPT-4 in diagnosing complex medical case challenges and compared the success rate to that of medical-journal readers. **GPT-4 correctly diagnosed 57% of cases**, outperforming 99.98% of simulated human readers generated from online answers. We highlight the potential for AI to be a powerful supportive tool for diagnosis; however, further improvements, validation, and addressing of ethical considerations are needed before clinical implementation. (No funding was obtained for this study.)

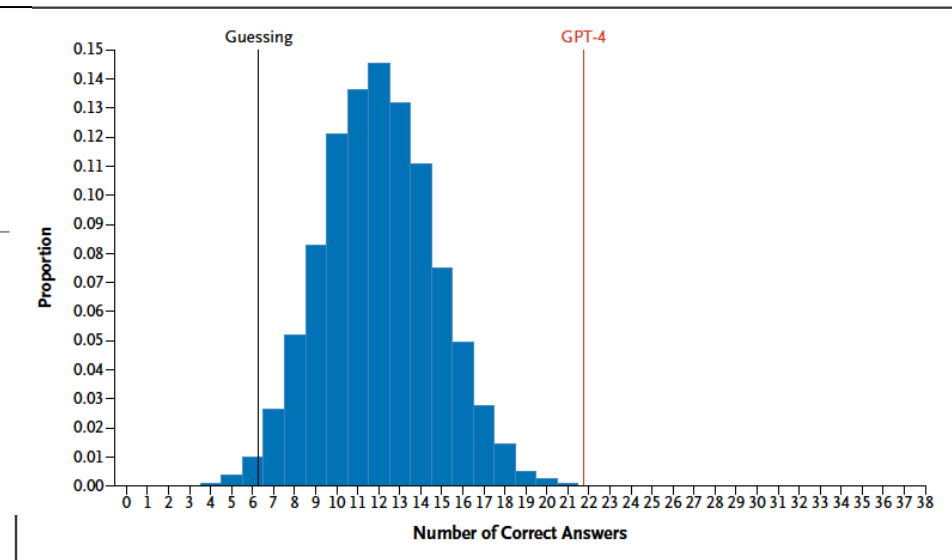
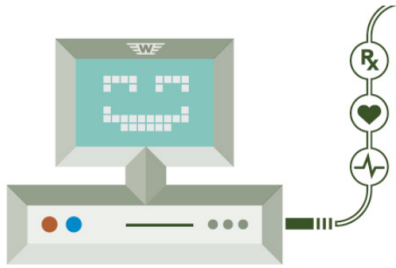
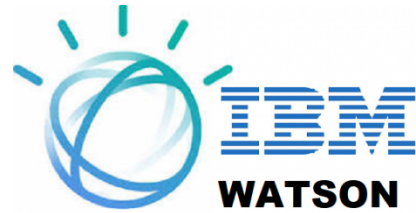


Figure 1. Number of Correct Answers of GPT-4 Compared with Guessing and a Simulated Population of Medical-Journal Readers.

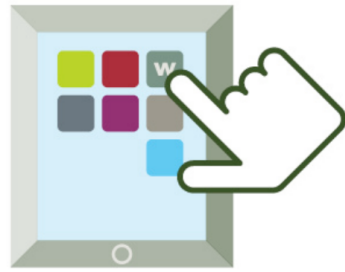
Number of correct answers of GPT-4 (red line) to 38 multiple-choice real-world clinical case challenges compared with what would be expected by purely guessing with uniform probability for all answer possibilities (black line) and to the proportion of correct answers by a simulated population of 10,000 medical-journal readers (blue histogram).



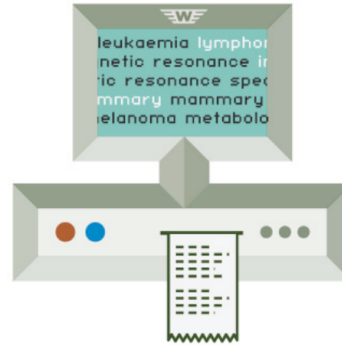
Memorial Sloan Kettering  
Cancer Center 2012



1. For well over a year, the Watson computers have been “trained” in science and medicine. Technicians feed Watson medical textbooks and journals, patient histories, and treatment guidelines.



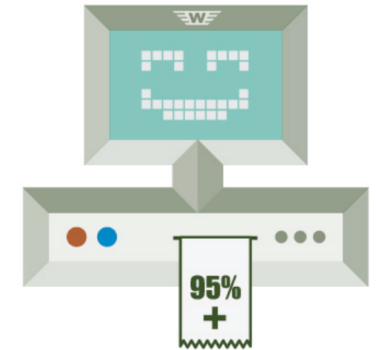
2. At Memorial Sloan-Kettering Cancer Center in New York, doctors have begun using a Watson app on a tablet to access the computer through the cloud. The doctor logs in to Watson and begins to input data and ask questions.



3. When the oncologist queries Watson about a course of treatment for a lung or breast cancer patient, the computer—with its ability to understand natural language—notes keywords in the query, such as the particular type of cancer and the genomic variant of the tumor.



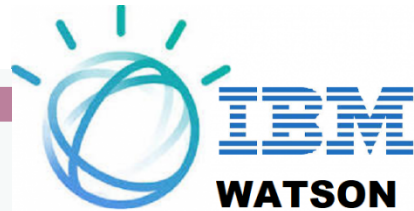
4. Watson then springs into action, using its massively parallel processors to review millions of pages of text in seconds. It explores the patient’s medical history, medications, and other existing conditions. It then combines this information with recent data from the patient’s medical tests and may comb through studies of patient groups at Sloan-Kettering who have had similar types of cancer. It also reviews doctors’ and nurses’ notes, recent medical research, journal articles, and treatment guidelines.



5. Watson then generates hypotheses for treatment. On the tablet app, these appear as separate options with varying levels of confidence. For instance, Watson might score one treatment option—a combination of chemotherapy drugs—with a 95% confidence level, suggesting it would be the most sensible path. It might also highlight options with lower scores as alternative treatment courses. The doctor then weighs the options and makes the call.

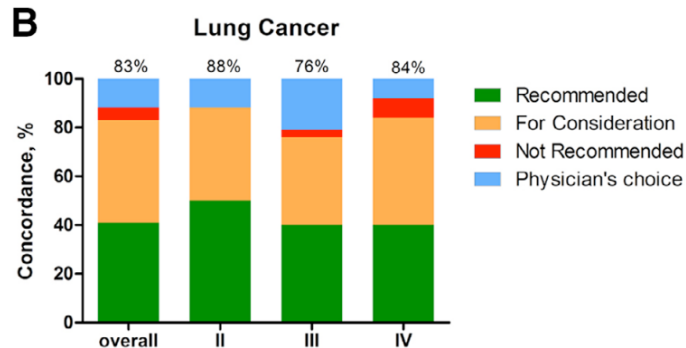
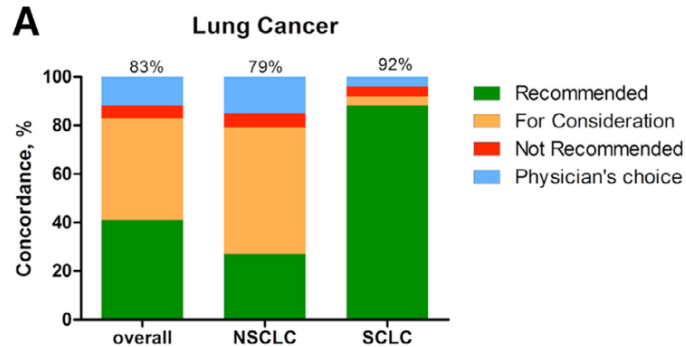
## Concordance Study Between IBM Watson for Oncology and Clinical Practice for Patients with Cancer in China

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 Disclosures of potential conflicts of interest may be found at the end of this article.



## Report: IBM Watson delivered 'unsafe and inaccurate' cancer recommendations

JULY 25, 2018 BY FINK DENSFORD



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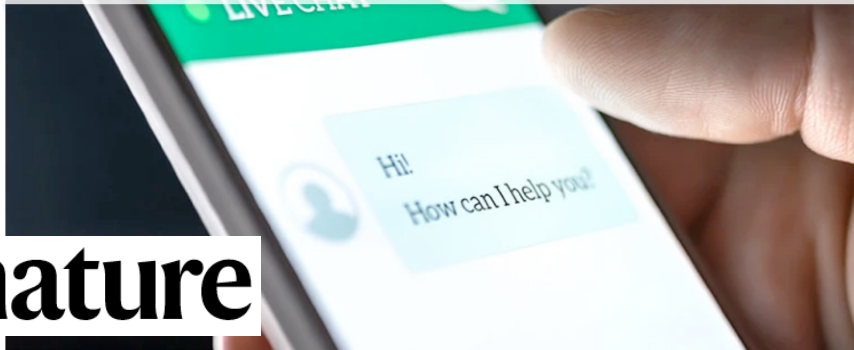
## IBM's Retreat From Watson Highlights Broader AI Struggles in Health

Watson Health was billed as a 'bet the ranch' move by Big Blue; now the company is prepared to throw in the towel

# GOOGLE AI HAS BETTER BEDSIDE MANNER THAN HUMAN DOCTORS

Researchers say their artificial-intelligence system could help to democratize medicine.

Google AI has better bedside manner than human doctors — and makes better diagnoses

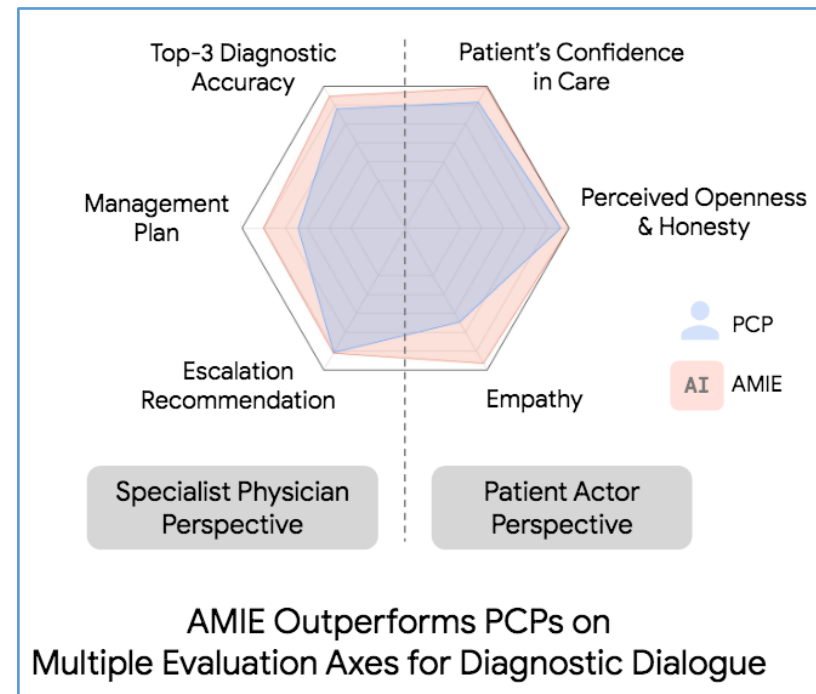
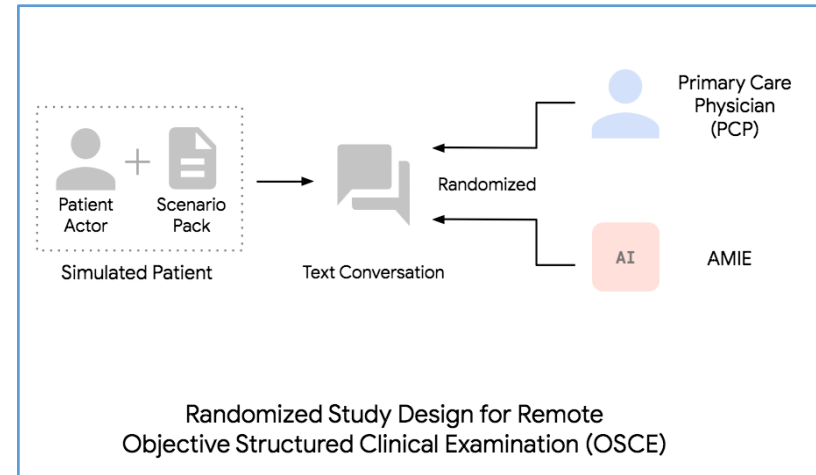


**nature**

A chatbot based on Google's large language model can take medical histories from simulated patients and offer a range of diagnoses. Credit: Tero Vesalainen/Getty

AMIE (Articulate Medical Intelligence Explorer), an LLM based AI system optimized for clinical history-taking and diagnostic dialogue

Tu, T. *et al.* Preprint at <https://arxiv.org/abs/2401.05654> (2024).





You

reply this email: "Muito obrigada, professor.

Espero não estar a abusar do seu tempo e gentileza com mais perguntas - se for preferível marcar outra consulta para abordar questões deste género por favor indique ser o caso.

1. Questionei sobre colocar em pausa planos de gravidez também porque tinha em mente possíveis TACs necessárias em consulta(s) de seguimento no hospital nos próximos meses.
2. Relativamente às vacinas visto que tomei a da gripe há 12 dias, estava a planear tomar a da pneumonia na próxima semana - uma dúvida no entanto assaltou-me: haverá alguma vantagem em espaçá-las mais para efeito mais eficaz/duradouro?

Desejo-lhe um bom resto de fim de semana!"



ChatGPT

"Prezada [Nome],

Fico contente por poder ajudar e responder às suas perguntas. Não está a abusar do meu tempo; estou aqui para esclarecer todas as suas dúvidas.

1. Compreendo a sua preocupação em relação à possível necessidade de TACs nos próximos meses. Caso seja necessário discutir esse assunto mais aprofundadamente, estou à disposição para marcar outra consulta. Podemos abordar todas as questões relacionadas aos seus planos de gravidez e exames de seguimento de forma mais detalhada.
2. Quanto às vacinas, é excelente que tenha tomado a da gripe. Quanto à da pneumonia, o espaçamento entre vacinas pode variar dependendo do tipo de vacina. Recomendo que discutamos isso durante a nossa próxima consulta para garantir a melhor orientação possível, levando em consideração o seu histórico médico e as recomendações específicas para cada vacina.

Agradeço pelos seus desejos de um bom resto de fim de semana. Estou à disposição para agendar a próxima consulta e abordar todas as suas preocupações.

Atenciosamente,

[Seu Nome]

[Seu Cargo ou Especialidade]

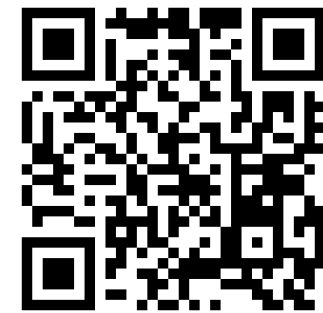
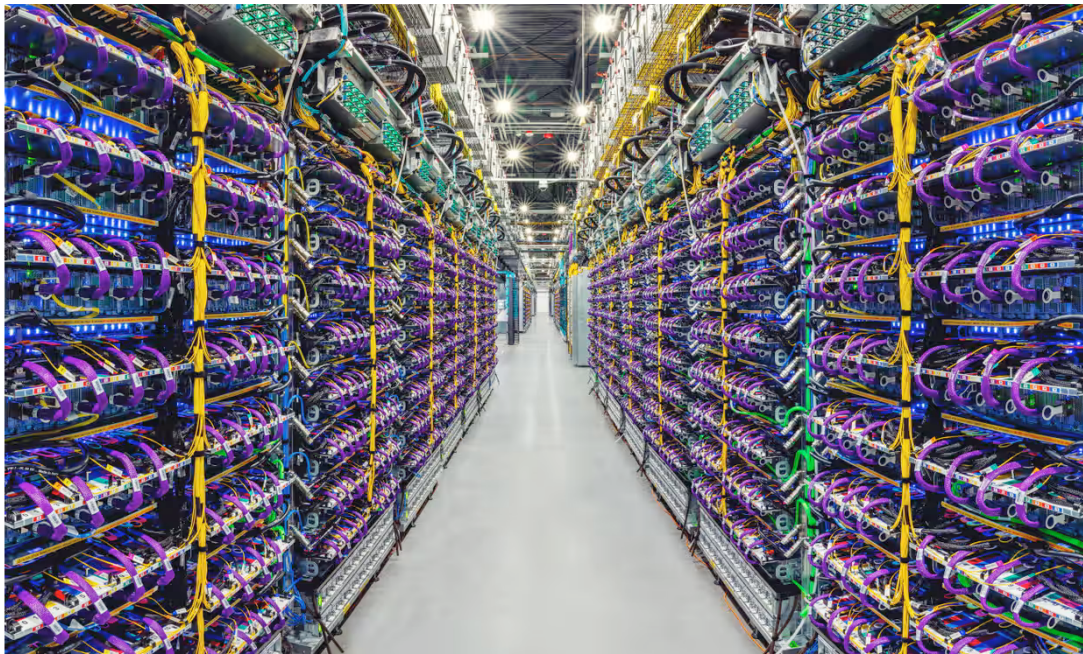
[Seus Detalhes de Contato]"





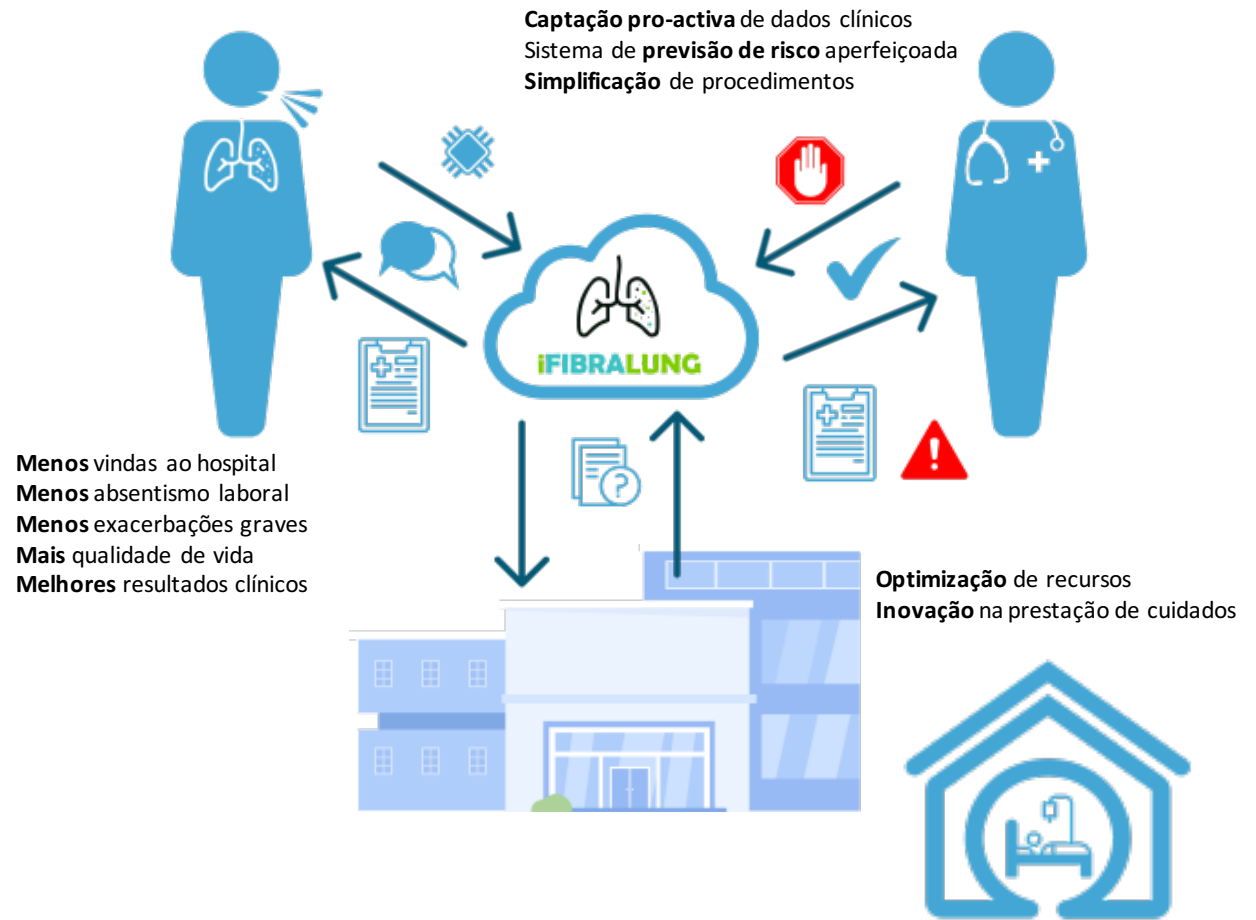
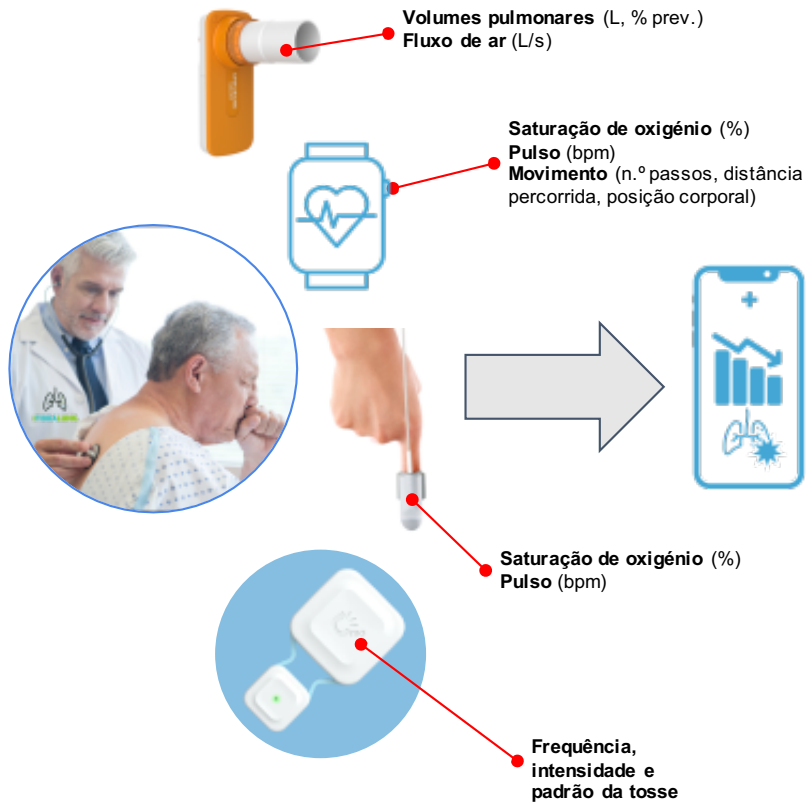
## Google says new AI model Gemini outperforms ChatGPT in most tests

**Gemini is being released in form of upgrade to Google's chatbot Bard, but not yet in UK or EU**









**A inteligência artificial não vai substituir os médicos, mas estes serão substituídos pelos médicos que a sabem usar.**



# DEEP THINKING

Where  
Artificial  
Intelligence  
Ends...



...And  
Human  
Creativity  
Begins

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the age of Artificial  
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# Life 3.0

Max  
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# DEEP MEDICINE

HOW ARTIFICIAL  
INTELLIGENCE  
CAN MAKE  
HEALTHCARE  
HUMAN AGAIN

ERIC TOPOL

With a foreword by  
ABRAHAM VERGHESE,  
author of *Cutting for Stone*

